

Fermentation with Syntropic Antioxidative Microbes: An Advanced Guide to Brewing EM Fermented Secondary Products

A guide which may help you in brewing high-quality EM fermented antioxidant secondary products for human, animal, agricultural, waste and industrial use, particularly Activated EM and EM brews for human and animal ingestion. Intended for intermediate and advanced brewers and technicians only

<p>Sootheox™ Amber Molasses Mineral Brew <i>A fermented antioxidant-rich, mineral-rich nutritional supplement for humans, pets and livestock. Non-alcoholic. for pets and livestock, offer as free-choice supplement only</i></p> <p>Naturally fermented in a lactic acid fermentation. Equilibrium pH at time of bottling was 3.7 or below. Any "scale" floating on top of liquid is normal and due to yeast from fermentation culture.</p> <p>Contains no significant alcohol. Some sediment at bottom of bottle is normal.</p> <p>Storage: Once opened, store in a cool place or refrigerator.</p> <p>Supplement facts and suggested usage on rear panel.</p> <p>Expiration date: _____ Net fl. ounces: _____ fl. oz.</p> <p>our website: http://www.antioxbrew.com</p>	<p>Brewed and bottled by Enhanced Vitality Resources, Frederick, MD 21702 301-694-1249</p> <p>Supplement Facts Serving size: 1 tablespoon (approx. 15 ml. or 0.5 fl. oz.) Servings per container: 12 oz. = 24; 23 oz. = 46; 32 oz. = 64; 1/2 gallon = 128 servings.</p> <p>Amount per serving:</p> <p>Lactic acid fermented, antioxidant-rich nutritional supplement liquid, 15.4 grams Antioxidant activity of at least 544 ORAC PU (Trolox eqn.) units and 1,080 FRAP units Carbohydrates 2 grams; Protein 0 grams; Fats 0 grams Calcium 20 mg. or 1% RDI; Magnesium 13 mg. or 3% RDI; Potassium 38 mg. as well as trace minerals in a live-culture, fermented lactic-acid rich broth.</p> <p>Sluggo and usage: one tablespoon (15 ml.), 2 or 3 times per day, may be taken with or without meals. Contains no significant alcohol. Some sediment at bottom of bottle is normal.</p> <p>Ingredients prior to fermentation: water, molasses, barley (well sprouted), blueberry juice conc., cherry juice conc., selected bentonite clays, natural lactic acid microbial culture (lactic acid bacteria, yeast, and organisms), kelp granules, sea salt. Naturally acidic, with final pH of 3.7 or below.</p> <p>Label Information and statements have not been approved by the FDA. Storage: Once opened, store in refrigerator.</p>
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An encyclopedic advanced tutorial and workbook for use in brewing fermented syntropic antioxidant products in a variety of settings, including:

- Commercial EM Fermentation Nutritional Brewery
- Research and Development Laboratory
- Homebrewing in Kitchen/Home
- Barn/Agricultural Setting
- Industrial production

Vinny Pinto

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Advanced Guide to Fermentation with Syntropic EM Microbes

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A guide which may help you in brewing high-quality EM fermented antioxidant secondary products for human, animal, agricultural, waste and industrial use, particularly Activated EM and EM brews for human and animal ingestion. Intended for intermediate and advanced brewers and technicians only

Note: some early versions of this book were titled *A Guide to Making High-Quality Activated EM and EM-fermented Human Brews*.

An encyclopedic advanced tutorial and workbook for use in brewing fermented syntropic antioxidant products in a variety of settings, including:

- **Commercial EM Products Brewery or Microbrewery**
- **Research and Development Laboratory**
- **Homebrewing in Kitchen/Home**
- **Barn/Agricultural Setting**
- **Industrial production**
- **Nutritional fermentation production laboratory**

note: this book is available in a printed and bound format at a somewhat higher price than the e-book version.

Author: Vinny Pinto, MA

e-mail: vinny@mindspring.com

website links: <http://www.vinnypinto.us> and <http://www.eminfo.info>

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Advanced Guide to Fermentation with Syntropic EM Microbes

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Description

This book is intended as a guide for intermediate and advanced users who are using EM in various applications in human health, animal health, agriculture, soil, compost, waste remediation, or other realms, and who are frustrated at times with the limitations of even the best EM-related public list groups -- primarily:

- repeated newbie questions and elementary discussions
- difficulty of accessing info in past posts, due to the inefficiency of the groups search engine, which searches only from 200 to 400 archived messages at a time (it can take a long to search 14,000 posts for even a single term!)
- the limitations to exploring the more advanced aspects of any topic given the broad nature and often elementary level of the list membership
- the fact that most posts in archives are on elementary topics or are irrelevant

This book, in printed/bound form, is also for those intermediate and advanced EM users who either do not have access to the Internet or who have no desire to belong to e-mail list groups.

This is a guide to brewing EM human brews, Activated EM (aka AEM), aka EM Extension. This book is intended only for intermediate advanced brewers and technicians; it is not for beginners. Much of the information in this book is material from the training courses and seminars which I deliver to individuals and nutritional product companies who need to know a lot about such matters fast, and which I deliver as a consultant to EM breweries and nutritional vendors/distributors. If you have sensed that I do not share everything that I know on the list groups, this is entirely true, because, among other things, the amount of (trivial and distracting and misleading) questions generated by such information -- as well as the follow-up replies which would be required of me, would be overwhelming. And, quite frankly, some information does not belong in full public view; it is better given only to those who can really use it, use it sanely, and who are committed to the work at hand.

There will, of necessity, be some degree of overlap between some of the material presented in this book, particularly material such as basic introduction, glossary and culture basics as found in Part I, and the material which will appear in some sections of the basic introductory book on EM which this author will hopefully release by April 2005.

This document contains both basic and advanced information, including recipes, ingredients, methods and techniques, for brewing very-high quality batches of EM brews (human use), Activated EM, aka AEM, EM Extended and EM Secondary Solution, and also hints on making very high quality fermented solid/granular products such as bokashi or EM-fermented grains for animal feed. As noted earlier, this book is intended only for intermediate and advanced brewers and technicians. Also covered is the topic of ormus elements in EM. Content goes beyond what I have offered on my websites and on the list groups. Among other things, with this information at hand, you should be able to make batches of high-quality Activated EM, which -- if stored properly -- will retain all EM properties as a microbial inoculant for at least 4 months, and possibly 10 months or longer.

Advanced Guide to Fermentation with Syntropic EM Microbes

If you are interested in seeing other books on EM and related topics which I offer, please see *Appendix H*, entitled *Books and E-newsletters on EM and Related Topics Offered by Vinny*.

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Preface

It is my intent in this book to offer the intermediate and advanced user a guide to making high quality Activated EM (AEM) and EM-fermented antioxidant brews for human use, along with recipes and hints; I will share here some of what I share with my private consulting clients and in training classes. This book is intended only for intermediate and advanced brewers and technicians, and not for beginners. Although I do offer, early in the work, a very brief introduction to EM, just to make sure that the reader knows what beneficial microbial culture we are talking about and also understands its general properties, it is NOT my intent to offer here a complete A-to-Z guide on EM, or on all possible uses of EM. Rather, my intent and focus are much more limited: I intend to offer you, the reader, a useful and rather comprehensive guide to brewing high-quality Activated EM (AEM) and EM fermented human brews, with some additional notes on fermenting grains for animal feed.

I am a degreed scientist with a graduate (Master's) degree in my field, plus tons of other formal and non-formal education in many scientific and health-related fields. I have spent over 4,000 hours researching and working with EM since December 2002, especially in the areas of formulating AEM and human EM-fermented brews, working with the phototrophic organisms in EM and related phototrophic organisms, and providing consulting to individual researchers and nutritional companies regarding brewing and use of EM as a nutritional supplement for human and animal health.

Due to time, space and expense, there are simply many other fascinating topics in the realm of the EM beneficial microbial culture, such as applications, uses, novel uses and creative uses which will not be covered in this document, while some may be hinted at. Further, there are a number of fascinating tangents to the whole topic of brewing AEM and human brews, such as adding other beneficial microbes, constructing hotboxes, aka fermentation incubators, which may be touched up on briefly, but which will not be explored in great depth, as each topic is deserving of its own separate book, replete with photos and diagrams.

There will, of necessity, be some degree of overlap between some of the material presented in this book, particularly material such as basic introduction, glossary and culture basics as found in Part I, and the material which will appear in some sections of the basic introductory book on EM which this author will hopefully release by April 2005.

Even though you are likely not a newcomer to EM, I urge you to read the *Introduction to EM* section, as there may still be a few new or fun things which you may learn. And, if you are a newcomer to EM, please not only read the Introduction to EM section, but also the brief Introduction to Terms section which follows it. Likewise, unless you have thoroughly digested the information on my EM Information website (at www.eminfo.info), it may be quite beneficial for you to read the section just after the Introduction sections entitled Basics of the EM Culture and Component Organisms. If you wish to really understand some of the hints and guidelines which I offer, and wish to be able to make

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really high-quality secondary products, then this material offers invaluable background on the microbes in EM.

I have written this booklet to share some of my own unique perspective on the uses of these powerful and impressive organisms, and to offer a bit of orientation and assistance to folks who may wish to make high-quality batches of AEM or human brews. Please understand that any statements and opinions offered in these pages are my opinions only, and do not reflect in any way the views of any creators, producers, distributors, marketer or vendors of various EM-type cultures or products, nor of the distributors or publishers of this book. All opinions and statements remain my own reportage and opinions, and at times my opinions and/or practices may differ wildly from those of the various creators, producers, distributors or vendors of EM products or EM-like products.

There are no guarantees offered or implied on any of the techniques, methods or formulations offered in this book, nor on or for any results you may or may not have. EM-type technology is based on living microbes, and is thus part art, part science, and your results will also be dependent upon the particular ingredients which you choose to use, their quality, and the microbes present in them. The author, publisher and distributors accept no responsibility for your results, end-products, quality of end-products or results obtained thereof; you use all suggestions at your own risk. Your results may vary, and in truth, even major producers of commercial EM products sometimes spend months brewing a batch of EM culture, only to decide it does not meet their standards, at which point they choose to pour it down the drain rather than market it. And, even folks brewing elementary and simple versions of AEM and brews occasionally hit bad batches. So, even basic and simple methods can sometimes yield variant results in the magical world of beneficial microbes, and, of course, playing with advanced techniques can introduce even more risks of possible occasional bad batches or weird batches. This is all part and parcel of being an intermediate or advanced brewer of EM: you are willing to experiment and play and to learn from your experiments and experiences.

I apologize for the delay in releasing this book. As I worked on the document during the last weeks, I kept getting drawn into many-hour long teleconferences with colleagues from the EM world on material in the document, and each conversation led to the decision to add even more material! Further, many folks who had ordered copies in the pre-publication offer also offered hints on new topics to be covered in the book, and this drastically expanded its size!

If you are interested in seeing other books on EM and related topics which I offer, please see *Appendix H, entitled Books and E-newsletters on EM and Related Topics Offered by Vinny.*

***Vinny Pinto
August 2004***

A Note of Caution

Use of this Document, Questions

Almost all of the methods and techniques disclosed here are ones which I have been using and playing with here for the past 20 months; many are advanced methods. I (and other EM specialists as well) have learned from experience not to share many of the more advanced methods or techniques on the public e-mail list groups, such as the *EM-Ag*, *EM-Health* and *EM-Ormus* list groups at Yahoo Groups (see *Appendix L*) which are often peopled by members at a very low level understanding, comprehension and ability – because each such past utterance has proved to lead only to chaos, confusion and problems and errors among less-experienced list members, and worse, has often led to tons of silly and irrelevant or misleading questions directed toward the author in reply – questions which I have neither the time, energy nor willingness to answer.

Therefore, while I disclose some advanced and sophisticated methods and techniques in this document, do not expect me to acknowledge them or discuss them, or answer questions about most of them, on the public e-mail list groups or other public forums. The chance of all of the above-cited hazards occurring is too real and too great. Rather, if you have some questions about the material in this book which you feel that you need me to address for you personally, then please feel free to initiate a short telephone consulting session with me – my consulting services and terms are fully disclosed in *Appendix J*, entitled *Details on Consulting Services Offered by Vinny Pinto*, and in the linked webpage offered there. Alternatively, if you do not feel it necessary to initiate a consulting call to me, you are welcome to send your questions or problems to me via e-mail, at vinny@mindspring.com, as candidate questions for my periodic subscription EM Advanced Topics e-newsletter (more details in Appendix H), where, if the question is deemed to be a commonly-encountered one, it will be addressed in the next issue of the newsletter.

There are no guarantees offered or implied on any of the techniques, methods or formulations offered in this book, nor on or for any results you may or may not have. EM-type technology is based on living microbes, and is thus part art, part science, and your results will also be dependent upon the particular ingredients which you choose to use, their quality, and the microbes present in them. Feel free to tinker and experiment – this is more art than science! The author, publisher and distributors accept no responsibility for your results, end-products, and effects which result from their use; you use all suggestions at your own risk. Your results may vary, and in truth, even major producers of commercial EM products sometimes spend months brewing a batch of EM culture, only to decide it does not meet their standards, at which point they choose to pour it down the drain rather than market it. And, even folks brewing elementary and simple versions of AEM and brews occasionally hit bad batches. So, even basic and simple methods can sometimes yield variant results in the magical world of beneficial microbes, and, of course, playing with advanced techniques can introduce even more risks of possible occasional bad batches or weird batches. This is all part and parcel of being an intermediate or advanced brewer of EM: you are willing to experiment and play and to learn from your experiments and experiences. Have fun!

Notice and Disclaimer

The primary intent of this document is to disclose and discuss some advanced hints and tips for brewing high-quality batches of AEM and EM brews for human or animal use, and little, if any space, is devoted to applications or uses of EM, whether in human nutrition, animal nutrition, agriculture, soil treatment, waste treatment, septic treatment, treatment of polluted waterways or bodies of water, or toxic waste remediation. Nonetheless, a few such possible uses may be referenced at times incidentally. Please be advised that a few of the potential uses and applications for AEM and other EM secondary products which are discussed herein may be contrary to regulatory rules or guidelines in your country, state, province, county or region. Further, some practices may be frowned upon by qualified health professionals (particularly in the realm of livestock or soil use), and some practices could be dangerous to human health, or could be dangerous to animal health (or crop health!) if performed or processed incorrectly. This document is offered for educational and informational purposes only. If you choose to use EM-type microbial inoculants, any secondary products such as AEM, or any other microbial inoculant products in any way for any application, you must first check with your local and national regulations to ensure that your planned use complies with all applicable rules and regulations in your area. If you choose to use EM secondary products such as EM fermented antioxidant brews for any purposes involving ingestions by humans or animals (or placement upon skin, etc.), I recommend that you exercise extreme care in your procedures, and that you first research all relevant information available in the literature and on the web carefully, and, for animal use, review what the regulatory guidelines for your country or region recommend, as regulatory agencies in some regions prohibit use of EM in farm animals to be used for food purpose.

Further, and once again, if brewing EM products for human or animal consumption, you will also wish to employ common sense and careful techniques. And, if brewing AEM or brews for animal consumption, please ensure that all ingredients used are of at least animal feed-grade, if not human food-grade quality. If brewing EM brews for human use, please ensure that all ingredients and containers uses are of human food-grade quality.

Any statements and opinions offered in these pages are my opinions only offered in reportorial and informational mode, and do not reflect in any way the views of the originator of EM, Dr. Teruo Higa, nor of any of the producers, vendors, distributors or resellers of any EM-type microbial inoculant cultures or other EM products. All opinions and statements remain my own reportage and opinions, and at times my opinions and/or practices may differ wildly from those of any the producers, vendors, distributors or resellers of any EM-type microbial inoculant cultures or other EM products. Neither the author, publisher nor distributors accept any responsibility for your results; you use all information at your own risk. All uses and applications and consequences thereof remain solely your own responsibility.

There are no guarantees offered or implied on any of the techniques, methods or formulations offered in this book, nor on or for any results you may or may not have. EM-type technology is based on living microbes, and is thus part art, part

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science, and your results will also be dependent upon the particular ingredients which you choose to use, their quality, and the microbes present in them. Your results may vary, and in truth, even major producers of commercial EM products sometimes spend months brewing a batch of EM culture, only to decide it does not meet their standards, at which point they choose to pour it down the drain rather than market it. And, even folks brewing elementary and simple versions of AEM and brews occasionally hit bad batches. So, even basic and simple methods can sometimes yield variant results in the magical world of beneficial microbes, and, of course, playing with advanced techniques can introduce even more risks of possible occasional bad batches or weird batches. This is all part and parcel of being an intermediate or advanced brewer of EM: you are willing to experiment and play and to learn from your experiments and experiences.

This Disclaimer will also be displayed again in the Appendix.

Part I

Introduction to EM and Brand Names, Terms, Microbes in EM, Other Basic Background Info

Introduction to EM

This section is intended to provide a brief introduction to a synergistic, metabiotic (where each organism creates favorable conditions for the growth of the others) and antioxidative microbial technology generically known as EM, also known as Effective Microorganisms, Efficient Microbes(EM)[™], EM-1, EM1, EM- 1[™], Beneficial Microbes, Beneficial Microorganisms (BM), Beneficial and Efficient Microbes (BEM), EM Kyusei, Kyusei EM, Vita Biosa, Terra Biosa, Effective Microbes, Efficient Microorganisms, Compound Microorganisms (CM), Molasses Culture, Cultured Molasses, and a dozen other names (discussed in more detail in the Introduction to EM section) -- and its uses in many fields, including agriculture, waste remediation, odor control, and human and animal health. Throughout this document, the simple and generic abridgement "EM" will be used as an abbreviation to denote this general class of synergistic metabiotic antioxidative microbial consortia; this is in keeping with the use of this contraction throughout much of the world as a shorthand to indicate all such cultures with similar microbial composition, properties and functionality, regardless of the brand names or trade names which may be employed by various vendors or in various regions.

So, EM is a generic shorthand name for a powerful and beneficial metabiotic and antioxidative microbial culture consisting of anywhere from 5 to 100 different species of organisms, depending upon exact variant. EM refers to a very special and unique microbial inoculant culture which has become known worldwide and has found uses in a number of different fields and areas of human endeavors, but particularly in the fields of sustainable agriculture and farm waste management, toxic waste remediation, and -- more recently -- human and animal health.

It is likely safe to say that the single largest area of EM utility is in farming (agriculture), and even moreso within the realms of organic farming, sustainable farming, grass-fed farming and so-called beyond-organic, uber-organic, super-organic or biological farming. However, EM has also found applications in protecting building materials (architects call EM "building friendly"), waste water treatment, toxic waste remediation, remediation of polluted waterways, human and animal health, and in many other diverse areas as well. Indeed, the fastest-growing area of use for EM lies in the realm of creating fermented antioxidant nutritional supplements for human use.

EM technology originated in Japan. It was developed by Dr. Teruo Higa, a horticulture professor in the Department of Horticulture at the College of Agriculture at University of Ryukyu in Japan. Indeed, Dr. Higa first learned of the power of the phototrophic organisms which are used in his consortium from an academic colleague, who was using the purple non-sulfur bacteria (PNSB) with great success for wastewater treatment, toxic

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waste management and odor control in waste lagoons. This academic colleague, Dr. Kobayashi, who is currently a professor at Kyoto University, eventually founded one or more companies which employed his technology for waste treatment and agricultural uses and also eventually patented some specialized uses and unique species variants of some of the PNSB phototrophic organisms. Dr. Higa extended Dr. Kobayashi's work with the near-magical PNSB by combining the PNSBs with other microbes commonly also found in soil and in ponds and streams. He actually stumbled upon the particular combination of microbes much by accident, as often happens with advances in the sciences; a more complete version of the story will be better left for an introductory work on EM and its origins. The EM microbial inoculant culture -- depending upon brand/label and region/country -- consists of a consortium (synergistic cooperative community) of from six to about 100 individual species of microorganisms, including lactic acid bacteria, phototrophic (aka photosynthetic) bacteria and yeast, all in a synergistic, metabiotic and cooperative "community". The member species of organisms in the consortium belong to any of several families and several genera. The individual microorganisms found in EM are all fully natural (indeed, EM is certified as an organic farming product), are commonly found worldwide in soil and ponds and even on many leaves and other surfaces in nature and are commonly found almost everywhere in nature (but not often in the quantity, balance or relationship as found in EM.) Dr. Higa eventually wrote about EM and the varied uses for it in his book *An Earth Saving Revolution*, which was followed a few years later by a second volume entitled *An Earth Saving Revolution II*. He has since penned additional books, including one on EM-treated salt.

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Names, Brands, Labels

The microbial culture/technology commonly known as EM is and has been known and marketed around the world under a number of different names, brands and labels, including:

- EM (has become a generic shorthand term worldwide for all similar cultures from dozens of producers, suppliers and vendors)
- Effective Microorganisms (has become a generic term worldwide for all similar cultures from dozens of producers, suppliers and vendors)
- Efficient Microbes(EM)TM EM-1
- EM1
- EM- 1TM Beneficial Microbes (BM)
- Beneficial Microorganisms
- Beneficial and Efficient Microbes (BEM)TM
- EM Kyusei
- Kyusei EM
- Vita Biosa
- Terra Biosa, aka Earth Biosa and Soil Biosa
- Effective Microbes (term commonly used in Europe)
- Essential Microorganisms (term commonly used in Europe)
- Efficient Microorganisms
- Compound Microorganisms (CM) (especially in South Korea and North Korea)
- Complex Fermented Microorganisms (CFM) (primarily in China and South Korea)
- Fermented Microorganisms
- Molasses Culture
- Cultured Molasses
- Frank's Septic Tank AdditiveTM
- Synergistic Syntropic MicrobesTM (SSM)
- Beneficial Syntropic MicrobesTM (BSM)
- SESO (regional brand name in Europe, Seso appears to have been originally a Japanese term)
- Stuff for Food DregsTM (Senong, So. Korea)

There are even more products, over a half-dozen in the USA alone, sold for pond, aquaculture and farm use which contain mostly PNSBs and some other commensal helper organisms, but not the yeasts and lactic acid bacteria found in most embodiments of EM. I have spent quite a bit of time in teleconferences with microbiologists for some of these companies, sharing information on the power and abilities of the PNSBs.

Once we venture into the realm of EM-fermented products for human nutritional supplementation and animal dietary supplementation, we encounter even more brand and label names, including:

- Lanox®
- Fervita®
- SootheoxTM
- FermaliveTM
- Eco-farm, Emos-farm and Emos No.1 (Senong, So. Korea)

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- Bio-farm and Oxydon (livestock products from Senong in So. Korea)
 - Time-X™ (human supplement product from Senong in So. Korea)
- as well as a hundred small brands of EM-fermented supplements in Japan and China, a few of which, such as fermented turmeric, are occasionally marketed in the USA.

Almost all of the above-named human and animal products are raw and do contain live culture, and there are also a few pasteurized and filtered non-live culture products such as EM-X.

On the other hand, it would be wise to bear in mind that a few microbial inoculant products with similar-sounding names, such as:

- Integrated Microorganisms (aka IM and IMO)
- Forest Beneficial Microorganisms (FBM)

are not at all part of the EM family, and rather, these terms denote various microbial preparations from the Integrated Microorganisms (IM) genre of wild-harvested microbes for farming use, which usually contain far more aerobic organisms and fungi than EM, and which may (or may not, depending upon variant and sample) be also missing the all-critical PNSBs. Many exemplars of IM reportedly do not have significant lactic acid bacteria activity either. Many of these cultures may not be fermentative or syntropic and antioxidative in nature.

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Uses

EM has found applications in the following areas, and likely many more:

- agriculture: for conditioning soil, compost and plant wastes. It has been proven that continued use of EM can convert a soil to a truly sustainable type of soil, called a zymogenic soil
- agriculture: for feeding livestock, for waste treatment, for odor control and pest management (e.g., flies);
- manages odors, improves feed utilization, improves health and vitality
- agriculture: for treating or controlling various fungal diseases or pests of plants
- lawn maintenance: for treating soil and compost or organic fertilizers, for preventing fusarium and molds
- buildings and architecture: to maintain healthy buildings and building materials (lumber, concrete, plaster, etc.), to prevent "sick building syndrome" and extend life of materials
- as a deodorizer for barns, waste treatment areas, homes, etc.
- as an aerosol spray deodorizer for home, agricultural and industrial use
- household: pets, odor control, treating pet wastes on floors, for shower stalls, kitchen sinks, dishpans, garbage pails, toilets, drains, sinks, sink drains, compost buckets, etc.
- human and animal use: ingestion of a wide range of antioxidative and regenerative products made from EM, as a healthful probiotic and antioxidant supplement
- waste treatment
- wastewater treatment
- septic waste treatment
- for remediation of polluted or unbalanced waterways, streams, bays, ponds and lakes
- toxic waste remediation
- preparation of waste biomass material for bio-conversion into fuels such as biodiesel and others

The essential basic technology of EM is a consortium of five or more species of microorganisms, from across at least three classes of organisms, in a synergistic culture (called a consortium) which produces lactic acid under anaerobic fermentation and which also produces an environment (in the liquid or plant matter under fermentation, etc.) which is highly antioxidative and regenerative, or syntropic (aka anti-entropic) and which contains numerous powerful antioxidants, largely produced by phototrophic anaerobic bacteria known as purple non-sulfur bacteria (PNSB).

Introduction to Terms – a glossary of terms used in this document

Activated EM

Activated EM is a secondary product, usually made at end-user site, from EM microbial inoculant culture, blackstrap molasses and water (usually assumed to be in a 1:1:20 ratio or similar ratio unless otherwise specified), and sometimes other ingredients as well. If properly brewed, AEM exhibits not only powerful deodorizing and antioxidative properties, but also will act as a microbial inoculant culture, much as does the EM parent microbial culture. Activated EM is also known as EM Activated, EM Extension, EM Extended, Extended EM and EM Secondary Solution (the latter primarily in Japan).

In this document, the terms Activated EM and AEM will be used to indicate AEM brewed primarily for utility use, including ingestion by animals. Of course, so long as a batch of AEM is made with care, and is made only using human food-grade ingredients, and so long as pH has dropped to below 3.7, then it may also be used for human ingestion if so desired. However, in this document, the term EM Brew will be used to indicate batches of EM-fermented brew which were brewed primarily for human (or even animal) consumption.

AEM

AEM is an abbreviation or shorthand for Activated EM. Please see the definition for the term Activated EM in this Glossary.

In this document, the terms Activated EM and AEM (usually assumed to be in a 1:1:20 ratio or similar ratio unless otherwise specified) will be used to indicate AEM brewed primarily for utility use, including ingestion by animals. Of course, so long as a batch of AEM is made with care, and is made only using human food-grade ingredients, and so long as pH has dropped to below 3.7, then it may also be used for human ingestion if so desired. However, in this document, the term EM Brew will be used to indicate batches of EM-fermented brew which were brewed primarily for human (or even animal) consumption.

Aerate

In this document, to aerate means to bubble air, or oxygen, or ozone thru a liquid. Unless otherwise specified, the term will indicate aeration with atmospheric air. If aeration with oxygen or ozone is referenced, it will be explicitly stated.

Airlock, aka air lock

An airlock is a mechanical venting device which keeps ambient atmospheric air (and oxygen) from entering a fermentation container, but allows excess gas pressure to escape easily, often by bubbling the gases through water trapped in a U or W or S shaped tube. The better air locks not only allow excess gas pressure to escape, but will -- if negative pressures (partial vacuum) develop in the headspace -- allow small amounts of air to enter to equalize the pressure.

Aerobic

An aerobic environment is one where oxygen is present, either as a gas (as in air, where oxygen comprises about 21% of air) or as a dissolved gas in liquids such as water.

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Anaerobic

An anaerobic environment is one devoid of oxygen. In this document, anaerobic refers to fully anaerobic or near-anaerobic conditions where reasonable and good precautions have been taken to exclude all or almost all atmospheric air from the fermenting batch of AEM or brew. Normally atmospheric air contains from 18% to 21% oxygen.

Antioxidant

An antioxidant is a substance which has the ability to neutralize or destroy oxidative radicals, also known as reactive oxygen species (aka ROS). Further, some antioxidants, in some situations, have the ability to reverse the damage caused by ROS. Antioxidants are actually a part of a larger family of substances called reducing agents, all of which neutralize oxidative radicals. Usually, particular reducing agents, which are useful in the fields of human or animal nutrition are called antioxidants. EM, AEM and EM brews contain large amounts of live-food form, raw antioxidants.

Blackstrap molasses

What is commonly called Blackstrap Molasses in the human food marketplace in the USA is a very heavy, thick and dark molasses, derived from the final stage of sugarcane processing for sugar extraction, when the content of simple sugars is lowest (usually 45% or less) and the content of other compounds such as complex carbohydrates and antioxidants, is highest. This product is often called Sugar Cane Molasses in the animal-feed grade molasses market, and in many countries outside the US. It is important to recognize that products called molasses, light molasses, medium molasses, middle molasses, Barbadoes molasses, Island molasses, and similar names are lighter and sweeter types of molasses from earlier stages of sugar refining, and do not have the properties of blackstrap molasses.

Brew

When used as a verb, brew means, of course, to ferment something. However, in this document, when used as a noun, this term refers solely to EM-fermented antioxidant nutritional supplement liquid beverages brewed for either human or animal ingestion.

Brix or Brix score

Brix score is an alternate means of measuring specific gravity (aka SG), often used in the food and drink industries. Brix is usually measured with an optical refractometer called a Brix meter. Brix meters may be purchased from any homebrew supply store (see Appendix D), from most laboratory supply houses, and from many vendors of supplies for organic farming and gardening. For more details on specific gravity (SG), please see the entry for that term in this section.

Consortium

see section entitled *microbial consortium*.

Elixir

An elixir is a concentrated human brew with even more ingredients than a typical brew, containing ingredients such as lots of Western or Chinese medicinal herbs, medicinal mushrooms, green superfoods, along with blackstrap molasses, barley malt syrup, blueberry juice concentrate, etc., and is thus even denser and richer than a normal human brew.

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EM brew

In this document the term EM brew refers solely to EM-fermented antioxidant nutritional supplement liquid beverages brewed for either human or animal ingestion.

EM

EM is a generic shorthand term for any of the brands/labels of microbial culture of synergistic, metabiotic, antioxidative, syntropic microbes from at least three different genera, and more often six or more genera -- and always containing purple non-sulfur bacteria (PNSB), aka phototrophic organisms; the culture is usually used in fermentation, but also in other settings as well. See *Introduction to EM* section above for more information.

EM Ceramic

EM ceramics are kiln-fired ceramic products into which EM or various EM secondary products, such as EM-X, were incorporated prior to firing. They are often marketed in various forms such as small shapes (BB-sized spheres, small pellets, small spheres, etc.) and powders. Used in wide variety of applications in industry, agriculture, waste remediation, and in making EM and AEM.

EM Ceramic Powder

EM ceramic powder is a powdered form of EM ceramics.

Fish Emulsion

Fish emulsion is a generic term used to indicate agricultural-grade fish liquid slurry made from ground fish parts, usually including head and guts, and sometimes mixed with seaweed as well, usually sold in 500 ml. bottles, 1 liter bottles, 4 liter jugs and 20 liter (5 gallon) buckets. Often marketed as *Fish Fertilizer* or *Seaweed and Fish Fertilizer*, also as *Fish Emulsion* and *Fish Emulsion Fertilizer*. Such products contain much-needed proteins and nutrients, and also often contain wild microbes from the fish or fish guts – they "seed" or "re-seed" the batch of AEM with much-needed commensal wild microbes, many of them aerobic, which are quite essential to making secondary EM-fermented products.

Most related products, such as most Neptune brand products (e.g., *Neptune's Harvest Organic Fish Emulsion* and *Neptune's Harvest Organic Fish & Seaweed Emulsion*), which are marketed as "no-odor" versions, have usually been pasteurized and hydrolyzed to kill odors – if so, the word "hydrolyzed" will appear somewhere on the labels, at the least, usually on the rear label or in ingredients list. Unfortunately, this hydrolyzation and/or pasteurization process also kills some of the desirable microbes which we would have preferred to help our batches of AEM, which are often present in the unpasteurized versions.

Thankfully, however, due to the pasteurization methods usually employed, some of the wild commensal microorganisms which we desire as useful adjuncts or boosters to the culture in AEM are often still present in such product to some (lesser) degree. Thus, these products are still useful for AEM, but just not as useful as the unprocessed versions. Nonetheless, for most of the applications of fish emulsion described in this book, the unpasteurized, odoriferous version is preferable!

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In summary, the term *fish emulsion* will be used to indicate only agricultural grade or animal feed-grade fish emulsion products.

Fish paste

In this document, the term fish paste will be used to indicate only human food-grade fish pastes, often fermented, usually sold in Asian grocery stores under the name *Fish Paste* or similar names. Such products contain much-needed proteins and nutrients, and also often contain wild microbes from the fish or fish guts -- they "seed" or "re-seed" the batch of brew or AEM with much-needed commensal wild microbes, many of them aerobic, which are quite essential to making secondary EM-fermented products.

These products have sometimes been pasteurized, and a few have even been vacuum-bottled at high temperatures, but thankfully, due to the pasteurization and bottling methods usually employed, some of the wild commensal microorganisms which we desire as useful adjuncts or boosters to the culture in AEM are often still present in such products, and thus the products are still quite useful for use in brewing secondary products such as brews. Most such products also contain about 5% to 20% sugar and from 15% to 40% salt; this is not harmful for our purposes and quantities used. Please note that these products are not the same as *fish sauce*, which is a watery liquid which has over 94% water content, and thus not very useful for our needs. See also *shrimp paste*, also a human food-grade product similar to fish paste.

By the way, here are some handy ways to differentiate between the fish paste or shrimp paste products which have been treated at high temperatures and those which were processed/bottled at far lower (cooler) temperatures (the latter are more preferable for our needs, although the former are still usable...):

If the product has been vacuum-bottled at high temperatures to kill most microbes, it will have been bottled only in a glass bottle with a standard lined metal lid with a seal, and the lid will be sealed under vacuum pressure. Conversely, if the paste was bottled at far lower temperatures or even without heat (e.g., raw) it will be bottled in a glass or plastic bottle with a plastic lid with no vacuum seal.

Fish powder

In this document, the term fish powder will be used to indicate only human-grade fish powder, usually sold under the name *Fish Powder* in Asian grocery markets, and sold in jars for about \$4, usually imported from Thailand, Malaysia, Indonesia, etc. Most of these products usually contain about 95% dried fish, 3% salt and 2% sugar, according to the ingredients list, and neither of the latter ingredients are a problem, from our viewpoint. Such products contain much-needed proteins and nutrients, and also often contain wild microbes from the fish or fish guts -- they "seed" or "re-seed" the batch with much-needed commensal wild microbes, many of them aerobic, which are quite essential to making secondary EM-fermented products.

Headspace

Headspace is the airspace above a batch of liquid (usually AEM or EM brew) in a sealed or nearly-sealed or vented container.

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High-Light version

A High-Light (aka HL) version of AEM or brew is one which has been specially formulated, handled and processed to yield a version high in the reddish-purple PNSB microbes, and thus very high in antioxidative, syntropic, regenerative substances and energies. More details on the High-Light formulas and techniques will be outlined in the section entitled High-Light AEM or brews; this section will be found under the *Very Advanced and Highly Specialized or Experimental Techniques* chapter in Part II of this book.

High-Red version

A High-Red (aka HR) version of AEM (usually only done with AEM, and not brew, but process could be applied, with some extreme care, to an experimental brew) is one which has been specially handled and processed to yield a version extremely high in the reddish-purple PNSB microbes, even far higher than the High-Light (HL) versions and thus extremely very high in antioxidative, syntropic, regenerative substances and energies. HR AEM is usually produced in a continuous breeder fermenter/reactor, rather than via a single-batch process. However, due to the incredibly high levels of PNSB organisms swimming in the liquid and their high levels of activity and high appetites, such versions must often either be used within 20 days after brewing is finished, or must be maintained via special aerobic dynamic techniques which will be outlined in the section entitled High-Red AEM or brews; this section will be found under the *Very Advanced and Highly Specialized or Experimental Techniques* chapter of Part II of this book.

HL version

See *Glossary* listing for *High-Light version* of AEM or brews.

Hotbox

A hotbox is a container (such as a picnic cooler) or small room with insulated walls and a heat source, used to keep fermenting batches of AEM or EM brews at a warm temperature, often 94F to as much as 112. A synonym is “incubator”.

HR version

See *Glossary* listing for *High-Red version* of AEM or brews.

Incubator

A container (such as a picnic cooler) or small room with insulated walls and a heat source, used to keep fermenting batches of AEM or EM brews at a warm temperature, often 94F to as much as 112. A synonym is “hotbox”.

Lactic acid bacteria

Lactic acid bacteria are microbes which produce lactic acid when they digest sugars and carbohydrates and sometimes other compounds as well. Many lactic acid bacteria exhibit syntropic and antioxidative effects, and work well in synergy with the other EM organisms. Lactic acid bacteria, aka LAB, are an essential part of EM-type microbial inoculant cultures. Most EM cultures contain from three to fifteen different species of LAB.

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LAB

LAB is a shorthand acronym for lactic acid bacteria, which are an essential part of EM-type microbial inoculant culture. Most EM cultures contain from three to fifteen different species of LAB.

Metabiotic

A metabiotic microorganism creates environmental conditions that favor the survival and growth of certain other microbes, and thus it cooperates with certain other microbes. A metabiotic relationship is one in which two or more species of microbes create conditions which nurture and support growth of each other, which is a type of synergy, often forming a relatively stable and robust *microbial consortium*.

Microbial consortium

Historians of science, as well as those who study the philosophy of science have noticed that biologists for much of the past two hundred years had tended to look at microorganisms only as single species at a time, and it was therefore (mistakenly) assumed by many that this was how they usually functioned in nature, as independent single species. It has been only quite recently that biologists have come to understand that this earlier assumption of "individualist" species and colonies was a misconception, and that most species of microorganisms are found in nature not alone, but rather as part of a cluster or aggregate of from nine to about 35 (sometimes far fewer and sometimes far more) synergistic species, which biologists have started to call by the name microbial consortium (or consortia, as some authors use it, depending upon plurality)

Monatomic elements

Monatomic elements, aka monatomic minerals. See *ormus elements*.

Ormus elements

Ormus elements, aka ormus minerals, aka monatomic elements, aka m-state elements. The term "ormus" is used to denote a variant atomic (nuclear) form of certain metals and other elements which seem to have been present throughout history to some degree in many raw natural food and (unprocessed) waters. It also seems that – just as with the normal forms of many elements – our bodies may need at least certain minimal amounts of such ormus substances for optimal health, and that such elements are largely missing from the modern Western diet. And, some folks claim that ingesting ormus elements is particularly helpful on the spiritual level. Many companies now offer nutritional supplements which are claimed to contain significant quantities of ormus elements. The EM fermentation culture seems to often transform ordinary or normal forms of certain elements to their ormus form; this has been noted by many observers. Unfortunately, the history of the ormus field has been rather rife with hype and bizarre exaggerated claims, and thus I am rather wary of this whole field, although it is my belief and experience that many EM brews do contain significant amounts of ormus elements.

ORP

ORP, aka oxidation-reduction potential, shows relative degree of oxidative power or reductive (antioxidant) power of a liquid. ORP is measured with a special probe and an ORP meter on a scale of +1,200 millivolts (mv.) to –1,200 mv., where a score of 1,200 indicates maximal oxidative ability and no reductive (antioxidant) ability, and where a score of –1,200 indicates maximal reducing (antioxidant) capability. However, since true

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hydrogen and reducing power is influenced strongly by pH as well, ORP alone is only a rough and relative indicator of true oxidative or reducing (aka antioxidative) power of a liquid, and relative hydrogen score (aka rH or rH₂ or RH), computed from pH and ORP, is a far more accurate indicator; please see section entitled *relative hydrogen score*.

Oxidant

please see *oxidizer*

Oxidative free radical

An oxidative free radical is an oxidant which is not bound, but rather, freely mobile, in a system, often a biological system such as human tissues, in contrast to a bound or locally-bound oxidant radical, which is still an oxidant radical, but is not freely mobile. Please see sections on oxidizer and reactive oxygen species (aka ROS) as well. ROS may be neutralized, and further, the damage which they wreaked may sometimes be reversed by, substances known as reducing agents, which, if useful in the field of human or animal nutrition, are often called antioxidants.

Oxidizer

An oxidizer, aka an oxidant, is a substance which aggressively tries to steal electrons from another substance, often damaging substances or living tissues in the process, thus resulting in a lower energy state and lower state of complexity and structure, which is also known as increased entropy. Please see sections on oxidative free radicals and reactive oxygen species (aka ROS) as well. Oxidizers may be neutralized, and further, the damage which they wreaked may sometimes be reversed by, substances known as reducing agents, which, if useful in the field of human or animal nutrition, are often called antioxidants.

pH

pH indicates relative degree of alkalinity or acidity of a liquid. Scale is semi-logarithmic, and runs from 0 to 14, where 7 indicates neutral, a score below 7 indicates acidity, and a score above 7 indicates alkalinity; 0 indicates maximum acidity, and 14 indicates maximum alkalinity.

Phototrophic organisms

Phototrophic organisms are microbes which are photosynthetic, which can use sunlight to produce energy and energy compounds. All EM cultures contain at least 2 or 3 species of phototrophic organisms, usually from the extremely powerful and versatile and near-magical Purple Non-Sulfur Bacteria (PNSB) family, a family of soil-based and pond-based microbes commonly found in nature in soils, in ponds, on green leaves, in pitcher plants, and in icicles and other ice formations in the wild. See section in *Glossary on Purple non-sulfur bacteria*.

PNSB

PNSB is an abbreviation used for the purple non-sulfur bacteria, an essential class of organisms found in EM culture, and the heart of the culture. Most EM cultures contain at least 2 or 3 species of PNSB.

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Purge

Within this document, to purge will mean to flush a space such as an airspace, aka headspace above a batch of liquid, with an inert gas such as CO₂, nitrogen, argon or neon.

Purple non-sulfur bacteria

Purple non-sulfur bacteria, aka PNSB, are a family of phototrophic microbes which seem to possess powerful and interesting energy and antioxidative effects; an essential class of organisms found in EM culture, and the heart of the culture. Most EM cultures contain at least 2 or 3 species of PNSB, a family of soil-based and pond-based microbes commonly found in nature in soils, in ponds, on green leaves, in pitcher plants, and in icicles and other ice formations in the wild.

Reactive oxygen species

Reactive oxygen species, aka ROS, is name coined by scientists to denote the whole family of oxidative radicals which can cause oxidative damage -- thus increasing entropy and destroying information and structure -- usually in living biological systems (but in non-living systems as well), due to their aggressive and usually unselective hunger for electrons, which they are willing to steal from other compounds. In brief, the most commonly-encountered ROS have been labeled as:

- singlet oxygen (a lone oxygen atom)
- peroxides, aka the peroxy radical, as is found in hydrogen peroxide, etc.
- superoxide radical
- triplet oxygen (e.g., ozone, O₃,)
- hydroxyl radical
- peroxy nitrite radical

ROS may be neutralized, and further, the damage which they have wreaked, may sometimes be reversed by, substances known as reducing agents, which, if useful in the field of human or animal nutrition, are often called antioxidants. EM, AEM and EM brews contain large amounts of live-food form, raw antioxidants.

Reducing compound or reducing agent

A reducing agent is a substance which neutralizes oxidative radicals, aka reactive oxygen species (ROS), and, if a reducing agent is useful in the field of human or animal nutrition, it is often called an antioxidant. Not all reducing agents known to science are useful antioxidants for life forms such as humans and animals, and so it may be said that not all reducing agents are effective antioxidants, but it is true that all antioxidants may function as reducing agents. Please see *antioxidant* section as well. EM, AEM and EM brews contain large amounts of live-food form, raw antioxidants.

Reductive agent or reductive compound

please see *reducing compound*

Relative hydrogen score, aka rH score

Relative hydrogen score, also known as rH₂ or RH score, is a score proposed by Clark in 1923, derived from the Nernst equation, which expresses true hydrogen concentration/power in a liquid far more accurately than ORP alone. rH score is computed from pH and ORP, and rH scores run from 0 to 42, where 28 is midpoint,

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scores approaching 42 indicate maximal oxidative power, and a score approaching 0 indicates maximal reducing or antioxidative power. RH score is often employed in various sectors of the beer brewing industry, in the high-end aquarium world and in the food industry (esp. bottling of juices, etc.) to indicate relative oxidative damage to a liquid product versus relative reducing power (aka antioxidant protection) levels in such a product.

ROS

please see entry for *reactive oxygen species*

SG

Please see entry for *specific gravity*

Shrimp paste

In this document, the term shrimp paste will be used to indicate only human food-grade fish pastes, usually sold in Asian grocery stores under the name Shrimp Paste or similar names, indicating usually an unpasteurized fermented shrimp paste, and sold in jars for about \$3, usually from Thailand, Malaysia, Indonesia, etc. Most brands also contain some sugar and salt as well; neither ingredient is a problem from the viewpoint of use as a fermentation ingredient. This shrimp paste contains much-needed proteins and nutrients, and also often contains wild microbes from the shrimp, and thus the past "seeds" or "re-seeds" the batch with much-needed commensal wild microbes, many of them aerobic, which are quite essential to making secondary EM-fermented products. See also *shrimp paste*, also a human food-grade product similar to fish paste.

By the way, here are some handy ways to differentiate between the fish paste or shrimp pate products which have been treated at high temperatures and those which were processed/bottled at far lower (cooler) temperatures (the latter are more preferable for our needs, although the former are still usable...):

If the product has been vacuum-bottled at high temperatures to kill most microbes, it will have been bottled only in a glass bottle with a standard lined metal lid with a seal, and the lid will be sealed under vacuum pressure. Conversely, if the paste was bottled at far lower temperatures or even without heat (e.g., raw) it will be bottled in a glass or plastic bottle with a plastic lid with no vacuum seal.

Specific gravity

Specific gravity, aka SG, is a measure of all the dissolved solids (sugars, salts, complex carbohydrates, etc.) in a liquid. Pure water has an SG of 1.0, and denser liquids display ever-higher SG. SG is usually measured with a hydrometer, which is usually in the form of a floating vertical device which looks much like an old-fashioned thermometer. Such specific gravity hydrometers may be purchased from any homebrew supply store (see Appendix D) or from most laboratory supply houses. Brix is an alternate scale for SG used often in the food and drink industry to express SG in the lower ranges, especially from 0% dissolved solids (Brix = zero) to about 70% dissolved solids. Please see the *Brix* entry for more details.

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Syntropy

Syntropy is a state or process which leads to higher degrees of structure, information, order, coherence, alignment and complexity. The term is often used synonymously with terms such as *negentropy* and *anti-entropy*. All life forms exhibit a strong degree of syntropy and death of a life form is characterized by entropy. Decay is a classical example of entropy. At first glance, syntropy appears to be an exact opposite or antithesis of entropy, which, according to some of the most fundamental laws of classical physics known as the Laws of Thermodynamics (which have been disproven to some extent in they years since they were formulated), is the inevitable tendency of all matter to return to states of lesser organization and greater disorder, chaos, randomness and decay. However, the concept that syntropy is an exact opposite of entropy -- while this model does “work” and does fit reality at times -- is an old and rather primitive model. A far broader, more inclusive and more enlightened model is to see syntropy and entropy as complements to each other, where the syntropic forces of building (anabolism) ideally exist in a fine balance with the entropic forces which break down old structures and life forms, thus allowing creation and manifestation of new order, new coherence and new life. Thus destruction and creation, aka entropy and syntropy -- and their near-analogues oxidation and reduction (antioxidant activity) -- are complementary rather than truly antagonistic.

Most oxidative forces and oxidative decay – often performed or facilitated by oxidative decay microbes – are classic examples of entropic activity. Most antioxidative forces are regenerative, serving to prevent oxidative destruction and even to repair damage to complex structures such as biological tissues in an organism, and are thus classical examples of syntropic activity. Many theorists have postulated that conditions in our modern biosphere or ecosphere (the thin layer of the planet’s surface and atmosphere in which we live) are rather unevenly unbalanced in the direction of oxidative, destructive and decay forces, all of which are entropic and rather lacking in syntropic forces. And no one can deny that the modern Western lifestyle, with environmental pollution, toxic contaminants in foodstuffs and processed foods and water lacking in natural nutrients, is heavily weighted toward entropic forces and processes. The goal in introducing syntropy or syntropic functions in a system – as is done when using EM-type cultures in a variety of settings and applications -- is not to totally overwhelm and destroy all entropy, but rather to achieve a more equitable balance, one which is far more favorable to life, to regeneration and to greater levels of functionality and vitality for living systems.

Syntropic

Please see *syntropy* above

Water

It may seem like overkill to have listed water here. Actually, it is not, since water, which comprises 88% to 97% of the volume of most EM and AEM, is the major ingredient of EM and AEM, and its quality can drastically affect the quality of the final product, or even whether a batch will succeed or fail. Please see notes on water quality in Part II for more information on this topic. .

Basics of the EM Culture and Component Organisms

Introduction

This section will hopefully remain relatively brief, offering you a reminder of the basic organisms known to comprise EM culture, plus some insights into some more advanced aspects of successful and effective EM-like cultures. However, since the focus of this book is advanced methods of brewing AEM and human brews, any really in-depth examination of the origins of EM, the interaction of the microbes, the various producers and vendors of EM microbial culture, and the intricacies of the cultures does not belong here, but rather either in a comprehensive introductory work on EM, or in a specialized volume devoted just to the topic of the EM microbial culture.

Basics

All microbes in EM microbial culture inoculants are non-genetically modified (aka non-GM, or non-GE), and all are soil-based and pond-based organisms which date back to at least the Paleolithic era. Dr. Higa has stated since the early 1980s that EM-like culture consortia may contain combinations of any of about 83 species of organisms, and indeed, I have been recently informed by folks who have studied with Dr. Higa at the graduate level in Japan that he has since raised the number of candidate species from the original count of 83 to somewhere over 130 species. Further, it appears that when Dr. Higa cites the number of candidate organisms which may comprise the consortium which makes up an EM-like culture, he is only speaking about the primary, or dominant, members of the consortia, and the reality appears to be that once the consortia has established a foothold in a local environment and established dominance – along with concomitant entrainment of other wild organisms – then the species present which are actively participating in the consortium and contributing to supporting the consortium may include many members which are not on the list of 130 primary candidate organisms.

It seems to be universally accepted that all the primary species present in the EM microbial consortium are what is known as “dominant” organisms, meaning that they can entrain and “control” other local environmental organisms, which are more passive and often open to “entrainment”. Further, the members of any particular EM-like consortium seem to form a hardy, robust, and highly adaptable synergistic microbial consortium which is far more robust and adaptable than any of its member organisms alone.

In practice, it appears to me that while the labels of EM microbial inoculant culture brands which choose to disclose the names of the primary organisms usually only show the names of about nine to fifteen microbes – usually primarily from the classes of lactic acid bacteria, yeasts and phototrophic PNSB bacteria -- the reality is that most of these cultures likely contain far more species of microbes than these, and, when the culture is used in practical real-world applications, it almost always entrains other wild local organisms, forming an even larger consortium.

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What are the Primary Classes of Organisms in EM?

The primary classes of organisms which are disclosed as being present in most current versions of EM-like microbial cultures are three, and these are often seen as the core of EM:

- lactic-acid bacteria
- yeasts
- phototrophic (aka photosynthetic) bacteria

Most brands which disclose exact composition declare roughly three genus and species per group, but this will vary a lot from brand to brand and from region to region, but usually this will yield a list of from nine to fifteen species of organisms on the label, usually always all from the above three listed groups. In the past, some declarations of microbial composition for EM-like cultures – made on labels and on associated websites -- have listed organisms from other classes as well, such as actinomyces species, aka ray fungi and also true mold fungi. It is my suspicion that these organisms are still to be found in most brands and formulations around the world, but they are often no longer declared for several reasons. Some disclosure of the range of candidate species from all five classes of organisms also tends to appear in all of Dr. Higa's patents, wherein his patents, (which, by the way, were apparently filed years after he publicly disclosed the typical components of the microbial consortia) specify that his claim covers using at least five species of organisms, and drawing at least one species from each of the five classes.

Interestingly, Dr. Higa has pointed out in several lectures that all three groups of organisms (listed above) have been found throughout the history of the human race in fermented foods, although only the first two groups (lactic acid bacteria and yeasts) have traditionally been intentionally used in Western cultures for food fermentation (it appears highly possible that the PNSB organisms have appeared as “un-named co-conspirators” in many naturally fermented foods and drinks throughout history.)

A list of organisms disclosed for one typical brand of EM microbial culture follows, broken into classes:

- Lactic acid bacteria (these are beneficial organisms widely found in fermented foods, and in the GI tract of healthy humans and animals):
 - *Lactobacillus plantarum*
 - *Lactobacillus casei*
 - *Lactobacillus fermentum*
 - *Lactobacillus salivarius*
 - *Lactobacillus delbrueckii*
- Phototrophic purple non-sulfur bacteria, aka PNSB (these are widely found in ponds, soil, on plant leaves, in ice, snow and in icicles):
 - *Rhodospseudomonas palustris*
 - *Rhodobacter sphaeroides* (aka *R. spheroides*)
 - *Rhodobacter capsulatus*
- Yeast:
 - *Saccharomyces cerevisiae* (these are beneficial organisms widely found in fermented foods, and in the GI tract of healthy humans and animals)
 - *Candida utilis*, another beneficial yeast

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As briefly referenced earlier, many EM microbial inoculant formulations in the past have also listed other organisms than those iterated above, including:

- phototrophic bacteria other than the three PNSB named above, including *Rhodospirillum rubrum*
- beneficial (non-pathogenic) members of the order Actinomycetes, aka Actinomycetales, such as *Streptomyces* and other so-called ray fungi, which are really a soil bacteria which happen to look like fungi (incidentally, it is many members of the Actinomycetes order which produce metabolites which are responsible for the musty, mildewy odor of old damp basements...)
- beneficial yeasts other than *S. cerevisiae* and *Candida utilis*
- other lactic acid bacteria than the five species named above
- beneficial members of the *Streptococcus* bacterial family, such as *S. lactis* or *S. thermophilus*; these are normal and beneficial members of the gut flora in humans and animals
- beneficial members of the *Streptomyces* family (one of the so-called ray fungi), such as *S. albus* and *S. griseus*
- beneficial members of the *Propionibacterium* family; these are normal and beneficial members of the gut flora in humans and animals
- fungi (although there has sometimes been some confusion here, on the part of authors of some of these citations, with ray fungi, which are really a bacteria). Nonetheless, various EM formulas have contained fungi, usually representative species such as *Aspergillus oryzae* and *Mucor hiemalis*.

There is also some evidence that some EM culture formulations may have included at times beneficial species from the following families or groups:

- *Leuconostoc*, a family of lactic acid bacteria
- members of the *Bifidobacterium* family (bifidobacteria, like lactic acid bacteria and *S. cerevisiae* yeast, are beneficial organisms normally found in the GI tract flora of healthy humans and animals).

My own sense, much as what Dr. Higa relates, is that the exact species and names in EM formulations are not very important, but, rather, it is the synergy and relationship (interdependence) between them which is important. Dr. Higa and many others have determined that EM is not some rigid nor rigidly-defined product, but rather a flexible, living, adaptable microbial consortium. As such, it is flexible and robust. Therefore, yes, there may indeed be many versions of EM, across space and time, but they all seem to work, and work quite well, for almost all applications.

A key concept of effective EM-like cultures seems to be that the actual makeup of the microbial consortium may vary greatly, and – if you include those organism which are never mentioned on the label as well – the number of different microbes in any one culture batch will likely vary from 35 to as many as over 200 organisms. And, as noted, the exact species may vary quite a bit from brand to brand and batch to batch, and over time, but all will contain some key core microbes from a relatively small pool of candidates

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(perhaps under 130 organisms) and each will contain some helper microbes which may come from a much larger pool of candidates.

I have had the opportunity to work here with a number of different batches of EM microbial culture from various producers and sources from around the world, and I can tell you that each seems to work fine for all of the applications for which I have tried them. This fully supports what Dr. Higa has been saying all along, and demonstrates the power, robustness and flexibility of the culture technology – it is flexible and adaptable. The only arena in which I have ever been able to detect a difference among various brands and batches of EM microbial inoculant brands and batches is that of brewing EM-fermented liquids for human consumption as a nutritional supplement, and even here, the differences have been rather subtle.

More Notes About the Consortium and its Member Microbes

As we have seen above, Dr. Higa and others who have gained long familiarity with EM have long assured people that it is not so much the exact species of the organisms which are important, but rather the dynamic and supportive relationship between each of the members of the consortium. Dr. Higa has also expressed his opinion that the phototrophic organisms are literally "nuclear-powered" (something may have been lost in translation, but some of the idea comes through...!) and that the phototrophs emit certain kinds of frequencies or energies which affect nearby organisms and matter, and can have a profound effect in "regulating" or encouraging nearby bio-chemical processes to proceed in a beneficial, or reducing (antioxidative, as opposed to oxidative) manner. We will discuss the PNSBs at slightly greater depth in a bit.

Another Perspective on the Cultures in EM

Matthew Wood, A Managing Partner of SCD, aka Sustainable Community Development, a vendor of EM products (their website may be found at <http://www.scdworld.com>) studied in Japan with Dr. Higa at the graduate level, eventually earning a Master's degree, and remains the only person from North America to have completed Dr. Higa's graduate program in EM technology. In a recent letter to me, Matthew described his perspective on the matter of the EM culture and the species found in it:

[excerpted from a letter from Matthew Wood] entitled *Comments on the question, "what organisms are in EM?"*:

This is a very difficult question to answer.

First of all, EM is produced using different methods, different raw materials, different equipment and different environments in many different countries. Therefore, the actual groups of organisms in EM are different in many different countries. They are even different from batch to batch from the same manufacturing facility. Some critics say this is a problem for EM, because it can produce inconsistent results. However, Dr. Higa teaches that there are many species of organisms that, if combined in a specific way, can create a mixed culture that will have similar effects to EM. He teaches that the "key" is to have a combined culture containing beneficial lactic acid bacteria, beneficial yeasts and beneficial phototrophic bacteria. This is "EM". For example, in Dr. Higa's patents, he lists many many species that could be used to represent these three key groups.

EM is "officially" manufactured in Japan by two companies and "unofficially" manufactured by at least one other company. Each of these companies produce distinctly different variants of EM. Many variables are different among the methods of the different groups. Yet, Dr. Higa teaches that they are "functionally" all similar. Many people prefer the EM-1™ manufactured by EM Laboratory. This company is a part of the International Nature Farming Research Center (INFRC). This is not an organization started, owned or controlled by the EM Research Organization (EMRO). However, EMRO has a "Know-How" agreement with INFRC so that they will receive a royalty for the use of Dr. Higa's technology. In fact, INFRC has been around for much longer than EMRO. INFRC was started, and is controlled by, Sekai Kyusei Kyo (SKK), which is a religious/philosophical

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organization founded on the teachings of Mokichi Okada. Another branch of the SKK religion is Mokichi Okada Association (MOA), which to this day distributes EM in Brazil. SKK, through INFRC, is what launched EM technology to the world during the mid to late 1980's. This occurred because one of Dr. Higa's students (who was studying EM) was a member of SKK and introduced Dr. Higa and EM to SKK as a tool that fit their philosophy and could be used in "Nature Farming". EMRO was not founded until somewhere around 1994.

Now, back to the organisms in EM. It is as much about the process, as it is about the organisms themselves. Dr. Higa teaches that the process will ensure that only "beneficial" organisms survive.

Most, if not all, manufacturers of EM do not grow EM from "pure culture". They do not grow EM in a sterile environment and they do not use sterile media. So, the dominant species can "drift" over time, largely affected by the substrates used. For example, one of the materials often used is fish emulsion (basically ground up fish parts). If this is pasteurized before using as a culture media, it will not contribute many organisms (depends on how it is "pasteurized"). However, if it is not pasteurized, the species of organisms living on that batch of fish guts will likely grow and be present in EM, if they can survive the process and compliment the other beneficials in "seed EM". As you may imagine, this makes EM a "nightmare" to manage for regulatory and labeling issues. It also means that many of the EM microbial culture labels from around the world are often not accurate.

Some of the more advanced producers of EM, such as EM Laboratory in Japan, will regularly "spike" their batches with species from pure culture. They call this "renewing" the cultures. This is probably the best way to maintain consistency (certain species always present in predictable populations), while also getting the species richness obtained from purposely not growing in pure culture. Dr. Higa taught his students that EM made from pure culture is not as effective as EM made naturally from high quality ingredients.

I have taken EM from different manufacturers and had it cultured out on various media, purified to pure culture and then identified each different species. They have never matched the species on the labels or in the literature.

It is because of these issues that many manufacturers have decided not to put species on the label. The less specific they can be, the less chance of "misbranding".

It can also be noted that because of these complex issues (only summarized here), there is no accurate and up to date patent on EM. I think this is because there are so many versions of what is functionally the same thing.

Our company, Sustainable Community Development, LLC (SCD) is committed to providing as much information about EM technology as we can afford to. Actually we have hundreds of research papers, case studies and reports on file in our office. Unfortunately, we have not had the resources yet to scan all of this and make them available to the public.

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When looking for EM products, please consider buying from our small grassroots company. Your purchase from us supports our effort to provide education, research and development with EM technology. You can buy products from our on-line store at www.scdworld.com.

If you have EM products to sell, please send us an email. We may be happy to offer your EM product at our on-line store."

[end of excerpt from letter by Matthew Wood]

The PNSB Revisited

Most phototrophic PNSB organisms are anaerobes, meaning that they thrive in an anoxygenic environment. Indeed, many species are found at the bottom of the sea or lake beds, or in deep soil. Phototrophic bacteria species will not activate or start reproducing unless they are exposed to either sunlight or suitable foods, or both. Further, while lactic acid bacteria and yeasts feed voraciously on molasses, which is the historically-favored culture media for stock EM microbial culture, for Activated EM (aka EM Extension) and other EM applications, phototrophic organisms do not thrive well at all on molasses alone; they vastly prefer animal waste products, other wastes or even toxic wastes or pollutants (although they can apparently survive on the wastes and other products of yeast and lactic acid bacteria, and even on the yeast themselves -- indeed, that is part of their mutual interdependence and synergy.)

It appears that in EM stock culture and in AEM, the phototrophic bacteria survive and grow (if slowly) on the wastes from the other two groups of organisms, and can also feed on the yeast themselves, especially the dead "yeast bodies." So, the phototrophic organisms are (deliberately) not increased as greatly in population count (volume) when EM is cultured on molasses alone, but rather stay somewhat dormant, awaiting a wake-up call by exposure to either a good light source or to a good food (again, their idea of food is waste and toxic waste...) This will often happen only as the batch ages, leading to accumulation of dead yeast and LAB which then act as food for the PNSB, when the culture encounters waste products, as when it comes into contact with animal wastes, soil, toxins, or when it is exposed to sunlight (or a combination thereof!) Further, while the first two families of organisms produce a brew which is very clean-smelling, with a fresh, sweet and sour smell and taste, phototrophic organisms, if present and active in very large quantities, may (not always) produce a bit of a "low-tide" sulfur smell or taste, or the slightly bitter smell and taste of butyric acid (a harmless and healthful antioxidant found in butter, which gives butter its characteristic flavor.)

Part II

Brewing Guidelines, Hints and Tips, An Encyclopedia of Techniques and Concepts

This section is the one which offers the “meat” of this book. While Part III does offer some basic recipes for simple and basic AEM and EM brews, the primary purpose of this part is to offer advanced techniques and methods for brewing high-quality batches of AEM or EM brews for various purposes. This will prepare you for Part III. This current part (Part II) is the heart and soul of this book.

Fundamentals and Advanced Methods Common to Almost All Batches
This is the most important sub-section in this book, although it builds upon information offered in Part I, and it serves as a fundamental platform or bedrock upon which later suggestions and discussions in Part III will rest. Indeed, this chapter and the Very Advanced and Specialized or Experimental Techniques chapter which follows it comprise the encyclopedia and bible of advanced brewing techniques. Any exceptions to general principles and considerations presented here will be noted explicitly in later text, if and when appropriate. Other than that sole exception, the guidelines presented here should be considered rock-solid and basic.

An Important Note on EM-type Microbial Inoculant Culture

This document is devoted to offering you hints on how to make very high-quality batches of AEM and EM brews. To do so, you will need to use EM microbial inoculant culture, often abbreviated as “EM”. In my consulting and troubleshooting work, I often find that many people in the US try to cut corners when mixing up batches of AEM or brew, and attempt to use far less EM than the standard ratio of 1:1 EM to molasses (or other sugar sources). If all other conditions are fine and optimal, yes, the user may indeed get away with halving the amount of EM culture used, in other words, one part of culture to two parts of molasses, or 1:2. However, even here, conditions must be quite optimal for things to turn out well, and significantly lower ratios of EM:sugar sources, such as 1:3 or 1:5 or worse, 1:10 will often simply not work, or may yield simply a lactic acid broth which is missing some key organisms. Indeed, as noted elsewhere in this book, I always use at least a 1:1 ratio for making AEM, and if conditions are less than optimal, I may go to a 1.5:1 or 2:1 ratio of EM:molasses. And, when making EM brews (human use), I always use at least a 1.5:1 or 2:1 ratio of EM:molasses, simply to ensure a really strong, safe and optimal brew, one which exhibits strong culture “trueness”.

So, why am I telling you all this in such painstaking detail? Because I find that so many people try to cut corners and use less EM culture than optimal. Many try to make a 1 liter bottle or 1 gallon Cubitainer or EM culture last for a whole year, and become very stingy in metering it out for use in making a batch of AEM or brew. I have seen this practice

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result in many failed batches and “weird” batches, which are missing the characteristic “EM punch”. If it is not obvious, let me remind you that EM microbial culture inoculant is incredibly inexpensive for what it does. I would like to encourage you to use at least the ratios discussed in this guide, if not stronger, to ensure a good chance at optimal results.

A Note on Useful Lifetime, aka Shelf Life, of EM Microbial Inoculant Culture

Because producers and vendors have no control over how a customer stores, dispenses or uses their EM culture, they tend to assign very short and conservative -- incredibly conservative -- shelf life to their bottles/containers or EM culture, usually 6 months from the date of bottling. My experience, corroborated by tales I have heard from any others in my network, is that the reality is usually far more optimistic than that six-month shelf life. Indeed, the reality is that the useful shelf life of EM culture is usually far longer than that, and I have even heard stories of EM culture being found useful and viable after 6 years of storage. My own experience here in both practical day-to-day usage and in my laboratory only tends to support far more liberal shelf life estimates of one year to two years or more.

So, bottom line: Your batch of EM inoculant culture is likely useful and good for far beyond the 6-month expiration date stamped on the bottle. Likewise, as will be discussed at length in this book, many well-made, high-quality batches of AEM – if truly high-quality -- will likewise be useful and good for a far longer period of time than the standard 30 days after brewing (post-fermentation) which is recommended by almost all producers and vendors of EM microbial inoculant culture, as imparted in their instructions for making AEM. This matter is discussed at greater length elsewhere in this document.

A Note on Color or “Thickness” of EM Microbial Culture

It is a given fact that at some times in some parts of the world, particularly some Asian countries, unscrupulous vendors have occasionally made repeated serial and sequential batches of activated EM (AEM) to the point where much or all of the potency of the original culture was lost, and then marketed the final product as EM microbial culture or EM-like microbial culture, although it no longer exhibited most of the beneficial effects of EM culture. Due to this fact, some mythology has arisen regarding how to detect or identify “suspect” or bad brands or batches of so-called EM culture which have been marketed as true EM-like microbial inoculants, but which rather are really the product of multiple serial activations (aka extensions) to the point that the original potency of the culture has been lost.

Due to the above-related factors and others, I occasionally hear rumors – tantamount to mythology or urban folklore – that it is possible to detect such spurious products by examining the color – most notably darkness or lightness of the liquid -- of the EM culture. This is interesting, because it is true that there is indeed some variance across brands, across countries and regions and across batches from the same vendor, of the darkness of color of EM cultures and EM-like cultures. And here, things get interesting, because there exist two rather different and contradictory versions of the legends referenced above:

- The first version maintains that darker versions of EM or EM-like microbial inoculant culture, or that those which appear “thicker” are simply the product of too many serial and sequential activations, and that the dark color is somehow “proof” of the matter.

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- The second major variant of the myth maintains that lighter versions of EM or EM-like microbial inoculant culture, or those which appear “watery” or “thin” are simply the product of too many serial and sequential activations, and that the light color is somehow “proof” of the matter.

So we have two contradictory snippets of folklore, and obviously, both cannot be true. Well, which one is true? The truth of the matter is as follows:

- Much as iterated above, the color of batches of EM microbial inoculant culture will vary across brands, across batches within brands, and across geographic regions and countries.
- Color of EM culture will also vary over time, sometimes lightening with age, and more rarely, darkening with age.
- Color of EM culture will depend to some extent on type and batch of blackstrap molasses used in making it.
- Color of EM culture will depend to a great extent upon the exact microbes in the final product, and, as stressed in the section covering the culture in Part I, there are, in truth, no two identical batches of EM culture; each will vary greatly in number and types of organism present.
- Intensity, or darkness or lightness of color of EM culture will vary somewhat depending upon the exact percentage of molasses used by the producer/brewer, and this can vary more than two-fold dependent upon formula and process employed.
- Darkness or lightness of color of EM culture will depend to a great extent upon the exact formula and ingredients used in making it, and there appears to be wide variance here in formulas and processes employed not only across brands, but often even within the same brand and organization over time. For example, at least one major and long-term producer of EM culture adds fruit juices or concentrates and also often whole fruit to EM in the early stages, in accord with established internal procedures and formulas. The exact juices and fruits chosen, as well as their age and batch or type, can influence the color of the final product greatly. Likewise, other brands which do not employ the same juices or fruits will exhibit a somewhat different color.
- Bottom line: Color, or color intensity, or darkness/lightness of EM microbial inoculant culture alone is not at all a good indicator of the usefulness or potency or integrity of the culture.
- About the only things which may be said are the following three statements:
 - Intensity of color will vary across brands and even across batches within brands, and this is normal and not a significant indicator of quality.
 - Intensity, or darkness or lightness of color of EM culture will vary somewhat depending upon all the factors iterated in bullet items above.
 - And, the lesser-known fact that batches which appear more strongly red or purple may likely contain a higher percentage of the PNSB phototrophic organisms, and even here, there is wide variance, as different batches of molasses contain varying amount of red and purple coloration from naturally-occurring pigments

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A Note on Useful Lifetime, aka Shelf Life, of High-Quality AEM

I seem to be asked again and again about the useful lifetime of Activated EM (AEM) once it has been made, since most vendors and distributors of EM culture seem to state that AEM has a useful lifetime of only about 30 days after it has reached maturity (e.g., finished fermenting.)

Activated EM Useful Life

First, let me make clear here that we are talking only of high-quality AEM made at a ratio of 1:1:20 or an even stronger ratio of 1:1:15 or 1:1:10. Higher ratio (lower percentage of molasses and EM) AEM batches, such as 1:1:40 or 1:1:100 or 1:1:200, are sometimes used as very short lifetime specialized types of AEM, and are usually intended to be used in entirety within a few days after mixing the batch. However, for well-made 1:1:20 or 1:1:15 batches, most distributors and vendors of EM culture seem to claim that the AEM - once fermentation has completed within about 5-10 days from start and pH has concomitantly dropped well below 4.0 -- is only useful or "good" for about 30 days after that time. As many have guessed, this estimate is often very conservative. The vendors are playing it safe, since they have no control over how the AEM is made. In reality, the true useful lifetime of AEM depends on how you make your AEM: care, ingredients used, quality of ingredients, processes, etc.

So, vendors and distributors of EM culture tend to assign very conservative expectations of usable shelf life to 1:1:20 batches of AEM made by customers, since they have no control over any of the following variables encountered or employed when the downstream customer makes AEM:

- type or quality of blackstrap molasses used
- cleanliness and purity of water used
- ratio of EM, molasses and water (often recommended as 1:1:20, but many customers use different ratios...)
- how the EM culture is stored and handled (heat, light, air, dust)
- use of ancillary ingredients such as rock dust clays, EM ceramic powder, sea salt, bran, fish paste, etc.
- quality of those ancillary ingredients (listed above), if used
- cleanliness and suitability of fermentation container
- quality of fermentation, e.g., was it kept anaerobic?
- fermentation temperature
- length of fermentation
- processes or methods employed
- storage of AEM after it has ripened or finished: light, temperature, air, etc.

In other words, the vendors and distributors have no control over whether the customer makes a high quality batch or a sloppy, horrible-quality batch of AEM. And so, quite reasonably, the various vendors of EM culture tend to recommend that any AEM made by customers be used within 30 days after it has ripened. This is a very safe and conservative time frame, and it pretty much guarantees that even a poorly-made batch of AEM will be active within that span of time.

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However, well-made, high-quality AEM can be good for at least one to two years after fermentation is complete, as shown by my research. For example, I have 57 gallon barrels of utility-grade (animal, farm, soil, compost) AEM on my unheated porch which are over a year old. My tests show all of the essential microbes to be yet active when used as an inoculant. I still use the AEM from these batches daily in my cooking and for my birds and household uses. Many visitors have told me that it still packs more punch than the AEM they make at home when the latter is three weeks old, and many who insist on having a sip of it tell me that it really packs a punch.

A short story to illustrate the point: I have an organic farmer friend who made fifteen 55 gallon barrels of high-grade 1:1:20 AEM some years ago, using cheap unpasteurized feed-grade molasses and highly alkaline well water. Due to circumstances beyond his control, he then abandoned them in a tin shed on his California mountaintop farm for a long time. Nighttime temperatures often went to below freezing; days often went above 110 F. He came back over a year later; one barrel had gone bad, with the other 14 still perfect, and he used them over the next year for farming and animals and his own drinking use; the AEM was still great.

BTW, one final word on the useful life of good, well-made, high-quality batches of Activated EM, aka AEM: Until 2002, a primary distributor of EM culture in the USA was EM Technology Network, aka EMTN or EMTNUSA, in Arizona. They had a number of distributors around the country. Several ex-employees of EMTN have told me that rather than ship EM culture to these distributors to be marketed in the various sized containers such as 1 liter, 1 gallon, 5 gallons and 55 gallons -- which would have involved shipping of large volumes of heavy liquid across the USA, EMTN simply shipped small amounts of EM microbial inoculant culture to their distributors, who were then carefully trained to make a very high-quality AEM from it. This AEM was then marketed in turn to their regional customers as EM culture (often called "EM1" in those days), and reportedly, the assigned shelf-life/expiration date was one year or more. In fact, I have been advised by folks who make and distribute EM culture in Southeast Asia (Malaysia, Thailand, etc.) and elsewhere in the world that EM culture is often still propagated in the same way in those regions, and that the assigned expiration date/shelf life on the final product is often one year or more.

Evaluating An Aged AEM Batch

If your batch of AEM was made with care, using high-quality ingredients as well as the various ancillary ingredients which I recommend in this document, it should likely have a useful lifetime of at least one year and perhaps as much as two years. If you must evaluate an aged batch, here are some quick tests:

- some scale or floaters on the surface, such as white, cream-colored, reddish or purple floaters or "scum" are normal, and simply due to growth of beneficial yeast
- some sediment on bottom is normal, and simply due to dead yeast bodies and other microbes or ingredients which have settled.
- pH should still be well below 3.6. Do NOT use if pH is higher than 3.6
- smell should be clean and sour, often with a strong trace of phenolics (antioxidants) as well

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- the occurrence of a "bad" smell such seashore low-tide smell, swamp smell, or Limburger-cheese odor is not necessarily a bad sign, especially if pH is still below 3.6. Leave the cap off to allow odor to dissipate for a few minutes, and then check again. Such a smell may simply indicate production by the EM organisms of various sulfur-containing compounds or various butyrates and hydroxybutyrates, due to the digestion of proteins (from yeast, etc.) as the sugars and simple carbs in the AEM became depleted. Such an odor often quickly dissipates after the container has been opened, as these compounds are quite volatile, to be replaced in short order by the more common clean sour smell, with perhaps a strong trace of phenolics (antioxidants) as well.
- presence of a truly foul spoilage or decay odor which persists more than a few minutes is not a good sign, and especially if the pH is above 3.6, the batch should not be used.
- if the AEM batch passed all above tests, you may wish to taste a tiny bit if you are daring: it should have the characteristic sour/clean AEM taste.

Reminder of Terminology – AEM vs. EM Brews

Please remember the distinctions employed in this document between the terms AEM (Activated EM) and EM Brew (or simply Brew), to wit:

- Activated EM (aka AEM) – a secondary product, usually made at end-user site, from EM microbial inoculant culture, from EM culture, blackstrap molasses and water (usually assumed to be in a 1:1:20 ratio or similar ratio unless otherwise specified), and sometimes other ingredients as well. If properly brewed, AEM exhibits not only powerful deodorizing and antioxidative properties, but also will act as a microbial inoculant culture, much the EM parent microbial culture. Activated EM is also known as EM Activated, EM Extension, EM Extended, Extended EM and EM Secondary Solution (the latter primarily in Japan).
- EM Brew – In this document the term brew or EM brew refers solely to EM-fermented antioxidant nutritional supplement liquid beverages brewed for either human or animal ingestion.
- And, an elixir is a concentrated human brew with even more ingredients than a typical brew, containing ingredients such as lots of Western or Chinese medicinal herbs, medicinal mushrooms, green superfoods, along with blackstrap molasses, barley malt syrup, blueberry juice concentrate, etc., and is thus even denser and richer than a normal human brew.

In summary, in this book, the terms Activated EM and AEM will be used to indicate AEM brewed primarily for utility use, including ingestion by animals. Of course, so long as a batch of AEM is made with care, and is made only using human food-grade ingredients, and so long as pH has dropped to below 3.7, then it may also be used for human ingestion if so desired. However, in this document, the terms EM brew (or simply "brew", or elixir) will be used to indicate batches of EM-fermented brew which were brewed primarily for human (or even animal) consumption, and usually brewed with far more ingredients and more complex formulas than batches of AEM.

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Robustness of EM Culture

While it is true that you will find a section in this part (Part II) of the book which addresses troubleshooting and preventing bad batches of AEM or brews, and while it is true that if your goal is to produce really high-quality batches of the same you will want to carefully follow the many hints and guidelines offered in this part of the book, it is also true that, in general, EM-type cultures are incredibly robust and hardy, especially once they have been established in a container/setting for a while. For example, most folks in the EM world – unless otherwise required to do so by local regulations which govern production of foods or supplements for humans or animals – do not even bother to wash fermentation and storage containers with sterilants or with soap prior to use (unless, of course, the container had been very dirty or had been one identified as one needing remediation), and yet, their batches turn out fine. For example, at the time of this writing, I have lived for years on a forested mountainside in a wilderness area in the Appalachian Mountains, and I have regularly brewed EM brews for my own use and AEM for ingestion by my animals (and for my kitchen/cooking use) using only totally unfiltered and unprocessed mountain well water for that purpose; all batches have turned out fine.

I have conducted numerous experiments with well-established containers of AEM, particularly ones which have been deliberately left partly-aerobic, where I have added to the well-established 3 gallon batch small amounts of fresh chicken droppings, human waste and topsoil from my forested backyard on a daily basis, along with small amounts of molasses and (unpasteurized agricultural grade) fish emulsion, and the culture simply continues to thrive, exhibiting appropriate pH and ORP measures and RH scores, and exhibiting, in test after test, excellent presence and activity of all the major classes of organisms (e.g., yeasts, LAB, PNSB phototrophes, along with their largely-un-named aerobic helper organisms), as well as excellent culturing activity. In fact, it was my experiences with an AEM-inoculated dishpan in my kitchen sink where I left the dishpan water unchanged for five months (I do not use soaps in my kitchen) which led me to the experiments described above, and which also led me to develop the continuous-breeder, partly-aerobic fermentation process described in the section devoted to making High-Red batches of AEM.

In summary, my experiences show that EM culture is primarily vulnerable and fragile when just starting a batch of AEM or brew, especially if one or more conditions (water quality, container quality, amount of culture used, etc.) are not optimal, and that once a good, broad EM culture has been established in a batch and container, it will usually be extremely robust and hardy. Unlike the maxims and beliefs extant in most traditions of beer brewing and wine-making, and even many sectors of yogurt and kefir making -- where sterility and purity of containers and ingredients is of utmost importance -- EM-type cultures actually do better in the presence of other, wild microbes, and will almost always entrain them, transforming some or all of them into cooperative members of the microbial consortium, often yielding a resultant culture which is broader, stronger and more robust than the starting culture.

Water and Water Quality

Please bear in mind that in any liquid preparation such as AEM or EM brew, water is your major ingredient, ranging from 80% to 97% of the product by volume. Water quality can affect your brew markedly. Water quality is often the single biggest factor in determining which batches will fail, followed by gross violation of

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***anaerobic brewing guidelines, followed by quality of fermentation container used.
Lets look more at the water situation:***

When making batches, well water, artesian well water, spring water, and even chlorinated municipal water usually work well, and even water from many ponds, lakes and streams (these latter would be for AEM intended for non-human use) works well, and strident filtering or purification are not required unless demanded by local regulations which govern production of foods or supplements for humans or animals. However, having said that, there are some types of water to avoid, primarily those where the subtle structure and subtle energies have been damaged by some factor, usually man-made. Speaking from broad experience, and after having heard tales of woe from many folks in the EM world, I would suggest that you try to avoid the following types of water, arranged in descending order, from top to bottom, from worst offender to least offender:

- Reverse-osmosis water, aka RO water (this is the worst)
- De-ionized water (this is almost as bad)
- Distilled water (still quite bad)
- Stagnant smelly water from a dead pond or other stagnant source (long-unused water from a storage tank, etc.)
- Water which has been very heavily treated or processed to “purify” it
- Water which has been chlorinated or ozonated far more heavily than municipal tap water
- Fluoridated water (some municipal tap water in the USA is fluoridated)
- Boiled water – in reality, boiled water hardly belongs on this list, as it is nowhere near as harmful as any of the above-listed types of water, but I include it in the list simply because so many folks have asked about its suitability for use in making batches. As you may be able to deduce from its position at the bottom of the list, it is not particularly harmful, but, in most cases, hardly necessary, unless you are faced with either of the following conditions:
 - If local or other regulations require boiling of water prior intended for use in human food or animal feed products
 - If your source of water is very heavily polluted with organics and laden as well with lots of undesirable decay microbes

If your water source is one of those named above, either switch to another source (best), or see the *Water Remediation* section below (second best.)

The Current-or-Recent Atomic Blast Hypothesis—Impact Upon AEM and Brews

Further, a number of EM mystics in Japan and the US believe that if an atomic blast is triggered anywhere on the planet, even if an underground test, that any batches of AEM or brew started within 20 hours before the blast and up about 2 days after the blast, will likely fail. Their reasoning is that the blast creates all kinds of very powerful subtle energy patterns which blanket the planet, erasing any beneficial patterns in water, and embedding some very harmful incoherent patterns in the water or liquid, and that this can interfere with the development of a very “young” batch of AEM or brew so much that it may be doomed to fail. As many of you know, Dr. Higa at some point encountered and befriended Dr. Emoto, the Japanese researcher/author who is devoted to the subtle structure and subtle energies of water. Dr. Emoto and many of his followers and adherents, some of whom are in the EM world as well, seem to be among the primary

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proponents of the theory iterated above, and they also seem to believe that RO water and de-ionized water are very harmful (I definitely agree with this contention...) However, Dr. Emoto and his followers are by no means the only water mystics who believe the theories I have outlined here regarding harmful and undesirable water; there are many other water mystics as well, and many who believe in orgone energy (Wilhelm Reich) and/or using orgone energy to modify weather patterns, also believe this to be true. Further, a very similar theory – although not specifically about EM – was promulgated by Capt. Bruce Cathie – now deceased – an author/lecturer on planetary grid lines, and is promulgated to this day by his modern followers.

Remediation of Suspect or Damaged Water Prior to Use

If you absolutely must make your batches using one of the types of water listed above, or if your neighbor triggered a small nuclear blast ten hours ago, then you may well wish to employ one or more of the following remediation measures:

- Pre-treat water with a small amount (1% to 2%) of EM culture or high-quality AEM at least 4 hours prior to using the water to mix your batch, and then let the water sit for at least 4 hours but no more than 12 hours (if you combine both the EM/AEM and ceramic powder, then okay to let sit for up to 24 hours before use.)
- Pre-treat water with EM ceramic powder at least 4 hours prior to using the water to mix your batch, at the rate of 1/16 to 1/8 teaspoon per gallon for lightly damaged water and up to ¼ tsp per gallon for badly damaged water. Stir the powder in well till well distributed, and then let the water sit for at least 4 hours but no more than 24 hours. When mixing ingredients for batch, add EM ceramic powder at the rate of 1/8 teaspoon per gallon for lightly damaged water and up to ¼ tsp per gallon for badly damaged water (okay to go higher, if you can afford expense.)
- When mixing ingredients for batch, instead of using the normal ratio of EM culture to sugar sources (usually 1 to 1, aka 1:1), use a higher ratio of EM culture to sugar sources, perhaps 1.5 to 1 or 2 to 1 or even more, if you can afford it.
- For any of the suggestions above which involved EM ceramic powder, small EM ceramic shapes may be substituted – if needed -- instead of powder, but due to their far smaller effective surface area, use up to ½ oz (15 grams) of pellets or spheres per gallon; they will rest at the bottom of the container.

My feeling is that the best EM ceramic powder for this purpose, as well as for batches of AEM or brews in general, is the one known by the laborious name of EM Super Cera C EM Ceramic Powder, but the others, especially the EM-X ceramic powders, are fine as well.

Molasses Considerations

Almost all batches of AEM and brews will use molasses as the primary food source for the microbes, or as one of the primary food sources for the microbes. In all cases, I recommend that you use only blackstrap molasses; no other type of molasses or sugar is recommended as the primary food source; only blackstrap molasses. A reminder of the definition of blackstrap or third-stage molasses from the Glossary:

Blackstrap molasses

What is commonly called Blackstrap Molasses in the human food marketplace in the USA is a very heavy, thick and dark molasses, derived from the final stage of sugarcane processing for sugar extraction, when the content of simple sugars is

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lowest (usually 45% or less) and the content of other compounds such as complex carbohydrates and antioxidants, is highest. This product is often called Sugar Cane Molasses in the animal-feed grade molasses market, and in many countries outside the US. It is important to recognize that products called molasses, light molasses, medium molasses, middle molasses, Barbadoes molasses, Island molasses, and similar names are lighter and sweeter types of molasses from earlier stages of sugar refining, and do not have the properties of blackstrap molasses.

A few basic blackstrap molasses facts:

- Most blackstrap molasses has a Brix rating (a type of measure of specific gravity, showing amounts of dissolved solids such as sugars, etc.) of 79.5. A few variants range in Brix score from 79 to 81.
- Blackstrap molasses weighs 11.9 pounds per gallon, as compared to water, which weighs around 8 pounds per gallon.
- As noted above, blackstrap molasses has a higher specific gravity than water; most blackstrap has an SG of about 1.43
- Most batches of organic blackstrap molasses will have even more Ca and Mg and other alkaline ions available per ounce than found in commercial-grade non-organic molasses, and thus the pH drop of some batches of AEM and brew may be somewhat slower, as the pH drop will be buffered by the alkaline ions.

Blackstrap molasses is commonly available in two forms:

- **Human food-grade**, which is pasteurized. While at one time some countries allowed sulfur and other preservatives to be added to human food-grade molasses, that is no longer the case in most countries, especially in the West, so you should not have to worry about such possibilities. Normally, food-grade is employed for EM brews, but there is no harm in using unpasteurized animal feed-grade molasses of good quality – particularly if simply brewing an EM brew for your own use -- so long as you observe the quality considerations noted below. If you use much, do not purchase it in supermarkets or natural foods stores, but rather in one-gallon or 5-gallon bulk containers from bulk molasses suppliers (see Appendix).
- **Animal feed-grade**, which is unpasteurized, and much cheaper, and often available from feed and grain stores, and also bulk molasses suppliers. **However, if you choose to use this product for your animal feed-grade and utility batches of AEM, please remember two things when purchasing the molasses (also noted in Appendix C):**
 1. If purchasing feed-grade blackstrap molasses from a feed and grain store or a molasses vendor, please be very careful to purchase only a feed-grade blackstrap molasses which is totally free of preservatives, chemicals, free-flowing agents, anti-mold chemicals, anti-fungal chemicals, and oils. Many types of feed-grade blackstrap molasses are mixed with such substances, and it will be your job to carefully check with your vendor and their suppliers to ensure that you are purchasing only pure feed-grade blackstrap molasses, devoid of any and all additives.
 2. Feed-grade blackstrap molasses is sold by the pound, and weighs considerably more than water; weighing 11.9 pounds per gallon.

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Organic vs. Commercial Grade?

Both animal feed-grade and human food-grade blackstrap molasses are sometimes available in certified organic form as well. The organic form, while more expensive, will usually have a somewhat higher antioxidant content than the already-extremely high antioxidant content of commercial grade blackstrap molasses, which is beneficial, but it will almost always have a far higher concentration of certain alkaline elements such as calcium, magnesium and potassium as well, particularly calcium, since it seems that the process used to make organic molasses during the extraction of white sugar often involves adding even more calcium than the non-organic process. This higher concentration of alkaline elements can slow down the pH drop quite a bit, particularly as it approaches the 3.6 or 3.5 mark, and, while a near-stop at pH 3.5 or 3.6 is not fatal, you may wish – if using organic molasses -- to keep your eyes open for slowdowns at even higher pH ranges, as such could be a problem. If such a slowdown happens with organic blackstrap molasses before the pH has dropped to at least 3.6 or lower, you may wish to try adding a small amount of white table sugar or corn sugar (about one to four tablespoons per gallon, or about one-half ounce to two ounces per gallon) to your batch to speed things up and provide more microbial food. I personally feel that when it comes to brewing AEM and brews, organic molasses is often not worth the extra expense and effort needed to locate it.

Hints on Purchasing Molasses

Much as briefly referenced in the section on sources of molasses in *Appendix C*, if you foresee that you will be using more than a quart or two of molasses (two to four 16 oz. bottles) per month, I strongly suggest that you consider purchasing your molasses in bulk, in any of the following forms from a bulk molasses supplier, rather than paying from \$3.29 to \$4.99 per pint (16 oz.) bottle:

- 1 gallon plastic jar; these will usually sell for about \$10 to \$20 for human food-grade blackstrap molasses.
- 5 gallon plastic bucket, which will weigh about 60 lbs; some come supplied with a collapsible pouring spout built into the lid. These will usually sell for about \$18 to \$34 for human food-grade blackstrap molasses, and for a few dollars less for animal feed-grade molasses.
- 55 gallon plastic barrel; this will weigh about 670 pounds. The price per pound or per gallon will be even far cheaper than when purchasing in 5 gallon buckets, but you then have the problem of handling a 55 gallon barrel.
- Many feed and grain stores sell animal feed-grade blackstrap molasses in bulk from a spigot on their feed room floor, usually for about \$2 to \$5 per gallon. You simply walk in with your own empty buckets and lids, have them filled, and then pay by the pound. Of course, you will need to first ask questions carefully to ensure that there are no additives, such as vegetable oils, anti-mold agents, anti-yeast agents, etc. in the molasses. I always take the precaution of first speaking with the buyer at the store and asking to see the invoice and bill of lading describing the batch of molasses, and I then copy the name and contact information for the producer or distributor and call them long-distance to ask even more questions. Most of these folks know what they are talking about, and can provide excellent and accurate information which will help you to decide whether the molasses is suitable for you.

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Very Old or Foamy Batches of Molasses

While many folks in the EM world advise that you avoid unpasteurized animal feed-grade blackstrap molasses which has gotten quite old and foamy due to action of wild microbes, I have never yet had a problem in using such batches for making AEM, and some such old batches have produced my best batches – I realized later that they had likely been loaded with all kinds of wild microbes which cooperated well with the EM consortium. I suspect also that some of these batches of old foamy molasses have even contained plentiful wild varieties of the phototrophic PNSB organisms.

Hints on Decanting Bulk Molasses

Especially if you are using unpasteurized animal feed-grade blackstrap molasses, which will be loaded with wild microbes (especially yeasts) and which has probably already been slowly fermenting for months in the storage container, you may wish to beware of short-term foaming of the molasses within the next 18 hours after decanting it into a smaller storage container. For example, if you decant some of your bulk molasses with a funnel into 1 gallon jugs for storage in the kitchen or brewery, be sure to leave at least 5 inches of airspace at the top, and leave lid of jug slightly cracked for first 24 hours, as molasses will briefly ferment and foam after being exposed to air, and you do NOT want to have a geyser of foaming molasses explode all over your kitchen or brewing/production room!

Use of Substitutes for Molasses as Primary Sugar Source

This topic is also covered to some extent in two other sections as well, in slightly different context. Much as is made clear in other sections on ingredients, it is rather important to use blackstrap molasses as the primary sugar source. Yes, some folks wish to use maple syrup, sugar, or brown sugar, or a supposedly “wholistic” or “good” brown sugar such as Sucanat, Rapadura, Jaggery (Panela) or Turbinado sugar, or honey instead, but the real truth of the matter is that they are all simply almost totally pure sugars, and are almost totally lacking the other vital and necessary nutrients such as minerals, trace elements, complex carbohydrates and antioxidants. They offer far fewer of these other nutrients than even the lightest grade of molasses, and we know, as mentioned elsewhere in this book, that light grades of molasses – although still far better than any brown sugars -- do not work well as replacements for blackstrap molasses. And, worse, as mentioned in other sections where honey is discussed, not only does honey consist of almost pure sugar, but it is extremely low in other nutrients and has anti-microbial properties if used at over 2% to 3% by volume.

The problem with any batch of AEM or brew made with light molasses or with these sugars instead of blackstrap molasses is that it is far less stable, results in more bad batches during fermentations, can go bad within one to six months after finish of fermentation, and offers far less nutritive value (than a similar batch made with blackstrap molasses) since the nutrients in these sugar products are not synergistic with EM microbes and their (antioxidative, syntropic) activity. Indeed, there are several “white” EM liquid products made and marketed in Japan, with a very clear, light color due to absence of molasses, one made using starch and simple sugars and another made using sugary waste left over from processing grapefruit and oranges, and both have notoriously short shelf lives, both in the sealed bottle and especially after the bottle has been opened. I have made EM brews from apple cider and several other fruit juices (such as citrus, which happen to be rather low in antioxidant and mineral content) and in each case, the resultant product tasted fine for a while, but eventually started to go bad after a few

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months. Moreover, as you may have guessed from the earlier discussion, the antioxidant scores for these brews were FAR lower than for brews containing at least 5% molasses, and the brews lacked what I call an “energetic punch”.

So, with a few exceptions to be discussed below, blackstrap molasses should – with very rare exceptions – remain the primary sugar source in all batches, with (in general) its percentage by volume higher than that of any other sugar source, or at least equal to them. In fact, unless you are an advanced brewer, it is safe to state that every batch of AEM (except for special purpose batches of AEM meant to be used within hours or days of mixing) or brew should ideally contain at least 4% to 5% blackstrap molasses, although it may be permissible at times to go down to 3% (perhaps in conjunction with fruit juice concentrates high in antioxidant content, such as grape, blueberry, cherry, or pomegranate; a bit more on this later.) Again, with the sole exception of barley malt syrup (aka barley malt extract, especially in the beer brewing field), which does contain at least some other nutrients of value, including antioxidants, the “sugar” type ingredients should largely be avoided. If you are even tempted to use them, far better to substitute instead fruit juice concentrates high in antioxidant content, such as grape, blueberry, cherry, or pomegranate, which also have far more nutrient value of all kinds than the sugars such as those named earlier. And, even when using the fruit juice concentrates, it becomes more important to use sea salt, Azomite rock dust bentonite clay, bran, and other supplemental nutrients as well, to ensure adequate spectra of minerals, trace elements, and other nutrients.

Another possible substitute for much of the volume of blackstrap molasses could be pomegranate molasses, but the hazards here (aside from price!) are as follows:

- it is far lower in antioxidants and many minerals and trace elements than is blackstrap molasses, so all the more important to provide these via other ingredients in brews, and also should not totally take place of blackstrap molasses.
- some brands of pomegranate molasses, as is true for many brands of pomegranate juice concentrate, contain seed squeezings as well, which are highly anti-microbial, and thus, any concentration of such a product at volumes over about 2% can inhibit the microbes in EM and thus retard fermentation or drive it primarily into an alcoholic direction (fueled by wild yeasts which are somewhat resistant to the anti-microbial activity).

If you do wish to decrease amount of blackstrap molasses in your brews, then I suggest you try using 2% to 3% blackstrap molasses plus 3% frozen grape juice concentrate (45 to 68 Brix) and perhaps 2% blueberry juice concentrate, but again, as noted earlier, be sure to use sea salt, EM ceramic powder, Azomite rock dust, granulated kelp, bran and perhaps other supplemental ingredients as well.

Indeed, it is possible to totally eliminate blackstrap molasses if absolutely necessary, and yet produce a stable and long-lived brew, but then you would need to be sure that the brew contained at least 5% to 6% by volume of fruit juice concentrates high in antioxidant content, such as grape, blueberry, cherry, or pomegranate (note warnings about the latter above), and that it also contained a goodly amount (at least 4 tbsp per gallon if in freeze-dried form), algae or vegetables (preferably in freeze-dried powdered form or juice from

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the fresh herb, where appropriate) which are high in antioxidant content, such as shown in the lists in the *Green Superfoods* section.

Indeed, many green superfood concentrates, especially those which claim to be high in antioxidants, such as *Pure Synergy*, already contain from 20 to 80 of these substances in powdered freeze-dried form.

Some more options, especially for AEM batches

Beet molasses can also sometimes be used as a substitute for blackstrap molasses, especially if supplemental ingredients listed above are used as well. Beet molasses may be found in feed and grain stores (see Appendix C), but the only problem with beet molasses is that it is not officially sold in human food-grade quality, but only in animal feed-grade quality.

Desugared beet molasses (aka *Raffinate* or *Concentrated Separator By-product* or *CSB*) which is a by-product from the beet molasses industry, available at feed and grain stores (see Appendix C), plus 50% barley malt syrup, maple syrup, honey, sugar, or grape juice concentrate by volume. But, much as noted above for beet molasses, the problem with the various brands of de-sugared beet molasses is that almost all of these products are not officially sold in human food-grade quality, but only in animal feed-grade quality.

Bottom line

I strongly recommend using blackstrap molasses as the primary sugar source, but if you wish to play with reducing the amount somewhat, or even eliminating it, you may wish to follow suggestions given above!

Anaerobic Brewing Techniques

From the Glossary:

Anaerobic – An environment devoid of oxygen. In this document, anaerobic refers to fully anaerobic or near-anaerobic conditions where reasonable and good precautions have been taken to exclude all or almost all atmospheric air from the fermenting batch of AEM or brew. Normally atmospheric air contains from 18% to 21% oxygen.

The assumption in this document is that all batches are to be fermented and stored only in anaerobic or largely-anaerobic (yes, this will be explained below) conditions, usually via an airtight container equipped with one or more airlocks or makeshift simulacra thereof to allow gas pressures to equalize, and are kept anaerobic except for occasional opening of the container during earlier stages of fermentation to inspect, smell or test the batch, or later, to use the some of the batch of AEM or brew. Any exceptions will be noted explicitly in this book.

A common exception – early stages of fermentation

One common exception will be the deliberate exposure of some liquid batches to air during their first few hours after mixing – as will be noted and explained in appropriate sections of this work -- but, even in these cases, conditions are allowed to return to largely-anaerobic conditions within 6, 12 or 24 hours after first mixing the batch and putting it in the hotbox.

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General Rules of Thumb – Fermentation

In general, it is never harmful to expose a batch to air during mixing/starting and during the first 12 to 18 hours of fermentation, and it is even often quite desirable. Indeed, controlled exposure to small amounts of air even during the next 4 to 8 weeks (after the initial 12 to 18 hours) of the fermentation period can also be beneficial for certain types of batches. Indeed, this is why the general guidelines of producing optimal batches, offered elsewhere in Part II, suggest leaving ample air headspace above the liquid surface in the fermentation container, and suggest opening the container daily for at least the first 4 to 6 weeks. Ad, this is why there are even some very successful – if highly specialized – techniques for producing certain types of AEM in partially-aerobic continuous breeder fermenters, much as outlined in the section in Part II on making High-Red batches of AEM. However, maintaining strict anaerobic or very near-anaerobic conditions becomes far more important during latter stages of fermentation, and especially during storage.

General Rules of Thumb – Storage

In general, it is very important to maintaining strict anaerobic conditions during the latter stages of fermentation, and particularly during storage. This is because simple carbohydrate (e.g., sugars) content is very low at these stages, and any exposure to air could re-awaken the now-dormant aerobic microbes (and also stray wild yeasts) which – while they were essential to the viability of the culture at earlier stages of fermentation – could play havoc with the batch if they became active at this stage. Indeed, if these largely-aerobic microbes are exposed to significant amounts of air at this stage and allowed to become active again, the following adverse effects may be seen in the batch:

- Development of bad smell or taste.
- Rise in pH to above 3.6 or even to above 3.8 (do not use batch in the latter case).
- Shift in culture from the beneficial EM-type syntropic consortium to a far less-desirable culture balance.
- Overgrowth of undesirable organisms (closely linked to above-described shift in culture.)

Are obsessive and extreme efforts to maintain anaerobic conditions needed?

No, as noted above, conditions which are simply *largely* anaerobic, starting within 12 hours or so of mixing up the batch, are more than sufficient during fermentation; strict anaerobic conditions become important only during later stages of fermentation and during storage, particularly if long lifetime for the batch is desired. As noted elsewhere in this section, I have become quite convinced that that one or two brief daily exposures of the liquid surface to air during the first 3 or 4 weeks of fermentation actually improves the quality of the batch, by offering “just enough” fresh air -- bearing oxygen -- to the aerobic organisms which are important commensals or cohorts in the culture to allow them to play an optimal role as essential members of the fermentation microbial community.

Does anaerobic mean that I cannot open cover on batch for testing, etc.?

No, much as noted in other subsections herein, conditions which are simply *largely* anaerobic -- starting within 12 hours or so of mixing up the batch -- are more than sufficient during fermentation. So, it is perfectly fine to open the container housing your fermenting batch one, two, three, or even four times per day – particularly during the first few weeks of fermentation, as needed -- for testing or inspection, so long as cover is replaced in short order (within 5 minutes) and anaerobic conditions are restored. Indeed,

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my own experience is that one or two brief daily exposures of the liquid surface to air during the first 3 or 4 weeks of fermentation actually improves the quality of the batch, as noted above.

Batch Starting Methods

and

Fermentation Process

This section will deal with the apparently mundane and dull – but in reality **extremely important** -- topics of mixing and starting a liquid (AEM or brew) batch, and management of the fermentation process during the first few weeks. Here are my guidelines, in bulleted form to make them more digestible; many items may refer to other sections in Part II which contain more detail on the topic at hand:

- Use only high-quality fermentation container (see appropriate section).
- Use highest-quality water possible (see appropriate section).
- Be sure to allow lots of air/oxygen to mix with liquid when mixing batch. Anaerobic considerations enter only later, and even then, the topmost layer of the batch liquid needs to be exposed to air at times during fermentation.
- Allow appropriate air headspace above fermenting liquid, to feed essential aerobic microbes also present in culture (see appropriate section.)
- Fermentation process: during first 4 to 5 weeks, open container at least daily to allow a bit of air into headspace, and even longer for high-specific gravity (high-Brix score) batches.
- Stir or mix or shake liquid in fermentation container at least daily during the critical period of the first 4 to 5 weeks, and even longer for high-specific gravity (high-Brix score) batches.
- Please strongly consider using recommended ancillary “helper” ingredients, ranging from EM ceramic powder to sea salt to a bit of fish paste or fish emulsion, etcetera, all discussed in appropriate section in Part II. While the primary reason for use of any of these helper ingredients is to improve batch quality, it is true that sometimes the inclusion of one or more of these ingredients may be the crucial factor which will spell the difference between a successful batch and a failed batch (see appropriate section).
- Consider occasional cycling of temperature of fermenting batch during first weeks/months, starting as soon as end of first week (see appropriate section).
- Your attitude, mood and intent (see appropriate section)

Airspace or headspace above liquid

Allow appropriate air headspace above fermenting liquid, to feed essential aerobic microbes also present in culture. The presence of significant airspace/headspace above liquid surface in fermentation container, particularly during first 6 to 8 weeks of fermentation, is very important. I suggest that you allow a headspace (air space) volume equal at about one-seventh ($1/7^{\text{th}}$) to one eighth ($1/8^{\text{th}}$) of the volume of liquid in the batch, or even a bit more. Yes, it is true that headspaces of as little as one fiftieth ($1/50^{\text{th}}$) of liquid volume may work, but then other factors (e.g., amount of air introduced during mixing/stirring, presence of ancillary ingredients) may become more critical. Headspace is important, because it allows presence of “just enough” air and concomitant oxygen (refreshed whenever container is opened) to feed the aerobic microbes in the batch, mostly in the top layer of the liquid.

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Your Attitude, Mood and Intent

At the risk of sounding like a hopeless mystic, I must stress that your mood, attitude and intent are very important, especially during the mixing and early fermentation stages. If you are having a really bad day, and are quite angry or unsettled, consider putting off mixing and starting a batch until you feel more centered, calm and loving. I suggest that you offer the microbes love and gratitude for what they do. If you notice that you are getting too serious about the process and trying too hard or straining, try to really notice that tendency, and allow yourself to relax and lighten up. Likewise, your attitude during the first 6 weeks of the fermentation process, particularly when you are near the fermentation vessel and checking on progress or stirring, etc. is important. I am not here to lecture you. If you feel uncomfortable with such suggestions as I have offered here, feel free to ignore them, but at your own risk!

Must the batch ferment under pressure?

This is a very interesting topic, and related somewhat to the issue of anaerobic conditions discussed above! When I first entered the world of EM in late 2002, I was strongly advised by representatives from all major vendors of EM in the USA that not only were rigorous and extreme anaerobic conditions during fermentation needed to produce high-quality batches (more on this in a bit...), but that it was vitally important that the fermenting batch be allowed to develop significant positive gas pressure (e.g., pressure above the ambient atmospheric pressure outside the container) in the fermenting vessel, otherwise the batch would “go bad”. Some vendor representatives even confidently stated that pressures in the brewing container must reach at least 2 psi above outside atmospheric pressure for the batch to turn out well.

Well, it turns out that both caveats offered to me were largely myths, with a few modest exceptions. We have already seen in the section on largely-anaerobic fermentation that minor deviations from strict anaerobic conditions during fermentation are not only harmless, but likely helpful in improving batch quality. Much the same is largely true regarding the assertion about the necessity of maintaining positive gas pressure to allow the batch to “develop” properly. My experiments and observations have shown me that while allowing pressure to build at times (even if the pressure is vented and released every time the container is opened to inspect contents and the progress of the fermentation process) during the first few weeks of fermentation can be mildly beneficial, significant positive pressure (beyond the tiny gas pressure differential needed to allow an airlock or other venting device to operate properly) is largely not needed. About the only exception here – and a *minor one* due to the relatively low importance of the pressure as a factor – is if your primary and overriding purpose for the batch is to serve as a microbial inoculant culture. If that is the case, then it appears that allowing significant positive pressure to develop at times (even if only for 8 to 12 hours at a time) in the fermentation vessel during the first 2 to 4 weeks of fermentation can indeed contribute to allowing development of a higher-quality batch. See subsection below for hints on how such significant positive pressures may be allowed or maintained during the early stage of fermentation.

Methods to allow development of a significant positive gas pressure

As noted above, it can be moderately beneficial for certain types of batches if the batch is allowed to develop significant positive gas pressure at times during the first few weeks of

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fermentation. How may this be done? Here are some points to bear in mind, which will help in creating a more complete understanding of the possibilities:

- Obviously, any freshly-started batch will usually exhibit significant off-gassing during at least the first few weeks of its life, and so the off-gassing can and will easily create significant positive pressure if the fermenting batch is housed in a sealed vessel which can withstand some degree of pressure.
- It is also likely obvious that the one-gallon cheap milk jugs which many folks use for batches cannot withstand significant positive pressure. Even if you were to place a solid cap (no pinholes, which are normally a cheap and dirty way to allow pressures to equalize safely) on the jug, any significant buildup of pressure would simply cause the cap to pop off – thus venting any gas pressure – or would cause the container to split or explode.
- Likewise, the vast majority of glass containers, with the possible exception of beer bottles and champagne bottles (which can often handle up to at least 60 psi), cannot handle significant positive pressure without the danger of explosion.
- For small batches, 1 liter and 2 liter PET soda bottles, with appropriate caps or methods as mentioned elsewhere in Part II, make ideal containers for fermenting under pressure, as they are designed to handle pressures up to at least 40 psi.
- For larger batches, many white plastic food-grade buckets in the 4 gallon to 8 gallon size, often used for fermenting beer and wine in the homebrewing world, if an appropriate solid lid (no hole provided for an airlock) is securely placed on the bucket, will often allow significant pressures (not a lot, but enough) to develop before the lid allows leaks around/through the pip and seal to equalize pressure.
- For larger batches, many white plastic food-grade buckets in the 4 gallon to 8 gallon size, often used for fermenting beer and wine in the homebrewing world, if an appropriate solid lid (no hole provided for an airlock) is securely placed on the bucket, will often allow significant pressures (not a lot, but “just enough” pressure) to develop before the lid allows leaks around/through the lip and seal to equalize pressure.
- For even larger batches, use of 15, 30 or 55 gallon food-grade plastic barrels with thread bung caps is ideal, because almost all of these barrels can easily withstand at least a few psi of pressure. So, there are two ways to take advantage of this robustness of the barrels, as outlined below:
 - One method is to tighten both bung caps securely, and to loosen them briefly at least two or three times every 24 hours during the more active early stages of fermentation to allow gas pressures to escape before the container explodes or ruptures. The downside of this method is that if the batch starts to off-gas extremely violently, pressures could build to a high enough level to damage or rupture the container. Or, if the brewer were to forget to crack the bung cap a few times per day during the more active “off-gassing” phases of fermentation, then again there looms the possibility of rupture or explosion of the barrel.
 - A second method -- but again, like the method above, one which is somewhat dependent upon human judgment and memory – is to simply leave one bung cap slightly loose – usually this will mean backing off one or two turns from complete tightness. This will allow moderate pressures to build, but at some point and excess gas pressure will start to escape through the threads and lip of the bung cap. The primary hazard here is

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that if the brewer were to forget to leave the bung cap “cracked” (e.g., left lightly loose), or if someone else were to come along and tighten it – all with the best of intentions -- then again there looms the possibility of rupture or explosion of the barrel. A partial remedy for these hazards is one which I regularly recommend to consulting clients who are considering use of this method, and that is to print and affix a large sign to the barrel and another to the bung cap area, announcing clearly in large bold font the fact that the bung cap has been left deliberately cracked, and why, and that it must be left cracked.

- Likewise, much as noted above for barrels, many so-called “1 ton totes” – plastic totes which hold about 275 gallons of liquid – can also withstand a bit of pressure, and many are equipped with a large threaded cap on top. If you are using a tote, and if it is so equipped with such a threaded cap, then you may also wish to take advantage of one of the two simple methods described above, bearing in mind however that most totes cannot tolerate pressures as high as those which can be tolerated by most plastic barrels.

Hotboxes and Incubators

Hotboxes and incubators, sometimes even the size of a whole room, are used to keep batches of AEM or brew warm during fermentation. Although several folks have pointed out that the topic of hotboxes and incubators is rather elementary, and therefore does not belong in a guide for intermediate and advanced techniques, I have chosen to cover the topic to at least some degree here; if only to offer some basic hints and suggestions. I realize that most of my readers will find this section superfluous, as they will have already devised many safe and efficient means of keeping their batches warm far earlier in their EM-brewing career. However, some basic hints follow, and for all vendors and suppliers, as well as product info, please see *Appendix D*:

Oven

For keeping containers such as 1 liter or 2 liter PET soda bottles or 1 gallon plastic jugs warm, many folks start by using an empty, unused oven, using either the 40 watt or 60 watt lamp bulb (left on at all times via the switch) to keep the interior warm, or using the gas pilot light (if a gas oven) to keep the interior warm. This will often provide an “incubator” environment with a temperature of about 87F to 103 F.

However, two very important notes:

- 1. If you decide to use an unused or spare oven as a hotbox via methods described above, it is very important to affix a sign to the oven door and another to the oven knob on the stovetop, reminding you and others in your household that you are fermenting brews in the oven. You could have a real messy disaster if you or someone else forgot that fact and turned on the oven!***
- 2. Regardless of the type of fermentation container which you choose to place in an unused oven, it is extremely important to place a deep splash pan – such as a dishpan, under each one, to catch spills, leaks, or massive leaks, such as if and when a cheap 1 gallon plastic jug splits and dumps all its contents (this happens a lot!)***

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Picnic coolers

Rigid insulated picnic coolers with hinged top lids are available in various sizes from 25 quart to 200 quart. They are sold seasonally in discount stores and department stores, and year-around in sporting good and outdoor stores. They may be heated easily with terrarium substrate heaters, available in pet supply stores.

Igloo Coolers -- Many folks end up using the Igloo coolers labeled as 54 quart, 55 quart, 56 quart or 57 quart – these are really all the same model, but simply bearing different labels (I suspect that the marketing person who designs the labels has an attention-span deficit!) These coolers work well, are well-insulated, and cost under \$20. Best, the two most common sizes of ExoTerra flat terrarium substrate heaters (below) fit easily in the bottom or near the bottom of these coolers.

Igloo also makes a larger model cooler, usually labeled at about 96 to 110 quarts, which they claim is even better-insulated.

If using terrarium heaters or other heaters at bottom of picnic coolers, it is extremely important to place a deep splash pan – such as a dishpan, under all fermentation containers in the cooler, to catch spills, leaks, or massive leaks, such as if and when a cheap 1 gallon plastic jug splits and dumps all its contents (this happens a lot!)

30, 32 and 45 gallon plastic trash pails with lids

These plastic trash pails may be purchased new for under \$20 apiece, often under \$12 apiece. I usually purchase Rubbermaid or some other very sturdy brand. Although such sturdy brands will cost a bit more, they offer paybacks in strength and durability. The 32 gallon models will easily hold one 6.5 gallon or 8 gallon fermenting bucket, or two 4 gallon fermenting buckets (stacked), or will hold numerous smaller fermenting containers. The 45 gallon pails, often rectangular in shape, will often hold up to three stacks of 4 or 5 gallon buckets, stacked two high, or a number of 5 gallon plastic jugs. Some notes:

- These trash pails may easily be wrapped with any of various kinds of insulation on the exterior. I prefer the flexible foil/plastic bubble/foil “sandwich-style” insulation wrap which is about 1/8th inch thick and usually sold in rolls about 10 yards long, and in widths ranging from 12 inches to 36 inches – rolls of such foil may usually be found in the HVAC (heating, Ventilation and Air Conditioning) aisle of any home improvement or home supplies store.
- All exterior insulation on the trash pail and lid may be held in place with duct tape.
- Further, the entire trash pail may be placed on a square of rigid foil/foam/foil insulation board of the type used for insulating walls, to provide insulation for the bottom.

Means of monitoring temperature in hotboxes

LCD aquarium and terrarium strip thermometers

Inexpensive (about \$3 apiece) LCD strip thermometers, which display temperatures along a scale of about 75F to 105F, are available at all pet supply stores – they are sold for use on the outside of aquariums and terrariums. I usually mount one or two of these on the interior of each of my hotboxes to allow me to quickly and easily monitor temperature.

Infrared (IR) digital thermometer guns

For about \$45, you may purchase infrared point-and-read digital thermometer “guns” from most electronics supply catalogs and from many home improvement stores. While these

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remote-reading thermometer guns are not quite so accurate as a direct contact thermometer, due to variances in reflectivity and emissivity of surfaces, they are extremely handy in that they work remotely – you can aim the gun from about a foot away at a fermenting bucket and get an accurate reading, within one or two degrees, of its temperature. I use mine frequently, if only because it is so convenient.

Probe thermometers

Most electronics supply houses and catalogs sell, for about \$23, small handheld digital thermometers with a probe on a three-foot cable. These probe-type thermometers usually read to one-tenth of a degree, and offer readings in both degrees F and degrees C; they are very accurate; I always have a couple of them lying around in my lab.

Means for heating hotboxes or incubators

Terrarium substrate heaters

You may wish to use terrarium substrate heaters to heat the interior of the cooler gently. Some points:

- I usually drill a large hole thru the wall of the cooler at a point about 3/4 of the way from bottom to top, to allow the AC cord to pas thru, and then seal the hole with duct tape.
- Remember to keep all heaters, especially terrarium substrate heaters, from direct contact with liquids, and to protect them from leaks and spills via using dishpans or splash pans above the heater element! Terrarium substrate heaters do operate on 120 VAC, so exercise prudent care to prevent shock and fire!
- The ExoTerra Heat Wave 16 Watt 120 VAC model terrarium substrate heater is usually fine for 26 quart thru 65 quart Igloo coolers and similar well-insulated brands of picnic coolers. Also fine for use in bottom of 20 gallon to 36 gallon trash pails, if well-insulated.
- The ExoTerra Heat Wave 25 Watt 120 VAC model terrarium substrate heater is usually fine for 50 quart thru 60 quart Igloo coolers and similar well-insulated brands of picnic coolers, if located in a very cool room, or for 70 quart to 130 quart picnic coolers in warmer rooms.
- For all terrarium substrate heaters, if they are to be placed on or near the bottom of the cooler interior, I suggest that you sandwich a terrarium heater between two 12" x 12" ceramic flooring tiles, tape tiles together with duct tape. The tiles protect the heater and act as a thermal reservoir. The sandwich effect also protects the plastic feeder for the AC line cord.
- I often use one or two of these heaters even on insulated 55 gallon barrels, either taped to the side of the barrel (with duct tape) near the bottom, or even placed under the barrel (with suitable precautions taken to protect the plastic feed for the AC line cord.)
- When using heaters inside a closed hotbox space, such as a terrarium substrate heater, or using heaters which actually attach to the fermentation container (which is usually enclosed within a hotbox), such as heater belts, heat tape, or a terrarium substrate heater taped to the side of a 55 gallon barrel, always place the heater near the bottom of the hotbox and near the bottom of the fermentation container. This gives the heat a chance to heat the entire container. Otherwise, if the heat source has been placed high in the hotbox or high on the fermentation container, and if the hotbox is poorly insulated (or not insulated at all, as in the case of a

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closet!), due to the laws of convection, most of the heat will simply rise as warm air to the top of the hotbox space, rather than appreciably heating the liquids in the fermentation container.

- ***If using terrarium heaters on the bottom of any kind of hotbox, it is extremely important to place a deep splash pan – such as a dishpan or deep tray, under your fermentation containers one, to catch spills, leaks, or massive leaks, such as if and when a cheap 1 gallon plastic jug splits and dumps all its contents (this happens a lot!) or if a PET soda bottle explodes. To fail to offer such layers of protection can result – if an accident occurs – in fire or electric shock hazard.***

Aquarium heater in a water bucket

For large areas to be heated, such as an insulated 6 foot by 6 foot by 5 foot box, or an insulated closet or insulated room, some folks choose to use a thermostatically-controlled 100 watt aquarium heater in a 5 gallon bucket of water, or even two or three such buckets. The heater warms the water in the bucket, which then heats the room. Such aquarium heaters are sold in all pet supply stores and aquarium stores. Many brands will not allow temperatures to go above 88 F, so be sure to pick a brand which allows temperatures of up to at least 94 degrees F, and preferably up to 102 degrees F (about the highest which any models reach...)

Heat belts marketed for homebrewing

Many homebrew supply stores sell 25 watt and 50 watt lengths of heat belts – designed to be wrapped around the exterior of a large (over 15 gallon) barrel. These work well. Be sure to follow precautions and instructions which accompany the heat belt to avoid hazards such as electric shock or fire!

A note about heat tape for protecting pipes from freezing

You may have noticed that the plumbing aisles of most major home improvement stores also seem to sell a product which appears similar to homebrewing heat belts, called heat tape, marketed for wrapping on pipes to keep them warm in cold weather. Most of these brands, unfortunately for our needs, have built-in thermostats which do not allow the temperature to go above 45 degrees F – their only purpose is to keep pipes from freezing in winter, and thus they will not allow significantly warmer temperatures. Thus, such types of heat tape are to be avoided.

A note about industrial heat trace tape

Many industrial supply catalogs offer various lengths of heat trace tape, which combined with any of several models of electronic thermostats, are marketed as “heat trace technology”. Several brewers of my acquaintance have acquired lengths of this heat trace tape and one or more thermostats, and then tried to use the heat trace tape to heat the interior of larger hotboxes or small insulated rooms. For some reason, most folks – unless they are very much technically inclined -- become dissatisfied with this method – complaining that they had a hard time managing temperatures closely -- and seem to abandon use of heat trace technology quickly. However, if you have a good background in electricity and electronics, and are a bit of an engineer and tinkerer, such heat trace tape technology is likely quite workable. If you are not inclined to be a tinkerer and engineer, I recommend avoiding such technology --- it will be too much of a strain to make it work.

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A note about using rooms or closets as hotrooms

The concept of using a small room (or even a large room) or a closet as a hotroom has a lot of merit – if your needs for incubator/hotbox space are that great – but I wish to offer a few words of warning if the room or closet is not well-insulated on all walls, floor and ceiling:

- you can expect massive temperature variations within the room, and massive differences between the temperature of the liquid in fermenting containers compared to air temperature. In general, the air temperature will often appear to be from 5 to 12 degrees warmer than the liquid in the containers. This is because containers which are placed near cool walls or are placed directly on the cool floor lose much of their heat (via both conduction and radiation) to the walls and floor, and thus it can be hard to effectively predict and manage temperatures in individual containers.
- you can expect that much of your heating costs will be spent on heating the house or barn in which the room or closet is located, as most of the heat from the heat sources in the so-called hotroom will quickly dissipate into the larger exterior structure or room.
- you can expect to find that temperatures near the top of the room or closet may be much warmer – often by ten to twenty degrees -- than temperatures near the bottom few feet of the room nearest the floor. Again, as noted above, this can make it hard to predict, monitor and control temperatures in individual fermenting containers.

A reminder about placement of heat source(s)

Once again, much as iterated above, when using heaters inside a closed hotbox space, such as a terrarium substrate heater, or using heaters which actually attach to the fermentation container (which is usually enclosed within a hotbox), such as heater belts, heat tape, or a terrarium substrate heater taped to the side of a 55 gallon barrel, always place the heater near the bottom of the hotbox and near the bottom of the fermentation container. This gives the heat a chance to heat the entire container. Otherwise, if the heat source has been placed high in the hotbox or high on the fermentation container, and if the hotbox is poorly insulated (or not insulated at all, as in the case of a closet!), due to the laws of convection, most of the heat will simply rise as warm air to the top of the hotbox space, rather than appreciably heating the liquids in the fermentation container.

As noted above, for all vendors and suppliers, as well as product info, please see *Appendix D*:

For even more hints on keeping batches warm during fermentation, you may wish to see the section entitled

Hints and Tips on Brewing AEM at Cool Temperatures, in the chapter entitled *Very Advanced and Highly Specialized or Experimental Techniques*.

Starting/Mixing Temperatures

Try to start the mix for most batches relatively hot, at temps such as 110F to 115F. This allows your batch to get off to a running start. I usually start with 125F water, add the molasses first – this cools it down to about 112 F, and then add the remainder of the

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minor ingredients, and finally, add the EM culture and stir. Lower temperatures are okay if necessary, and some folks have even started successful batches at temperatures as low as 68 F or even lower, but the hazards of possible failure are far greater at these temperatures, and your batch will take a very long time to finish fermentation.

Remember the Tables in Appendices When Creating Batches

When formulating ingredients for a batch, or when trying to scale ingredient quantities to suit various batch sizes, please be advised that there are several tables in the appendices which may be of assistance to you. A complete list of the tables and other resources in the appendices may be found in the *Table of Contents*. A partial list, showing three tables, is reproduced below:

Appendix E - Table

Percent by Volume of AEM/Brew Ingredients to Common Measure Equivalences

Appendix F - Table

Brix to Specific Gravity (SG) Scale Conversion

Appendix G - Table

Lookup Table for Volume/Percentage for Common AEM/Brew Ingredients

Fermentation Temperature and Hotboxes or Incubators

Try to keep your batch at temps of over 90 F, and up to about 111F, for the first few weeks. For longer-fermentation batches, best if you can keep at such a warm temp for at least 6 weeks (with possible occasional temperature cycling as noted elsewhere), and then okay to complete fermentation at lower temperatures if needed for any of various reasons.

Fermentation Containers

So long as the considerations of providing an anaerobic environment and some type of air lock are met, and so long as you realize it is very unwise to ferment (or store) batches in glass (unless extreme care is taken) due to danger of breakage or explosion if your airlock fails, your choice fermentation container may range anywhere across the following spectrum (please see Appendix D for possible sources for many such containers and accessories):

- 1 or 2 liter PET soda bottle with a pressure-relieving cap such as OZTop (Oz-Top) or EZ Cap (warning: do not use OzTops or Ez caps on glass bottles; danger of explosion.) Most of these containers are transparent, and thus perfect also for making the High-Light (HL) versions or High-Red (HR) versions of AEM or brews.
- 1 gallon used translucent milk jug or spring water jug with 3 pinholes in cap for pressure relief (a cheap makeshift "airlock"). These containers are ubiquitous and inexpensive, but are not very reliable – the microbes literally eat through their seams after a while, destroying them. However, these jugs are translucent, and thus perfect also for making the High-Light (HL) versions or High-Red (HR) versions of AEM or brews since they pass enough light for such uses. (see *hints for airlock/venting in Airlock section*) **Overall, be extremely careful if you ever choose to use these inexpensive translucent 1 gallon plastic jugs – they often develop leaks or split and dump all their contents (this happens a lot!)**

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- 1 gallon clear PET jugs of the type in which some high-end versions of milk and spring water are often sold. Shaped much like the 1 gallon milk jugs mentioned above, these jugs are made of a truly clear PET plastic and are far tougher and more resilient than their cheaper cousins. Better, these jugs are transparent, and thus perfect also for making the High-Light (HL) versions of AEM or brews since they pass enough light for such uses. (*see hints for airlock/venting in Airlock section*)
- 4 gallon white plastic HDPE food grade pail with tight-fitting lid (jams and fruit concentrates are often sold in bulk in such containers.) If you choose to use such buckets, you may wish to see the sub-section in the **Airlock** section below entitled *Airlock Venting Hints for 4 and 5 Gallon Buckets with Tight-fitting Lids* for hints on easy approaches to venting gas pressures encountered during fermentation.
- 5 gallon collapsible translucent plastic water jugs (with handles) sold for camping and survival use; designed to fold and collapse for storage when empty. Sold by many camping supply and survival supply shops. And, these jugs are translucent, and thus perfect also for making the High-Light (HL) versions of AEM or brews since they pass enough light for such uses.
- 5 gallon rigid translucent plastic jugs with handles in which bulk oils, bulk soy sauce and bulk syrups are often shipped. Often available as empty used jugs for free or for pennies apiece from restaurants, microbreweries, and natural foods stores, which sell them after they have been emptied. However, these jugs are translucent, and thus perfect also for making the (HL) versions High-Red (HR) versions of AEM or brews since they pass enough light.
- 5, 6.5, or 8 gallon fermenting bucket from homebrew supply shop, with spigot and with an air lock inserted in grommeted hole in lid. If you choose to use such buckets, you may wish to see the sub-section in the **Airlock** section below entitled *Airlock Venting Hints for 4 and 5 Gallon Buckets with Tight-fitting Lids* for hints on easy approaches to venting gas pressures encountered during fermentation.
- 5, 6, 8 or 15 gallon wine fermentation carboy from homebrew supply shop with plastic cap and airlock. Most of these have clear walls which pass light easily, and are thus great for making HL and HR versions of AEM and brews.
- 15 gallon Plasti-keg or other plastic keg, with a rubber cork/stopper inserted in smaller bung-hole, into which an airlock has been fitted (*see other hints for airlock/venting in Airlock section*)
- 30 gallon plastic food-grade barrel (*see hints for airlock/venting in Airlock section*)
- 55 gallon plastic food-grade barrel (*see hints for airlock/venting in Airlock section*)
- 1 ton tote, holding 275 gallons of liquid.
- 500 gallon to 580 gallon fermentation tanks as used in microbreweries
- 1,500 gallon stainless steel tanks as used in dairy industry plants

As noted above, please see *Appendix D* for possible sources for many such containers and accessories.

A note on dispensing from barrels

By the way, a quick note about 15 gallon, 30 gallon and 55 gallon barrels: once fermentation is finished, how do you get the finished batch of AEM or brew out of your barrel? For small quantities up to a gallon or two at a time, simply purchase a hand pump dispenser (available online, see *Appendix D*) for about \$12, which will screw into one of

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the bunghole openings. For larger quantities such as 20 gallons at a time, use an auto-start siphon with flexible plastic tubing; about \$8 at a homebrew supply store, or purchase a hand pump dispenser which allows continual siphon flow if you attach a length of tubing to its spout.

Fermentation Container Quality and History

Next to water quality and failure to maintain at least somewhat anaerobic conditions, the biggest reason for batch failure is the quality of the container used. Obviously, the fermentation container must be one which will allow you to maintain reasonably anaerobic or near-anaerobic conditions during fermentation and subsequent storage, and so that is a minimal qualification. Try to use only food-grade containers which are either new or which have been used only for storage of food-grade edible substances such as dairy products, syrups, soda, fruit concentrates, juices, etc. Try to avoid containers which have ever been used to store any really powerful oxidizers such as fluoride, oxidized chromium (aka chromium 6 or Cr 6, used on farms), pesticides, chemical fertilizers, herbicides, poisons, etc. And, especially, try to avoid using any container in which a bad batch of AEM had previously been fermented. Using any of the prohibited containers could easily shift brewing conditions enough that a batch could fail, unless some or all of the precautions noted in the *Fermentation Container Remediation* section were followed. This is not just theory: I have seen failures where folks have attempted to use such used containers, and I have heard some very wild stories of great failures due to such factors.

Fermentation Container Remediation

Containers Which Had Housed Bad Batch, Rotted Compost, etc.

If you absolutely must make some of your batches in a container which had previously housed a bad batch of AEM or brew, or perhaps had contained rotted compost or rotted foodstuffs, then I recommend first conditioning the container, lid, bung caps and any accessories, as follows:

- Wash and scrub thoroughly with detergent
- Rinse well and repeatedly with water
- Soak, rinse and sponge with either Iodophor (an iodine-based sterilant available from homebrew supply shops) in water mixed up to about 50 ppm, or with chlorine bleach in water
- Rinse well with water
- Soak, rinse and sponge with EM or AEM mixed about 1:10 in water; even better if you can add some EM or EM-X ceramic powder to the water, about 1 tsp per gallon of water. Preferably soak for at least 24 hours, followed by sponging or rolling and shaking to distribute liquid well over all surfaces. For a large container, such as a 15 gallon or 55 gallon barrel, no need to fill entire container for soaking, but simply put a half-gallon of the mix in the container, and roll it, shake it and invert it to ensure that all inner surfaces are well-wetted. Then let sit for 24 hours, shaking or rolling or inverting occasionally to bathe all inner surfaces repeatedly.
- Drain and rinse lightly with water; drain again
- For a container which had been in really bad shape, you may wish to repeat steps 5 and 6 above once more.
- Your container is now likely ready for use.

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Containers Which Had Housed Powerful Oxidizers or Fertilizer

These can never be used to make AEM which will be fed to animals or humans, but, after remediation, might be used for making AEM for utility use (e.g., soil, compost, septic, waste, waste remediation), if your national and local regulations permit re-use of such containers. So, if you absolutely must make some of your batches in a container which had previously housed powerful oxidizers, pesticides, herbicides or chemical fertilizer, then I recommend first conditioning the container, along with all lid, bung caps and accessories, as follows, wearing suitable protective gloves and goggles as appropriate:

- Make sure that all traces of previous contents have been removed
- Rinse repeatedly with water and drain well
- Wash and scrub thoroughly with detergent
- Rinse well and repeatedly with water
- Soak, rinse and sponge with either Iodophor (an iodine-based sterilant available from homebrew supply shops) in water mixed up to about 50 ppm, or with chlorine bleach in water
- Rinse well with water
- Soak, rinse and sponge with EM or AEM mixed about 1:10 in water; add EM or EM-X ceramic powder to the water, about 2 tsp per gallon of water. Soak for at least 24 hours, followed by sponging or rolling and shaking to distribute liquid well over all surfaces. For a large container, such as a 15 gallon or 55 gallon barrel, no need to fill entire container for soaking, but simply put a half-gallon of the mix in the container, and roll it, shake it and invert it to ensure that all inner surfaces are well-wetted. Then let sit for 24 hours, shaking, rolling or inverting container occasionally to bathe all inner surfaces repeatedly.
- Drain and rinse lightly with water; drain again
- Repeat steps 7 and 8 above once more, again letting sit for at least 24 hours.
- For containers which were in really bad shape repeat steps 7 and 8 above once more, again letting sit for at least 24 hours.
- Your container is now likely ready for use, but when you use it for the first time to make AEM, be sure to add EM ceramic powder (1/16th 1/4 tsp per gallon), sea salt (1 tsp per gallon), and increase the ratio of EM culture to molasses from 1 to1 to 1.5 to 1.

Bad Batches -- Troubleshooting

By this point in Part II, we have discussed at length and in depth the following topics, plus some:

- Anaerobic fermentation conditions
- The issue of positive pressure
- Blackstrap molasses
- Water quality
- Fermentation container quality
- Temperatures
- Microbial culture

However, you may have noticed and wondered about the fact that there has been little explicit discussion of bad batches of liquid secondary products such as AEM and brews, not even in the section on molasses, which is the culprit which seems to be most often

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blamed (incorrectly, in my opinion) for bad batches of AEM or brew. In my experience, most bad batches are caused by the following factors, ranked in order from top down of most important/most common to least important/least common:

- Fermentation container quality and history (see appropriate section). This, in my opinion, is the most important factor in bad batches.
- Water quality and recent history (see appropriate section). This, in my opinion, is the second most important factor in bad batches
- Mixing/starting methods, particularly failure to allow enough air/oxygen to mix with liquid when mixing.
- Failure to allow significant airspace/headspace above liquid surface in fermentation container, particularly during first 4 to 6 weeks of fermentation – this is somewhat related to *mixing/starting methods* item above and the *fermentation process* item below.
- Fermentation process during first 3 to 4 weeks, particularly failure to open container at least daily to allow a bit of air into headspace, and failure to stir liquid in fermentation container at least daily during this critical period.
- Culture quality and viability – next to molasses quality, culture quality or viability is most often blamed for bad batches. While I have definitely encountered and heard of bad culture batches, in my opinion, this matter of blaming the culture batch is over-emphasized, and bad culture is far more rare than most people realize.
- Molasses quality – yes, molasses is very often blamed for bad batches, but this is not true in my experience. Yes, it is true that some batches of molasses, particularly if very aged or if they contain (often unbeknownst to seller and buyer) anti-microbial or anti-yeast or anti-fungal additives, may indeed cause bad batches of AEM or brew, but this far more rare than most folks realize.
- Failure to use recommended ancillary “helper” ingredients, ranging from EM ceramic powder to sea salt to a bit of fish paste or fish emulsion, etcetera, all discussed in appropriate section in Part II. While the primary reason for use of any of these helper ingredients is to improve batch quality, it is true that sometimes the inclusion of one or more of these ingredients may be the crucial factor which will spell the difference between a successful batch and a failed batch.

Storage Containers

If you will not be storing the finished product in the original fermentation container, but rather in another container, then any containers used for storage after fermentation must meet the following criteria:

- be capable of storing the batch anaerobically
- must be flexible (plastic, etc.) or, if rigid, must have some foolproof means of allowing any gas pressure buildup to escape
- if used for a batch intended for animal or human use, must be clean and food-grade

The very best option for storing and dispensing large volumes (e.g., one gallon and over) is a container or system which does not allow air to enter the headspace when liquid is decanted from the spigot or valve. Some examples of such anaerobic dispensing systems are:

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Cubitainers

A Cubitainer is a flexible collapsible plastic bag in a box, with a spigot near the bottom. The bag collapses as liquid is dispensed. Cubitainers are available in sizes from one quart, one gallon, three gallons and 5 gallons. I strongly recommend avoiding the quart size, as they are quite useless due to the large dead-volume space. Once easy and cheap source of Cubitainers is to order your EM culture in 1 gallon or 5 gallon Cubitainers and then re-use them. I have been doing that for over a year. Suppliers listed in *Appendix D*.

Party Pig

These are sold for dispensing homebrew beer anaerobically – the Party Pig is a 2.5 gallon plastic bottle with a spigot. The Party Pig does not use CO₂ gas from a tank or mini CO₂ cartridge, but rather employs sealed expandable plastic pouches which create CO₂ internally from mixing vinegar and baking soda -- the expanding bag fills the headspace and pushes liquid out of the container when dispensing. Available as a complete kit for about \$85 from homebrew supply stores. Suppliers listed in *Appendix D*.

Tap-A-Draft

Also sold for dispensing homebrew beer anaerobically – bottles are sold in 3 liter and 5 liter sizes, a special valve is needed, along with small CO₂ cartridges. A kit usually contains 3 bottles and 3 caps, plus one valve/CO₂ cartridge assembly. Tap-A-Draft (aka TAD) system; it is a bit cheaper than the Party Pig (comparing prices for a complete bottle/valve setup). This method uses a proprietary CO₂ valve assembly which uses commonly-available 8 gram CO₂ cartridges. A 3-bottle starter kit which includes valves seems to sell for about \$55 from most homebrew online vendors. Suppliers listed in *Appendix D*.

Soda keg or beer keg

Such kegs must be properly fitted with a CO₂ tank, regulator, tubing and dispensing spigot, and these CO₂-pressurized dispensing kegs range in size from a 3 gallon Cornelius keg (“Corny keg”) thru the 5 gallon Cornelius keg size and larger. This is the most expensive system, as the kegs may run from \$35 to over \$100, and then there is the expense of leasing and filling a large tank of CO₂ gas, purchasing a regulator and tubing, and purchasing a dispensing spigot and tubing. A fact that must be considered is that some kegs have bare metal inner surfaces – I would strongly recommend avoiding such kegs and purchasing only kegs which are fully lined with an inert plastic. Homebrew suppliers listed in *Appendix D*.

Airlocks

From the *Glossary*, please remember the definition of an airlock:

Airlock, aka air lock – A mechanical venting device which keeps ambient atmospheric air (and oxygen) from entering a fermentation container, but allows excess gas pressure to escape easily, often by bubbling the gases through water trapped in a U or W or S shaped tube. The better air locks not only allow excess gas pressure to escape, but will -- if negative pressures (partial vacuum) develop in the headspace – allow small amounts of air to enter to equalize the pressure.

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Airlock notes

Bubbling water airlocks for use on lids of fermenting buckets, vats, kegs and carboys are well-known in the homebrew brew and wine worlds, and every homebrew vendor/supplier sells at least three different types. They make a great, cheap and useful airlock for fermenting barrels or kegs with a small grommated hole in the top which will accept the stem of an airlock, or in which a one-hole rubber cork may be fitted which will then accept the airlock stem. These water-airlocks have a small diameter (1/4" to 3/8") stem at bottom; they are designed to be fitted securely in a rubber-grommated hole of the same size drilled in the lid of plastic fermentation buckets (available in 4, 5, 6.5 and 8 gallon sizes) or a single-hole rubber cork/stopper. They can even be used with soda bottles or jugs of water, or even the bungholes on 15 gallon Plastik Kegs or 55 gallon barrels, if you purchase also a single-hole rubber stopper (like a cork), but then you add 3 or 4 inches of height to your jug or bottle or keg.

BTW, if and when you are purchasing such water-bubble airlocks, as I have stated in the past, I strongly recommend NOT purchasing the more common 3-piece locks, which do not easily allow air to flow into the container when negative pressure exists, but rather, I strongly recommend the two-piece bubble tube airlocks, which look like a double **U** -- they are also cheaper than the 3-piece airlocks. The beauty of the 2-piece U airlocks is that they allow gasses to flow in either direction as needed, and yet without siphoning the airlock blocking water back into the fermentation container under conditions of temporary negative pressure.

Remember That Negative Pressures May Develop

Although many beginners believe that the purpose of a pressure-equalizing airlock is only to relieve excessive gas pressures which may build up in the fermentation container due to off-gassing, the reality is that in later stages of fermentation -- and even in storage after fermentation -- negative pressures may develop -- due to the PNSB microbes "eating" carbon dioxide and other gases in the headspace -- and these pressures could collapse or destroy a container unless vented. So, it is very important that your airlock be able to vent pressures both ways!

Airlock Venting Hints for One Gallon Plastic Jugs

If you are fermenting in one gallon plastic jugs which have snap-type caps (the most common) or screw caps (found on the more expensive clear plastic jugs) a simple and expedient method to allow gas pressures to equalize is to simply punch two pinholes in each cap, using a pushpin tack.

Airlock Venting Hints for Barrels with Threaded Bung Caps

Frankly, if you are fermenting in a barrel (15, 30 or 55 gallon) which has screw-type bung caps, and if you are not a die-hard purist who insists in making up some kind of drilled cork-and-bubble airlock combination, a simple expedient is to simply leave one bung cap slightly loosened, to allow gas pressures to equalize easily. This keeps air from flowing freely from outside to the internal headspace, but allows positive or negative pressures of over about 1/2 psi to easily equalize. However, be careful to ensure the bung cap is loose enough to pass gases easily -- and you may even wish to mark the bung cap with a sign to that effect -- you do not want the mess of an exploding 55 gallon barrel in your brewing room!

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Airlock Venting Hints for 4 and 5 Gallon Buckets with Tight-fitting Lids

In my area, it is often possible to purchase used white food-grade plastic buckets from a local jam and jelly bottling plant. These are buckets in which jams, jellies and fruit concentrates had been delivered, and these white plastic buckets have sturdy lips and tight-fitting lids. I have discovered that it is possible to use these buckets and similar buckets as fermentation buckets without the need for any hole in the lid and a concomitant airlock. Rather, I have found that the lid and bucket lip from a good seal, but one which will readily release gases around the seal if the gas pressure grows excessive. Of course, if you find such buckets in your area, you will need to assess the lids, seals and bucket lip to see they will allow the same venting possibilities. A bucket which has too-sturdy a lid which fits the bucket very tightly, and which also has a rubber O-ring seal may be too well-sealed, and thus, excessive gas pressures may not be able to easily escape and this could cause the bucket to rupture or explode. Of course, you could always put three or four tiny pinholes in the lid with a pin or tack... This is an acceptable measure in many circumstances, and does not allow excessive fresh air to enter the headspace above the batch.

Anyway, such buckets, if suitable candidates can be found, make wonderful fermentation containers. I do find that if try to store the batch in such a bucket after fermentation is done, it will sometimes happen that negative gas pressures (partial vacuum) caused by continued fermentation in the bucket may cause the bucket wall to buckle inward slightly due to the vacuum.

Pressure-relieving Caps for PET Plastic Soda Bottles

For fermenting in 1 liter or 2 liter PET soda bottles, the best methods to relieve excess pressure during fermentation are (in order of increasing ease but increasing expense):

- loosen the screw cap at least once per day for first 4-6 weeks to release pressure, and occasionally thereafter.
- Leave screw cap very slightly loose, just loose enough to allow gases above about 8 or 10 psi to escape.
- Use commercially available pressure-relieving soda bottle caps, sold for homebrewing beer, wine and sparkling alcoholic fruit juices in soda bottles; these are marketed under various names such as OzTops, Oz-Tops, and a dozen other brand names. You can usually purchase a package of 6 or 7 assorted pressure-relief screw caps for about \$15 online.

Ratios of Major Ingredients for Most Batches

All volume ratios are expressed as **E:M:W** where E is always EM culture, M is blackstrap molasses or combination of blackstrap molasses and other sugar sources such as fruit juice concentrates, and W is, of course, water. So, a 1:1:20 by volume ratio would indicate 1 part EM culture, 1 part molasses or other sugar sources, and 20 parts water, which yields about 5% molasses by volume (or about 6% molasses by weight.) *For all batches of AEM intended to be kept for more than 20 days, I recommend ratios of only 1:1:20 or even – for special purposes, some of which will be discussed herein – 1:1:15 or 1:1:10.*

Yes, I know that 1:1:40 ratio is very common in Japan, and that one popular \$3,000 automated bulk AEM brewing machine sold in Japan employs a 1:1:40 ratio and another employs a 1:4:180 ratio (about 1:50 molasses:water ratio) , but those “diluted” or high-

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ratio batches of AEM are intended to be used almost immediately after fermentation is complete (in such machines, usually 3 to 4 days, when pH has gone below 3.8.) And, yes, for special applications in farming, composting, waste treatment, toxic waste remediation, and waterway remediation, folks will often prepare a batch of AEM with ratios on the order of 1:1:100 to 1:1:300, but again, these special-purpose batches of AEM are intended to be used immediately upon mixing, or within 24 hours after mixing, after which their quality is often highly suspect.

So, if your intent is to make a high-quality batch of AEM or brew which is intended to have strong and stable properties over 30 days or longer, and sometimes up to 2 years, then you will want to use only 1:1:20 ratio (or, at times, 1:1:15 or 1:1:0 ratios) for your batch. This will, if made properly – and dependent upon length of fermentation -- yield an AEM which has the potential to offer strong and stable properties over time; where the stable properties include:

- pH below 3.5
- good microbial inoculant properties
- good antioxidant properties
- good deodorizing and preservative properties
- good regenerative and syntropic properties
- good anti-corrosion, anti-rust and rust-removal properties

Don't Cheat on Your Ratios – Use Enough EM Culture

If you have added 6 ounces of molasses, 6 ounces of blueberry concentrate, and 6 ounces of cherry juice concentrate per gallon to a batch, your total volume of simple carb sources is 18 ounces per gallon, and so you will need to use at least 18 ounces of EM culture per gallon. Many folks try to cheat here; it is not worth it. Use at least a 1:1 ratio of EM culture to volume of simple carb sources.

A Hint About the Ratio Amount of EM Culture to Molasses (Optional)

In reciting the ratios such as 1:1:20 in sections above, I have cited the first “1” rather loosely. In fact, the quality of the batch will often be even better if you employ a ratio of 1.5:1:20, using a somewhat higher ratio of EM culture to molasses. In fact, when brewing EM brews (human use) I usually use a 2 to 1 ratio of EM culture to molasses (or molasses plus other sugar sources), simply to ensure a higher-quality brew. I do much the same when trying to make high-quality batches of AEM: I will often employ a 1.3:1 or 1.5:1 ratio of EM inoculant culture to blackstrap molasses.

Quality of Ingredients: Low-grade, Feed-grade or Food-grade

This consideration has been mentioned before, but bears repeating:

- If you are brewing AEM only for utility uses such as waste treatment, septic use, soil treatment, or compost treatment, then the quality of water, molasses, any ancillary ingredients, and even the container itself, need only be good enough to ensure that you will end up with a good batch.
- If you are brewing AEM or brew for consumption by animals in water or feed, then you will want to ensure that all ingredients and containers used are of at least animal feed-grade quality.
- If you are brewing EM brew for consumption by humans, then you will want to ensure that all ingredients and containers used are of human food-grade quality.

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By the way, the reality here is that when many of us are brewing brews only for our own personal use, we sometime stretch these rules a bit, using some less than food-grade ingredients, simply because we know that the powerful syntropic EM organisms will usually remediate any quality problems of such ingredients.

- If you are brewing AEM for consumption by animals in water or feed, and you are employing some of the optional ancillary helper ingredients, please be aware that in many countries and/or states/territories, as part of the BSE-prevention effort, it is illegal to feed to any ruminant animals used for food production (cows, sheep, buffalo, goats, etc.) any foods containing blood meal, animal meal, fish meal, fish emulsion or fish paste. Thus, if you are tempted to use any such ancillary ingredients to boost your AEM batch, realize that if you use them, you may be prohibited in your country or state/territory from allowing ruminant animals to ingest it.

Ancillary Ingredients Which Help Improve Batch Quality

While a barebones AEM can be made at a convenient and safe 1:1:20 ratio using EM culture, blackstrap molasses and water as the only ingredients, ANY type or ratio of AEM or EM brew will be improved by adding one or more of the ancillary ingredients listed below, and to achieve a useful lifetime for your AEM batch of over about 45 days after end of fermentation, then you will need to employ at least some of these measures. They are, in brief:

Fish paste or fish emulsion

If you want highest quality AEM, add unpasteurized fish emulsion, aka fish paste. A good typical brand is Fertrell "Fish Fertilizer" (really fish emulsion or fish paste). Neptune brand fish emulsion is quite available, but it has been pasteurized and hydrolized with acids to kill microbes and odor, and, while it adds a wonderful dimension to AEM, unpasteurized, non-hydrolized brands such as Fertrell are even far better. I use perhaps up to 1 tbsp per gallon, although 1 tsp is fine. Since the unpasteurized fish emulsion is more digestible to microbes than the Neptune hydrolized protein product, and since the emulsion contains wild microbes from fish guts and skin, it "seeds" and "re-seeds" the AEM with much-needed commensal wild microbes, many of them aerobic, which are quite essential to EM, but which can get lost in successive extensions/activations. Most importantly, the fish paste helps to provide not only much-needed microbes and trace nutrients, but also proteins and other substances which feed and boost the PNSB phototrophic bacteria. This is reportedly how most EM microbial inoculant culture is made around much of the world anyway, esp. when made by INFRC, APNAN and the Japanese religious organizations such as SKK.

Blood or blood meal

For AEM only, some folks use blood meal or even raw blood from the butcher shop as an additive, either in lieu of the fish emulsion or in addition to it. Both the blood and the fish paste help to provide not only much-needed microbes and trace nutrients, but also proteins and other substances which feed and boost the PNSB phototrophic bacteria. I sometimes use raw deer blood along with fish emulsion as a foodstuff for my high-phototrophic, aka high-PNSB, deep red-purple versions of AEM.

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Fermented shrimp paste

If you want even higher quality AEM, also add some unpasteurized fermented shrimp paste from an Asian grocery market (sold in jars for about \$3, usually from Thailand, Malaysia, Indonesia, etc.) Contains much-needed proteins and nutrients, and also contains wild microbes from the shrimp -- it "seeds" and "re-seeds" the AEM with much-needed commensal wild microbes, many of them aerobic, which are quite essential to EM, but which can get lost in successive extensions/activations. Start with ¼ tsp per gallon, less is okay if expense is a limiting factor.

Shrimp powder or fish powder

If you want even higher quality AEM, also add some dehydrated shrimp powder or "fish powder" (usually containing 95% dried fish, 3% salt and 2% sugar, according to the ingredients list) from an Asian grocery market (sold in jars for about \$4, usually from Thailand, Malaysia, Indonesia, etc.) Contains much-needed proteins and nutrients, and also contains wild microbes from the shrimp and fish -- it "seeds" and "re-seeds" the AEM with much-needed commensal wild microbes, many of them aerobic, which are quite essential to EM, but which can get lost in successive extensions/activations. Start with ¼ tsp per gallon, less is okay if expense is a limiting factor.

Unpasteurized blackstrap molasses

If you want highest quality batches of AEM, use unpasteurized animal feed-grade blackstrap molasses rather than human food-grade pasteurized molasses, as it contains much-needed wild microbes -- it "seeds" and "re-seeds" the AEM with much-needed commensal wild microbes, many of them aerobic, which are quite essential to EM, but which can get lost in successive extensions/activations. Be extremely careful about using such unpasteurized molasses for EM brews (for humans); because of the wild microbes present, the brew may develop strong or objectionable tastes.

Rice bran or wheat bran

Much as many vendors of EM microbial inoculant culture do when making their inoculant product, add some rice bran (or wheat bran), perhaps a tablespoon per gallon (of course, even more for recipes which call for lots of bran!). Contains much-needed nutrients, but also contains wild microbes -- it "seeds" and "re-seeds" the AEM with much-needed commensal wild microbes, many of them aerobic, which are quite essential to EM.

Rock dust

Add some powdered bentonite clay rock dust. I recommend primarily Azomite rock dust clay (in powdered form), which I have been recommending since January 2003 for this use -- use from 1 teaspoon to 6 tablespoons per gallon. For cheap utility-grade AEM, even 1 teaspoon per gallon is far better than none. I also sometimes use Pascalite as well, but in smaller quantities, due to its high Ca content. Pascalite is a magical calcium bentonite clay from Wyoming. Due to higher availability of alkali metal ions, use only 1 teaspoon or less per gallon of Pascalite. Be extremely careful if you use Mezotrace rock dust -- it is very high in free calcium ions, and can arrest pH drop if more than 1/4 tsp is used per gallon. These rock dust bentonite clays provide much-needed trace elements; many (Azomite, Pascalite, etc.) also provide wild microbes as well. See Appendix C for sources of Azomite and Pascalite.

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Sea salt

Despite the most recent wave of "warnings" from some of the latest generation of young techs at a Japanese producer of EM culture against using sea salt in AEM and brews, I do strongly recommend using sea salt, in quantities up to about 2 teaspoons per gallon. Makes for a much better AEM and brew. Some of these newer Japanese techies like to claim that this can arrest pH drop -- horsescrap! Of course, if you use too much sea salt, then it can retard pH drop, but you would need to use well over a tablespoon, or even more, before seeing significant retardation.

EM ceramic powder

I have been recommending use of EM ceramic powder in batches since January 2003. Despite the most recent wave of "warnings" from some of the latest generation of young techs at a Japanese producer of EM culture against using any EM ceramic powder in batches, I do strongly recommend using an EM or EM-X ceramic powder, preferably EM Super C EM Ceramic Powder, but quantities needed are quite minute, perhaps a tiny pinch per gallon or a teaspoon to tablespoon per 30 or 55 gallon barrel; more is okay, but it can get more expensive. Do use more per gallon if water quality is lousy, per water quality section in this book. If EM ceramic powder is not available, then use of small EM ceramic shapes, such as the small pellets or small spheres, is okay. I would recommend, if substituting the shapes, using about 10 to 15 grams per gallon, although even less will work okay. The use of the EM ceramic powder or shapes makes for a much better AEM. Some of the newer Japanese EM techies from one Japanese vendor of EM cultures have recently started to claim that the use of EM ceramic powder can arrest pH drop... Nonsense.

Natto bacteria

Adding very small amounts of *Bacillus subtilis* var. natto spores, aka natto spores (avail. from commercial suppliers, see Appendix C for sources) at start can also help AEM. Three small squirts of spore powder (from squeeze bottle, contains about 35 squirts of powder) per every five gallons is fine. I often add *Bacillus subtilis* var. natto to my brews at start; the beneficial microbe primarily grows during the first, aerobic stage, but does continue to slowly digest sugars in the background even after anaerobic conditions have been reached. However, the presence of these critters and their metabolites can change the flavor of the brew slightly, so I suggest you play with using the method till you are sure of what results you may expect. The simplest way to add *B. subtilis* var. natto is to add it in spore form at start of brewing, when mixing brew components, and then stirring it in. After mixing all components and stirring, simply add about 3 "squirts" of spore dust from an inverted container (tiny squeeze bottle) of spores (the \$11 size) from GEM Cultures (see Appendix C), and then stir it in.

Paramagnetic rock dust

Add a bit of paramagnetic rock dust (fine paramagnetic sand or fine gravel okay as well, but will settle to bottom; dust is optimal), perhaps 1/16th tsp. to 1/8th tsp. per gallon. The paramagnetic energy helps to activate the microbes and make them more powerful. Been using this since March 2003. Numerous brands of paramagnetic rock dust and sand/gravel are available in the organic farming/gardening marketplace. I usually use Summa II or Planter's brand paramagnetic rock dust, but there are plenty of brands.

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Granulated kelp, dulse and other sea vegetables

Add a bit of granulated kelp, aka kelp meal, about 1 tbsp per gallon. Loaded with nutrients, esp. trace elements. Been using this since January 2003; it is wonderful. It is possible to add other sea vegetables such as dulse or alaria instead of kelp, but somehow, I am consistently drawn to use kelp. And, one advantage of kelp is that it is readily available on the human food market and animal feed market in granulated form (called kelp meal in the animal feed and organic farming world), and very inexpensive in bulk. The granulated or meal form releases far more nutrients than would whole pieces of kelp.

Kelp and the Inevitable Iodine Question

Many folks express concern because they have heard that kelp is very high in iodine, far higher than other sea vegetables, and worry that the iodine levels might inhibit the beneficial microbes. Even though I have used rather high levels of granulated kelp at times in specialized brews, up to 2 ounces per gallon or even far more, I have never hit a problem with microbial inhibition. Frankly, the levels of dissolved available iodine would need to reach levels of over 8 ppm to become a problem, and in my experience, such levels are very hard to reach. Inexpensive iodine test strips are available in many homebrew stores (about \$2 for a bottle of 25 strips) and if you have concerns about a particular formula or batch, you are free to test a sample of the liquid (after mixing and after at least a few days of fermentation) with an iodine test strip to observe levels. In my experience, even my Golden Bran Kelp brew -- which contains up to 2 to 4 ounces of granulated kelp per gallon -- has never exhibited iodine levels of over 3 ppm. A further consideration is that the reality is that several different species of sea vegetable are marketed under the name "kelp" and not all are high in iodine. Further, many other sea veggies are also high in iodine, and thus I feel that kelp need not be singled out for undue paranoia.

Liquid colloidal prehistoric minerals

Consider adding a good brand of so-called liquid colloidal prehistoric minerals, leached from humic shale deposits from Utah or Nevada, often sold as a human nutritional supplement. These are loaded with wonderful trace elements. I most recommend the brand known as Coenzyme Minerals liquid colloidal prehistoric minerals, from Enzymes International (EI) in Wisconsin, USA (see listing in Appendix C). The minerals are mined and leached from a deposit in Utah, and the liquid bottled in Utah for EI. I use from 1 to 4 oz. per gallon; even less is okay and still beneficial if economy is a large factor.

Molybdenum

Molybdenum is a trace element, and is sold on the human nutritional supplement market in several brands as tablets, mostly from 150 mcg to 500 mcg. per tablet. It is also often sold in animal-grade in combinations with several other trace elements as a trace element supplement for high-end aquariums by upscale vendors of aquarium/fish tank supplies. Molybdenum is much needed by the PNSB microbes to do their work in growing and producing antioxidants, but often is rather scarce in the ingredients commonly used in AEM and brew batches, and thus, adding molybdenum can really activate and wake up the PNSBs, definitely improving the quality of any batch of AEM or brews. I usually add from two to eight 150 mcg. tablets per gallon, but even less is fine if expense is a factor. As noted above, for AEM batches (not intended for human consumption) only, some high-

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end aquarium stores sell a trace element liquid concentrate mix for high-end aquariums, containing molybdenum, strontium, and sometimes a few other trace elements as well. These are fine to add to AEM, at the rate of about 10 to 15 drops per gallon or more, and, again, if economy is a factor, then even lesser amounts are fine. For sources of molybdenum supplements for human use, please see *Appendix C*.

Vitamin C

I feel that many EM brews can be improved in quality if one tablespoon per gallon of vitamin C (ascorbic acid) powder is added at start. I have even brewed a special elixir containing very large quantities of ascorbic acid, from 4 to 9 ounces per gallon. It is worth noting here that there seems to be a rumor that “will not die” extant in many of the more hysterical corners of the alternative health world that “some scientists” have found that the ascorbic acid form of Vitamin C is incredibly toxic to all beneficial microbes, and many such rumors are also accompanied by more specific – if impossible to verify – “details”, claiming that the owner of a company which produces fermented foodstuffs for use as human nutritional supplements found that all of the desirable microbes in his fermentation diet if even a tiny trace of Vitamin C was added. This rumor is repeated ad infinitum by those who have no idea of its veracity and who have never tested the hypothesis themselves, and often each added repetition sees new levels of fear and hysteria added. My repeated findings in my laboratory here are that I have never seen any inhibition of the activity of the beneficial EM microbes even by very large amounts of ascorbic acid, much less the tiny amounts cited in the fear-based rumors.

Soy flour

I find that batches of AEM and brew are often improved by adding anywhere from ½ teaspoon to 1 tablespoon of soy flour per gallon; this is due to the nutrients in the soy.

Malic acid

Food-grade malic acid is a fruit acid – it is what gives apples their tart flavor – and is available in powdered form via many homebrew supply vendors for literally a few dollars per pound of food-grade powder. Malic acid contains the succinate chain, which is a preferred foodstuff for the PNSB microbes, and yet it does not feed the lactic acid bacteria or yeasts in EM culture, and so, adding perhaps 1 tsp of food-grade malic acid per gallon, or even less, can really help to potentiate the PNSB organisms. For suggestions on sources, please see *Appendix C*.

Other Ancillary Ingredients That Folks Sometimes Try to Add

Since folks tell me that they add – or wish to add -- many things to batches of AEM and brews – often because they are hoping to get extra “punch” or some special nutritional property from the batch -- let us take a look at some of the things they try to add, and I will offer my advice on the suitability of each – some are strongly contra-indicated, while others are usable or advisable:

Vitamin B12, usually in form of cyanocobalamin

Powdered vitamin B12 (cyanocobalamin) is available rather inexpensively from many natural foods vendors and from wholesalers and distributors of nutritional. If your aim is to make a brew rich in highly-bioavailable forms of vitamin B12, you may add up to at least 4 ounces (about 120 grams) per gallon. I would suggest starting your experiments with about 20 to 30 grams (one ounce or less) per

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gallon. There is some good evidence that the beneficial microbes digest the purified B12 and convert it to even more bioavailable forms, likely an array of closely-related forms of B12. As you may know, the PNSB organism in the culture are well-reported in the scientific literature to produce B12 (not the ineffective analogues produced by some seaweeds and some microbes, but true active forms of B12) in fermentation.

Hydrogen peroxide (H₂O₂)

Peroxide is a powerful oxidizer, aka oxidant free radical, and thus entropic (destructive) in its action, and thus its properties are exactly opposite to those which we are trying to allow the microbes to achieve, which is a syntropic (anti-entropic), regenerative, antioxidative liquid. So, avoid use of peroxide like the plague.

“Oxygen drops” or “oxygen supplements”

These are all fancy words for sodium and potassium oxide or peroxide-type compounds which release lots of microbubbles of oxygen, often in highly reactive oxidative form. These are a powerful oxidizers, aka oxidant free radicals, and thus entropic (destructive) in their action, and thus the properties are exactly opposite to those which we are trying to allow the microbes to achieve, which is a syntropic (anti-entropic), regenerative, antioxidative liquid. So, avoid use of these products like the plague.

Chlorine bleach or other strong oxidizers

Again, these are powerful oxidizers, and antithetical to what we are trying to allow the microbes to achieve. Avoid these products like the plague, even in small quantities. Of course, any of these oxidant substances, in large enough quantities, will not only act to counteract the good stuff which the microbes are trying to do, but will actually end up acting as an anti-microbial, killing all the microbes in your batch.

Colloidal silver

This is an odd one. Colloidal silver, and other forms of silver as well, have a strong reputation as being bactericidal – that is, they kill microbes – even at relatively low concentrations in the order of parts per million. Worse, colloidal silver can have rather pronounced oxidative effects on tissues and other substances when ingested. So, at first, we might easily be led to believe that adding any significant amount of colloidal silver could be harmful to a batch of brew. In reality, several folks make molasses-based EM-fermented colloidal silver elixirs and tonics, using up to about a 25 to 30 ppm concentration of silver at times, and with good success.

Grapefruit seed extract, aka GSE

Very antibacterial in its action. Do not add.

Oregano oil

Very antimicrobial in its action. Do not add, or at least do not add more than one drop per gallon (and some would warn not to use more than one drop per 5 gallons.)

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Essential oils, spice oils, incense oils, olive oil, etc.

Many essential oils, especially if truly from natural sources and not synthetic, ferment quite well in AEM concoctions, and seem to be digested and potentized by the fermentation. However, be aware that some essential oils – especially in any significant quantity – can exercise powerful antimicrobial effects, and thus harm or kill your batch. Some oils to watch out for, aside from oregano oil, are pine oil, cedar oil, sage oil, tea tree oil, and rosemary oil (at least in stronger concentrations.) If an oil is known to be anti-microbial, try to keep its percentage by volume below 1% to 2% until you can gauge effects on batch. It is impossible to give exact allowed percentages of the more anti-microbial oils, due to incredible variance across brands, batches, etc., and also between natural and synthetic versions (many vendors sell synthetic as natural.)

By the way, there is a myth present in some corners of the EM world that all oils, if fermented by EM, will simply turn into alcohol. This is not true.

If you are interested in fermenting oils (e.g., essential oils, sesame oil, vegetable oils, traditional spice or incense oils, etc.) in bulk, rather than simply adding small amounts of oils to a batch of AEM as a minor supplement, please see the section below on *Fermenting Oils*.

Green superfood powders, herbs and mushrooms from Eastern and Western herbal medicine

Almost all work quite well in fermentation, and many are high in antioxidants. Indeed, I make special and rather expensive brews – called elixirs – which contain up to eight to ten or more of such ingredients in freeze-dried powdered form per gallon, along with other special ingredients. Of course, I ferment these elixirs for at least 3 to 4 months, and usually for a year or longer before using. And, as when adding anything in quantity to a batch (this is also noted elsewhere in this section of the book as well), I suggest adding much of the bulk of these superfood powders only during the second week of fermentation, when pH has already dropped to well below 3.7. The next few sections discuss each individual category individually.

Adding Green Superfoods, Herbs, Vegetables High in Antioxidants

One great thing to do with some batches of brew (or even AEM) intended for human or animal use is to add herbs, algae, vegetables and other substances high in antioxidants and other nutrients. Some examples follow. Most may be added in amounts of up to 6 to 14 tablespoons per gallon (total quantity across all powdered additives), if the basic precautions are followed (e.g., add only a few spoonfuls at start of brew; add remainder after pH has dropped below 3.7)

Western herbs:

pine needles, turmeric, nettle leaf or root, thistle, milk thistle, rosemary, oregano, basil, olive leaf (careful of quantity of latter, due to anti-microbial properties)

A special note on turmeric

Many biochemists and medical researchers get very misty-eyed when they first discover the massive amount of antioxidants -- mostly curcuminoids (a type of carotenoid) present in turmeric, and the fact that many are potent anti-tumor

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agents as well. However, their optimism and expectations tend to crash when they continue their research and discover that these same curcuminoids, when present in turmeric, tend to have very low bioavailability, only on the order of 2% to 6%. The good news is that just as fermentation with the EM organisms tends to make many beneficial components of many foods far more bioavailable, there is some good anecdotal and scientific evidence the EM-fermentation does the same for the massive amount of antioxidants and other substances present in turmeric. In fact, it appears that there are two Japanese patent applications and several articles in Japanese-language journals reporting just this result from EM-fermentation of turmeric. In fact, there are over seven companies in Japan (mostly in Okinawa), and reportedly several more in large cities in China and South Korea which produce EM-fermented turmeric in powdered, granulated and teabag form, and in Japan, the first two-mentioned forms of fermented turmeric are marketed aggressively as cures for hangover and other ills due to alcohol abuse, and even as being able to prevent drunkenness and hangover from drinking too much alcohol, and as being able to reverse liver damage resulting from alcohol abuse. On a related note, many of the same claims, but somewhat milder, are made in Asian countries for many EM-fermented antioxidant liquid nutritional supplements as well, such as Lanox in South Korea.)

Vegetables high in antioxidants :

pepper (red stronger than green), spinach, beet, tomato, red onion

Fruit juice concentrates high in antioxidants:

have been covered extensively in other sections

Algae and microalgae high in antioxidants:

chlorella, spirulina, blue-green algae, dulse, kelp

Chinese herbs and mushrooms herbs high in antioxidants :

Yincheng, Latin name *Herba artemisiae scopariae*

Hangbaiju´, Latin name *Fros chrysanthemi*

Jingyinghua, Latin name *Flos lonicerae*

Qinghao, Latin name *Herba artemisiae annuae*

Huanglian, Latin name *Rhizoma coptidis*

Dansheng Radix, Latin name *salviae miltiorrhizae*

Shegan, Latin name *Rhizoma belamcandae*

Huangqin, Latin name *Radix scutellariae*

Dahuang, Latin name *Radix et rhizoma rhei*

Indeed, many green superfood concentrates, especially those which claim to be high in antioxidants, such as *Pure Synergy*, already contain from 20 to 80 of these substances in powdered freeze-dried form, and all work well in brews.

Addition of Fruit Juice Concentrates, Other Sugar Sources

Blueberry, blackberry, cherry, elderberry concentrates

Some sugar sources, especially those high in antioxidants and other good nutrients, such as blueberry juice concentrate, cherry juice concentrate, blackberry juice concentrate, and elderberry concentrate (careful, this last one can create weird flavors if more than 1% by

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volume is used!) make excellent additions to brews. These berries are ideal for brews, because they are loaded with antioxidants and other nutrients which are naturally synergistic with EM.

Other berries

Some other berries, such as cranberries, make for a good and healthful brew, but the taste may be rather unbearable, due to sulfur compounds and butyrates produced during fermentation.

Grape juice concentrate

This is simply wonderful, if used in amounts equal to or less than the molasses content, or even volumes slightly higher than the volume of molasses. Grape juice concentrate is loaded with antioxidants and other powerful energy compounds, and thus is very compatible with EM fermentation. I usually use Welch's frozen grape juice concentrate (100% pure grape juice) from the freezer aisle at my supermarket. In the first month or two of fermentation, this yields a rather sweet grape brew. As fermentation proceeds past the 2 or 3 month mark, and especially after the 4 to 6 month mark (yes, it will keep slowly fermenting even at room temperature while in storage!), all traces of the sweetness disappear, and the brew becomes incredibly dry and tart, tasting exactly like – as some of my friends in trendy Los Angeles put it – a \$450 bottle of fine Cabernet wine. And, some versions of these brews end up with a somewhat higher alcohol content than most EM brews, stabilizing at perhaps about 1.5% alcohol, thus imparting a pleasant alcohol flavor as well.

Barley malt syrup, also a fermentation acceleration agent

Barley malt syrup (aka barley malt extract, particularly in the beer brewing field), available in liquid form from almost any beer/wine homebrew supply shop is wonderful, so long as not used to excess. *It contains a goodly amount of antioxidants as well, and modest amounts (1% to 2%) of barley malt syrup in a brew can accelerate the initial stages of fermentation quite a bit, resulting in faster pH drop below 3.7.*

This point just made is important enough to repeat, so here goes: *modest amounts (1% to 2%) of barley malt syrup in a brew can accelerate the initial stages of fermentation quite a bit, resulting in a far faster pH drop below 3.7.*

For sources and caveats, please see *Appendix C*.

Warning: do not purchase dried or powdered barley malt, but only the liquid syrup. The dried and powdered forms are often dried at high heat, and this creates some toxic compounds in the powdered malt.

Pomegranate juice concentrate (also pomegranate molasses)

Pomegranate juice concentrate has received a lot of attention lately because its antioxidant content is fairly high (but not as high as that of wild blueberry concentrate), but many types/brands of pomegranate juice concentrate and pomegranate molasses (available in many Middle Eastern grocery marts) have been made by squeezing the whole fruit, including skin and seeds. The problem here is that the seeds contain some powerful anti-microbial properties, and the seed juices have been shown in studies to inhibit or destroy many of the organisms found in EM culture. So, if you use pomegranate concentrate or molasses, you may wish to start with very small percentages, well below

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1% by volume, and never go above about 1.5% by volume until and unless you are sure that your particular batch/brand does not exhibit this problem.

Citrus fruit, oranges, grapefruit

These juices and concentrates make for a wonderful minor ingredient in brews, but if used as a primary sugar source, i.e., over about 2% by volume, the taste may be rather unbearable, due to sulfur compounds and butyrates produced during fermentation. And, if their volume exceeds that of the blackstrap molasses, the brew may be very unstable and exhibit short shelf life.

Apple juice, apple cider

These are great, if used with an equal or larger volume of blackstrap molasses as well, for making brews which will be fermented for only a few weeks and then used completely within a month or so after fermentation is done. They yield quite delicious, and often slightly alcoholic brews. The problem is that due to other compounds in apple juice, and due to the low percentage of antioxidants and other syntropic compounds, such brews can often go bad or at least develop weird flavors after a while, unless at least 5% blackstrap molasses by volume has been included.

Honey

In my book, honey is largely a no-no unless used as a minor ingredient which is kept below 1% or at most 2% by volume. The problems are manifold:

- first, honey is largely pure and simple sugars, offering few other nutrients. If you intend to use ingredients other than just molasses, why not pick ingredients which offer some powerful antioxidant and energy nutrients, such as blueberry or blackberry juice concentrate?
- while honey does contain antioxidants, the amount is relatively small compared to blueberry, cherry, blackberry or grape juice concentrate, or even pomegranate concentrate
- honey contains some relatively powerful anti-microbial compounds, and, if present at about more than 1% to 2% by volume, these properties may inhibit or destroy many of the organisms found in EM culture.

If you must use honey, it is imperative to also use blackstrap molasses, in greater quantity than the honey, and also important, due to the deficits of honey, to use additives/amendments such as sea salt, rock dust and bran.

Fermenting Oils

If you are interested in fermenting oils (e.g., essential oils, sesame oil, vegetable oils, traditional spice or incense oils, etc.) in bulk, rather than simply adding small amounts of oils to a batch of AEM as a minor supplement, this is the section for you. (For advice on fermenting only small amounts of oils added to batches of AEM, please see the subsection on oils in the section above named *Odd Ancillary Ingredients That Folks Sometimes Try to Add*.)

For fermenting oils as the primary ingredient, my recommendations follow, and I have adjusted them for 8 ounce (228 ml.) batches, because bulk oils are often fermented in relatively small batches ranging from 4 ounces (about 114 ml.) to a 2 quarts (2 liters). Some guidelines follow, all for 8 ounce batch sizes; scale to your needs:

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- Pick your oils carefully. As mentioned in an earlier section, some oils, such as eucalyptus oil, tea tree oil, oregano oil, sage oil, mint oils, and some spice oils, are strongly anti-microbial in action if present in volumes larger than about 1% to 2% (sometimes even less!) And, many essential oils (be sure that you are purchasing natural oils, and not synthetic oils) are mildly anti-microbial, so you can use perhaps 4% to 10% by volume, but certainly no more, as larger amounts would kill or inhibit the beneficial microbes. It is impossible to give exact allowed versus prohibited percentages of either strongly anti-microbial or mildly anti-microbial oils, due to massive variance across brands, batches, etc., and also between natural and synthetic versions (many vendors sell synthetic as natural.) So, if you wish your fermented oil batch to remain largely oils when fermenting such oils, then those oils will need to be mixed with a base oil such as olive oil or a cold-processed vegetable oil.
- By the way, there is a myth present in some corners of the EM world that all oils, if fermented by EM, will simply turn into alcohol. This is not true.
- Add 1 ounce of blackstrap molasses (per 8 oz.)
- Add 2 to 3 ounces of EM culture
- Consider adding a very tiny amount – a tiny pinch – of EM ceramic powder
- Consider adding a very tiny amount, perhaps a pinch (less than 1/32 tsp.) of sea salt
- Blend all ingredients in a blender for at least a minute or two, till well –mixed.
- Decant to fermentation container (usually a 500 ml or 1 liter PET soda bottle)
- Place in hotbox
- Shake or stir daily for first 3 weeks, then occasionally after that point, while fermenting in hotbox.
- If you wish to test ORP or pH in these high-oil batches, you will need to allow ingredients to separate by leaving container undisturbed for about three days, and then using a laboratory pipette, bulb pipette or sampling tube to remove a small amount of the aqueous liquid from the bottom layer and then run tests on that. It is not possible for you to perform pH or ORP tests on the oily components, and you will succeed only in gunking up your probes/electrodes if you try to do so.
- Ferment for at least 2 to 3 months to get good antioxidant effects, and for 4 to 5 months for stronger antioxidant effects, and even longer for stronger antioxidant and syntropic effects.
- Much as will often be observed when fermenting cream or milk -- especially cream, which consists of over 95% fats by volume – if you ferment oils, you may notice some separation of ingredients even after a lengthy fermentation with repeated shaking to mix ingredients. When this occurs, this will usually manifest as a thin layer of water-based components at the bottom of the fermentation container, with a thicker layer above it, containing the oil-based components. Each of these liquids – assuming that fermentation was successful and that you shook/mixed the batch regularly during fermentation – will have unique and interesting properties, and each will be highly useful in its own way. Feel free to play with them.
- This method is somewhat similar to how the famous/infamous Bokashi Rub Oil, aka Oles Bokashi, aka Minyak Oles Bokashi, aka Bokashi Lubricate Oil, is made in Indonesia, as created by Indonesian EM expert Pak Oles, alias Dr. Ir. I Gede Ngurah Wididana, M.Agr., who studied in Japan with Dr. Higa at the graduate

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level. Bokashi Rub Oil, which consists of about 6 oils fermented for over 2 months with EM, is marketed mainly in Bali, but is famous (or infamous) the world over!

- BTW, even in commercial EM-fermented old products such as the Bokashi Rub Oil mentioned above, several of the “active” essential oil ingredients are kept to only a few percent each by volume, to prevent their presence from inhibiting or killing the beneficial microbes, and thus the base oil is a vegetable oil or olive oil.
- The fermentation will usually not result in disappearance of oils. Rather, you will usually end up with an oily product; the final product may still look and feel oily, but it will have been changed in many ways, with many antioxidant, syntropic and regenerative properties.
- If you hit problems with a particular formula or batch, try increasing the ratio of water molasses and EM culture to oil, using less oil and more of the former.

Ratio of Molasses to Juice Concentrates and Other Sugar Sources

Unless you are making a brew which you will drink and finish within a few weeks after fermenting, such as EM fermented apple cider or EM-fermented whey, it is always best to use at least 4% (about 1:25 ratio) to 5% (about 1:20 ratio) by volume of blackstrap molasses to water, and then keep the total of any and all other sugar sources such as fruit juice concentrates, barley malt syrup, etc. at that same amount or below. So, if you added 5% molasses, I suggest you add a maximum of 5% of other sugar sources by volume. If you used 6% molasses, then keep other sugar sources to 6% or below (careful here... as you approach any percentage by volume over about 8%, the amount of time needed for fermentation to be complete drastically increases!)

Maximal Percentage of Molasses, Concentrates, etc.

Make your first few batches of AEM or brew at a 1:20 ratio (about 5%) of sugar sources (e.g., blackstrap molasses, fruit juice concentrates) to water. As you learn more, you can then, if needed, gradually increase your molasses content, or add more of certain sugar sources, such as blueberry concentrate. In general, each time you double the amount of sugar sources over the standard 5%, you quadruple the amount of time needed for fermentation. In other words, fermentation time increases roughly as the square of the increase in volume of sugar sources. So, a 10% sugar source by volume brew can take almost four times as long to ferment fully. And, there is a cutoff point for concentration of sugar sources by volume, usually somewhere between 14% and 19%, where fermentation may simply grind to a halt or a near-halt, due to excessive concentration of certain nutrients in the molasses or fruit juice concentrates which can inhibit microbial growth. Having said that, it is true that I have successfully made batches of molasses brew with concentrations as high as 23%, but I do not recommend this for many reasons! For all practical purposes, keep the concentration of sugar sources by volume below a ceiling of 10% (about 1:10) to 12% (about 1:8).

Barley malt syrup as a fermentation accelerant

This point has been made before, albeit in a sub-section devoted to various possible sugar sources which may be used in brews, but it is important enough to bear mentioning again in its own dedicated section. Barley malt syrup (aka barley malt extract, particularly in the beer brewing world) is a wonderful accelerant of fermentation and can result in a much more rapid pH drop, when added in modest amounts of from 1% to 2%. Optimal amounts for acceleration of fermentation and pH drop are usually in the range of

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1.5 to 2.0%. And, barley malt syrup contains some useful antioxidants and other nutrients as well. For sources and caveats, please see *Appendix C*.

Making Brews with High Concentrations of Sugars/Foods

As noted elsewhere in this book as well, if you plan to add significant quantities of sugar sources (blackstrap molasses, barley malt syrup, fruit juice concentrates, etc.) to your batch which will bring percentage of sugar sources to well over 7.5% (about 1:15 ratio), then consider strongly adding some of those components only toward the end of the first week of fermentation, when pH has already dropped to well below 3.7. And, I offer much the same advice for green superfood powders, medicinal herbs from Eastern or Western herbal medicine, or medicinal mushrooms from Eastern or Western herbal medicine, if they are to be added in quantities greater than two ounces of powder per gallon of AEM/beer. While almost all work quite well in fermentation, I suggest adding much of the bulk of these superfood powders only during the second week of fermentation, when pH has already dropped to well below 3.7.

Fermenting Juices or Dairy Products

There are cases where folks may not wish to add EM culture and molasses to water, but rather, may choose to ferment juices or dairy products. This is rather simple: some guidelines follow:

- Many of the liquid foodstuffs discussed in this section should be consumed within a few weeks or months of completing fermentation. Some (esp. some fruit juices such as apple juice and apple cider) may not be stable in storage over long term.
- If attempting to ferment fruit juices, apple cider or vegetable juices, please see the general guidelines about percentage of sugars in other sections. Most fruit juices weigh in with a Brix of about 8 to 12, but luckily, some of the Brix score is caused not by sugars alone, but by other nutrients as well.
- If starting Brix before adding blackstrap molasses is over 9, consider diluting with water to bring Brix down to a score of 6 to 8 before adding molasses.
- In general, add at least 3% blackstrap molasses by volume to fruit juice or apple cider.
- In general, add about 3% to 5% blackstrap molasses by volume to vegetable juice, milk, whey, or cream (raw is best, but pasteurized dairy is okay and quality is improved by fermentation.)
- Add 8% to 14% EM culture by volume to unpasteurized fruit juices or apple cider.
- Add 5% to 8% EM culture by volume to pasteurized fruit juices and apple cider.
- Add 3% to 8% EM culture by volume to vegetable juices.
- Add 3% to 5% EM culture by volume to milk, raw (liquid) whey or cream. If the dairy product is raw, and has already started to “turn” a bit (judging by smell or taste) add about 8% culture.
- Consider adding a bit of sea salt as an amendment.
- Shake or stir.
- Decant to a suitable fermenting container if not already in one.
- Ferment at heat for minimal length of time as follows, shaking or stirring daily for first few weeks:
 - for fruit juices or apple cider, ferment for at least 4 weeks. Okay to start drinking even after 2 weeks so long as pH has dropped to below 3.7, but if

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- you intend to bottle for long term storage, then you will need to ferment for about 2 to 3 months till fermentation has fully ended
- for vegetable juices, ferment for at least 3 weeks. Okay to start drinking even after 1 week so long as pH has dropped to below 3.7, but if you intend to bottle for long term storage, then you will need to ferment for about 1 to 2 months till fermentation has fully ended.
- For raw milk, liquid whey or cream, okay to start drinking even after 1 week so long as pH has dropped to below 3.7, but if you wish maximal bioconversion of nutrients and nutritive value, then ferment for far longer. I do not recommend attempting to bottle such products for longer term storage, but if you must try, then ferment for at least 2 months first, with temperature cycling.
- For pasteurized dairy products, I suggest adding at least 1 to 2 months to all times suggested above for raw dairy, to give the beneficial microbes time to accomplish bioconversion and digestion.
- If you must bottle such liquids as discussed in this section, please be sure to bottle only in containers designed for bottling liquids which may develop high gas pressures, such as glass or PET plastic beer or champagne bottles.
- If fermenting cream or milk, and if you wish to test ORP or pH, you will need to allow ingredients to separate by leaving container undisturbed for about three days, and then using a laboratory pipette, bulb pipette or sampling tube to remove a small amount of the aqueous liquid from the bottom layer and then run tests on that. It is not possible for you to perform pH or ORP tests on the oily components, and you will succeed only in gunking up your probes/electrodes if you do so.
- As has been noted in an earlier section, If fermenting milk or cream – each of which contain significant amounts of fat – as has already been noted in the section on fermenting oils, these products -- especially cream, which consists of over 95% fats by volume – will often exhibit some separation of ingredients even after a lengthy fermentation with repeated shaking to mix ingredients. When this occurs, this will usually manifest as a thin layer of water-based components at the bottom of the fermentation container, with a thicker layer above it, containing the fat-based components. Each of these liquids – assuming that fermentation was successful and that you shook/mixed the batch regularly during fermentation – will have unique and interesting properties, and each will be highly useful in its own way. Feel free to play with them.

Consider Your Intended Purpose and Application Prior to Brewing

I have made this point many times on many EM list groups and also to my consulting clients, and here it is: Consider carefully, before starting your batch of AEM or brew, your primary purpose in making it. In other words, what is the primary intended application? Do you want it to be:

1. An AEM which will function primarily as a microbial inoculant for compost, waste treatment, water remediation, or septic treatment
2. An AEM or brew whose primary purpose by far is to act as a probiotic microbial inoculant for ingestion by animals or humans, and any antioxidative, detoxifying, regenerative or syntropic (anti-entropic) effects are far less important (this instance will be rare!)

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3. An AEM with good or at least moderate microbial inoculant properties, but primarily very strong antioxidative, syntropic (anti-entropic), regenerative, deodorizing and detoxifying (e.g., for waste or waterways, etc.) properties, for purposes such as deodorizing, waste remediation, waterway treatment, treatment of building materials, etc.
4. An AEM for animal consumption or brew for human consumption, where you want good or at least moderate microbial inoculant properties, but primarily a liquid which is very high in antioxidants, syntropic (anti-entropic) substances, regenerative properties and substances, energy compounds such as COQ10 and NADH, and good detoxifying properties.
5. An AEM for animal consumption or brew for human consumption, where you want good or at least moderate microbial inoculant properties, but primarily a liquid which is extremely high in antioxidants, syntropic (anti-entropic) substances, regenerative properties and substances, energy compounds such as COQ10 and NADH, and good detoxifying properties.
6. An AEM with extremely strong antioxidative, syntropic (anti-entropic), regenerative, deodorizing and detoxifying (e.g., for waste or waterways, etc.) properties, for purposes such as deodorizing, waste remediation, waterway treatment, treatment of building materials, etc., and yet with at least moderate activity as a microbial inoculant.

Some sample recipes for different types of AEM (optimized for various properties) and EM brews are given in Part III in the appropriately-named sections therein.

If your primary intent falls under items 1 or 2 above, then you will ferment your AEM batch at hotbox temperatures only until pH has dropped to below 3.55. This can happen within about seven to eight days of fermentation at hotbox temperatures, but may well take up to 16 days (or even longer if fermented at cool temperatures), and you will wish to use a hotbox temperature range of 90 F to 104 F, which is slightly lower than the range recommended for other types of AEM and EM brews. And, the microbial culture and balance in the batch will be even more optimal if you ferment at warm temperatures for at least 18 days (after start) before using it, even if pH has already dropped even further than the benchmark of 3.55. And, dependent upon quality of batch, maximal and optimal microbial inoculant properties may stay at an absolute peak for only about 30 to 40 days after this point, or even less if the quality was very poor, or it may stay at optimal levels for many months, if made carefully and with recommended supplemental ingredients. So, for such applications where microbial activation is the prime consideration, you will want to make relatively short-fermentation length batches as described here, but you may need to make them frequently, perhaps once every month to once every 6 months (depending upon quality of previous batch), so that you always have a fresh and optimal batch at hand. However, be advised that even AEM batches which have fermented for far longer times (usually 10 weeks or longer; to be described below), if made in the proper way, will still retain good microbial inoculant properties for up to 10 months or longer, but will simply not be as active microbially as these shorter-fermentation-length brews are during the first 30 to 40 days (or longer) after reaching the finish point.

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For further information on this matter of microbial balance and viability across batches and stages of a batch, please see the sections below entitled *Length of Fermentation and Microbial Activity/Viability Across Batches* and *Stages of Batch*.

If your primary intent falls under items 3 or 4 above,

then you will want to make a long fermentation length batch, where you will ferment the batch at heat for at least 7 to 8 weeks or longer, and often far longer. And, if your fermentation temperatures are below 90F, then you will want to ferment even longer. Basically, the longer the fermentation at a given temperature, the greater the strength and concentration of the following properties:

- deodorizing and detoxifying properties
- antioxidants
- syntropic (anti-entropic) properties, substances, and subtle energies
- regenerative properties, substances and subtle energies
- energy compounds such as COQ10, NADH, ATP, bacteriochlorophyll
- energy compounds such as ACE energy pigments (“alternate cellular energy pigments”)
- beneficial and syntropic subtle energies
- ability to beneficially restructure water and other substances at subtle energy level
- ormus-like effects

If your primary intent falls under item 5 above,

where you wish an AEM or brew with extremely strong antioxidative and syntropic properties, then you will want to make a long fermentation length batch, where you will ferment the batch at heat for at least 7 to 8 weeks or longer, and often far longer, and you will wish to make the variant known as High-Light (HL) – please see the section on High-Light versions in the (following) Very Advanced Methods chapter. This version can exhibit even far stronger antioxidative, deodorizing, syntropic, regenerative and energetic properties than the normal long-fermentation batches, due to enrichment of the activity and population count of the PNSB organisms.

If your primary intent falls under item 6 above,

where you wish extremely strong antioxidative and syntropic properties, but the product will not be used for consumption by animals or humans, then you have two options, listed in ascending order of increasing power and effectiveness, but where the second option is an experimental method reserved only for every advanced technicians:

- you may wish to make the variant known as High-Light (HL) – please see the section on High-Light versions in the (following) Very Advanced Methods chapter. As noted earlier, this HL version can exhibit even far stronger antioxidative, deodorizing, syntropic, regenerative and energetic properties than the normal long-fermentation batches, due to enrichment of the activity and population count of the PNSB organisms.
- you may wish to make the experimental variant known as High-Red (HR) in what is known as a continuous breeder fermenter or continuous breeder reactor – please see the section on High-Red versions in the (following) Very Advanced Methods chapter. This HR version can exhibit even far stronger antioxidative, deodorizing, syntropic, regenerative and energetic properties than the HL version of a long-fermentation batch, due to massive enrichment of the activity and

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population count of the PNSB organisms. However, as noted above, the method is an experimental process reserved only for every advanced technicians

Length of Fermentation

Before reading this section, please be sure that you have already read the section above entitled *Consider Carefully Your Intended Purpose and Application Prior to Brewing a Batch*. Then, and only then, can we talk about length of fermentation.

Here are basic guidelines:

- If your primary goal falls into categories #1 or #2 listed in the “...*Intended Purpose and Application...*” section above, where maximal and optimal microbial balance and activity are most important, then I suggest using hotbox temperatures between 88 F and 104 F (note that this range is a bit lower than the range for fermenting high-antioxidant versions), you will ferment your AEM batch at hotbox temperatures only until pH has dropped to 3.60 or below. This can happen within about seven or eight days of starting fermentation, and even sooner at times, but may well take up to 16 days at hotbox temperatures (and longer if fermented at cool temperatures, such as 75 F!). However, the activity and balance of the microbial culture in the batch will be even more optimal if the total time of fermentation at warm hotbox temperatures has been at least 18 days from start before using it, although this may lower pH even a bit further further than the minimal threshold floor of 3.60.
- If your primary intent falls into the realm of bullet items #3, 4 or 5 above, then you will want to make a long fermentation length batch, where you will ferment the batch at heat for at least 7 to 8 weeks or longer, and often far longer, and ideally (especially for the first couple of weeks, at temperatures in the range of 92 F to 112 F. And, if your fermentation temperatures are below 90F, then you will want to ferment even longer. As noted elsewhere in the sections on various percentages of sugar sources by volume, the fermentation time required tends to increase not linearly as you increase concentration of sugar sources above 5% or 6% by volume, but rather increases almost exponentially, almost as the square of the increase in sugar concentration.
- And, as noted elsewhere as well in this section, if your batch of AEM or brew has over 9% (about 1:11 ratio) of sugar sources by volume, you may wish to consider adding only the first 6% to 7% by volume of sugar sources (primarily molasses) at start, and then adding the remainder of sugar sources -- along with a bit more EM microbial culture inoculant -- at about 10 days after start, after pH has dropped to about 3.6. This staggered addition of sugar sources helps to maximize initial startup an initial pH drop, and to make for a better brew.
- As noted elsewhere as well in this section, if you plant to make your batch of AEM or brew with over 2 tablespoons of Azomite bentonite clay per gallon of water, you may wish to add only 2 tbs per gallon at start, and then add the remainder of the bentonite clay rock dust only at a point about 8 days after start, after pH has dropped to 3.7 or below. This staggered addition of bentonite clay or other rock dust helps to maximize initial startup an initial pH drop, and to make for a better brew.

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- Please remember that some sample recipes for different types of AEM (optimized for various properties) and EM brews are given in Part III in the appropriately-named sections therein.

Microbial Activity Across Batches and Stages of Batch

Many uses and applications for AEM need to make use not only of its antioxidant, syntropic and regenerative abilities, but also are dependent upon its microbial activity and viability, wherein the AEM or brew is needed to exhibit good and balanced activity as a microbial inoculant with EM-like activity (I deliberately use the term, “EM-like activity” because, frankly, no two batches or brands of EM microbial culture sold anywhere in the world are identical or even nearly identical in microbial composition, and that is part of the power of EM-like cultures!) The viability of a particular batch of AEM or brew across time as an effective microbial inoculant depends upon its quality, or, in other words, pretty much the following factors:

- The microbial balance and viability of the EM microbial inoculant culture (or, in some cases, the batch of high quality AEM) used to start the batch
- The care with which the batch was made
- Which supplemental ingredients were added to the batch to improve strength and viability, where in general, use of recommended supplemental ingredients yields a batch with much stronger and more hardy microbial balance and activity
- The quality of the ingredients (major and supplemental) used in making the batch
- The microbial complexity and spectra offered by the ingredients used in making the batch, where greater complexity and spectra offer greater power and strength to the microbial makeup of the batch

Lastly, there are three other factors which influence microbial viability, and these are:

- Length of fermentation of the batch – this has been treated at length in a section entitled Length of Fermentation, just above this section.
- Length of storage time – this will be treated at length in a section below
- Storage conditions for the batch, once fermentation has finished (this, of course, affects quality!) – this will be treated at length in a section below

Please remember that some sample recipes for different types of AEM (optimized for various properties, including some for maximal microbial balance and activity) and EM brews are given in Part III in the appropriately-named sections therein.

As promised above, here is a brief discussion of three latter-listed factors which influence microbial viability:

Length of fermentation of the batch

Please see the section entitled Length of Fermentation, just above this section.

Length of storage time

The length of storage time can greatly affect microbial balance and viability in a batch of AEM or brew. Here are some general guidelines, and I will offer two different storage times, one for maximal or optimal microbial viability and another for usable and acceptable microbial viability – all figures shown are in terms of

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days after batch has finished fermenting and been removed from warm hotbox temperatures, and all figures assume anaerobic storage in dark place at cool temperatures (45 F to 78 F):

- For very low-quality batches of AEM made sloppily, with only minimal ingredients and with poor-quality ingredients, optimal microbial viability may only exist for 20 to 30 days (after batch has finished fermenting), and the batch may exhibit acceptable microbial viability for up to 50 days or even far less.
- For low-quality batches of AEM made with only minimal ingredients and perhaps poor-quality ingredients, optimal microbial viability may only exist for 30 to 40 days (after batch has finished fermenting), and the batch may exhibit acceptable microbial viability for up to 60 days.
- For average-quality batches of AEM made with some care and only minimal ingredients (and perhaps sea salt as well), optimal microbial viability will usually exist for 40 to 60 days, and the batch may exhibit acceptable microbial viability for up to 70 days.
- For high-quality batches of AEM made with great care, using many of the recommended supplemental ingredients to ensure greater batch vitality, high quality ingredients, and using a 1:15 ratio of blackstrap molasses to water, optimal microbial viability may exist for 90 to 200 days (e.g., three months to over six months), and the batch may exhibit good and acceptable microbial viability for up to 12 to 18 months.
- For extremely high-quality batches of AEM made with great care, using many of the recommended supplemental ingredients to ensure greater batch vitality, high quality ingredients, and using a 1:10 to 1:12 ratio of blackstrap molasses to water, optimal microbial viability may exist for five months to over eight months), and the batch may exhibit good and acceptable microbial viability for up to two years or even longer.

Storage conditions for the batch

Optimal storage conditions for any batch of AEM or brew (other than the High-Red, aka HR, variant) are as follows:

- Store in dark place
- Store completely anaerobically, using guidelines for storage given elsewhere in this chapter
- Transfer between containers, or to bottles, using guidelines for decanting or bottling given elsewhere in this chapter
- Store at temperature of 45 F to 78 F; 50 F to 66 F is even more optimal, if possible.
- Try to prevent significant or frequent shifts in temperature, but rather, try to leave at one stable temperature, or at least keep within 3 to 4 degrees either way of that “center” temperature

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Stirring or Shaking to Mix Contents

In my early forays into the EM world, I encountered nearly uniform warnings not to shake or stir ANY kind of AEM preparations -- whether liquid or solid, for any purposes, whether for human use, ag use, soil, ag or waste remediation use -- during fermentation. I heard this from a wide number of online sources and even received such warnings verbally from staffers at several marketers/vendors of EM culture. Again, this was in the early days.

The exact words were along the lines of:

"Do not stir or shake while fermenting. Dr. Higa says the microbes are not to be disturbed for best growth. Treat them like human babies. After all, how would you like to be shaken violently every few hours if you were baby?"

However, guided by my intuition, I always shook all my liquid EM preparations from the very beginning of my EM days -- a lot of shaking/stirring in the beginning of each batch, such as first ten days, and continued for many weeks, but less frequently than at start. I found that even once per day or every other day is better than nothing, if shaking/stirring several times per day is too much effort.

Suddenly, around the time I started printing recommendations to stir/shake all liquid EM batches (e.g., AEM, brews, etc.) on my EM Info website, a number of websites which had recommended not stirring started to disappear from the web, more vendors started to recommend shaking liquid batches, and two staffers at one vendor who had been recommending not stirring disappeared from the EM scene. In fact, I can no longer find any websites which recommend NOT stirring /shaking (if you know of any yet extant, please send me the link; I would love to see it!) -- I am not sure quite what happened or what caused the change in policy among vendors and producers of EM-type microbial cultures, but I describe below what I see as a likely scenario:

Shaking or stirring an anaerobic liquid batch can usually be done quite easily, without allowing entry of much air or even allowing any air at all. However, stirring or shaking a solid batch, such as bokashi, is almost bound -- due to the types of containers/bags used, and also the granular nature of the material -- to allow a lot of air to enter the depths of the mixture, thus destroying anaerobic conditions, and worse, encouraging molds and undesirable organisms. And, much of the usage/employment of EM in third-world countries is via solid means such as various types of bokashi and EM-compost. So, I suspect that since stirring or shaking solid EM preps can have rather disastrous effects (via introduction of air), and since APNAN, INFRC, SKK, MOA and later EMRO were often marketing EM and EM technology to sometimes illiterate and poorly educated folks in such countries, someone somewhere -- a long long time ago, apparently in the late 1980s -- made the decision simply to offer a carte blanche one-size-fits-all generalized warning, to wit:

"Do not stir or shake while fermenting. Dr. Higa says the microbes are not to be disturbed for best growth. Treat them like human babies. After all, how would you like to be shaken violently every few hours if you were baby?"

It is only recently that they have apparently started to re-think this overly-broad, overly-generalized warning and instead started to refine or fine-tune the warning....

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Conclusion

So, the actuality is that stirring or shaking of fermenting liquid batches of AEM or brews as described earlier is most beneficial. Stirring or shaking of solid EM preps such as bokashi, fermented grains and compost IS INDEED NOT ADVISED once initial mixing has been done -- it can be disastrous.

And, one more reason why the various organizations which had been distributing EM culture may have recommended against shaking/stirring even liquid EM preparations may have been to avoid liability from occurrences such as folks shaking containers of liquid and causing a volcanic eruption of brown or black foamy liquid across the room via the opening as the cap blew off, or worse, an exploding container if the person had unwisely used a glass jar or a tightly sealed plastic container without an air vent, etc.... So, I suspect the "Do not shake or stir batches" warning came from a very conservative mindset.

Bottom line: Even the most conservative organizations in the EM world now seem to recommend shaking or stirring AEM liquid during fermentation for best results.

Odors Encountered at Various Stages of Brewing

Batches of AEM and brew often smell quite raunchy for the first few weeks of brewing, largely due to presence of transitory quantities of acetic acid (as in vinegar), thiols (sulfur alcohols), butyrates, hydroxybutyrates, polyphenols, heavy alcohols, congeners, fusel oils and etc. In fact, the smell can be quite foul for at least the first 2 to 8 weeks (at hotbox temperature), till the pH has dropped well below 3.5 in some cases. I have heard off-the-record tales of commercial EM brewing techs who have gotten nosebleeds after repeatedly opening large EM brewing vats (330 gallons to 1,500 gallons) every two hours for 30 days on end to stir and take samples, apparently due to the powerful harsh odor present for the first 2-3 weeks.... Other reasons for nasty smell:

- using too much molasses, thus extending length of "bad smell" phase of fermentation
- stray microbes present in water or molasses or container
- variance in batches of molasses, namely in various compounds in the molasses
- presence of oils in molasses
- brewing at a cooler temperatures is generally known to produce weirder and stronger smells than brewing above 94 F, at least for the first few months of fermentation, due to higher rate of occurrence of acetic acid, thiols, butyrates, congeners and heavy alcohols.

And yes, sometimes a long-sealed batch of EM culture or AEM will exhibit a weird smell when first opened, for much the same reasons as noted above, but if the smell passes quickly within a few hours, and if the pH and taste are fine, then the batch is likely good,

pH and Other Benchmarks for Minimal or Optimal Readiness

While it is true that many EM vendors, particularly in Asia, often claim that a batch of AEM or brew is ready for use once pH has dropped below 4.0, I do not recommend using this standard. Instead, I recommend that you wait till the pH has dropped to 3.7 or below, and preferably 3.6 or below, for AEM batches, and 3.5 or below for EM brews, for your batch to be considered even minimally acceptable for use. Of course, in over 95% of cases,

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dependent upon your intended usage of the batch, you will likely be fermenting your batch for far longer than necessary to reach such minimal setpoints, and thus the final pH of your batch will often end up at or below 3.5. In other words, pH is not the final determinant of readiness of a batch, but rather, certain pH points are minimal thresholds to be reached. It is fine for pH to go beyond them by going even lower, and even desirable for it to go lower, but these are at least minimal thresholds to be sought.

Measuring pH

If you are at all serious about brewing AEM or brews you will have at hand one or more reliable means of measuring pH. Period. No exceptions.

In the USA, SCD (see *Appendix A*) sells pH test papers in ranges suitable for making measure of batches at various stages of brewing. While I have pH paper at hand, I never use it; I vastly prefer the reliability of digital pH meters and the fact that they can be readily calibrated with simple pH calibration solution (see notes in *Appendix D* for vendors). If you do a quick search on portable digital pH meters on Google, you will find literally hundreds of models of pH meters (for more notes and hints on models or sources, please see *Appendix D*). One word of caution, however – I strongly recommend against purchasing the small, cheap, pen-style shirt-pocket digital pH meters. Almost invariably, these are constructed so cheaply and out of such poor materials that they fail or become hopelessly inaccurate within months of purchase.

If you do plan on using any kind of digital pH meter, the electrodes must be cleaned occasionally, and the meter and probe must be calibrated at least once per month. Please see *Appendix M* for more details.

Cycling Fermentation Temperature

All batches of AEM or brew, during the active fermentation stage, seem to be helped by some modest degree of temperature cycling. Some brewers employ daily temperature cycles, as in day/night cycles, but frankly, for any batch size above 4 gallons, the actual shift in temperature of the liquid will be only minimal due to the caloric mass of the volume of the liquid. Therefore, most brewers who wish to employ temperature cycling simply periodically remove batches from the hotbox for at least 3 to 4 days and sometimes longer, allowing them to cool to room temperature before returning them to the hotbox.

These longer-period bouts of intentional temperature cycling comprise an advanced technique, and is one primarily used for EM brews where the percentage of sugar sources (blackstrap molasses, barley malt syrup, fruit juice concentrates) is over 7% by volume, and particularly if it is over 10% by volume, where the batch is usually fermented at hotbox temperatures for at least 6 weeks and often as much as 10 to 15 weeks or longer. Cycling of fermentation temperature can accelerate the fermentation process and also awaken stuck or semi-stuck fermentations (more common at sugar source percentages over 8% by volume), and it involves allowing the batch to cool from hotbox temperature to room temperature of 68 F to 79 F for 2 to 3 days, before returning it to hotbox temperature. Normally, if cycling is employed, it is done twice, once at about the one or two week point after starting the brew, once pH is below 3.6, and again at about the third or fourth week.

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Maximal Fermenting Temperatures

Here are a few observations on maximal fermenting temperatures:

- For most types of batches – and any exceptions such as lower recommended temperature ranges are noted explicitly in sections devoted to specialized batch types -- it seems best to keep liquid temperature below about 112 F. In reality, however, 115 F is rather harmless, and brief accidental excursions – although not preferable -- to about 122 F (about 50 C) are rather harmless. However, much as noted in the appropriate sections, maximal temperatures for certain types of batches, such as those intended primarily for use as a microbial culture inoculant and also those where maximal ormus effects are desired, should be kept somewhat lower.
- For many purposes, many batches may not be harmed by an occasional, brief and accidental rise of temperature to as much as 130 F, but this is not desirable, as some nutrients and some microbes will be harmed.
- I have intentionally made some batches of brew which employed the addition of small amounts of molasses at the end of the 3 month “normal” fermentation, followed by a second fermentation at high temperatures in the range of from 134 F to 155 F. Overall, I have not been particularly impressed with the results, and have not repeated the experiments. While there was some microbial activity during the second fermentation at the higher ranges, particularly due to the PNSB organisms, there was noticeable damage to certain nutrients, although the brews still retained many healthful properties.

Decanting from Primary Brewing Container to Secondary or Storage Containers or Bottles

If you are decanting some finished AEM or brew from the fermenting container into a secondary container for use within the next five or six days, you can simply fill a plastic bottle, bucket or other container from the master fermentation container via a spigot or via pouring, filling the secondary container from the top, even though this transfer method obviously introduces a goodly amount of air into the liquid in the secondary container. However, if you are filling containers for long-term storage, over about one or two weeks, then it will be well worth your effort to take several precautionary steps to ensure that the finished batch will not reawaken and start fermenting vigorously in the container, or possibly even go bad over time due to introduction of too much air from pouring/filling procedure, as pouring and filling from the top introduces millions of tiny air bubbles in the liquid as the container is filled. So, for all longer-term storage, and especially when filling beer-style bottles (glass or plastic) with EM brew for long-term storage, it becomes very important to fill the bottle or other container anaerobically, and then to seal it within one hour of filling to ensure totally anaerobic storage conditions.

How do you fill a container without introducing air into the liquid? You insert a flexible plastic tube (food-grade and clean, if batch is intended for human or animal use) into the to-be-filled container until it strikes the bottom, or you use a bottom filling stem or tube, available from any homebrew supply store for \$3, and you attach that tube to the spigot or tap on your master fermentation container. This way, the liquid fills the container from the tube or stem, filling from bottom up, and thus preventing introduction of air bubbles.

So, whenever you transfer AEM or brew to any container, whether a master storage container or a bottle, for any application other than full use of the dispensed liquid over

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the next two weeks or less, it is strongly recommended that you always transfer or dispense such liquids only in a fully anaerobic fashion. This means use of flexible plastic tubing and bottom-fill techniques, with the upper end of the plastic tubing attached to a spigot or an auto-siphon device (available from any beer/wine homebrew supply shop.) As is likely obvious, the problem with top-fill methods -- such as filling a bucket or mug from a spigot or tap, or worse, by pouring liquid from one container to another -- at least if the liquid dispensed will not be fully used within two or three weeks, is that top-fill dispensing allows introduction of lots of air in the form of millions of small bubbles formed as the liquid fills the container. This immediately destroys the anaerobic nature of the liquid which had been maintained so far, and can immediately allow development of wild aerobic microbes which can cause spoilage of either quality or taste of the liquid. So, it becomes important to consider dispensing or transferring completed AEM or brew only anaerobically if you intend it to be useful for more than a few weeks.

Some folks choose to dispense and use their batches directly from the fermentation container, which also serves double duty as the master storage container for the batch as well. And, this is quite fine and acceptable -- I often use this method myself, especially if my fermentation container had a convenient spigot mounted near the bottom of the container, which makes for easy dispensing. The only concern here is that if you use the contents of the container gradually over time, once more than a few inches of headspace of air (bearing oxygen) is introduced above the surface of the liquid, then the quality of the remaining batch will usually start to slowly degrade over time, due to the creation of partly aerobic conditions and growth of aerobic organisms. So, to preserve and maintain maximal quality of any finished batch of AEM or brew, it is important to keep it relatively anaerobic at all times. And, it is obvious that conditions do not remain primarily anaerobic for long if you allow a headspace of 10 inches of air to develop in a 5 gallon bucket of brew. This is perfectly fine over the short run, for perhaps a period of three weeks or a bit more, but after more than a month has passed, there will indeed usually be noticeable degradation of the product remaining in the storage/dispensing container. What are some solutions? Well, there are several possibilities:

- You may realize that you will use up all of the contents of the master storage container within about three or four weeks of starting to “tap” it (drain it), in which case the issue is largely a moot point.
- You may decide -- especially if your batch is a simple low-Brix/low-SG AEM with only about 4% to 6% molasses content and is not intended for human ingestion -- to ignore the issue, as minor degradation will not matter for your applications (I often make this choice with utility-grade batches of AEM).
- You may decide -- especially if your batch is a simple low-Brix/low-SG AEM with only about 4% to 6% molasses content and is not intended for human ingestion -- that the introduction of fresh air into the headspace will be so slow, due to very slow rate of usage/decanting, that the beneficial yeast in the batch will be able to grow and consume most of the oxygen introduced; you do run the risk with this approach of the growth of undesirable yeasts or aerobic bacteria which may seriously degrade taste or quality.
- Purging with CO₂ or other inert gas -- You may decide to continue dispensing from the master container, but to purge the headspace with CO₂ gas or nitrogen gas from a tank/regulator combination after each dispensing activity. Usually you will fix up a length of small diameter plastic tubing attached to the regulator, so

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that all you need to do after creating more headspace is to temporarily remove the airlock, insert the tubing thru the airlock hole, and gently bleed CO₂ or nitrogen gas into the headspace, allowing air to escape from the headspace as you do so. If you choose to purge headspace with inert gases such as CO₂ or nitrogen, please see *Appendix D* for sources of tanks, regulators and other accessories for supplying these inert food-grade gases.

- You may choose to transfer the contents of your master container to a new storage container, such as a Cubitainer (available in sizes from 1 gallon to 5 gallons) via anaerobic transfer techniques. Then, as you decant liquids from the Cubitainer, air is excluded, as the soft collapsible inner bag simply collapses to conform to liquid level, thus excluding air. Alternatively, instead of a Cubitainer, you may choose to dispense to a Party Pig or some other anaerobic dispensing systems marketed by homebrew supply houses for use with beer.
- You may choose – if your master storage container holds a gallon or more of finished AEM or brew – to transfer the liquid to smaller storage bottles (anaerobically, of course!) so that only one bottle needs to be opened at a time. Also, sealed bottles are easy to store and easy to transport.

Purging Headspace of Storage Containers

Much as noted in earlier sections on keeping conditions in master containers or storage containers rather anaerobic after fermentation has ended, at least if headspace greater than about 1/5 of the volume of the container is allowed to develop, some folks choose to continue dispensing from the storage container, but to purge the headspace with food-grade CO₂ gas or nitrogen gas via a length of flexible plastic tubing fed from a gas tank/regulator combination after each dispensing activity. Usually you will fix up a length of small diameter plastic tubing attached to the regulator, so that all you need to do after creating more headspace is to temporarily remove the airlock, insert the tubing thru the airlock hole, and gently bleed CO₂ or nitrogen gas into the headspace, allowing air to escape from the headspace as you do so. If you choose to purge headspace with inert gases such as CO₂ or nitrogen, please see *Appendix D* for sources of tanks, regulators and other accessories for supplying these inert food-grade gases.

To Bottle or Not to Bottle?

This question, regarding what to do with a batch after fermentation has been completed, applies primarily to higher-density complex EM brews because of each of the following factors:

- EM brews tend to have a higher concentration of sugar sources and other ingredients per ounce (and therefore, a higher Brix and higher specific gravity, aka SG) than batches of AEM,
- they are intended to be ingested by humans (versus household or utility uses)
- they are more susceptible to off-gassing and foaming due to continued fermentation after end of primary fermentation
- they are more susceptible to eventual introduction of bad tastes due to growth of aerobic wild yeasts as more and more air is introduced into headspace of master storage container as brews are decanted for use
- they are more susceptible to eventual spoilage due to high SG and introduction of wild microbes plus lots of air over time

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My general rule of thumb in this matter is as follows:

Once you have allowed an airspace equal to over one-third of the volume of total liquid enter your master container, if you do not anticipate using the remainder of the contents within three weeks, then bottle the liquid (anaerobically, of course!) in bottles. Some tips follow in the next section.

Tips for Bottling with Low Post-Bottling Fermentation and Off-gassing

and

Tips for Bottling Brews to Ensure Long Shelf Life

This section applies primarily to bottling EM brews for long term storage, but really do apply equally well to any AEM batches that you may wish to bottle and store in plastic bottles or even Cubitainers or other suitable containers. I have decided to pull together in one place much of the information which I offer on bottling EM brews to minimize chances of heavy off-gassing or foaming upon opening due to continued fermentation in the bottle - they are presented below:

However, having offered to share these points, I must now back-pedal slightly and share my point of view that some small degree – sometimes very small but nonetheless present -- of continued fermentation and consequent gas pressure build-up with most batches of AEM or EM brews is simply inevitable, especially if the concentration of sugar sources (e.g., molasses, etc.) was much over 6% (about 1:18) at start. After all, the concentration of foodstuffs and sugars per ounce is far greater than that found in simple EM microbial culture inoculant, and most of us are aware that even very well-aged EM culture can continue to off-gas and even burst its storage bottles or Cubitainers at times. Indeed, when I ship my research-grade Sootheox brews to customers, I enclose multiple flyers/notes in each shipment as a package insert, offering people warnings that the contents of a few of the brew bottles may well be somewhat pressurized, and offering hints on how to carefully open them.

Now, for my tips on how to reduce continued heavy fermentation and gassing after bottling:

- make sure that fermentation takes place at or above 95 F, especially during first two or three weeks to ensure rapid fermentation... I prefer about 104 F or a bit above, up to about 110 F. Alternatively, if you choose to continue fermentation at a lower temperature after the first week or two of fermentation, then no harm at all, but you must simply allow far longer brewing times, perhaps up to 3 or 4 months or even longer for very complex brews.
- this might seem counter-common-sense at first, but I strongly recommend leaving at least a few inches of air headspace above the fermenting brew, and allow some fresh air to enter the headspace either every day or at least every few days, during the more active stages of fermentation. This allows small amounts of oxygen to periodically enter the topmost layer of the brew, and increases speed of fermentation, and also drastically increases production of certain low molecular weight (LMW) antioxidant such as the phenols and some polyphenols... it is the phenols which give some batches of EM culture and AEM the distinctive phenolic smell. This process also speeds up growth of the yeast...

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- for the first six weeks after adding the last input of sugars/foodstuffs to brew, shake or stir the brew rather vigorously every day, and, per the note above in item #2, make sure to introduce a bit of fresh air into the air headspace above the liquid surface prior to each stirring or shaking. As noted above, this distributes the ingredients and any sediment on the bottom, and also allows small amounts of oxygen to periodically enter the topmost layer of the brew, and increases speed of fermentation, and it also speeds up growth of the yeast....
- if you wish fermentation to accelerate further, allow temperature to cycle to cool temperatures at least twice during fermentations – see appropriate section in this part of the document on *temperature cycling*. This tends to re-awaken the fermentation, particularly the activity of the yeast and some aerobic helper microbes, which serve as foodstuff for some of the other organisms.
- be absolutely sure to allow your batch to ferment long enough to consume all or almost all of the available sugars. There is no substitute for this step, and failure to observe it – in other words, attempting to bottle into sealed bottles before fermentation has reached a natural finish and lain dormant for at least 3 weeks, will often result in disaster.
- as you near time when you plan to bottle: make sure that most sugars and simple foodstuffs have already been consumed by the organisms during a fermentation of sufficient length. The easiest way to tell this is by tasting, or by bottling a sample bottle or two (e.g. amber plastic PET beer bottle or empty 1 liter soda bottle) via an AEROBIC method such as top-fill pouring (one which allows introduction of a liberal amount of air bubbles during bottling), sealing them, and letting them sit for at least 17 days, with occasional shaking, at room temperature, after which they may be opened. If the test bottles off-gas or foam excessively during opening, then there are still too many sugars present. You eventually get to the point where you can tell, both by intuition and by taste, if there are still too many sugars present to allow safe bottling.
- allow the batch (in the fermentation keg, vat or bucket) to be bottled to cool to room temperature and remain there for at least 48 hours prior to any bottling activity.
- allow any sediment in fermentation container to settle undisturbed on bottom by leaving container undisturbed for at least 48 hours prior to bottling operations. This prevents almost all of the sediment from getting into the bottles, where it might possibly continue to feed fermentation, albeit at a slow pace.
- bottle anaerobically -- during bottling of "production" bottles, do not allow any air bubbles to be mixed with the liquid as it is decanted into the bottle (as air re-awakens the yeast, and re-starts fermentation). For more on this, please see the section in this part of the book on bottling precautions. Briefly, the easiest way to accomplish anaerobic filling of bottles is by using a "filling stem" (aka "filling wand" or "bottom-filling stem"), sold in homebrew supply stores for a few bucks. The

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bottom-filling stem has a spring-loaded ball valve at the tip, and when the stem is inserted into an empty bottle and the tip pressed against the bottom of the bottle, the liquid will flow to fill the bottle from the bottom up (thus no air is introduced); as soon as pressure is released, the flow stops and the bottle stops filling, so you can remove the stem and place it in the next bottle without dripping or leakage...

- one final method to ensure even more removal of any sediment and particulates from the brew prior to bottling – usually never worth the effort in terms of reduced fermentation in the sealed secondary bottles -- is to employ, in the bottle-filling tubing line at time of production bottling, an inline filter system, using a rather coarse filter (akin to cheesecloth) to remove most particles and sediment. However, I feel that this is a largely unnecessary step, as careful bottling technique will eliminate at least 97% of any sediment and larger particulates prior to bottle-filling.
- lastly, when bottling, always put aside the first quart or two from such an operation after first starting a new bottling operation setup (e.g., tubing, filling stem, any inline filter, etc.) for your own use over the next two weeks. This prevents you from accidentally bottling and sealing the first bottle or two of liquid from the line, as this “first run” liquid is sure to have admixed with it many small air bubbles which have rendered it largely aerobic, thus limiting its useful lifetime. So, I recommend putting aside those first two pints for your own use!

Which Brews or Batches Are Most Prone to Off-Gassing After Bottling?

In general, the following factors seem to hold true in this area:

The batches of AEM or brew which are most stable after bottling are those:

- Which were bottled anaerobically and sealed within 30 minutes after filling
- Where fermentation was allowed to completely finish, followed by cooling-down and aging period at room temperature (at least 2-3 weeks) in the fermentation container
- Even better, if at least two temperature cycling phases (see appropriate section) were employed during fermentation
- Where total starting Brix score due to sugar sources (molasses, juice concentrates, barley malt syrup, etc.) was at or below 12. In other words, brews with very high sugar source percentage often tend to yield incomplete fermentation, thus increasing chances that fermentation may re-start in bottle
- Where appreciable amounts of sediment from the bottom of the fermentation container have not been allowed to enter bottles, although this is a minor factor, and, in the case of some specialized brews and elixirs, (such as golden bran kelp brew, turmeric elixir, green superfood elixir, etc.) it will actually be desirable to allow some of the large amount of sediment from the brewing container to enter each bottle (unless you wish a very “light” version of your brew or elixir!)

What Types of Bottles to Use for Bottling

As has been already mentioned in several other sections, if you plan to bottle any fully finished fermented liquids in sealed bottles for long-term storage, then please be sure to bottle only in containers designed for bottling liquids which may develop high gas

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pressures, such as glass or PET plastic beer or champagne bottles. Suppliers for such bottles may be found in *Appendix D*.

Very Advanced, Specialized or Experimental Techniques

Aeration With Air

This as an extremely advanced technique, and if misused, can wreck a batch. Aeration supplies plentiful oxygen to the yeast, accelerating their growth and activity drastically, and also strengthens and boosts the many aerobic strains of microbes which are the “invisible partners” hidden in EM, but essential to good batches of EM, AEM and brews. I have employed aeration for some batches since March 2003, and I often employ aeration (using an aquarium air pump, a length of aquarium plastic tubing and cheap white foam, plastic or ceramic air stone sold for aquarium purposes) of my batches for the first 4 to 12 hours, and, occasionally, for EM brews with greater than 9% sugar sources by volume, very brief aeration at about 4 weeks into fermentation (latter very hazardous, however, can easily wreck a batch), for the following purposes:

- to improve overall quality of batch
- to assist, boost and vitalize the many aerobic lesser-known microbes which are really an essential part of EM culture
- to accelerate development of batch

This is an extremely advanced technique. Play with it only after you have mastered the other advanced methods and protocols. However, this technique is not unknown in the brewing field. Many microbreweries and homebrewers of high-end beers and wines aerate their batches for the first 12 to 24 hours after mixing, in order to stimulate yeast activity. Further, in the EM world and related worlds, it appears that one of the methods used for starting EM culture in the past involved aerating the batch for the first few hours; I receive conflicting reports as to whether this technique is still in wide use for brewing EM culture by different vendors. Many EM microbial culture producers/vendors in the Western world seem to claim that this is an older technique, rarely used any more in starting EM culture batches, but I do hear from some brewers in Japan and Southeast Asia that they still employ this method in starting EM culture batches. And my perusal of the US patent application from M21 Environmental Technologies, aka Lanox Korea, the producers of Lanox Antioxidant Liquid, and EM-fermented antioxidant brew for human use, has revealed that they disclose that they aerate their starting batch after mixing, often for the first 24 hours. I have also discovered at least one US patent application from a man in Japan, who applied for a patent on using the PNSB phototrophic microbes in combination with other microbes (usually yeast) to produce nutritional supplements for human use, and again the matter of aeration surfaced in the methods disclosure section of the application.

Aeration With Pure Oxygen or Ozone for Brews

This as an extremely advanced technique, and largely beyond the scope of even this document. If misused, it can wreck a batch. Ozone aeration in later stages of fermentation, after pH has dropped to below 3.5, stresses the microbes with oxidative stressors, forcing them to increase production of low molecular weight antioxidants. In fact, this method is widely used (also UV light as well) in the nutritional supplement industry to force yeast to produce higher levels of antioxidant nutrients. And, ozone aeration is the mysterious second step employed by *Tropical Plant Research Institute* (TPRI) and other Japanese producers of EM-X and EM-X-analogue liquid antioxidant

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nutritional supplements in Japan, as well as their EM-Z industrial/automotive counterparts. However, ozone stressing usually so changes the characteristics of the culture and the dominant microbes that the pH can easily end up above 4.4 – much as happens with the pasteurized filtered version of EM-X commonly sold in Japan and the USA -- yielding all kinds of other problems, such as necessity for refrigeration of the finished product. This is an extremely advanced technique, and it is really only for EM-X-like products. We will not be discussing this method further in this document.

Serial and Sequential Activation – Possibilities, Limitations

The Issue and the Normal Prescriptive Reply

We have all heard from some vendors of EM microbial culture that you cannot make serial activations (aka extensions) of EM culture, i.e., that you cannot serially and sequentially make new batches of AEM using previous batches of AEM as the microbial inoculant, but rather, that each batch of AEM or other secondary EM product must be made only from stock EM inoculant culture. And, many of us who have been in the EM world for a while have heard at least a few horror stories of small “bootleg” vendors in China, India, and even in various corners of the USA, who have at times set up shop selling what they claimed to be an EM-type microbial culture – and worse, often even using trademarked brand names and symbols owned by legitimate EM culture vendors – and yet what these small vendors were really selling was sixth or tenth generation AEM, that is, AEM which had been serially activated for 6, 8 or 10 generations. In almost all cases, the product quality from such vendors was horrible, and the stuff they were selling really did not possess any of the properties of EM-type microbial inoculant culture, but rather were likely pure lactic acid bacteria (LAB) cultures, or LAB and yeast cultures, or even vinegar cultures, consisting largely of acetobacter bacteria which produce acetic acid.

The problem is that there is some great truth to the warnings from some of the Japanese vendors about serial activation of AEM batches, and this is true especially if lower-quality batches of AEM are used, or if the serial activation is done without exercising great care. The challenge is that any EM-like culture (and there are thousands of variants of EM cultures, all of which work well) is a complex synergistic and metabiotic microbial consortium of literally at least 50 microbes, although only a tiny fraction (the yeast, LAB and phototrophes) may appear on the official labels or ingredients list. While in many ways this consortium is very hardy and robust, and will, in many situations even dominate or entrain other wild microbes already present in the environment, the consortium is nonetheless somewhat fragile in serial activations, largely due to the following facts:

- It is a complex consortium with many members
- Some of the members of the consortium are anaerobic while others are aerobic
- Optimal storage conditions differ somewhat from optimal early-stage brewing conditions, and either, if prolonged, can inhibit, attenuate or kill off certain members of the consortium, thus rendering the entire consortium less robust and more fragile
- At least 99.9% of the time, the conditions under which AEM is brewed and stored are far less than tightly-controlled laboratory conditions, and rather, are settings wherein all kinds of stressors may be accidentally introduced, each of which may challenge or weaken the culture over time.

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The Question

So, what is the truth? Can AEM -- and we assume here that the AEM under discussion is 1:20 ratio or even stronger, perhaps 1:15 or even 1:10 ratio -- be serially activated for at least a few generations? Or does the culture attenuate and lose its magic by even the second generation (a generation which was started with first-generation AEM) of AEM?

The Answer

The answer to this question is complex, and, as you might guess, depends to a large extent upon the quality of each previous batch of AEM. In general, a well-made 1:1:20 batch of AEM containing only EM culture molasses and water, will usually be good for a total of two generations of activation, the first one made from the EM culture, and a second generation made from the first-generation AEM following general culture-use guidelines offered for AEM elsewhere in Part II.

On the other hand, if the first batch (and any subsequent batches as well) of AEM was made with extra care, employing many of the hints given in this section of Part II, such as using a 1.5 to 1 ratio of EM culture to molasses, adding a number of the ancillary ingredients, and observing the other guidelines for making a really high quality batch of AEM, then it is my observation that the AEM may be extended or activated serially and sequentially for up to perhaps four or five generations. And, these latter generations do even better if spiked with small amounts of EM microbial inoculant culture in addition to the 1.5 to 1 ratio of AEM to molasses. However, there are no guarantees here: much depends upon the quality of your ingredients, choices you made regarding ingredients when mixing your batches, the quality of the water, the quality of the container, and what processes were employed during fermentation. The worst case scenario, as Dr. Higa mentions in his *Earth Saving Revolution, Vol 2*, is that even some batches of first-generation AEM may "go bad" within ten days of making it, and obviously, a batch of AEM which goes bad within ten days will be of no use in producing a second-generation batch of AEM or other EM secondary product.

Hints and Tips on Brewing AEM at Cool Temperatures

You may wish to skip this section unless or until you have a need to know how to handle brewing batches of AEM at very cool temperatures, such as below 75 F. While these guidelines were primarily written for brewing AEM batches at cool temperatures, they could be applied as well to brewing human brews at such temperatures as well if necessary.

EM culture does seem to work quite well even at fairly low temps in final or "end-point" usages in the outdoor environment. However, the matter of "growing" AEM from EM is a different matter, and one which is somewhat more critical, because making AEM is not simply an end-point outdoor environmental application, but rather a process in which you are trying to make large quantities of a high quality microbial inoculant (e.g., activated EM, aka AEM) which also will have excellent antioxidative, syntropic, regenerative and energetic properties, to be later used for end-point applications. Hence, since the culture must remain relatively "true" and pure and robust for the AEM to work effectively as a microbial inoculant (or even as an antioxidant or deodorizing liquid), it is important to take as many steps as possible to ensure the robustness and purity of the culture (much like Dr. Strangelove was obsessed with maintaining the purity of our bodily fluids) when brewing at cool temperatures. And, hence, one critical thing which will usually demand

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attention is the fermentation temperature, and in general, it is best to keep it above about 80 F if possible, and even hotter for at least the first few days if possible...

So, if we are simply speaking about outdoor environmental end-point applications for EM or AEM, where some high-quality EM or AEM has been applied to treat soil, compost, ag scraps, livestock waste, or a polluted pond or stream, then the EM, once it has been applied in adequate amounts, seems to work right in such environments right down to about 32 F (albeit at lower speed and efficiency at these temperatures than it would at higher temps...). So, if we are speaking of brewing up a reasonably high-quality batch of AEM, then a number of considerations suddenly become far more important, and foremost among them is fermentation temperature. On the other hand, there is some leeway and there are some things which may be done to help to ensure success when brewing at cooler temperatures.

The optimal temperature for brewing any batch of AEM or brew is one above about 85 F, and preferably even above 90 F or more, even if only for the first three or four days, where temperature is most important. The higher temperature not only encourages the desirable organisms in the consortium to grow faster and therefore establish a robust "true EM" culture well ahead of any competing undesirable organisms which might be present, partially by allowing the pH to drop as rapidly as possible to below 3.7, but it also discourages some psychrophilic and psychrotrophic (low-temperature thriving) competing organisms from getting a fast and early foothold before the EM organisms can establish dominance. Therefore, temperature remains an important consideration in making large batches of AEM, and all the moreso if you are employing other somewhat risky shortcut measures, such as:

- using only unpasteurized animal feed-grade molasses, which contains far more "wild" competing organisms; this tactic is not too risky so long as other guidelines are observed, and unpasteurized molasses can even be beneficial at warmer temperatures because of the wild helper microbes which it can introduce. However, at cooler temperatures, matters become a bit more critical.
- trying to get away with using less than one part of EM for every one part of molasses. For example, some local organic farming consultants whom I know (who shall remain un-named) often try to start a 55 gallon barrel of AEM using 2.75 gallons of unpasteurized feed-grade blackstrap molasses and only a pint or two of EM, which is rather suicidal even if startup brewing temperatures are kept high, since the ratio of EM to molasses is not 1 to 1, but rather on the order of 1 to 38 (ouch!)

Ultimately, it is often possible, if all the other guidelines for good brewing are followed, to successfully brew AEM in unheated buildings which are at temperatures of 40 F or possibly even a bit lower; the guidelines for optimizing all this are listed below.

First, however, while we are talking about cold-room or cold-weather brewing, a major hint: batches of AEM and brew generates some degree of heat during the most active phases of fermentation, which are usually the first 6 to 8 days, and this heat alone can easily raise the temperature of the liquid by at least 4 degrees F over ambient, and even farther for larger batches of brew -- such as 55 gallon barrels -- due to the high caloric

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mass (aka thermal mass) of the large volume of liquid. And, let me again point out that it is amazingly easy and inexpensive to keep a large batch (e.g. a 55 gallon barrel) of AEM quite warm – with just a bit of warm water to start, plus a tad of insulation and a tad of heat -- even in 40 degree F ambient air temperature for at least the first three to five days of its brewing life, which is by far the most important time period.

So, I will first offer the ways in which a 55 gallon barrel may be kept quite warm, at least for long enough for the pH to drop to below 3.8 (or even lower), and later in this section, I will offer the guidelines for safe brewing of batches of high-quality AEM in cooler settings even if precautions are not taken to keep them warm for the first few days.

Here are some hints and comments on how to keep things warm when brewing AEM in large containers (55 gallon barrels, etc.) in unheated settings, as it is amazingly cheap and easy to insulate a 55 gallon barrel (you may scale these recommendations for smaller or larger containers); here goes:

- first, let us deal with the top and bottom of the barrel: simply cutting two squares of rigid foam foil-backed wall 1/2" thick or 5/8" thick insulation (costs about \$10 at Home Depot for a 4'x8' rigid panel large enough for two barrels), and placing one square under the barrel and one square on top of it will provide a tremendous level of insulation for the top and bottom, reducing heat loss drastically (for about a \$4 expenditure.)
- next: insulating the round circumference of the barrel. For about \$16, you can purchase a 25 foot long and 18 inch wide roll of foil/foam-bubble/foil 1/4" thick flexible HVAC duct insulation at a home supply store, along with a roll of duct tape for about \$2. The roll of foil/foam/foil insulation, when wrapped (and taped in place) around the barrel circumference, will more than cover the entire barrel.
- for even further insulation efficiency, place the bottom square of foam on a piece of plywood or an old pallet or even an old rubber mat, so that the bottom square does not sit directly on a cold dirt or concrete floor.
- for even further insulation efficiency, after you have filled the barrel, mixed and stirred all the ingredients, and closed the top bung hole, and after you have placed the top square of insulating foam in place, you can throw a triple-folded old tarp over the whole thing to add one more layer of insulation. You can even throw an old blanket or quilt over that for even greater insulation capability.
- consider that it is amazingly simple and cheap to heat a 55 gallon barrel (already insulated per notes above). Simply purchase a 16 watt (about \$19) or 25 watt flat terrarium heater (about \$24) and slip it between the bottom of the barrel and the top of the rigid foil-backed foam square.

Finally, here are guidelines for brewing AEM in large quantities (55 gallon barrels, 1 ton totes, etc.) in unheated settings such as open porches or barns or sheds:

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- especially if ambient air temperatures are below 65 F, try to use at least some minimal methods of insulating and heating the barrel, as described in the section above. However, if you cannot do so, never fear... continue reading below!
- if at all possible, do not fill the barrel with cold water when mixing your brew. Rather, fill it with hot water, running even as hot as 125F or more, drawn from your bathtub or a mop sink faucet and carried to the barrel in buckets, or via a hose from the outlet on your hot water heater. Starting the AEM with hot water gets it off to a roaring start, and it will take days for that heat to fully dissipate into the environment (particularly if the barrel is insulated) thus keeping your batch of AEM toasty-warm for the first 3-4 days. Hint: when using real hot water, add most of the water first, then add the molasses and any other ancillary ingredients, and then lastly add the EM culture inoculant.
- if the weather is cold, make sure that the bucket of blackstrap molasses has been allowed to sit in your warm kitchen for a few days to warm up to at least room temperature before trying to use it for making AEM. That way, you are using molasses which is at a temperature of at least 70F for starting.
- much as noted above, especially for cool brewing temperatures, be sure to use at least one part of EM per one part of blackstrap molasses. Using less than a 1:1 ratio is a sure recipe for failure when brewing at cooler temperatures, or with unpasteurized feed-grade molasses. Better, as disclosed in a section above which offered hints for making extremely high-quality batches of AEM or brew, consider employing a 1.5 to 1 or even 2 to 1 ratio of EM culture to molasses if you know your batch is getting off to a rather cold start.
- since your batch may be getting off to a far less than optimal start due to the cold temperatures, please consider employing some or all of the ancillary ingredients and techniques listed in the earlier section on how to brew extremely high-quality batches of AEM or brew. Some of these measures and ancillary ingredients, may – in the case of a cold-start batch which must then ferment at cold temperatures – make the difference between success and failure of your batch.

Some Tales of Experiences with Cold-Temperature Brewing

Much as I have recounted in various forums in the past, I have followed these guidelines myself when brewing large batches of AEM (1:1:15 ratio) in a 55 gallon barrel on an unheated screened porch during a week in early spring when the average porch temperature was 52F. The barrel was insulated per notes above, and was heated with one 16 watt terrarium heater under its bottom. Using the methods outlined above, by the time I had finished filling the barrel, mixing ingredients, and closing it, the temperature of the contents was about 102 F. Over the next day, the temperature dropped slowly to about 98F and within less than 24 hours from start, the pH had dropped to 3.9. By 48 hours from start, the barrel temperature was 97.3F, and pH had dropped to 3.7. By the end of 5 days from start, the temperature had dropped to about 93F and the pH had dropped to below 3.6. Even though the AEM was now well in the "safe" zone, I then allowed it to ferment for another month or longer while I made at least minimal effort to keep the temperature from sliding downward too fast, although the temperature of the

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contents had dropped to 78F within 2.5 weeks, and then to below 70 F by the end of the third week. I continued to allow the batch to ferment at ambient temperatures – by then in the mid 60 degree F range, going up almost to 70 degrees F, for another several months. The AEM from that barrel was still very potent over a year after starting brewing, despite storage throughout winter on an unheated porch.

I performed a similar experiment, starting a second barrel next to the first a few days later, again in 52F average air temperatures, but the second barrel was only minimally insulated (not much insulation or effort at all), and not heated at all by any means. Due to some errors on my part (I used only warm water instead of hot water...), the starting temperature of the batch of AEM after all mixing was done was only about 99F. The contents of the barrel followed much the same fermenting and pH curve as shown above, only running about 24 hours slower to get to each pH way-point from starting date. Again, the average porch temperature during this run was 52 F. The contents of this second barrel are still quite excellent over one year later, and I am still using the AEM on a daily basis both for utility purposes and even in my kitchen for cooking, for soaking frozen berries, etc.

On the other hand, it is also entirely possible to make mistakes and produce a bad batch at low temperatures if you do not use means to insulate the barrels and/or do not follow the other guidelines above. In late November of 2003, I tried brewing two 55 gallon batches of a wet EM-fermented grain scrap bokashi – for eventual use in feeding to my chickens and geese -- in a very cold basement (39F) in minimally insulated, unheated barrels using 68 F water for starting, dirty very aged, bubbly and moldy feed-grade molasses, to ferment moldy dusty grain scrap. By the way, when mixing up the liquid to be mixed with the grain, I did not employ the standard 1:1:100 mix recommended by many EM culture vendors. Rather, I used a mix of about 1:1:15, although I did use the liquid to soak the grains immediately after mixing, as recommended by most vendors in their instructions for making bokashi. And, in one more deviation from what most EM culture vendors recommend in their instructions for making bokashi, I did not add only enough liquid to achieve about 30% moisture, but rather, based upon my prior experience, added quite a bit more of the 1:1:15 “AEM” liquid to the grains, raising moisture level to about 55%. The batches were painfully slow. They did not fail, but it took the contents of the two barrels seven months of fermentation at average basement temperatures of 44 F to finally reach the stage where they looked like, felt like, smelled like and behaved like true EM-fermented grain scrap.

A Brief Discussion of Light Exposure

When I first entered the EM world, I was sternly warned by staffers at three different EM vendors in the USA to avoid exposing fermenting EM batches to light; I was told that this would somehow damage the batch, and could even destroy it, because supposedly the phototrophic PNSB microbes – stimulated by the exposure to light -- would consume all the other microbes and thus destroy the culture. However, as time passed and I played with various types of batches and various degrees of light exposure, and also heard interesting tales from users in Asia who often brewed batches successfully in moderate light and in clear bottles on windowsills, I came to a number of realizations, some of which I will elucidate below:

- All batches can be improved to at least some degree by exposure to at least modest amounts of light during fermentation.

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- Even indirect sunlight, such as the light levels found on many windowsills, is helpful during fermentation.
- Light exposure stimulates growth of the phototrophic organisms, yielding greater antioxidative, regenerative and syntropic activity.
- To be effective, light exposure should be for at least 5 to 8 hours per day, if not longer, and 24 hours per day is even better.
- Optimal spans of light exposure for simple EM/molasses/water batches during fermentation may range from 3 weeks to over one month.
- Optimal spans of light exposure for complex batches which include levels of molasses higher than 5% and also include at least several additives can be up to 2 to 3 months.
- Even a bit of light exposure will usually be more helpful than none.
- I have yet to find a batch which was not helped or would be harmed by at least moderate light exposure.
- A few folks have told me they wished to take their batches out of the hotbox each day and place them in sunlight, returning them to the hotbox as the daylight fades. This is not harmful, provided that the temperature of the liquid does not rise above about 115 F during light exposure. And, any temperature fluctuation of the liquid in the batch due to daily shutting between hotbox and sunlight should be harmless if less than about 20 degrees. Bear in mind that the temperature of the liquid will not shift rapidly, due to its caloric mass, aka reserve effect, and, the larger the batch, the slower and less extreme will be any such shifts in temperature of the liquid. However, all this shuttling of fermenting vessels sounds like too much work to me; I would personally simply choose to install a fluorescent light source in the hotbox.
- If your primary intent for a batch is use as a microbial inoculant culture, then avoid strong light exposure for more than a week or two during fermentation.
- All batches, once fermentation is largely complete, should ideally be stored in a cool, dark place for maximal storage lifetime. Light exposure at this stage could reawaken bacterial activity and possibly shorten lifetime of batch.
- The blue plastic bottles in which high-end spring water is sold do not pass enough light in the important red/orange/purple range to be useful; light transmission of the plastic walls at these desirable wavelengths is often only about 18% or less.
- A following section will offer detailed guidelines for making very High-Light batches, but it bears repeating that almost any batch will be improved by at least some moderate light exposure, even if only occasional.

Brewing High-Light (aka HL) Versions of AEM or Brews

Much as recounted in the *Glossary*, a High-Light (aka HL) version of AEM or brew is one which has been specially formulated, handled and processed to yield a version high in the reddish-purple PNSB microbes, and thus very high in antioxidative, syntropic, regenerative substances and energies; higher than in batches made in low light conditions or dark conditions.

Process

There is little change in the formula or process, but for the following points:

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- You may wish to add some type of fish emulsion (for AEM not intended for ingestion by humans or animals) or fish paste or shrimp paste (if intended for ingestion by humans.)
- The other recommended ancillary ingredients such as molybdenum, minerals, bentonite clays, etc. (listed elsewhere in this book) are also quite helpful in this formulation.
- Expose batch to strong light for 12 to 24 hours per day (notes below), for from perhaps 2 weeks to as long as 5 to 8 weeks or even longer. I expose some long-fermentation length batches to moderate or strong light for up to 2 or 3 months.
- Of course, since the batch must be exposed to light, you must use a transparent or at least a translucent container which passes appreciable amounts (at least 35%) of light.
- The blue plastic bottles in which high-end spring water is sold do not pass enough light in the important red/orange/purple range to be useful; light transmission of the plastic walls at these desirable wavelengths is often only about 18% or less.
- Due to the incredible inefficiency of incandescent bulbs, and the excessive heat which they give off, I usually recommend using only fluorescent lamps as the lighting source – one good option is the compact screw-base fluorescent lamps sold as direct replacements for incandescent lamp bulbs.

Basically, within the constraints just discussed, you would mix up a batch of AEM or brew as you normally would and start fermentation in a hotbox. However, starting immediately, or perhaps waiting until after pH has dropped to below 3.7, you will expose the batch to strong light, usually about 40 to 80 watts of focused fluorescent light, or 5 times that amount of incandescent light, taking precautions in the latter case to prevent fire and to prevent overheating the brew from the heat. Light exposure may be for 24 hours a day, or may be periodic, for perhaps 12 to 14 hours of each day, with off time at night. I usually use 24-hour exposure to light, and I also find that you can often shorten fermentation time somewhat using this method. I usually start light exposure as soon as I start fermentation, but some purists in the EM world have insisted that too much light in early stages could result in the phototrophic PNSB organisms becoming so active that they “eat up” all the other microbes, such as the yeast and LAB. Frankly, I have never seen this happen.

These HL brews will often turn out to be redder than normal low-light brews, but, due to limitations upon protein-rich foods available, the brew will not develop a deep brilliant red color (as often happens with High Red versions), and if it does, that rich coloring cannot last for long, due to the limitations on protein sources in the brew and also the fully anaerobic nature of the brew.

Brewing High-Red (aka HR) Versions of AEM or Brews

High-Red is sometimes also known as High-Purple version. This is an extremely advanced and somewhat experimental method, and I strongly recommend not trying it until you have already successfully brewed a number of batches of high-quality AEM using advanced methods for achieving high-quality batches. As related in the Glossary, a High-Red (aka HR) version of AEM is one which has been specially handled and processed to yield a version extremely high in the reddish-purple PNSB microbes, even

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far higher than the High-Light (HL) versions and thus extremely very high in antioxidative, syntropic, regenerative substances and energies.

Usually, High-Red techniques are used only to produce batches of AEM which are **NOT INTENDED** for ingestion by humans or animals, since, by necessity, some of the ingredients are not necessarily suited for ingestion by humans or animals. And, in any case, the microbial spectra may be so wide as to cause some interesting and possibly undesirable effects! Moreover, due to the above factors plus short lifetime of the High-Red components, HR techniques are usually only worth the effort when making batches of AEM intended for specific deodorizing or antioxidative applications in agriculture, waste management or industry.

However, due to the incredibly high levels of PNSB organisms swimming in the liquid and their high levels of activity and high appetites, such versions must often either be used within 20 days after pH has stabilized below 3.6, or must be maintained via special aerobic dynamic techniques which will be outlined to some degree in this section. Usually these advanced and somewhat experimental High-Red techniques are applied only to AEM which is not intended to be ingested by humans or animals, but, with some care and some modifications of the process, these methods could be used to make short-lived EM brews for human or animal ingestion.

Some hints and guidelines on producing High-Red batches of AEM

Some guidelines and brief instructions follow. Instructions cannot be more extensive nor complete, as this is a highly experimental method which depends more upon art, intuition and experience (aka learning curve) than any exact science or recipe. Here are some hints:

- Since the AEM, once you have dispensed a quantity of it from the master continuous breeder fermenter, will likely only retain its high-red state for a few weeks at most (after removal from fermenter), you will wish to make HR AEM only when you need a relatively short-lifetime (a few weeks) version of AEM extremely high in the reddish-purple PNSB microbes, even far higher than the High-Light (HL) versions and thus extremely very high in antioxidative, syntropic, regenerative substances and energies.
- Remember, do not attempt HR methods until and unless you have already successfully brewed a number of batches of high-quality AEM using advanced methods for achieving high-quality batches.
- Remember that HR techniques are normally used only to produce batches of AEM NOT INTENDED for ingestion by humans or animals, since, by necessity, some of the ingredients are not necessarily suited for ingestion by humans or animals.
- Remember that this may be the one AEM recipe in this book which is not largely anaerobic and where large surface area of liquid plus exposure of surface to air are important. Rather, a semi-aerobic condition, especially in the upper levels of the liquid, is important to maintain certain critical microbes, microbes which are not listed on any EM microbial culture label in the world. These microbes then help to create ideal conditions for the phototrophic PNSB microbes.
- Just as when producing certain other versions (such as high ormus content) of AEM or brew, it appears that the diversity of the EM-like microbial culture is very

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important: the greater the range and diversity of microbes present, and the more wild organisms present, the more powerful the batch and the greater the proliferation of the PNSBs under these unique breeder fermenter conditions. However, as noted earlier, it can be important to introduce many of the wild microbes only after pH has dropped to at least 3.8 and ORP has fallen below about -200, and where rH score has fallen below about 8.5.

- Please understand that the following method is unique in that rather than producing one fixed batch of AEM at finish, the fermentation container becomes more of a continuous breeder reactor, from which – after a certain stage has been reached -- you may draw up to a half-gallon per day of HR AEM, and add warm water to replenish liquid to normal level, and this process may continue for many months, if not longer.
- When removing HR AEM for use, or when adding more water, DO NOT take precautions to keep things anaerobic; rather, feel free to splash pour and make lots of bubbles!
- If and when you have mastered the basic art, these principles and the process may be scaled to almost any size container, provided that the container chosen offers a relatively large surface area of liquid compared to depth of liquid; we always want, for this application, a low, squat and wide container rather than a tall thin container.
- Please understand that once certain benchmark ORP, pH and rH scores (described below) have been reached, it is important to maintain the fermenter in a dynamic state, and to remove liquid at least every other day and to replenish levels with warm water each time you do so. This is a dynamic fermenter, and the viability of the AEM depends in part upon periodic removal of AEM and addition of warm water.

Again, as noted above, please bear in mind that the following method is unique in the semi-aerobic nature of the process, and the fact that rather than producing one fixed-size batch of AEM, the fermentation container becomes more of a continuous breeder reactor which may run successfully for many months, and from which – after a certain stage has been reached -- you may draw up to a half-gallon per day of HR AEM, and add warm water to replenish liquid to normal level.

Now, here are some steps to guide you, but your own art, improvisation, intuition and experimentation are essential:

1. Find a large dishpan (most are in the 2 gallon to 4 gallon capacity range), plastic storage container or other container where the ratio of surface area to depth or liquid is fairly high at least two to one, and perhaps three to one. In other words, we want a container which offers a relatively large surface area of liquid compared to depth of liquid; we always want, for this application, a low, squat and wide container rather than a tall thin container. And so, no PET soda bottles, as they are tall and thin and offer very small surface area of liquid at top, and worse, the neck of the bottle is small, tending to restrict air access.
2. Unless brewing in a room totally free of flies, fruit flies and ants, you may wish to find a means – such as a screen or screen cloth top -- to cover the container top to exclude insects, while allowing most light and air to reach surface of liquid in container. I often choose simply not to worry about this matter, and opt not to use

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any kind of screen top, as prevention of insect intrusion is only a matter of aesthetics – insects will not harm the quality of the HR AEM. Likewise, if your cat or a stray chicken occasionally takes a sip of the still-fermenting batch, no harm done to the batch of HR AEM.

3. Find a place to keep the container once the batch has been mixed, and where there is strong overhead lighting available for at least 16 hours per day. Make sure that the site is one where the container will not be disturbed or sloshed, causing spillage, or where the liquid may become accidentally contaminated with other substances or chemicals.
4. Put container in position, bearing in mind considerations above.
5. Fill container halfway with warm water at about 110 F.
6. Add about 5% (about 1:20 by volume, or about 6 ounces per gallon) of unpasteurized animal feed-grade blackstrap molasses
7. Add about 12% to 15% (by volume) of a good first-generation batch of high-quality AEM which was fermented for at least 3 months, preferably aged far longer
8. Add 2 tablespoons per gallon of bran.
9. Add 2 teaspoons per gallon of sea salt
10. Add 3 tablespoons per gallon of fish emulsion (unpasteurized, smelly type)
11. Add 2 tablespoons of Azomite rock dust per gallon
12. Add 1 teaspoon of paramagnetic rock dust per gallon
13. Add 1 tablespoon of granulated kelp per gallon
14. Add EM ceramic powder at rate of ½ teaspoon per gallon.
15. Add one ounce per gallon of Tabasco brand hot sauce or some other naturally-fermented hot sauce. We are adding this, same as with the bran, unpasteurized molasses, kelp and fish emulsion, to gain needed wild microbes.
16. (Very important step!) Add all of the sediment and dregs from the bottom of the bucket of two 5 or 6.5 gallon buckets of long-fermentation time (over 3 to 4 months) HR AEM which was brewed with bran, sea salt, fish emulsion, rock dust, paramagnetic rock dust and liquid colloidal prehistoric minerals (or better, even more ingredients!) This is a very important step, as this serves as a seed.
17. Add warm water to bring liquid level to within about 2 inches of top of container. Adjust this to suit your own needs and concerns about spillage and splashes.
18. Stir well for three minutes. Measure and record pH and ORP
19. Let sit at ambient temperatures of at least 74 degrees F (as high as 94 F is okay, low 80 F range is optimal)
20. Make sure fairly strong lighting is provided (e.g. 50 to 80 watts of overhead fluorescent lighting.)
21. Stir each day, agitating surface to allow some air to mix with the liquid.
22. Measure and record pH and ORP each day. pH should drop fairly rapidly to below 3.9, and ORP should start to drop well below –200 mv. (rH at 8.0 or lower), finally reaching at least –420 mv or lower, where the rH score should be below 2.0, or even below 1.0
23. Within eleven days, pH should have dropped to below 3.8, and ORP should have reached at least –380 mv., if not lower, yielding an rH score of about 1.6.
24. When this level is reached, do the following:
25. add one ounce per gallon of fecal material from chickens which have consistently been fed EM (in food and water) and organic diets for at least the past five months. Feces from grass-fed (pastured) goat, cow or buffalo okay if chicken

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- poop not available; better if these animals were EM-fed. Repeat process once per month.
26. Add one small handful of dried Sphagnum Peat Moss (garden supply store) or similar peat per 3-5 gallons. Repeat process once every 2-3 months.
 27. start adding one ounce of blackstrap molasses per gallon per day and stir.
 28. start adding a squirt (about a teaspoon to a tablespoon) of fish emulsion every third day
 29. Once ancillary ingredients have been added, and once pH has dropped to at least 3.8 or below and ORP is at -400 or below, yielding an rH score below 2.0, the liquid should appear fairly strongly reddish or purple-colored within days. Once this reddish color has been reached, start removing up to one-half gallon per day of HR AEM and replenishing levels with warm water. This process of periodic removal of HR AEM and addition of warm water is essential, and should be done at least once every 3 days from this point onward --- it aerates the liquid and starts to dilute it, allowing you to keep adding more molasses and fish emulsion (above) on schedule.
 30. Some batches will succeed, while some may fail to produce the strong red color. One common cause for failure to produce strong red color is too high a concentration of nutrients, so if liquid continues to appear too dark or too brown, draw off half the volume and replenish with water.
 31. If all went well, you should now have a continuous breeder fermenter, from which you may remove from one pint to one half-gallon or more (if container is size of normal dishpan) per day of HR AEM for use.
 32. A well-running continuous breeder fermenter set up in a dish pan-sized container (about 3 to 4 gallons in size), if well-maintained, may run for up to six months or longer, producing up to a half-gallon or more per day of HR version AEM, while you add warm water to replenish liquid levels and keep adding other ingredients periodically as recommended above.
 33. Do NOT be afraid of introducing wild and stray microbes to the fermenter once pH has dropped below 3.8 and ORP is down around -380 or below (rH score below 3.0) – a good part of the heart of this technology is the plethora of “wild” helper organisms which support the primary EM organisms, and which primarily feed and nurture the phototrophic PNSB organisms.
 34. If batch seems to be stuck and the conditions described (pH, ORP, color, etc.) do not arise, then add more chicken poop, and, if that fails, add a tablespoon of soil taken from about 3 inches below soil surface from a forested area or a meadow.
 35. If batch is still stuck, try aerating for 5 minutes per day every two days, with an aquarium air pump and air stone.
 36. Remember, this is a dynamic fermenter, and the viability of the AEM depends in part upon periodic removal of AEM and addition of warm water.
 37. Once a quantity of HR AEM has been withdrawn for use, try to store this HR AEM in at least partly aerobic conditions, where some air hits the surface of the liquid. Liquid must be used within 2-3 weeks of drawing from the breeder fermenter, before the high volume of PNSB organisms start to die off from lack of food and then drop to the bottom.
 38. Yes, quantities of the HR AEM liquid may be frozen and stored in a Nalgene or other high-quality plastic bottle in a freezer as a booster starter culture for later batches of HR AEM.

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39. The volume of PNSB may be so high that if some finished HR AEM is stored in a 2 liter PET soda bottle for at least 8 weeks, long enough to allow most of the PNSB organisms to die off and fall to the bottom, the red layer of sediment formed by dead PNSB organisms may easily fill the bottle to a depth of one to three inches.

Ormus elements and ormus-like effects

I assume here that you are either already familiar with ormus elements, or that you have read the entry on ormus in the *Glossary* section of Part I. Herein is a summary of what I have observed about ormus elements occurring in EM batches, including ways to optimize their occurrence.

A number of observers, myself included, have noticed that EM microbes tend -- under anaerobic fermentation -- to produce very significant quantities of ormus elements from the "normal" forms of such elements present in the ingredients. This observation is hardly surprising -- a number of folks in the ormus field have postulated that the way in which ormus elements may be created in nature is likely primarily via microbial action of anaerobic microbes deep in soil and rock strata, aka microbial transmutation. And, since the microbes in EM are all soil organisms and pond organisms which date well back to the Paleolithic era and earlier, and these EM organisms, particularly the phototrophic PNSB organisms, have already been linked to a number of near-magical transmutational phenomena, where they are reputed to transmute one element to another, or even transmute certain radioactive elements to other non-radioactive elements.

To maximize formation of ormus elements, you may wish to follow or tinker with the following guidelines:

- Keep volume of sugar sources (primarily blackstrap molasses) at or below 7% (about 1:16 ratio by volume). In fact, if you are just starting out in making batches of high-ormus content, I suggest you start with a 5% (~1:20 ratio by volume) or 6% concentration of blackstrap molasses.
- Try to stick to blackstrap molasses as your primary or sole sugar source, and, with the sole exception of some experiments with grape juice concentrate as an additive, it is likely best to avoid most other sugar sources if your primary goal is only maximal ormus production.
- If your primary goal is only maximal ormus production, then try to keep fermentation temperatures between 87 F and 99 F.
- Add from 2 tbs to 7 tbs per gallon of Azomite rock dust, which already seems to contain some ormus activity anyway. In fact, if you can get hold of some Azomite rock dust mined prior to 1996, this is even far better. A number of folks -- myself included -- seem to feel that this older material is more powerful; apparently the folks who mine Azomite seem to have hit a slightly different vein sometime in 1996 and the quality of the bentonite clay seems to have changed in some subtle ways since then. I am lucky to have some of the early Azomite clay here from a bag I had ordered in the early 1990s.
- Add about 1 teaspoon or less per gallon of Pascalite clay
- Add about 1 teaspoon per gallon of sea salt
- Add about 1 teaspoon -- or even more -- of paramagnetic rock dust or sand (if sand or gravel, be sure to filter or otherwise separate and exclude sediment prior

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to bottling or drinking...), preferably a basaltic rock dust or sand. This is an important step,

- Consider adding about 500 mcg to 3 mg (or more, if you can afford it!) of molybdenum (see Appendix C) per gallon; this will enable the PNSB organisms to work more efficiently.
- Consider adding from 1 tablespoon (1/2 ounce) to 5 ounces per gallon of prehistoric colloidal liquid minerals from humic shale – I recommend Enzymes International Coenzyme Minerals (see Appendix C)
- Ormus content is very much dependent -- to a far greater degree than other properties of AEM or brews such as syntropic, antioxidative or deodorizing powers – upon the exact microbial makeup of the EM microbial inoculant culture used, and it is almost always true that a “broader” or “dirtier” EM culture, one containing a wider range of organisms – will produce far stronger ormus effects. A few ideas on how to broaden the culture are given in some bullet items below. See also the section on High-Red (HR) versions of AEM for even more ideas on how to broaden culture.
- Due to the importance of breadth and complexity of microbial culture, I personally feel that there is indeed a notable difference between brands of EM microbial inoculant culture and even between different batches from the same producer.
- To broaden microbial spectrum available, consider adding fish paste or shrimp paste and fish powder, or all three. These high-protein foodstuffs will also feed the PNSB organisms, allowing them to flourish more strongly – this is important, as I feel that it is primarily the PNSB organisms which are responsible for creating ormus effects.
- Again to broaden microbial spectra, consider using at least a bit of unpasteurized blackstrap molasses.
- Consider aerating the batch for the first 10 hours – this will help to activate many of the more minor and lesser-known aerobic organisms in EM which are nonetheless essential to its efficacy, particularly in producing ormus effects. See section on aeration for more hints on how to do this.
- You will likely want to use relatively long fermentation times of at least 6 weeks or longer, but feel free to try samples of your batch at all stages, once pH has dropped to below 3.7, in order to allow you to assess your own sense of ormus content and “punch” at various stages.
- Once you have made a few high-ormus batches, consider making one as a High-Light (aka HL) version, per instructions given in the relevant section of this book to allow you to ascertain the effects of lighting upon ormus content and overall “punch”. My own sense is that High-Light brewing seems to increase ormus content, but my sense may be vulnerable to other variables such as antioxidative, syntropic and energy-related properties.

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Advanced Topics – Culture, Testing, etc.

This section will offer some advanced information about EM cultures, testing batches of EM, AEM or brews, and various testing methods. However, much of the material in this section, particularly that in the sections entitled:

- *Is it possible to make EM culture from scratch?*
- *Testing for presence of phototrophic PNSB organisms*

Is technically well outside of the scope of this book, which is devoted only to methods and hints for brewing high-quality batches of AEM and brews, and thus these “extra-curricular” topics will be treated only briefly. Any discussion of these matters which pretends to be even halfway complete would easily take up a volume almost the size of this book.

ORP and rH Score (aka rH2 Score)

It is not my intent to get into a lengthy treatise in this book on ORP and relative hydrogen score (aka rH or rH2), which is computed from ORP and pH. Any discussion which follows assumes that you have read the basic definitions of terms in the *Glossary* section of Part I. First, let me state that it is NOT necessary to own an ORP meter in order to brew good or even very high quality batches of AEM or EM brews. Yes, having an ORP meter available can help, but it is not essential.

Computing rH

There are a number of slightly variant formulas in circulation for computing rH score from pH and ORP measures. I strongly prefer the following formula, which is essentially the formula used by both Patrick Flanagan, the researcher and discoverer of Megahydrin (aka MegaH), as well as by many organic farming soil experts:

$$rH = ((ORP + 200) / 30) + (2 * pH)$$

Here are a few samples of pH and ORP measures and the resultant rH score using this formula:

pH = 3.63, ORP = -410, rH = 0.26
pH = 3.70, ORP = -110, rH = 10.4
pH = 3.70, ORP = +050, rH = 15.73
pH = 3.30, ORP = +100, rH = 16.6

It is very easy to program this formula into an Excel spreadsheet to allow it to perform the math for you, allowing you to simply enter values for observed ORP and pH, and to see the resultant rH score instantly.

ORP and rH Related to Brewing

Briefly, here are some essentials about ORP as it relates to brewing batches of AEM or brews:

- It is not necessary to own and use an ORP meter to make high-quality batches of AEM or brew, but an ORP meter can help. It is not essential, however, unless you

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are interested in using some of the more advanced methods and processes described in this book.

- It is not necessary to compute rH score in order to make high-quality batches of AEM or brew, unless you are interested in using some of the more advanced methods and processes described in this book. On the other hand ORP and rH scores can help you to understand what is going on in your batches of AEM or brew. However, to compute rH, you will need to own a digital pH meter (although pH paper can be pressed into service as a rough indicator) and a digital ORP meter.
- For care, maintenance or cleaning of ORP or pH probes, please see Appendix M.
- For guidelines on use of ORP or pH probes, please see appropriate notes Appendix M
- In general, there will always be a stage early in the fermentation cycle for any batch of AEM or brew where ORP will drop to below -200 , and finally, to below -410 often yielding rH scores at this time of one or lower, and sometimes as low as zero, indicating maximal reducing or antioxidative powers. This extremely low ORP and rH score are a signature of the presence of large amounts of some simple very lightweight hydrogen antioxidants. Eventually, these lightweight antioxidants will be incorporated by microbial action into larger, heavier (higher molecular weight) and more complex biochemical antioxidants, which will not influence ORP or rH score nearly as strongly.
- The very low dip in ORP and rH scores will often happen as the pH falls through the window between 4.3 and 3.7, and this low dip – indicating maximal antioxidant activity of lightweight hydrogen antioxidants – may occur in the first 24 hours or at least sometime during the first 5 days of the lifetime of a batch.
- This very low dip in scores – indicating maximal antioxidant activity of lightweight hydrogen antioxidants – may last for as short a time as four hours or as long a time as 14 days, dependent upon percentage of sugar sources by volume, other helper microbes present (or absent), fermentation temperature, and other factors. In fact, in the highly specialized partly-aerobic continuous breeder fermenter used for making High-Red (aka HR) AEM (described elsewhere in this book), this stage may last for anywhere from 20 days to 6 months or longer. However, for anaerobic batches of AEM or brew, this stage is often relatively short in duration, and easy to miss unless you are taking frequent measurements.
- A finished batch of AEM or brew, depending upon exact formula, ingredients and the percentage of sugar sources by volume, will usually exhibit an ORP of below 110 mv at a pH of 3.5 or below, and an rH score of 17.3 or lower. In fact, dependent again on the afore-named factors, the ORP may be as low as -150 and the resultant rH score may be as low as 8.0.
- A good batch of EM microbial culture will not only exhibit a pH below 3.5, but also an ORP below about 130, and definitely below about 160. If it has been exposed to air for long, then these ORP values may be somewhat higher.

Is it possible to make EM culture from scratch?

I receive several letters or calls each year asking me if it is possible to create an effective EM-like culture from scratch, using either:

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- microbial cultures from a culture bank such as ATCC (American Type Culture Collection)
- microbes selectively cultured from various wild settings
- a combination of both methods

Frankly, beyond a cursory look at the matter, any serious treatment of such a topic is well beyond the scope and range of this book, and indeed, would deserve to be treated in a specialized book (or at least a mini-book) dedicated to that topic. However, here, below, is a very brief overview of the matter.

Any effective EM culture is a complex synergistic and metabiotic consortium consisting of at least 50 to 60 microbes, only a few of which are the microbes (yeast, LAB, phototrophic PNSB) listed officially on labels or in other supporting documentation. So, making an effective EM-like culture is not so simple as purchasing suitable species of each of the above-listed classes of microbes from a culture bank and mixing them with some molasses or other foodstuffs. Rather, the process by which they are grown and then combined is critical, as is the concomitant introduction at various stages of appropriate helper microbes.

Over time, I have received samples here at my labs of EM-like cultures from several parties who have claimed to produce the culture from scratch, using any of the sources (culture bank, wild or combination) listed above, and most samples seemed to be quite effective EM-like cultures. Of course, I have only the word of the suppliers as to how they created their culture. And, if any containers which they used had ever been used before for making good batches of AEM or other secondary EM products, or if they also used some EM ceramics in their batch, then there exists a reasonable chance that their batch may have been “contaminated” – albeit accidentally and unintentionally – with many of the needed organisms from that earlier “official” batch of EM or AEM.

Do EM-like cultures exist in the wild?

The answer to this question is that while each of the primary classes of organisms are well-represented in the wild, particularly in the following settings:

- On green leaves or other surfaces of wild plants
- Soil
- water and mud in ponds and lakes
- Water and mud in many swamps
- Water and mud in some streams

they often do not exist in quantities or a relationship necessary to produce an EM-like culture. Indeed, each class of organism is often found in nature in slightly different strata of the ecosphere or biosphere. My own research, largely in the literature, has led me to conclude that the liquid in the “pitchers” of many wild carnivorous pitcher plants, particularly members of the Sarracenia (Sarraceniaceae) family (found growing wild in many parts of the world, including many parts of North America, and including the USA), and likely members of similar families such as Nepenthaceae and Cephalotaceae, may be one likely place where at least most members of the typical EM culture may be found living in harmony. It is quite well-known that the liquid in the pitchers of such plants growing in the wild almost invariably contains extremely large numbers of PNSB phototrophic organisms, and also large numbers of various lactic acid bacteria (LAB).

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Obviously, this would be one place to start if someone wished to try to culture from wild sources.

There is also some evidence that the waters of some warm springs and some hot springs below about 120 F may contain both the requisite phototrophic organisms and even some LAB. It has also been suggested that the scales of many wild freshwater fish may also contain large amounts of the PNSB phototrophic organisms, and there exists evidence as well that the scales and skin of such fish may also contain some lactic acid bacteria as well as commensals which help to maintain an acidic environment for the skin of the fish.

Lastly, there is some good evidence that many traditional hot sauces, yogurts, kefir wines and traditional alcoholic drinks such as pulque which are not cultured and fermented with pure cultures, but rather with wild cultures, will contain not only various LAB but may likely contain numerous PNSB as well.

Any further treatment of this topic must be reserved for a dedicated specialized tract.

Testing for presence of phototrophic PNSB organisms

I am sometimes asked by correspondents how they may test for the presence of the phototrophic PNSB microbes in batches of EM, AEM, brews or in other EM secondary products. I will offer a quick overview below.

Standard microbiological cultures or plate tests

First, the average microbiological testing laboratory in the Western world (and also in much of Asia) will usually be hopelessly inept at culturing the phototrophic PNSB organisms from samples sent to them. This is due largely to three factors:

- Most are totally unfamiliar with PNSB and the specialized culturing techniques needed, and PNSB will not appear using standard aerobic plate or anaerobic plate methods, nor will many other specialized microbes.
- The PNSB phototrophic organisms are usually present in far lower concentrations in most batches of EM and AEM (with the exception of some HL and HR batches) than are the other microbes
- The unique nature of the synergistic metabiotic EM culture tends to “protect” or shield the PNSB organisms; this can shield them from detection via standard culture methods

Therefore, it is rather futile to ask any microbiological lab other than one with acknowledged and recognized expertise in culturing PNSB phototrophes to attempt to isolate or confirm the presence in samples of any of the PNSB.

DNA “fingerprinting”

Of course, if you are willing to spend far more money per sample than the relatively inexpensive price for culture-based tests, there are some specialized microbiology labs which can perform DNA fingerprinting to identify the DNA patterns unique to any species within the genera (plural of genus) of Rhodobacter, Rhodopseudomonas or Rhodospirillum. A related fingerprinting technology using analysis of unique RNA patterns from microbes is quickly evolving, and in this field the best known test is one called “riboprinting”, but I do not believe that any of the RNA-analysis fingerprinting

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methods can yet test for the PNSBs, simply because the appropriate “fingerprints” apparently have not been added to their databases yet.

Some easy and inexpensive alternatives

In light of the above considerations, I often suggest use of any of the following methods:

- Modified Winogradsky column
- Digital spectrophotometer to identify the absorption spectra of the bacteriochlorophylls and/or carotenoids present in PNSB

Each will be examined below:

Modified Winogradsky Column

One easy and inexpensive means to test for presence of phototrophic PNSB is to employ one or more modified Winogradsky columns exposed to strong light; it is quite easy to make a Winogradsky column with makeshift materials (there are also a zillion articles on web on how to make a Winogradsky column, which may be found via a search on Google for that term.) You may even choose to use test tubes as Winogradsky columns, open at top (or screened), and exposed to light. The presence of red or purple color in anaerobic middle and lower layers indicates presence of PNSB; color should develop within 4 weeks if conditions pretty good, and often far sooner. More detailed instructions appear below.

Details on making a Modified Winogradsky column

Here are more details and suggestions on how to use a modified Winogradsky column method to test a finished or nearly-finished batch of AEM, or even a batch of EM, for that matter. So, here goes with some suggested steps, and all quantities for additives depend upon size of the makeshift Winogradsky column which you are using and its volume of liquid -- if you are using a test tube (mounted vertically or on a slant in a test tube rack), as I often do, the volume is only an ounce (30 ml) or two ounces (60 ml), but if you are using a much larger transparent vertical tube or graduated cylinder, then the total volume may be as much as 500 ml or more. The quantities which I give are for a test tube holding under two ounces (60 ml.) of fluid:

- locate some type of clean clear (transparent) glass or plastic (e.g., Perspex) tube which may be mounted vertically or at a slant; the tube or cylinder must be sealed at bottom
- locate batch of EM or AEM to be tested
- pour off a bit of that batch, enough to fill the tube, into a temporary container
- mix that amount 1:2 (one part test batch, two parts water) with water to dilute it a bit
- add about 12 to 20 drops (about 2% to 3% by volume) of pasteurized food-grade blackstrap molasses
- add about 6 to 13 drops (about 1% to 2%) of pasteurized fish paste or shrimp paste (from Asian grocery/marketplace)
- mix and stir well, allowing some air bubbles to enter mixture
- mount tube or tubes vertically or at a slant not far from vertical
- pour some of this liquid into the tube(s) to within one inch of top
- leave top of tube(s) uncovered, exposed to air

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- place tube(s) under fluorescent light or sunlight, offering light at least 11 hours per day.
- do not shake or stir tube or contents
- do not cover tube surface to exclude air
- observe tube(s) over ensuing few weeks carefully, noting colors of each (vertical) region carefully each time. Digital photos made under fixed fluorescent light are even better method of objectively recording color changes.
- You know the rest -- look for red/purple color developing in the anaerobic regions of tube!

Very Quick and Dirty Modified Winogradsky Bucket

By the way, a far more quick and dirty modified Winogradsky column-like test may be done as described below; I often use this method to test batches of aged AEM which are over a year old:

- Find a clean 4 or 5 gallon white or light-colored plastic bucket which has never been used to store toxins, bleaches, EM or AEM
- Fill bucket with water to 2/3 mark.
- Add 18 ounces of AEM or EM to be tested
- Add 18 ounces of human food-grade (pasteurized) blackstrap molasses
- Add 1 tablespoon of sea salt
- (optional but helpful) Add 3 tablespoons human food-grade pasteurized fish paste or shrimp paste (see *Appendix C*)
- Stir.
- Fill with water to within about 3 inches of top.
- Leave top of bucket uncovered – it is important for sunlight to reach the liquid in the bucket
- Place bucket in a place outdoors (if average temperature above 75 F) which is exposed to strong sunlight daily, or in a protected place in a warm room indoors with exposure to strong overhead fluorescent light (at least 11 hours per day.)
- do not shake or stir bucket or contents after initial mixing
- do not cover bucket surface – it must be left exposed to air and overhead light
- observe liquid in bucket over ensuing few weeks carefully, noting colors over time. Digital photos made under fixed fluorescent light are even better method of objectively recording color changes.
- You know the rest -- look for red/purple color developing in the liquid! In my experience, the liquid will often turn quite a bright shade of red or purple when PNSB are present.

Best of all, when the batch has turned deep red or purple, and the pH is well below 3.7, not only is your test ended, but you now have an excellent variant of a High Light (HL) batch of AEM to use as you wish in your garden or on the farm!

Spectrophometry – absorption spectra of bacteriochlorophyll or carotenoids

Another, but more complex method is to use a good high-resolution digital spectrophotometer (at least near UV-visible-near IR range) to try to identify some of the various bacteriochlorophylls and commonly present in most PNSB -- a quick Google search will find you a list of such substances and their absorption spectra.

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Briefly, some of the carotenoids most commonly found in PNSB are lycopene, lycopenal, lycopanol, rhodopin, rhodopinal, rhodopinol, chloroxanthin, spheroidene, spheroidenone, okenone and the okenone series, anhydrorhodovibrin, rhodovibrin, violaxanthin, rhodobacterioxanthin and zeaxanthin. Luckily, blackstrap molasses does not contain significant quantities of any carotenoids, and thus any carotenoids present in your batch – and particularly if evidence of three or more is found – are excellent indicators of PNSB activity. Alternatively, you may choose to look for absorption spectra due to the bacteriochlorophylls present in the PNSB.

The Catch – Challenges and Guidelines

However, if this all has sounded relatively easy so far, here is the tougher part: using a digital spectrophotometer to test for absorption spectra of such above-mentioned substances in a sample of EM or AEM is not quite so easy nor simple as purchasing a \$5,000 or \$10,000 digital spectrophotometer along with some cuvettes (transparent glass or quartz sample holders which sits in the testing well) and then pouring a sample of the liquid to be tested into a cuvette and testing it; rather there are a number of prerequisites and preparatory steps which must be followed first to ensure reliable, accurate and meaningful results, and there are also some caveats which must be borne in mind, all which I will offer in bullet form to itemize the major challenges:

- Such an analysis will likely need to be done only with a sophisticated digital spectrophotometer offering at least near-UV, visible and near IR coverage, with accompanying PC software to adequately compute transmission and absorption spectra according to commonly-accepted international standards (in order to yield meaningful results and data.)
- The sample may likely need to be diluted with distilled water to allow optimal penetration of light from the light source.
- The bacteriochlorophylls present in PNSB are notoriously difficult to detect via absorption spectra, since they do not usually exhibit narrow and “tight” absorption peaks at very specific wavelengths, but rather tend to exhibit very broad absorption peaks over widths of 100 to 200 nm or more in the red and orange ranges. This is good for the PNSB, because it means that they can effectively utilize much of the light spectra present, but it makes it hard for us to isolate any particular “fingerprint” which will uniquely identify the presence of these bacteriochlorophylls.
- Any liquid (e.g., EM, AEM, brews) which contains molasses, even if it has been fermented, will pose special problems in analysis due to the broad-band “dark” absorption spectra across much of the visible and near-IR spectrum exhibited by the numerous anthocyanins, proanthocyanadins, phenolics, polyphenols and bioflavonoids which were originally present in molasses or were produced during by EM culture. These broad signatures can blur or obscure the signatures of other components unless these “contaminants” are first removed.
- Most good laboratory protocols for spectrophotometric analysis of absorption spectra of carotenoids or bacteriochlorophylls in a molasses culture base would demand that the sample first be purified, usually by repeated washings in various solvents, to remove many substances such as the above-mentioned anthocyanins, proanthocyanadins, polyphenols and bioflavonoids which are present due to their occurrence in molasses or due to formation during fermentation. Suggestions for such sample washing, cleaning and preparation

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procedures may be found in many advanced textbooks and journal articles on UV-vis-IR absorption spectrophotometry. It can take a very good and well-experienced spectrophotometric lab technician to effectively dilute, wash and clean a sample of EM or AEM to prepare it adequately for spectrophotometric analysis of absorption spectra.

Any further treatment of this topic must be reserved for a dedicated specialized tract.

Testing for Antioxidant Activity

It is not the purpose of this book to delve deeply into the topic of testing your finished batches for antioxidant activity, and, in fact, that topic will be covered in depth in an upcoming book on EM and health. However, a very brief orientation will be offered here, along with some suggestions on some antioxidant activity tests which you may commission at an outside independent antioxidant-testing laboratory.

Background Information on ORAC and other Broad Antioxidant Tests

For some basic information on ORAC and other broad tests of antioxidant activity, you may wish to see the page entitled *Technical Info: Antioxidants, Oxidative Stress, Lab Tests*, at:

www.antioxbrew.com/science-backqnd-test-results-1.html

ORAC and other Antioxidant Tests at Brunswick Labs

If you wish to have an independent testing laboratory test any of your batches for antioxidant activity, you may send a sample (at least 3 oz. per test) -- decanted anaerobically to a sealed and labeled leakproof plastic container -- to Brunswick Laboratories (website at www.brunswicklabs.com/) and ask them to test your sample for various types of antioxidant activity. An ORAC FL (hydrophilic) assay would cost \$200, or, for a more complete picture of antioxidant activity, you would order each of the following, as a package:

- ORAC FL hydrophilic for activity against the peroxy radical
- HORAC for activity against the hydroxyl radical

I believe the package price for the two tests is around \$525.

And, I would also suggest the following tests to gain an even broader picture of true antioxidant activity:

- SOD Activity Test – a test for antioxidant activity against the superoxide radical; it usually runs about \$200
- Total Phenolic Contents (about \$200)
- Total Anthocyanin Contents (about \$200)
- Another fun test might be the COQ10 activity test, it runs about \$250

If you also submit a sample of stock EM culture for tests as well, you can compare the results for your AEM of brew against the activity of the EM culture. Many batches of AEM and brews will yield far higher antioxidant scores than stock EM culture, simply because the former will often contain far more ingredients per ounce, in other words, they have a

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higher Specific Gravity (SG) and a higher Brix score, and so there will be more antioxidant activity per ounce than EM culture. Of course, any testing fees will apply to the EM sample as well, and so your overall charges will be doubled.

Contact Information for Brunswick Labs – Sending Samples

Brunswick Laboratories is located in Massachusetts in the USA.

Phone: 508-291-1830

e-mail address: info@brunswicklabs.com

website: www.brunswicklabs.com/

They offer their complete list of tests, services and pricing in a PDF file available for downloading via their website – download the **Ordering** file.

Note: If you plan to send samples to Brunswick, please contact them via phone first to arrange permission to ship, exact pricing, and to arrange payment!

Quick and Dirty Test -- Rust Removal

Rust, or iron oxide, is a product of oxidation, and the process is not only preventable in the presence of suitable antioxidants (aka reducing agents) but is also reversible in the presence of a suitable antioxidants. In other words, certain antioxidants which exhibit the appropriate antioxidant activity will remove rust and actually reverse the process, converting it back to the metallic form of iron (in a powdered or ionic form) again. While not all antioxidant supplements sold for human and animal use will exhibit this behavior, EM is quite effective at preventing and reversing rust.

For an article – accompanied by before and after photos of effects on rusty nails -- on experimental use of EM brews to remove rust from rusty nails, you may wish to see an the appropriate section of the webpage entitled *Technical Info: Antioxidants, Oxidative Stress, Lab Tests at:*

www.antioxbrew.com/science-backgnd-test-results-1.html

I have also written some stories on the same rust removal phenomena in the farming and agricultural sector, and the article, along with photos, appears on a page entitled *Details on Uses of EM in Removing Rust, Corrosion and Tarnish from Metals, a Fun Demonstration with Some Practical Applications!*, which may be found at:

<http://www.eminfo.info/em-and-rust-corrosion-etc.html#rust>

Additional information on the topic of tests for antioxidant activity will be covered in depth in an upcoming book on EM and health.

Part III

Brewing Hints and Recipes

Suggestions and Recipes Specific to AEM

Basics

Frankly, much as is also noted in the section specific to human brews, if you have already waded through Part I and managed to read and understand the first two chapters in Part II, entitled *Fundamentals and Advanced Methods Common to All or Almost All Batches of AEM and Brew* and *Very Advanced and Highly Specialized or Experimental Techniques*, you have already absorbed the encyclopedia and bible of methods and concepts at the heart of this book. Thus, the hard work is already completely behind us! All that remains for me to do in this AEM section is to offer a few basic recipes to get you started on your way. If you become stuck or confused as to concepts and principles, refer again to the first two chapters in Part II, or even go back to Part I – especially the *Glossary* -- to ensure that you understand the basics.

In summary, if you have made it this far and have digested the previous two parts, the hard work is behind you, and anything in this part is a downhill coaster ride.

A Reminder About Quality of Ingredients, Water and Container

As we have noted before in several previous sections, please pick your ingredients and the quality of all ingredients – including water -- and containers used based on what the application of the batch will be. A batch of AEM made only for use on animal waste, waste, soil, compost and deodorizing need be made only with soil-grade or agriculture-grade ingredients and water. A batch of AEM made for use in feed or water fed to animals should be made only with ingredients, water and containers rated as animal feed-grade or higher. And a batch of AEM which will be ingested by humans --often called an EM brew, especially if the formula is rather complex) – will need to be made only with ingredients, water and containers rated as human food-grade and higher.

For Your First Few Batches

I assume that most readers have already passed this point, but I strongly advise you to approach brewing AEM batches by starting simple, especially in terms of percentage of molasses by volume. To start simple, I would suggest making your first batches with just 5% or 6% molasses by volume, using only the basic ingredients (EM culture, blackstrap molasses, water) plus some sea salt, bentonite clay rock dust, and perhaps a bit of fish emulsion or fish paste. Some recipes of varying complexity appear below.

For all suggested recipes which follow, actual times for fermentation length will vary, dependent upon many variables, including fermentation temperature, batch of EM microbial culture inoculant, and ingredients used. All recipes offer quantities per gallon, which may be scaled easily to any sized fermentation vessel. Some quantities may be expressed also as percentages by volume or as ratios to water (e.g., 1:20)

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Basic Recipe for “Normal” Batch of AEM

You already know how to make a “normal” or standard batch of AEM, using only molasses, EM culture and water in a 1:1:20 ratio from the instructions which accompanied your purchase of EM microbial inoculant culture from your vendor. Therefore, a normal batch will be viewed as a base or platform and no further details will be offer here. Instead, since this is a book for intermediate and advanced EM users, we will look at recipes for more sophisticated versions.

A Sample Recipe for a Good Quality Batch of AEM with Strong Microbial Activity

(note: all quantities per gallon; some quantities may be expressed also as percentages by volume or as ratios to water [e.g., 1:20])

- Pick a suitable container for anaerobic brewing, with some kind of airlock or venting to allow gas pressure to escape; see guidelines in Part II of book.
- In all steps which follow, be sure to fill container only to reasonable fill level, leaving at least three inches or more of headspace at top to allow for foaming, bubbling, etc.
- Fill container to 2/3 of volume with warm water (if possible) at about 115F to 125F
- Add 8 ounces of feed-grade blackstrap molasses (about 6.5% by volume, or about 1:17 ratio) and stir
- Add 1/16th tsp to 1/8th tsp of EM ceramic powder
- Add 1 tbsp bran (rice or wheat)
- Add ½ tsp sea salt
- Add 1 tsp fish emulsion or fish paste
- Add 1 tbsp Azomite bentonite clay rock dust
- Add ¼ tsp Pascalite clay
- Stir all ingredients
- Add 9 ounces of EM microbial inoculant culture
- Stir
- Add warm water at about 115F to 125F to bring to fill level. Be sure to leave at least three inches of air headspace.
- Stir for one minute.
- Close container.
- If possible to shake container or otherwise agitate to allow some air to mix with liquid, do so now for 30 seconds.
- Place container in a hotbox or incubator at temperature of 88F to 104F
- Shake or stir daily for at least first 10 days, and at least once every 2 or 3 days after that till done
- For first 24 hours, leave container lid slightly loose or slightly open to allow air to enter (taking precautions as necessary to prevent entry of insects, etc.) Often this may be made possible simply by removing airlock device and covering hole with a piece of screen, etc.
- After 24 hours, seal lid or cover of container, putting airlock or venting device or mechanism in place.
- Allow to ferment at hotbox temperature of 88 F to 104 F for at least 8 days to 2 weeks till pH has dropped to 3.60 or below.

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- Once pH has dropped to 3.6 and at least 10 days have passed from start, batch is usable, but microbial activity will be even more balanced after about 18 days
- Store or decant to storage container or bottles per recommendations in storage and bottling sections in Part II.
- AEM batch should retain robust and useful microbial inoculant properties for at least 3 to 4 months after finish, and likely be a useful and balanced microbial inoculant for up to 8 months or longer after finish

A Sample Recipe for a Good Quality Batch of AEM with Very Strong Microbial Vitality and Robustness

(note: all quantities per gallon; some quantities may be expressed also as percentages by volume or as ratios to water [e.g., 1:20])

- Pick a suitable container for anaerobic brewing, with some kind of airlock or venting to allow gas pressure to escape; see guidelines in Part II of book.
- In all steps which follow, be sure to fill container only to reasonable fill level, leaving at least three inches or more of headspace at top to allow for foaming, bubbling, etc.
- Fill container to 2/3 of volume with warm water (if possible) at about 115F to 125F
- Add 10 ounces of feed-grade blackstrap molasses (about 8.5% by volume, or about 1:13 ratio) and stir
- Add 1/8th tsp of EM ceramic powder
- Add 2 tbsp bran (rice or wheat)
- Add 1 tsp to 1 tbsp granulated kelp
- Add 1/2 tsp sea salt
- Add 1 tbsp fish emulsion or fish paste
- Add 2 tbsp Azomite bentonite clay rock dust
- Add 1/4 tsp Pascalite clay
- Add 1/4 tsp paramagnetic rock dust or sand
- Add 1 oz. liquid colloidal prehistoric minerals (Coenzyme Minerals, see *Appendix C*)
- Add 1 tsp soy flour
- Add at least 500 mcg molybdenum
- Stir all ingredients
- Add 15 ounces of EM microbial inoculant culture (1.5:1 ratio to molasses)
- Stir
- Add warm water at about 115F to bring to fill level. Be sure to leave at least three inches of air headspace.
- Stir for one minute.
- Close container.
- If possible to shake container or otherwise agitate to allow some air to mix with liquid, do so now for 60 seconds.
- Place container in a hotbox or incubator at temperature of 88F to 104F
- For first 24 hours, leave container lid slightly loose or slightly open to allow air to enter (taking precautions as necessary to prevent entry of insects, etc.) Often this

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may be made possible simply by removing airlock device and covering hole with a piece of screen, etc.

- If you have an aquarium pump and airstone aerator, aerate for first 6 hours with airstone on bottom of container. If not, no problem.
- After 24 hours, stir or shake again and then seal lid or cover of container, putting airlock or venting device or mechanism in place
- Shake or stir daily for at least first 10 days, and at least once every 2 or 3 days after that till done
- Allow to ferment at hotbox temperature of 88 F to 104 F for at least 8 days to 2 weeks till pH has dropped to 3.60 or below.
- Once pH has dropped to 3.6 and at least 12 days have passed from start, batch is usable, but microbial activity will be even more balanced after about 20 days
- Store or decant to storage container or bottles per recommendations in storage and bottling sections in Part II.
- AEM batch should retain robust and useful microbial inoculant properties for at least 5 to 6 months after finish, and likely be a useful and balanced microbial inoculant for up to 12 to 14 months or longer after finish.

A Sample Recipe for a High-Quality Batch of AEM with Strong Antioxidative, Syntropic and Regenerative Activity

(note: all quantities per gallon; some quantities may be expressed also as percentages by volume or as ratios to water [e.g., 1:20])

- Pick a suitable container for anaerobic brewing, with some kind of airlock or venting to allow gas pressure to escape; see guidelines in Part II of book.
- In all steps which follow, be sure to fill container only to reasonable fill level, leaving at least three inches or more of headspace at top to allow for foaming, bubbling, etc.
- Fill container to 2/3 of volume with warm water (if possible) at about 115F to 130F
- Add 9 ounces of feed-grade blackstrap molasses (about 7.5% by volume, or about 1:15 ratio) and stir
- Add 1/16th tsp to 1/8th tsp of EM ceramic powder
- Add 2 tbsp bran (rice or wheat)
- Add 1 tbsp granulated kelp
- Add ½ tsp sea salt
- Add 2 tbsp fish emulsion or fish paste
- Add 2 tbsp to 3 tbsp Azomite bentonite clay rock dust
- Add ¼ tsp Pascalite clay
- Add ¼ tsp paramagnetic rock dust or sand
- Add ½ oz. to 1 oz. liquid colloidal prehistoric minerals (Coenzyme Minerals, see *Appendix C*)
- Add 1 tsp soy flour
- Add at least 500 mcg molybdenum
- Stir all ingredients
- Add 9 ounces of EM microbial inoculant culture (1:1 ratio to molasses)
- Stir

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- Add warm water at about 115F to bring to fill level. Be sure to leave at least three inches of air headspace.
- Stir for one minute.
- Close container.
- If possible to shake container or otherwise agitate to allow some air to mix with liquid, do so now for 60 seconds.
- Place container in a hotbox or incubator at temperature of 90F to 110F
- For first 24 hours, leave container lid slightly loose or slightly open to allow air to enter (taking precautions as necessary to prevent entry of insects, etc.) Often this may be made possible simply by removing airlock device and covering hole with a piece of screen, etc.
- If you have an aquarium pump and airstone aerator, aerate for first 6 hours with airstone on bottom of container. If not, no problem.
- After 24 hours, stir or shake again and then seal lid or cover of container, putting airlock or venting device or mechanism in place.
- Shake or stir daily for at least first two weeks, and at least once every 2 or 3 days after that
- Allow to ferment at hotbox temperature of 90 F to 110 F for at least 9 weeks (usually pH will have dropped to 3.50 or below.
- Once pH has dropped to 3.5 or below, and at least 9 weeks have passed from start, batch is usable, but antioxidative and syntropic activity will be even more balanced after about 14 weeks.
- Store or decant to storage container or bottles per recommendations in storage and bottling sections in Part II.
- If stored properly, AEM batch should retain robust and strong antioxidative and syntropic properties for at least 18 months after finish, and likely exhibit strong and useful properties for up to at least 3 years, if not longer, from finish.

A Sample Recipe for a High-Quality Batch of AEM with Very Strong Antioxidative, Syntropic and Regenerative Activity

High-Light (HL) version

It is possible to make the above formula as a ***High-Light (HL) version***, as follows, with even more antioxidative, deodorizing and syntropic activity:

- The above formula for a batch with strong antioxidative activity, if made in a transparent container or translucent container which transmits at least 35% light, and if exposed to strong fluorescent light (incandescent lamps tend to produce too much heat and too little light for power consumed) or sunlight for from 12 to 24 hours per day, will yield a batch with even stronger antioxidative, syntropic and regenerative activity.
- Light exposure may start immediately upon start of fermentation, or after pH has dropped below 3.7. Your choice!
- Increasing quantity of colloidal prehistoric minerals to 2 oz per gallon will improve batch further
- Increasing molybdenum content to at least 2 mg per gallon will improve batch even further

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- If stored properly, AEM batch should retain robust and strong antioxidative and syntropic properties for at least 18 months after finish, and likely exhibit strong and useful properties for up to at least 3 years, if not longer, from finish.

If You are an Advanced Experimenter, Consider a High-Red Version

For even stronger antioxidative, syntropic and deodorizing activity, if you are an advanced EM specialist, you may wish to play with the High-Red version discussed the *Very Advanced Methods* section in Part II.

Suggestions and Recipes Specific to Human Brews

Basics

Frankly, much as has been noted in the previous section specific to AEM, if you have already waded through Part I and managed to read and understand the first two chapters in Part II, entitled *Fundamentals and Advanced Methods Common to All or Almost All Batches of AEM and Brew* and *Very Advanced and Highly Specialized or Experimental Techniques*, you have already absorbed the encyclopedia and bible of methods and concepts at the heart of this book. Thus, the hard work is already completely behind us! All that remains for me to do in this Brew section is to offer some few suggestions specific to brewing high-quality brews, which are simply a specialized type AEM made with all human food-grade ingredients, and often made with a much higher percentage of ingredients than AEM (and often fermented for a longer than AEM batches), and to offer a few basic recipes to get you started on your way. If you become stuck or confused as to concepts and principles, refer again to the first two chapters in Part II, or even go back to Part I – especially the *Glossary* -- to ensure that you understand the basics.

In summary, if you have made it this far and have digested the previous two parts, the hard work is behind you, and anything in this part is a downhill coaster ride.

A Reminder About Quality of Ingredients, Water and Container

As we have noted before in several previous sections, please pick your ingredients and the quality of all ingredients – including water -- and containers used based on what the application of the batch will be. While a batch of AEM made only for use on animal waste, waste, soil, compost and deodorizing need be made only with soil-grade or agriculture-grade ingredients and water, a batch of EM brew made for ingesting as a nutritional supplement by humans should be made only with ingredients, water and containers rated as human food-grade or higher. Since this chapter is devoted only to human brews, it is assumed that you will use only ingredients, water and containers rated as human food-grade.

For Your First Few Batches

I assume that most readers have already passed this point, but I strongly advise you to approach making brew batches by starting simple, especially in terms of percentage of molasses by volume. To start simple, I would suggest making your first batches with just about 7% molasses by volume, using only the basic ingredients (EM culture, blackstrap molasses, water) plus some sea salt, bentonite clay rock dust, and perhaps a few other ingredients. Some recipes of varying complexity appear below.

For all suggested recipes which follow, actual times for fermentation length will vary, dependent upon many variables, including fermentation temperature, batch of EM microbial culture inoculant, and ingredients used. All recipes offer quantities per gallon, which may be scaled easily to any sized fermentation vessel. Some quantities may be expressed also as percentages by volume or as ratios to water (e.g., 1:20)

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Basic Recipe for “Normal” or Standard Batch of Brew

You already know how to make a “normal” or standard batch of human-grade AEM, using only human food-grade blackstrap molasses, EM culture and water in a 1:1:20 ratio from the instructions which accompanied your purchase of EM microbial inoculant culture from your vendor. This yields a simple basic brew. A normal batch will be viewed as a base or platform and no further details will be offer here. Instead, since this is a book for intermediate and advanced EM users, we will look at recipes for more sophisticated versions.

A Sample Recipe for a Good Quality Batch of Brew with Ormus Properties and Strong Antioxidant Properties:

Molasses Blueberry Cherry Mineral Brew

(note: all quantities per gallon; some quantities may be expressed also as percentages by volume or as ratios to water [e.g., 1:20])

- Pick a suitable container for anaerobic brewing, with some kind of airlock or venting to allow gas pressure to escape; see guidelines in Part II of book.
- In all steps which follow, be sure to fill container only to reasonable fill level, leaving at least three inches or more of headspace at top to allow for foaming, bubbling, etc.
- Fill container to 2/3 of volume with warm water (if possible) at about 115F to 130F
- Add 7 ounces of blackstrap molasses (about 6.5% by volume, or about 1:17 ratio) and stir
- Add 2 ounces of barley malt syrup
- Add 1/16th tsp of EM ceramic powder
- Add 2 tbsp bran (rice or wheat)
- Add 1 tbsp granulated kelp
- Add ½ tsp sea salt
- Optional: Add 1 tsp fish paste or shrimp paste
- Add 2 tbsp Azomite bentonite clay rock dust (*note: more will be added later*)
- Add ¼ tsp Pascalite clay
- Add ¼ tsp paramagnetic rock dust
- Add ½ oz. to 1 oz. liquid colloidal prehistoric minerals (Coenzyme Minerals, see *Appendix C*)
- Add 1 tsp soy flour
- Stir all ingredients
- Add 10 to 12 ounces of EM microbial inoculant culture (at least a 1.3:1 ratio to molasses)
- Stir
- Add warm water at about 115F to bring to fill level. Be sure to leave at least three inches of air headspace.
- Stir for one minute.
- Close container.
- If possible to shake container or otherwise agitate to allow some air to mix with liquid, do so now for 60 seconds.

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- Place container in a hotbox or incubator at temperature of 90F to 112F
- For first 24 hours, leave container lid slightly loose or slightly open to allow air to enter (taking precautions as necessary to prevent entry of insects, etc.) Often this may be made possible simply by removing airlock device and covering hole with a piece of screen, etc.
- If you have an aquarium pump and airstone aerator, aerate for first 6 hours with airstone on bottom of container. If not, no problem.
- After 24 hours, stir or shake again and then seal lid or cover of container, putting airlock or venting device or mechanism in place.
- Shake or stir daily for at least first two weeks, and at least once every 2 or 3 days after that
- In about 4 to 10 days, once pH has dropped to below 3.7, add the following:
 - Add 1 ounce of cherry juice concentrate
 - Add 2 ounces of blueberry juice concentrate
 - Add 4 tbsp Azomite bentonite clay rock dust
 - stir
- Allow to ferment at hotbox temperature of 90 F to 110 F for at least 10 weeks from start (usually pH will have dropped to 3.50 or below.)
- Once pH has dropped to 3.5 or below, and at least 10 weeks have passed from start, batch is usable, but antioxidative and syntropic activity will be even more balanced after about 15 weeks.
- Batch may be removed from hotbox at anywhere from 10 to 14 weeks, and must be left to age and ferment at room temperature for at least two weeks after removal from hotbox.
- Store or decant to storage container or bottles per recommendations in storage and bottling sections in Part II.
- If stored properly in glass, brew batch should retain robust and strong antioxidative and syntropic properties for at least 2 years, and likely for at least 3 years.

High-Light (HL) version

It is possible to make the above formula as a **High-Light (HL) version**, as follows, with even more antioxidative, deodorizing and syntropic activity:

- The above formula for a brew with strong ormus and antioxidative activity, if made in a transparent container or translucent container which transmits at least 35% light, and if exposed to strong fluorescent light (incandescent lamps tend to produce too much heat and too little light for power consumed) or sunlight for from 12 to 24 hours per day, will yield a batch with even stronger antioxidative, syntropic and regenerative activity.
- Light exposure may start immediately upon start of fermentation, or after pH has dropped below 3.7. Your choice!
- Increasing quantity of colloidal prehistoric minerals to 2 oz per gallon will improve batch further
- Adding molybdenum, to levels of at least 2 mg per gallon will improve batch even further

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A Sample Recipe for a Good Quality Batch of Grape Brew with Ormus Properties and Strong Antioxidant Properties:

Molasses Grape Brew

(note: all quantities per gallon; some quantities may be expressed also as percentages by volume or as ratios to water [e.g., 1:20])

- Pick a suitable container for anaerobic brewing, with some kind of airlock or venting to allow gas pressure to escape; see guidelines in Part II of book.
- This is a relatively long-fermentation length batch, so consider making it in at least a 5 gallon carboy or fermenting bucket equipped with a spout.
- In all steps which follow, be sure to fill container only to reasonable fill level, leaving at least three inches or more of headspace at top to allow for foaming, bubbling, etc.
- Fill container to 2/3 of volume with warm water (if possible) at about 115F to 130F
- Add 6 ounces of blackstrap molasses (about 5% by volume, or about 1:20 ratio) and stir
- Add 3 ounces of frozen (100% pure juice) grape juice concentrate (more concentrate will be added later; I usually use Welch's brand of frozen grape juice concentrate)
- Add 1 ounce of barley malt syrup
- Add 1/16th tsp of EM ceramic powder
- Add 2 tbsp bran (rice or wheat)
- Add 1 tbsp granulated kelp
- Add ½ tsp sea salt
- Optional: Add 1 tsp fish paste or shrimp paste
- Add 2 tbsp Azomite bentonite clay rock dust (*note: more will be added later*)
- Add ¼ tsp Pascalite clay
- Add ¼ tsp paramagnetic rock dust
- Optional: Add ½ oz. to 1 oz. liquid colloidal prehistoric minerals (Coenzyme Minerals, see *Appendix C*)
- Stir all ingredients
- Add 10 ounces of EM microbial inoculant culture
- Stir
- Add warm water at about 115F to bring to fill level. Be sure to leave at least three inches of air headspace.
- Stir for one minute.
- Close container.
- If possible to shake container or otherwise agitate to allow some air to mix with liquid, do so now for 60 seconds.
- Place container in a hotbox or incubator at temperature of 90F to 112F
- For first 24 hours, leave container lid slightly loose or slightly open to allow air to enter (taking precautions as necessary to prevent entry of insects, etc.) Often this may be made possible simply by removing airlock device and covering hole with a piece of screen, etc.

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- If you have an aquarium pump and airstone aerator, aerate for first 6 hours with airstone on bottom of container. If not, no problem.
- After 24 hours, stir or shake again and then seal lid or cover of container, putting airlock or venting device or mechanism in place.
- Shake or stir daily for at least first two weeks, and at least once every 2 or 3 days after that
- In about 7 to 13 days, once pH has dropped to below 3.6, add the following:
 - add 9 ounces of grape juice concentrate (so you will be using a total of one 12 oz. container of grape juice concentrate per gallon, overall)
 - add 1 tbsp Azomite clay
 - add 2 ounces of EM culture
 - stir
- Allow to ferment at hotbox temperature of 90 F to 110 F for at least 14 to 16 weeks from start (usually pH will have dropped to 3.40 or below.) May be ingested at earlier stages, but will not develop strong dry, tart and Cabernet-like flavor till at least 16 to 22 weeks at hotbox temperature have passed. And, antioxidative and syntropic activity will be even more balanced after about 20 weeks.
- Batch may be removed from hotbox at anywhere from 14 to 16 weeks, and must be left to age and ferment at room temperature for at least five weeks after removal from hotbox.
- Batch improves and ferments even further if left at room temperature for up to one year after finish of hotbox fermentation.
- Store or decant to storage container or bottles per recommendations in storage and bottling sections in Part II.
- If stored properly in glass, brew batch should retain robust and strong antioxidative and syntropic properties for at least 2 years, and likely for at least 3 years.

High-Light (HL) version

It is possible to make the above grape formula as a **High-Light (HL) version**, as follows, with even more antioxidative, deodorizing and syntropic activity:

- The above formula for a brew with strong ormus and antioxidative activity, if made in a transparent container or translucent container which transmits at least 35% light, and if exposed to strong fluorescent light (incandescent lamps tend to produce too much heat and too little light for power consumed) or sunlight for from 12 to 24 hours per day, will yield a batch with even stronger antioxidative, syntropic and regenerative activity.
- Light exposure may start immediately upon start of fermentation, or after pH has dropped below 3.7. Your choice!
- Increasing quantity of colloidal prehistoric minerals to 2 oz per gallon will improve batch further
- Adding molybdenum, to levels of at least 2 mg per gallon will improve batch even further
-

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A Sample Recipe for an Aged Long-Fermentation Batch of Golden-Bran Kelp Brew with Strong Ormus Properties and Strong Antioxidant Properties:

Golden-Bran Kelp Brew

(note: all quantities per gallon; some quantities may be expressed also as percentages by volume or as ratios to water [e.g., 1:20])

- Pick a suitable container for anaerobic brewing, with some kind of airlock or venting to allow gas pressure to escape; see guidelines in Part II of book.
- This is a very long-fermentation length batch, so consider making it in at least a 5 gallon carboy or fermenting bucket equipped with a spout.
- In all steps which follow, be sure to fill container only to reasonable fill level, leaving at least three inches or more of headspace at top to allow for foaming, bubbling, etc.
- Fill container to 2/3 of volume with warm water (if possible) at about 115F to 130F
- Add 7 ounces of blackstrap molasses (about 6% by volume, or about 1:18 ratio) and stir
- Add 1 ounce of frozen (100% pure juice) grapefruit juice concentrate (*more concentrate will be added later*)
- Add 1/16th tsp of EM ceramic powder
- Add 2 oz. bran bran (rice or wheat)
- Add 2 tbsp granulated kelp (*more will be added later*)
- Add ½ tsp sea salt
- Optional: Add 1 tsp fish paste or shrimp paste
- Add 2 tbsp Azomite bentonite clay rock dust
- Add ¼ tsp Pascalite clay
- Add ¼ tsp paramagnetic rock dust
- Optional: Add ½ oz. to 1 oz. liquid colloidal prehistoric minerals (Coenzyme Minerals, see *Appendix C*)
- Stir all ingredients
- Add 10 ounces of EM microbial inoculant culture
- Stir
- Add warm water at about 115F to bring to fill level. Be sure to leave at least three inches of air headspace.
- Stir for one minute.
- Close container.
- If possible to shake container or otherwise agitate to allow some air to mix with liquid, do so now for 60 seconds.
- Place container in a hotbox or incubator at temperature of 90F to 112F
- For first 24 hours, leave container lid slightly loose or slightly open to allow air to enter (taking precautions as necessary to prevent entry of insects, etc.) Often this may be made possible simply by removing airlock device and covering hole with a piece of screen, etc.
- If you have an aquarium pump and airstone aerator, aerate for first 6 hours with airstone on bottom of container. If not, no problem.
- After 24 hours, stir or shake again and then seal lid or cover of container, putting airlock or venting device or mechanism in place.

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- Shake or stir daily for at least first two weeks, and at least once every 2 or 3 days after that.
- In about 7 to 13 days, once pH has dropped to below 3.6, add the following:
 - add 14 ounces of bran (so you will be using a total of one 16 oz. of bran per gallon, overall)
 - add 2 ounces of EM culture
 - add 2 tbsp of granulated kelp
 - stir
- In another 7 to 21 days, once pH has dropped again to below 3.6, add the following:
 - add 3 ounces of frozen (100% pure juice) grapefruit juice concentrate
- Allow to ferment at hotbox temperature of 90 F to 110 F for at least 14 to 16 weeks from start (usually pH will have dropped to 3.40 or below.) However, for best results, ferment at hotbox temperatures for total of at least 6 months after start, and then should be left to age and ferment at room temperature for at least three to six months after removal from hotbox.
- Store or decant to storage container or bottles per recommendations in storage and bottling sections in Part II.
- If stored properly in glass, brew batch should retain robust and strong antioxidative and syntropic properties for at least 2 years, and likely for at least 3 years.

How About a High-Light Option?

While it is technically possible to make a high-light version of this brew if you wish, the reality is that a really well-formulated batch of golden bran kelp brew will exhibit very high opacity, due to its deep golden brown color, and significant amounts of light simply will not be able to penetrate far at all into the liquid, thus yielding only minimal effects. If you do choose to try to make a High-Light version, I suggest that you use strong lighting, and continue light exposure for perhaps 2 to 3 months during the more active (e.g., earlier) stages of fermentation.

A Highly-Experimental Ozonated version, more like EM-X

It is possible, if you are an advanced experimenter, to make the above golden bran kelp formula with a second fermentation stage, starting at about 16 to 18 weeks which involves – per the aerobic/ozone sections in the *Very Advanced Techniques* chapter in Part II – aeration with ozone for about 5 minutes per day every other day for about three weeks, followed by the normal regimen of long fermentation. It may also be necessary to add small amounts of molasses or grapefruit juice concentrate to feed the microbes as well during this stage. This is a very experimental formula, employing the same second fermentation stage using aerobic/ozonation stage which is employed with by TPRR and other Japanese vendors in making EM-X and EM-X-like brews.

Aeration with ozone is accomplished by using an ozone generator with a built in air pump, and bubbling the ozone gas thru a length of aquarium hose and an airstone placed in the bottom of the brewing vessel. If done right, it will yield a brew with a larger amount of very light weight antioxidants, but if done to excess, will encourage a different microbial flora which may allow the pH to rise above 3.7, or even – as in the case with EM-X – to 4.5 or above, yielding a relatively non-acid product. From my viewpoint, this is highly

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undesirable, since once the pH goes significantly above 3.7, the batch is no longer highly stable without refrigeration, freezing, pasteurization or micro-filtering, none of which I prefer.

So, if you are an advanced brewer, and are tempted to use this method, employ it carefully and conservatively, making frequent measures during second-stage fermentation of pH, ORP and rH. I suggest not even considering this method until you have made at least a few gallons of the golden bran kelp brew via the “normal” method outlined in the section above.

A Sample Recipe for a Turmeric or Green Superfood Elixir

Turmeric powder or Green Superfood powder elixir

This particular formula is called an elixir and not a brew simply because it contains so many more ingredients per ounce than most brews. Between that and the long fermentation time, the resultant product is truly an elixir.

(note: all quantities per gallon; some quantities may be expressed also as percentages by volume or as ratios to water [e.g., 1:20])

- Pick a suitable container for anaerobic brewing, with some kind of airlock or venting to allow gas pressure to escape; see guidelines in Part II of book.
- This is a relatively long-fermentation length batch, so consider making it in at least a 5 gallon carboy or fermenting bucket equipped with a spout.
- In all steps which follow, be sure to fill container only to reasonable fill level, leaving at least three inches or more of headspace at top to allow for foaming, bubbling, etc.
- Fill container to 2/3 of volume with warm water (if possible) at about 115F to 130F
- Add 7 ounces of blackstrap molasses (about 6% by volume, or about 1:18 ratio) and stir
- Add 1 or 2 ounces of barley malt syrup
- Add 1/16th tsp of EM ceramic powder
- Add 2 tbsp bran (rice or wheat)
- Add 1 tbsp granulated kelp
- Add ½ tsp sea salt
- Add 1 tsp fish paste or shrimp paste
- Add 2 tbsp Azomite bentonite clay rock dust
- Add ¼ tsp Pascalite clay
- Add ¼ tsp paramagnetic rock dust
- Add 2 oz. liquid colloidal prehistoric minerals (Coenzyme Minerals, see *Appendix C*)
- Stir all ingredients
- Add 12 ounces of EM microbial inoculant culture
- Add 4 ounces per gallon of powdered turmeric or freeze-dried green superfood powder (I prefer Mitchell May's *Pure Synergy*)
- Stir
- Add warm water at about 115F to bring to fill level. Be sure to leave at least three inches of air headspace.

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- Stir for three minutes.
- Close container.
- If possible to shake container or otherwise agitate to allow some air to mix with liquid, do so now for 60 seconds.
- Place container in a hotbox or incubator at temperature of 90F to 112F
- For first 24 hours, leave container lid slightly loose or slightly open to allow air to enter (taking precautions as necessary to prevent entry of insects, etc.) Often this may be made possible simply by removing airlock device and covering hole with a piece of screen, etc.
- If you have an aquarium pump and airstone aerator, aerate for first 6 hours with airstone on bottom of container. If not, no problem.
- After 24 hours, stir or shake again and then seal lid or cover of container, putting airlock or venting device or mechanism in place.
- Shake or stir daily for at least first two weeks, and at least once every 2 or 3 days after that
- In about 7 to 13 days, once pH has dropped to below 3.6, add the following:
 - add up to 8 additional ounces per gallon of powdered turmeric or freeze-dried green superfood powder
 - stir
- Allow to ferment at hotbox temperature of 90 F to 110 F for at least 16 to 20 weeks from start (usually pH will have dropped to 3.40 or below.) May be ingested at earlier stages, but will not develop full power until it has fermented for at least 18 to 22 weeks at hotbox temperature.
- Batch may be removed from hotbox at anywhere from 16 to 22 weeks, and must be left to age and ferment at room temperature for at least five weeks after removal from hotbox.
- Batch improves and ferments even further if left at room temperature for up to one year after finish of hotbox fermentation.
- Store or decant to storage container or bottles per recommendations in storage and bottling sections in Part II.

High-Light (HL) version

It is possible to make the above elixir formula as a **High-Light (HL) version**, as follows, with even more antioxidative, deodorizing and syntropic activity:

- The above formula for a turmeric or green superfood elixir, if made in a transparent container or translucent container which transmits at least 35% light, and if exposed to strong fluorescent light (incandescent lamps tend to produce too much heat and too little light for power consumed) or sunlight for from 12 to 24 hours per day, will yield a batch with even stronger antioxidative, syntropic and regenerative activity.
- Light exposure may start immediately upon start of fermentation, or after pH has dropped below 3.7. Your choice!

Some Hints on Making EM Fermented Grain

The section will offer some hints and suggestions for making very high-quality EM-fermented, antioxidant rich grain products as a poultry or livestock feed additive (supplement). Such products are often called bokashi in the EM world in Asia. This section will offer some advice on making EM fermented grain products for animal consumption out of common grain or agricultural surplus items such as:

- Rice bran or wheat bran
- Crimped or cracked oats, milo, barley, rye, wheat, corn, etc.
- Beet pulp or other cheap agricultural by-products often sold cheaply at feed mills, grain mills, and feed and grain stores
- Grain scrap, bran scrap and husks which are often available for free from beneath grain dryers or husking machines
- Cracked, milled, or crimped soybean or soybean pieces and scrap left as waste and surplus from drying or milling operations
- Grain mash waste created by beer breweries and microbreweries

The standard or “normal” recommendations and recipes given by most EM vendors and producers for making bokashi from such products as listed above for use in animal feed tend to recommend using a freshly-mixed batch of EM microbial inoculant culture, blackstrap molasses and water, mixed in a 1:1:100 ratio, which is then used to wet the grain or scrap only just to a level of about 30% moisture (most vendors offer all kinds of hints on how to gauge this level of moisture, such as just enough moisture so that the grain or bran will form a clump when squeezed in your fist, but which will crumble easily when touched.) I have made over a ton of bokashi using bran, grain scrap or grains in this “traditional” manner, and I eventually stumbled upon a method and process for making what I consider to be a far more stable and nutritious and mold-resistant version of fermented grain bokashi, and these more stable and more mold-resistant properties are especially useful if the product is to be stored in its moist or wet state (and hopefully stored largely anaerobically!), rather than processed in a dryer to yield dehydrated (dried) bokashi.

My Method

My method involves several different features than the older standard bokashi formula, as follows:

- Ratio 2:1:20 (or, in other words 10:5:100) of EM culture to molasses to water, but okay to use a good batch of AEM which was optimized for microbial activation properties instead of stock EM microbial culture
- Use higher ratio of liquid (e.g., EM, molasses, water) to dry solids, about 50% to 65%, than the 30% to 35% recommended for traditional bokashi batches
- Use cheap but good quality unpasteurized feed grade molasses
- Sea salt, about 1/8 tsp to 1/4 tsp per gallon
- Azomite rock dust powder, about 1/2 tbsp to 1 tbsp per gallon
- Kelp meal, about 1/2 tbsp to 1 tbsp per gallon
- EM ceramic powder, about 1/16th tsp per gallon
- Longer fermentation time, up to 4 to 12 months, dependent upon temperature (longer if colder)

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- Remember, as is true with any batch of solid or granular type of EM secondary preparation such as bokashi, once the EM culture, molasses, water and other ingredients have been thoroughly mixed with the grain or agricultural by-products (grain scrap, husks, beet pulp, etc.), the batch should ***never again*** be stirred, shaken, or mixed, as such actions would inevitably introduce a lot of air into the moist mix, and could possibly cause great harm. So, once mixed and placed in an airtight container, the moist or wet mix *should not be disturbed*.

The differences and the reasons

The suggested guidelines above yield the following benefits:

- Higher ratio of molasses to water offers not only more antioxidants but far more food for the microbes
- Higher ratio of EM culture (or AEM) to molasses helps to maintain culture quality despite all the wild microbes in the bran/grains/scrap, etc.
- Higher overall moisture content (45% to 70% by volume) yields more complete fermentation and utilization of the foodstuffs in the molasses and in the grains.
- More complete digestion of the grains or ag by-product materials
- Longer fermentation time yields much more stable culture and much higher amount of antioxidants and syntropic substances and energies.

These factors together all create a batch of EM-fermented grain with far more antioxidative, syntropic, and regenerative powers and energies in the finished product, and will usually make it – if stored damp/wet -- more resistant to oxidative damage, to overgrowth of harmful molds on portions which may be exposed to a bit of air, etc.

My method admittedly uses much more EM microbial culture than the 1:1:100 ratio mentioned above, and thus may raise cost a bit, and so, if bare-bottom lowest possible cost is your overriding consideration, you may well wish to stick to the 1:1:100 ratio recommended by most EM vendors, but you may still wish to incorporate some of my other hints in this section to ensure a better batch. Alternatively, if you have at hand a batch of very high-quality AEM which was made to yield strong and robust microbial inoculant properties, it is possible to use that AEM as your inoculant culture instead of employing stock EM culture.

This method admittedly uses up to ten times more blackstrap molasses than the 1:1:100 ratio normally recommended, but it is often possible to obtain clean feed-grad blackstrap molasses in bulk quantities very inexpensively.

A Tale of a Typical Batch

In late 2003, I was offered a ton of free dry grain scrap by my local feed and grain mill, consisting of scraps of corn pieces, corn bran, corn husk particles, wheat bran, barley husks, soy husks, grain dust, etc, which had fallen out of the cracks and screens of a massive 100 foot long outdoor grain dryer onto the concrete apron at ground level below. I fermented some of it with EM culture and molasses in multiple 4 and 5 gallon buckets in October and November to use a supplement to the feed for my chickens, duck, geese, guineas and turkeys, but soon got tired of mixing up small 5 gallon lots and then having to ferment them in a hotbox or other warm spot in the house. So, I ended up, by November, with a surplus of about 900 pounds of the dry (and slightly damp in spots) stuff, and it was

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of a slightly "off" quality; while it was largely dry, there were large clumps in it of damp/wet moldy grain scrap -- the scrap on the concrete apron below the outdoor grain dryer had been wetted by a rainstorm a few days before I picked up the grain scrap and bagged it on the site. I picked up -- from a nearby surplus vendor -- two surplus food-grade polyethylene 55 gallon barrels (\$9 each) with full-diameter airtight lids and put them in one of my basements (which is also my electric fence control room) which stays above freezing all year around due to the presence of a water heater, a light bulb and other gizmos such as a large bank of electric fence chargers and backup batteries on trickle charge.

And so, in late November 2003, after rinsing both barrels, I spent about 5 minutes insulating them loosely with bits and scraps of cardboard, plastic and foam insulation which I had found lying around, so they would stay a bit warm, filled them to within a few inches of the top with dried grain scrap (at about 50F), and then added to each barrel about 30 gallons of a 3:1:30 mixture of (feed-grade) blackstrap molasses (at 50 F), EM culture and water, with the water at about 78 F, the warmest I could manage in that setting. If you are perhaps wondering why I filled the barrels nearly to the top, it is because my experience with grains and grain processing by-products has shown that their volume decreases significantly when wetted.

If anyone is curious about the ratio of 3:1 for EM culture to molasses, I used a surplus of (homemade culture line, a type of very high-quality AEM) culture simply because I had tons of 5 gallon buckets full of the stuff in my house and lab at the time, and so I felt free to use it very liberally. At that time, the basement temperature was 54 degrees F. After that point, outdoor temperatures really started dropping as winter hit the Western Maryland mountains here, and the basement temperature dropped to around 40 F to 44 F for much of the winter and early spring while the grain fermented in the barrels. I opened one barrel in March 2004, about 4 months after I had started fermentation, but I was not happy yet with the quality -- there were still lots of moldy clumps which appeared to have not yet been "re-educated" by the fermentation culture, and the whole thing smelled a bit funny. It all made sense, because the average temperature in the basement had been below 50 F. So I decided to wait a while.

At a point about 7 months after start of fermentation, I decided to start using the contents of one of the barrels as feed for my birds. When I opened it, I found a layer about one inch thick of darkened grain and mold on the top, because an air headspace of increasing size, finally reaching 10 inches, had formed as the mass compacted and shrank over time, and under it was a very good quality light-colored wet mass of fermented grain scrap with a good clean smell. I shoveled the moldy layer into a separate dedicated bucket, because chickens and turkeys are very sensitive to toxic effects from certain molds, and I planned to discard that back in the woods so they could not get at it. I also shoveled 6 gallons of the good clean layer of fermented grain scrap into a 5 gallon bucket for use over the next few days. However, when I momentarily put down the bucket filled with moldy grain (from the top layer) in the chicken pen, all the birds started to eagerly pick at it. I checked with my intuition, which told me that the moldy scrap was fine for the birds (my inner sense had already told me that even before I opened the barrel, but I like to double check on such things...), and so I fed them not only some of the high-quality fermented grain, but also a large quantity of the chunks from the layer on top which had gotten darkened and moldy from air exposure; there have been no signs of toxicity in my

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birds from eating it. It seems like the only molds and other aerobic organisms which the EM had allowed to grow on the top layer of grain -- which was exposed to the airspace -- were beneficial and harmless molds, with no presence of toxic molds. Indeed, when I first got a whiff of that moldy top layer which had been exposed to air, the odor reminded me much of the smell of the moldy rind on well-aged raw moldy cheeses.

I am rather impressed with the performance of EM culture in this case, in that the starting temperature of the mix, after mixing was done, was about 68F, and the barrels were poorly insulated, and so the interior temp rapidly fell within days to basement air temperature, which was about 50 F and soon dropped to 45 and even 40 F or below. Nonetheless, the two barrels of grain scrap, after 7 months of fermentation at very cold temperatures, turned out just fine, and even the moldy lumps of grain scrap which had been present in the original batch of grain were now almost-fully remediated and “re-educated” (re-cultured). While I am sure that the fermentation would have gone far faster and even better if I could have kept the temperatures in the barrels above about 84 F, they turned out quite fine anyway, and my birds love the fermented grain scrap from both buckets, even the scrap bucket full of the topmost moldy layer of grain, and they beg me for more of the stuff.

One purpose of this story was to illustrate how EM can work -- in this case, to ferment grain scrap -- even at very low temperatures and even with grain scrap which contains quite a few damp moldy clumps from having been exposed to the elements prior to being collected and fermented.

Please Remember -- Do Not Stir!

Please remember the warning from Part II that once the EM culture, molasses, water and other ingredients have been thoroughly mixed with the grain or agricultural by-products (grain scrap, husks, beet pulp, etc.), they should never again be stirred, shaken, or mixed as such actions would inevitably introduce a lot of air into the moist mix, and could possibly cause great harm. So, once mixed and placed in an airtight container, the moist or wet mix should not be disturbed.

In fact, in the tale which I recounted above of using my method to ferment moldy grain scrap at very low temperatures, I pre-mixed the liquid, consisting of water, EM culture, blackstrap molasses and the various amendments/additives which were mentioned above, and then the liquid was simply poured over the grain in the barrels until all of the grain was sufficiently moistened; for me -- as previously disclosed -- this came out to just under 30 gallons of liquid per 58 gallon volume of dry grain scrap. Then the barrels were sealed to keep out most air... just enough looseness of cover to allow gases to escape when needed.

FAQ – Some Frequently Asked Questions

Fermentation length vs. percentage of sugar sources

You mention that for every doubling of the sugars (from 1:20 to 1:10, e.g.), the fermentation time quadruples, giving as an example that the brewing time would extend from 6-8 weeks to 20-24 weeks. However, shouldn't that be 24-32 weeks fermentation for a 1:10 brew (assuming EM is in ratio of 1.6:1 with sugar)?

Well, the increase in fermentation time, at least in that region of sugar/solids percentages, may not be fully a square function, but close to it, and there is always some leeway or variability as well in deciding when a brew is ripe enough to use. However, the general rule of "fermentation time increases roughly as the square of the sugar/solids concentration increases" is useful.... In reality, the function may be a bit less than square in some regions of the curve, and more than square in other regions of the curve, as when you try to increase sugar/solid concentration from 10% to 20%, etc....

Adding alcoholic beverages to EM brews

You once mentioned adding rum or brandy to the EM and molasses for fermenting cream. Were you kidding? Wouldn't alcohol kill some of the microbes? Or provide food? Or both?

Is it to be avoided because it is potentially unbalancing?

My comment was a joke, and I seem to remember it was in response to someone earlier in the thread who had expressed a wish for an alcoholic EM brew. In reality however, the EM microbes are rather hardy and resistant to alcohol, since the yeast make some alcohol as a normal waste product, which is then used by the other microbes. And, in reality, if someone wished to make an alcoholic EM brew, they could start with up to about 2% to alcohol (rum, brandy, etc.) content with no problem. Indeed, some specialized AEM-type agricultural preparations use cheap distilled alcohol (such as cheap vodka or grain liquor) in the formula. Or alternatively, someone wishing to make an alcoholic preparation could simply forego adding alcohol, but simply spike the culture at start with wine or beer yeast, and aerate for 24 hours to give the yeast a head-start. Most times, this will yield a final brew with about 2% to 3% alcohol content. Many folks even brew EM beer and EM wine at home, and indeed, one of my friends (he is an EM brewer; his EM human brews will hit market in a few months) is currently working with a microbrewery on the West Coast of the USA to produce a line of EM beers.

Lastly, please recall that even EM stock culture usually contains from 0.2% to 0.35% alcohol content, according to published laboratory analyses, and EM human brews -- since they are more concentrated (more ingredients per ounce) -- often contain 0.3% to 0.9% alcohol, still lower than most commercial yogurts, kefir, orange juices, etc. Some of my brews have contained up to 1.5% alcohol.

Rice wash water or starch as primary food for EM microbes

Can I make AEM using rice wash water or starch as the main food for the microbes instead of blackstrap molasses?

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The method you describe, using the rice wash water (laden with nutrients) is how a type of Activated EM (AEM), aka EM Extension, aka EM Secondary Solution, is made in many institutions and homes in Japan. The resultant AEM is sometimes called "White EM Secondary Solution" and a dozen similar names as well, because of its very light color, due to the extremely low molasses content, and because of this light color, it is often used for spraying on fabrics, or in hospital rooms or kitchens as a deodorizer and air freshener. It seems rather universally agreed that such AEM has a very short lifetime, and must be used fairly fast before it either "goes bad" or loses its potency, and this short lifetime is directly connected to the fact that the primary "food" source for the microbes was not blackstrap molasses but rather rice washings or starches alone. Blackstrap molasses is extremely high in antioxidants, minerals and trace elements, all of which are needed by the microbes to create a highly potent AEM with longer lifetime than the AEM-White. So, as long as you use the "white" AEM within about 10 to 20 days of making it, it should be fine.

There are even several brands of White EM products on the market in Japan, sold for use on laundry and bedsheets. Each has a very light color, as it was made from starches of high-starch agricultural by-products, and each contains no molasses. These products reportedly have a very short shelf life, and bottles can go bad even before opening.

Any genetically modified (GM) Organisms in EM?

No, EM microbial cultures consist of only naturally occurring microbes, found in nature since at least the Paleolithic era or even earlier.

I have been told that all oils and essential oils, if fermented by EM, will simply turn into alcohol. Is this true?

It seems that there is indeed a myth present in some corners of the EM world that all oils, if fermented by EM, will simply turn into alcohol. This is not true. That would be as simplistic as saying that all sugars, if fermented, turn into alcohol. Yes, this may be true under very specialized and controlled circumstances, such as when producing beer or wine via fermentation only by beer or wine yeast. But, sugars can just as easily be fermented to yield a wide variety of other substances as well by employing other processes and microbes. For example, anaerobic fermentation of sugars or oils by EM will usually result in production of lactic acid and numerous antioxidants and energy/regenerative compounds, such as COQ10 and NADH.

Can I make a human brew with about a pint dry weight of green superfood powder per gallon of liquid?

Until you are really sure of your processes and methods, try not to overload any one brew with too many food sources. So, if you will be adding a lot of green superfood or herbal powder, then use only 5% (1:20) to 7% (about 1:17) molasses by volume. In general, until you have a lot of confidence, try to keep starting Brix score below about 9, or about 11 to 13% by volume of starting sugar/carb sources. Better, your first few sophisticated brews should have a Brix even lower than that! And, limit the volume of dry green superfood or herbal powder added to your brews to about 8 tablespoons (4 ounces) per gallon, until

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you have garnered some experience, at which point you may wish to try increasing to as much as 10 to 12 ounces per gallon. I also suggest that you add only a small amount of the dried superfood or green powders at the start of fermentation, and only add the remainder one week later, when pH has dropped to below 3.7.

I keep trying to get all my friends and relatives to try these EM brews, and some have not liked the results. What went wrong?

The question in full was: "I try to get all my friends and relatives to try these EM brews, as I am sure that they can save the world. But things are not going as well with most of these people whom I have pushed to take it. Several people have experienced side effects from taking it, including an apparent increase of uric acid in the system causing what seem like gout symptoms. My mother, whom I convinced to take the brew, gets an acidic reaction in her mouth. Another person got bad gas and couldn't continue taking it. What is wrong?"

Well, first, since it sounds like they -- and their bodies -- are newcomers to EM nutritional products, I wonder how large a serving size they were ingesting per dose. I believe that most brew labels and website/flyers recommend a starting dose of 1 tablespoon (1/2 ounce), two or three times per day. Frankly, everything which you describe sounds like classic cleansing symptoms, aka "detox reaction" or "healing crisis" or "retrace", all of which are extremely common in folks who are just starting on EM products or other healthful measures, such as raw diets, partly-raw Paleo diets, acupuncture, or even increasing intake of strong antioxidants -- for an example of the latter, distributors of high-quality blueberry juice concentrates tell me that many of their customer often experience detox reactions when they first start ingesting a few spoonfuls of blueberry juice concentrate each day....

These cleansing symptoms or detox reactions are EXTREMELY common to EM newcomers, and even affect folks who are drinking such relatively tame (pasteurized, micro-filtered) EM products such as EM-X from Japan. In fact, in many of the articles presented by medical and healthcare practitioners in the 2-volume proceedings of the *First International EM Medical Conference* in Okinawa, Japan in November 2001, the problem most frequently encountered by clinicians with their seriously chronically ill patients was poor patient compliance -- meaning that patients stopped taking EM-X due to the cleansing symptoms, which they violently disliked (several patients were reported to have stated sentiments along the lines of "I would rather die from my disease than feel ill from these nutrient products"....!) And this happened despite the fact that subjective reports and clinical tests showed that the patients were healing due to ingestion of EM and EM-X, and even though many of these patients had been classified as "terminally ill" by their doctors, and thus, risked losing their lives if they did not take the EM-X or EM.

I note that you labeled some reactions as "apparent increase of uric acid" levels... I truly wonder whether such an increase was measured and documented by a clinician or a medical laboratory based upon blood tests, or rather, whether this was a guess on your part. You see, a classic sign of gout and "too much uric acid" is pain in the joints and bodywide inflammatory response, including muscle pain, and bodily aches and pains -- aka neuralgia, arthralgia, and fibromyalgia. So, many laypersons, when they feel such symptoms, tend to invoke "pop medicine" or "street medicine", and blame them on

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"increased uric acid levels" or "gout", when, in reality, the person may be experiencing some of the most common classic "detox reaction" symptoms.

In such situations, the person may wish to reduce their dosage of EM products, and ESPECIALLY to make ABSOLUTELY sure that they are drinking enough water, at least one-half gallon per day, or more. Detox reactions can be especially painful if the person is dehydrated.

A quick note: while bodily, muscle and joint pain and inflammation are very common detox symptoms, practitioners report that some people experience other detox symptoms such as diarrhea, black foamy volcanic diarrhea full of dead parasites, excessive gas, gut cramps, flu symptoms, fever, rashes or pimples/sores on the skin (classical cleansing symptom), or, if they have a history of abuse of drugs and alcohol, they may experience some mild recurrence (aka retrace) of old symptoms as the toxins clear -- these symptoms may include all kinds of mental and emotional symptoms...

And, as far as the beverage leaving an acid taste in the mouth... well, gee, EM fermented antioxidant brews are an acidic lactic acid-rich product, and if you drink it straight, well, yes, it should result in an acidic taste in the mouth, same as if one drinks yogurt, kefir, eats kimchee, or drinks orange juice. I personally love this taste, but I fully understand that some people may dislike it... This is why some EM products recommend that users consider diluting it in fruit juice, water, or tea if they dislike the taste...

Finally, I have spoken with many persons who regularly drink EM brews, and also with many healthcare practitioners who are using them with their clients, and I also run the EM-Health list, where the 300+ members are almost all drinkers of EM brews, and yet I have never heard anyone complain yet of any true occurrence of "increased uric acid levels" or "gout", although many have acknowledged that in the beginning they hit a period of uncomfortable detox reactions or cleansing symptoms. Indeed, many raw foodists and health nuts deliberately try to intensify cleansing reactions, figuring that they are a beneficial symptom indicating increased rates of healing. To this end, some of my customers and friends -- all of whom were still relative newcomers to EM nutritional product and therefore "should" have been sticking to very low starting dosages such as 1/2 ounce per dose -- have sometimes sat down and drunk one, two, three or four bottles of my brews at once, hoping to push their bodies into a massive healing crisis. A few succeeded; a few others were disappointed that they could not create a massive healing crisis. To each their own...! I regularly drink -- as do many of my friends -- over 20 to 30 ounces per day of concentrated EM brews with no ill effect.

Lastly, I must note with regret that it seems that you may have tried to twist the arms of some of your friends and family members to get them to try EM brews, literally against their will, just because *you* were enthusiastic about it. I feel that this is a horrible idea and a horrible practice. Why not let people run their own lives? I tend to hate missionary zealotry and proselytizing of any kind, and this approach you have reported is sure to turn many folks off and make them feel defensive. If you try to force them to use a nutritional supplement in which they were not interested in the first place, you are setting yourself up for failure, or worse. In general, we all notice far more complaints about detox symptoms from folks who did not purchase the product themselves because of their own informed or intuitive decision to purchase, but rather, who were either given free samples or were

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pressured or forced by well-meaning spouses or family members into trying the stuff to “improve their health”.

Bottom line: Let people make their own choices, do not try to pressure them to try anything “for their own good...”. I remind you that EM brews are the same as any other healthful product – the best results come only when the person taking it has some level of willingness and commitment.

I am considering using clay which I dig from the fields locally in my AEM and brews. Any problems?

This can be done, but unless you are very intuitive or have access to a good lab to do some testing of clay, or are willing to run your own tests/experiments, it can be iffy. Some clays, indeed, many clays, are high in things you do not necessarily want to add to AEM, while low in desirable elements and trace elements. Some even contain high levels of toxic elements. I suggest that you stick with tried and true bentonite nutritional clays.

My batch of EM microbial inoculant culture has a weird smell when I first open it. Could this be because the vendor added some natto bacteria? I hear this is common in some parts of the world!

This “bad smell” phenomenon seems to happen occasionally with batches of EM microbial culture from several vendors, and is likely due to various sulfur-containing substances or butyrates produced by the phototrophic organisms under certain conditions.

When evaluating your batch of EM culture, I suggest that so long as the pH is still below 3.5 or 3.6, and so long as the bad smell passes within an hour after opening the container, it should be fine... In response to your question about natto: I have no idea if some of the EM culture producers add *Bacillus subtilis* var. natto to some particular batches of EM culture. It is true that Dr. Higa played with this organism as an EM adjunct for a while, and I often produce EM-like cultures containing BS v. natto; it is also big in Malaysia, Thailand and parts of India, and a few areas in Japan, and it works better for several applications, including feeding chickens, than normal EM alone. And, it is possible that the natto organisms may introduce, at times, a slightly strange smell. In any case, BS v. natto is often present as a commensal organism on the bran used by all EM manufacturers in their brewing, but may not be as concentrated as when it is added deliberately by a producer. While it is true that natto admittedly does lend a nasty smell to soybeans after it has fermented them (although they are now highly nutritious), I am not convinced that it produces a nasty smell when added to EM used to make AEM or human brews. Many of my EM-like culture lines here contain lots of BS var. natto (aka BSvn) which I have added deliberately, and yet my batches of AEM and human brews do not smell any harsher than other (non-BSvn versions) when brewing.

Funny smells in batches of AEM or brews during early stages

Here are some more thoughts and ideas on funny and bad smells, with some attention to AEM or brews: AEM often smells quite raunchy for the first few weeks of brewing, largely due to presence of weird and transitory thiols, butyrates, hydroxybutyrates, polyphenols,

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heavy alcohols, congeners, fusel oils, etcetera. In fact, the smell can be quite foul for at least the first 2 to 8 weeks (at hotbox temperature), till the pH has dropped well below 3.5 in some cases. Other reasons for nasty smells at times:

- using too much molasses, thus extending length of "bad smell" phase of fermentation
- stray microbes present in water or molasses or container
- variance in batches of molasses, namely in various compounds in the molasses
- presence of oils in molasses

I want to use a higher concentration of molasses and fruit syrups than the standard 5%, or 1:20 ratio. Can I push the Brix score up to about 12 or 15?

I have found in practice that I can usually make successful and stable brews with a Brix of up to about 13 or 14, or even a bit higher, which corresponds to sugar sources by volume of 13% to 18%. However, even though such brews seem -- in my experience -- to be very stable in the bottle while sealed (as long as they were bottled with care under largely-anaerobic conditions), it is true that once they are opened, even if the bottle is refrigerated, then the flavor may degrade noticeably if the person leaves the bottle unfinished for more than 3 weeks (21 days). Of course, this is rather harmless, and simply due to the activity of EM organisms and wild organisms as air gets into the bottles and causes even further fermentation.

Why can't I brew my AEM at very low temperatures?

Why do you say that I would have a higher rate of failures from undesirable organisms which thrive in the cold (psychrophilic organisms)? I would hope that the EM would eventually re-educate/convert any harmful or non-desirable bacteria, perhaps at any temperature above freezing, so long as they were shaken or stirred regularly as you have clearly described as a no-no for batches of grain and bokashi.

Well, bitter experience of many folks shows that failure rate of human EM brews and agricultural AEM drops greatly if done below about 68 F, worse below 50F, unless great care is taken. But yes, it can work, and I have made several successful cold-weather batches. It just takes more care, better ingredients, more ancillary ingredients, and far more time!

Do you happen to know how many and what size containers easily fit into a 55 quart Igloo cooler hotbox?

I realize that the size of the splash-pan dishpans may also affect what size brewing containers can be used!

Yes, I can offer some guidelines here. if you cut two standard size dishpans to size (cut off lips and top 2.5") and squeeze them side-by-side in bottom, then each dishpan will hold a maximum of four one-gallon plastic jugs or 8 or 9 2-liter soda bottles or 17 1-liter soda bottles or 38 hot sauce bottles (for making EM hot sauce in bottles), yielding a maximum count for one converted 65 quart cooler Igloo cooler of any one of the following:

- 8 one-gallon plastic jugs

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- 18 2-liter soda bottles
- 34 1-liter soda bottles
- 76 hot sauce bottles (for making EM hot sauce in bottles)

How many 5 gallon or 6.5 gallon fermentation buckets can I fit in a 55 quart Igloo cooler hotbox?

Once you get up close to an Igloo 55 quart (or 56 thru 58 quart label) cooler and take a look at it, you will know the answer to this question – none at all! Such buckets will not fit in this cooler hotbox! However, one four or 4.5 gallon bucket with a tight-fitting lid (the type in which bulk fruit concentrates and jellies are shipped to distributors) will fit neatly.

I recently opened some bottles of your research-grade Sootheox™ Golden Bran Kelp™ brew. I really like the somewhat salty fishy finish and flavor. How did you achieve this?

It is due to massive quantities of granulated kelp (and also bran) used in the original fermentation, along with some sea salt. Some people dislike this fishy or seaweed-like taste, while others love it!

In the ESP (extended secondary process) version of your research-grade Sootheox™ Golden Bran Kelp™ brew, is the wonderful milkier (more opaque) quality of the GBK ESP due to its longer fermentation, or is it incidental?

This was due to all the following factors:

- higher percentage of suspended solids due to the second fermentation process and the (drain liquid/mash thru mesh) decanting process
- longer (actually a second) fermentation
- due to partially-aerobic nature of second fermentation

Endnotes

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Appendix A

Vendor of EM Microbial Inoculant Culture

SCD World, aka Sustainable Community Development

Product name: Efficient Microbes(EM)TM microbial inoculant culture

Producer: Matthew Wood, a Managing Partner of SCD, is the only person from North America to have completed the entire program of graduate study and earned Master's of Science Degree in Dr. Higa's laboratory at the University of the Ryukyus, in Okinawa, Japan; where he learned advanced methods of brewing and using EM. SCD's microbial inoculant culture is produced by a food-grade laboratory in Kansas City with several scientists and technicians on staff who have benefited from Matthew's graduate training under Dr. Higa. Other EM-related products marketed by SCD World are from various manufacturers and producers in Japan and the USA.

Other EM-related products carried: Dried bokashi, EM ceramic powder, EM ceramic shapes, EM-X, pH paper and Garden of Life nutritionals. SCD is the exclusive distributor for Fervita EM-fermented antioxidant brews.

Contact information:

SCD World
Post Office Box 15155
Kansas City, Missouri 64106-0155 USA
phone: 913-541-9299
FAX: 816-876-2261
e-mail: info@scdworld.com
website: www.scdworld.com

Discount Note: For a 7% discount on all products, please mention my discount code of **VP2004**

Appendix B

Notice and Disclaimer

The primary intent of this document is to disclose and discuss some advanced hints and tips for brewing high-quality batches of AEM and EM brews for human or animal use, and little, if any space, is devoted to applications or uses of EM, whether in human nutrition, animal nutrition, agriculture, soil treatment, waste treatment, septic treatment, treatment of polluted waterways or bodies of water, or toxic waste remediation. Nonetheless, a few such possible uses may be referenced at times incidentally. Please be advised that a few of the potential uses and applications for AEM and other EM secondary products which are discussed herein may be contrary to regulatory rules or guidelines in your country, state, province, county or region. Further, some practices may be frowned upon by qualified health professionals (particularly in the realm of livestock or soil use use), and some practices could be dangerous to human health, or could be dangerous to animal health (or crop health!) if performed or processed incorrectly. This document is offered for educational and informational purposes only. If you choose to use EM-type microbial inoculants, any secondary products such as AEM, or any other microbial inoculant products in any way for any application, you must first check with your local and national regulations to ensure that your planned use complies with all applicable rules and regulations in your area. If you choose to use EM secondary products such as EM fermented antioxidant brews for any purposes involving ingestions by humans or animals (or placement upon skin, etc.), I recommend that you exercise extreme care in your procedures, and that you first research all relevant information available in the literature and on the web carefully, and, for animal use, review what the regulatory guidelines for your country or region recommend, as regulatory agencies in some regions prohibit use of EM in farm animals to be used for food purpose.

Further, and once again, if brewing EM products for human or animal consumption, you will also wish to employ common sense and careful techniques. And, if brewing AEM or brews for animal consumption, please ensure that all ingredients used are of at least animal feed-grade, if not human food-grade quality. If brewing EM brews for human use, please ensure that all ingredients and containers uses are of human food-grade quality.

Any statements and opinions offered in these pages are my opinions only offered in reportorial and informational mode, and do not reflect in any way the views of the originator of EM, Dr. Teruo Higa, nor of any of the producers, vendors, distributors or resellers of any EM-type microbial inoculant cultures or other EM products. All opinions and statements remain my own reportage and opinions, and at times my opinions and/or practices may differ wildly from those of any the producers, vendors, distributors or resellers of any EM-type microbial inoculant cultures or other EM products. Neither the author, publisher nor distributors accept any responsibility for your results; you use all information at your own risk. All uses and applications and consequences thereof remain solely your own responsibility.

There are no guarantees offered or implied on any of the techniques, methods or formulations offered in this book, nor on or for any results you may or may not

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have. EM-type technology is based on living microbes, and is thus part art, part science, and your results will also be dependent upon the particular ingredients which you choose to use, their quality, and the microbes present in them. Your results may vary, and in truth, even major producers of commercial EM products sometimes spend months brewing a batch of EM culture, only to decide it does not meet their standards, at which point they choose to pour it down the drain rather than market it. And, even folks brewing elementary and simple versions of AEM and brews occasionally hit bad batches. So, even basic and simple methods can sometimes yield variant results in the magical world of beneficial microbes, and, of course, playing with advanced techniques can introduce even more risks of possible occasional bad batches or weird batches. This is all part and parcel of being an intermediate or advanced brewer of EM: you are willing to experiment and play and to learn from your experiments and experiences.

This Disclaimer is also displayed in the early part of the main body of this book.

Appendix C

Vendors and Sources for Brewing Ingredients

Blackstrap Molasses

If you use blackstrap molasses in quantity, I suggest that you do not purchase it from supermarkets or natural food stores, but rather from feed and grain stores (if animal feed-grade) or bulk molasses suppliers, which usually sell for both human food-grade and animal feed-grade. You may be able to find a local (within 100 miles) bulk molasses supplier via your telephone book yellow pages, or via an online search for molasses vendors.

As one example of such vendors, let me tell you where I purchase my molasses:

I purchase all of my human feed-grade molasses in 5 gallon buckets from **Golden Barrel** (a division of **Zook Molasses**), near Lancaster, PA, at www.goldenbarrel.com/ or 800-327-4406 (if you decide to use this source, ask for Ron in the *Golden Barrel* division, and mention my name, so he knows the type you want.) A 5 gallon bucket costs about \$18.50. A 5-gallon bucket of clean, chemical-free, additive-free animal feed-grade molasses from their *Zook Molasses* division costs about \$16.50.

I usually purchase all of my animal feed-grade blackstrap molasses from a local feed and grain store (a **Southern States** store) whose molasses quality I have researched very carefully, going all the way back to the original vendor and downline distributors and shippers. Price per gallon (it is sold by the pound; you supply your own bucket and lid) comes to anywhere from \$1.02 to \$2.69, or about \$6 to \$13 for 5 gallons, depending upon current market price. Obviously, purchasing blackstrap molasses in larger bulk sizes, such as 55 gallon barrels and 275 gallon totes, or by the tankerful, yields an even far lower price per gallon (or pound.)

Please remember two things when purchasing blackstrap molasses, as noted in main body of this book:

- 1) If purchasing feed-grade blackstrap molasses from a feed and grain store or a molasses vendor, please be very careful to purchase only a feed-grade blackstrap molasses which is totally free of preservatives, chemicals, free-flowing agents, anti-mold chemicals, anti-fungal chemicals, and oils. Many types of feed-grade blackstrap molasses are mixed with such substances, and it will be your job to check with your vendor and their suppliers to ensure that you are purchasing only pure feed-grade blackstrap molasses.
- 2) Blackstrap molasses weighs considerably more than water; it weighs 11.9 pounds per gallon.

Beet Molasses, De-Sugared Beet Molasses (aka Raffinate, Concentrated Separator By-product, CSB)

Most of these products are available in animal feed-grade only, and available at many feed and grain stores in bulk quantities or in 50 pound bags (dry materials).

Unfortunately, these products are often not readily available outside the Midwest (USA)

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and other areas where there is high concentration of beet farming and beet sugar processing plants, but most feed and grain stores can special order some if you wish to play with it. But, be sure that you carefully check the product quality and composition to make sure that it is only beet molasses (aka beet sugar molasses) or only de-sugared beet molasses (aka *Raffinate*, *Concentrated Separator By-Product*, or *CSB*), e.g., that it is pure, and that no other substances such as oils, anti-mold agents, preservatives or antibiotics, etc, have been added. Some versions of the desugared product will have been mixed with betaine (usually in the form of betaine hydrochloride or trimethylglycine), which is simply a rather innocuous vitamin-like nutritional supplement which is a part of the extended B-vitamin family, and rather harmless. And, in any case, the EM organisms will likely convert the synthetic betaine to an even more helpful live form.

Fruit Juice Concentrates

Blueberry, Cherry and Pomegranate Juice Concentrates

Brownwood Acres Foods

I wholeheartedly recommend the blueberry juice concentrate, cherry juice concentrate and pomegranate juice concentrate sold by Brownwood Acres Foods. Prices are very good for these high-Brix (most are around 68 Brix) concentrates, and service and speed are excellent.

phone: 877-591-3101, Monday through Friday, 8:30 to 5:00 EST

website: www.brownwoodacres.com/

Elderberry Juice Concentrate Sources

Nature's Flavors

A source which looks real good so far for small quantities is Nature's Flavors, at 888-704-4900

Nature's Flavors: Red Elderberry Juice Concentrate

Red Elderberry Juice Concentrate, Sizes: 1 qt. (\$38.99), also 1 gallon

Options: Sizes: 1 qt. (\$38.99)

www.naturesflavors.com/product_info.php?products_id=3361

Herbal Remedies, dba HerbalRemedies.com

Another vendor, but with smaller sized bottles (12.5 oz.) and higher prices, is:

Herbal Remedies.com, at 866-467-6444

Elderberry Juice Concentrate - 12.5 fl. oz., \$23.99 or 2 for \$44.99

www.herbalremedies.com/elcon125oz.html

Barley Malt Syrup

Barley malt syrup, aka *barley malt extract* in the beer brewing world, may be purchased in liquid syrup form from any beer or wine homebrew supply vendor (especially brick-and-mortar stores); many have it on tap from kegs in various colors/strengths. Be sure, as noted in main body of book, to only purchase liquid barley malt syrup, and not the dried powder. For more information, please see *Appendix C*.

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Kelp Granules, aka Kelp Meal

The most convenient form of kelp -- and most affordable -- for this kind of work is, in my opinion, the kelp granules, aka kelp meal, which are marketed under two different names, each for a different niche market:

1) "Kelp granules" -- The stuff is marketed as "kelp granules" for the human natural foods market. Most natural foods stores, if they carry this stuff, carry only 1.5 ounce bottles, and it is pricey -- yuck! However, if you go out on Google and search for the term "kelp granules", you will find hundreds of phone/mail order vendors selling organic-quality kelp granules in 1 lb. size for anywhere from \$3.50 to \$15.00 per pound. I have appended a few potential online vendors below.

2) "Kelp meal" -- In the organic animal feed market, the same stuff is called "kelp meal" (and three to 350 times cheaper than the stuff sold in natural foods stores!). So, if you want the stuff in large bulk quantities, for animal or soil use, Fertrell and a few other organic feed and feed supplement dealers carry 50 pound bags of kelp meal (really much the same stuff as the "kelp granules" sold to the human market), many brands of which are fully organically certified for use in animal and livestock feed intended to human food chain, for about \$23 per bag. In fact, I know of many cases where folks (small health food stores, etc.) have simply bought such bulk kelp and re-sold it in smaller bags or bottles for human consumption, and all the organic grass-fed farmers I know eat this bulk kelp as a livestock feed supplement and feed it to their families as well.

A few online vendors for "kelp granules", which is the name used in the natural foods niche market:

http://www.seaveg.com/kelp_granules.html

Kelp Granules - Certified Organic

The Kelp granules are sustainably harvested and certified organic by QAI. We also voluntarily test for heavy metals, herbicides, pesticides, PCB's, fuel oil, and microbiological contaminants.

\$2.25 1.5 oz.

\$6.25 1 lb.

<http://www.kalyx.com/store/proddetail.cfm/ItemID/2820.0/CategoryID/12500.0/SubCatID/210.0/file.htm>

Kelp Granules (hand harvested off the NW Coast of Iceland) 1 lb.

Kalyx Fulfillment Center ships only to the USA and Canada

\$11.35 for 16 ounces

<http://www.mothenature.com/shop/detail.cfm/sku/01403>

Kelp - Granules

1 lbs, Brand, North American Seasonings

Item #01403; Usually ships in 24 hours

\$3.50 1 lb.

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Bentonite Clay Rock Dusts and Other Rock Dusts

I recommend most highly Azomite bentonite clay rock dust from Utah, as well as smaller amounts of Pascalite clay (which is a rare calcium bentonite clay) from Wyoming. It is fine to use other bentonite clay rock dusts as well if you wish to experiment, but be cautious – some may have high amounts of available Ca and other alkaline ions, which can, in any quantity beyond 1/3 teaspoon per gallon, seriously retard the pH drop of a batch. This is also an issue with powdered Mezotrace rock dust, which is a variant form of limestone – it is very high in available Ca and other alkaline metal ions, and too much can kill a batch due to pH drop retardation. Some sources follow:

Azomite Bentonite Clay Rock Dust

Very inexpensive. You will pay more for UPS shipping costs for a 40 or 50 pound bag than you will pay for the bag of rock dust clay itself. Available in two labeled grades: soil and livestock feed grade powder (dust) Use only the powdered the livestock feed grade, it is also a bit cleaner than the lower soil grade (which is sometimes pelletized nowadays – avoid it!), but still very inexpensive.

Main website for the producer, plus list of their distributors (who will all ship within US and Canada), at www.azomite.com For other countries, do a web search on Google – it is well-distributed over much of the world, or call the parent company, Peak Minerals, via the number on the Azomite website.

Pascalite Clay

Pascalite clay powder is sold for human use, as a food grade product in 4 ounce and 1 pound plastic bottles, and is far more expensive than Azomite, averaging \$9 for a one-pound bottle. Wonderful stuff, but use sparingly.

For Pascalite, vendors change constantly, so simply go to Google and do a web search on [Pascalite clay] to find vendors in your area or who will ship to you.

Paramagnetic Rock Dust

I cannot really give you many brand names and sources here, as the vendors and brands -- and their contact information -- change often, but here are a few brand names:

- Summa Mineral Rock Dust
- Planters II (aka Planters 2) rock dust, available from many organic gardening/farming suppliers, including Mother Earth Organics in PA , at www.motherearthorganics.com/pricing/pricing.htm
- Mineral Rock Dust (a very generic name; the brand here indicates one available from Mother Earth Organics, a farm/garden distributor in PA ; link above.)
- Gary Wilson's paramagnetic basalt rock sand from Canada. His USA distributor is Doug Murray in Paw Paw, MI, at 269-674-3078. I believe he sells 25 lb. boxes for \$10 plus UPS shipping....
- Black Lava Rock Dust or Sand
- Lava Sand
- Agrowinn
- There is also AdzsumPlus™, a product from Jared Milarch's Earth Plus company, which combines Azomite with paramagnetic basaltic rock sand from the Canadian Shield. However before you order this product, first speak with Jared to ensure that these are the only two components of his current formulation, as at times he has also added organic fertilizers as well; two links follow:

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www.earthplusproducts.com and
www.championtrees.org/topsoil/Adzsum.htm

For other sources, I suggest a web search on Google on the terms in the title of this subsection. However, in general, most bentonite clays and limestones have little paramagnetic properties, and most basaltic dusts, sands and gravels, and also some lava sands, have good paramagnetic properties.

Prehistoric Liquid Colloidal Minerals from Humic Shale

I feel that the best brand, and also quite inexpensive, for using in AEM and brews is "Coenzyme Minerals" liquid, from Enzymes International in Wisconsin, USA. Contact info:

Enzymes International
Hwy 51, PO Box 157
Manitowish Waters, WI 54545
phone (715) 543-8401
no known website

Molybdenum Trace Element Nutritional Supplement Tablets

To find the best suppliers which will ship molybdenum trace element nutritional supplements to you, use the **Froogle** shopping search engine at **Google**, and search on Molybdenum. You will find dozens of brands and suppliers.

Natto Starter Culture

The best single source for natto starter culture which I have found in the USA is G.E.M. Cultures in CA, at:

http://www.gemcultures.com/soy_cultures.htm

Send check or money order (they do not take credit cards or C.O.D. orders) with your written order to:

G.E.M. Cultures
30301 Sherwood Road
Fort Bragg, CA 95437 USA

From their online catalog:

Commercial Natto Starter A concentrated spore preparation, this vial has sufficient spore to start 48 pounds of dry soybeans making about 86 pounds of natto.

Natto Starter Kit makes 4.5 pounds \$2.50

Commercial Natto Starter makes 86 pounds \$11.00

Malic Acid Powder

Food-grade malic acid powder may be purchased from any beer or wine homebrew supply vendor (especially brick-and-mortar stores); many have it for sale in small one or two ounce bottles for a dollar or two, plus bulk bags. For one example of a homebrew supply shop, please see the mention of **Flying Barrel** homebrew supply in *Appendix D*.

Appendix D

Vendors and Sources for Brewing Supplies, also Testing Laboratories

An Introduction to Homebrew Supply Shops

Please remember, much as mentioned in the main body of this document, that (beer and wine) homebrew supply shops (brick-and-mortar, phone/mail order, or online) will be one of your primary potential sources for fermentation and bottling supplies such as:

- fermentation buckets with spigots, usually in 4, 5 6.5, 8 and 15 gallon sizes
- fermentation bucket lids, with holes for airlocks
- fermentation carboys, usually in 5, 6 and 15 gallon sizes
- fermentation kegs, with spigots, often up to 15 or 20 gallons in size
- spigots for buckets and kegs
- air locks, such as the U-shaped and double U-shaped bubble locks mentioned in text
- pressure-relieving caps for PET soda bottles, such as OzTops and Ez Caps
- heat wrap tape for fermenters
- sampling tubes
- bottom filling stems or tubes for filling secondary containers or bottles
- auto-start siphons, aka auto-siphons or self-start siphons, also tubing
- sterilants such as Iodophor
- amber glass beer and champagne-style bottles
- amber plastic PET beer-style bottles (more on these below)
- pH test paper
- CO2 tanks, regulators, and tubing for purging; small CO2 and nitrogen cylinders.
- Anaerobic dispensers -- kegs, Party Pigs, Tap-A-Draft system, Cubitainers
- food-grade malic acid
- Brix meters and floating hydrometers for measuring specific gravity (SG)

Since a number of folks – both local and across the USA – have asked me for leads to good homebrew supply vendors which have all of the above products, including the hard-to-find amber plastic PET beer-style bottles -- here are recommendations for two great sources within the USA with fast service and good prices, and cheap shipping:

Flying Barrel homebrew supply

If you need any of the above-listed products, including amber plastic PET beer-style bottles in 500 ml or 1 liter sizes, I can recommend ***The Flying Barrel*** homebrew supply shop in Maryland. His prices are among the cheapest, and Bob can ship the very light bottles via US Mail, which costs almost nothing. If you contact him, please mention my name (Vinny Pinto) so Bob will understand that your needs are for brewing EM, and not for beer use! And, if you mention my name, Bob will throw in the bottle caps for free.

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Contact information:

Flying Barrel homebrew supply
103 S. Carrol St.
Frederick, MD 21701
Phone: 301-663-4491
FAX: 301-663-6195
e-mail: mfrank2923@aol.com
website: <http://www.flyingbarrel.com/>

Over a dozen local brewers of EM fermented antioxidant brews and AEM already purchase their supplies from Flying Barrel. If you have a hard time reaching Bob by phone, please check his shop hours on the "Hours" page of his website, as his hours are not the 8AM to 8 PM hours of large mega-stores.

The Brew Haus of Cazenovia homebrew supply

A good and inexpensive supplier is The Brew Haus of Cazenovia, but I have been advised that he may be ceasing marketing of some products unless purchased in bulk (case lots):

Brew Haus
RR 2
Cazenovia, NY 13035
Phone: 315-662-7888
e-mail: donfeola@cazbrewhaus.com
website: <http://donfeola.tripod.com/>

Very inexpensive, and a very reliable guy and company, but shipping (time which passes before shipping...) may be a bit slow!

Fermentation Containers and Bottling Supplies

Your primary source will be homebrew supply shops; please see relevant section above.

Other sources for fermentation containers of smaller sizes (5 gallons and below) are noted in the section on *Fermentation Containers* in the main body of this book.

Please remember that if some of your batches of AEM or brews will be High-Light (HL) versions or High-Red (HR) versions, then you will want to use containers with transparent or at least translucent walls (with at least 35% light transmission) which will pass large amounts of light.

Fermentation Barrels

15 gallon food-grade Plastikegs and 55 gallon food-grade barrels may be purchased new from a wide variety of online vendors, along with spigots and pumps for the bung holes.

Further, if you look diligently in your area, you may often be able to find empty, used surplus food-grade plastic 15 gallon Plastikegs and 55 gallon barrels for prices ranging from \$3 to \$10 each, often from local food packaging or bottling facilities which receive many of their ingredients in food-grade 55 gallon barrels. As an example, a local bottling facility which bottles soda pop often sells empty 55 gallon food-grade plastic barrels in

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which cola syrup was shipped, for \$3 apiece. And, a local bottling facility which bottles and markets apple cider, apple butter, jams and jellies, sells used empty food-grade 55 gallon plastic barrels (in which syrups and concentrates were shipped) for \$9 apiece. They are available in both the style which has two bungholes on top, and also in the style with a full diameter wide mouth, along with a full-diameter airtight lid and sealing clamp, included.

Many brick-and-mortar homebrew supply stores and microbreweries, if they sell or use barley malt syrup on tap, will have lots of empty food-grade 15 gallon Plastikegs available, often for about \$10 apiece. As an example, my local homebrew supply shop, which has 7 kegs of barley malt on tap, often sells me used empty 15 gallon Plastikegs for \$10 each.

Lastly, you can, if needed, always purchase 15 gallon, 30 gallon and 55 gallon food-grade plastic barrels new, from any of dozens of online suppliers, but then you must pay shipping. Many online and local vendors specializing in safety, survival and emergency supplies often stock 15 gallon and 55 gallon water barrels and supplies for them (spigots, pumps, etc.) as well. Of course, make sure they are food-grade if intended for human brews.

One great online vendor is Baytec; their barrel webpage may be found at:

<http://shop.store.yahoo.com/baytec/barrels.html>

A few more possible online vendors:

www.safetycentral.com/55galwatstor.html

www.safetycentral.com/15galwatbar.html

www.crd.bc.ca/water/waterrecycling/rainbarrels/suppliers.htm

www.ne-design.net/water-storage-barrel.html

www.bayteccontainers.com/rechigdenpol.html

www.plastmo.com/y2kh20.html

Hand Pumps, Spigots, Bung Cap Wrenches, Accessories for Barrels

Many online and local vendors specializing in safety, survival and emergency supplies often stock not only 15 gallon and 55 gallon water barrels, but also a complete line of supplies for them, such as spigots, pumps, and bung cap wrenches as well.

One great online supplier for both barrels and accessories is Baytec; their main accessories webpage may be found at:

<http://shop.store.yahoo.com/baytec/accessories.html>

You may do a web search at Google to find even more suppliers or local suppliers.

PET Plastic Beer-Style Bottles With Replaceable Screw Caps for Bottling Brews

Some homebrew beer supply shops -- brick-mortar and online -- sell PET amber plastic beer-style bottles, in 500 ml and 1 liter sizes.... However, many folks seem to have a hard time finding such suppliers... so please see the section above on homebrew suppliers, which contains a few suggestions as well for suppliers.

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When ordering, remember to order the caps separately, as they are sold separately and do NOT come with the bottles.

BTW, the PET amber plastic beer bottles sold by homebrew supply stores such as *Flying Barrel* and *Brew Haus* are made by a large producer named **Constar**, located in NC (USA); they do NOT sell retail, and only sell to major vendors and distributors, but if you are interested in learning more about their bottles, their site may be found at:

<http://www.constar.net/>

Pressure-relieving Caps for Fermenting in Plastic PET Soda Bottles: Oztops, Ez Caps, etc.

Pressure relieving screw caps for use while fermenting in PET plastic soda bottles are sold under a number of names on the homebrew market, but the best-known brand name is OzTops, aka Oz-Tops. A goodly amount of homebrew supply shops sell OzTops, and many online homebrew supply vendors on the web sell them as well via mail order. Some OzTops links to get you started:

- www.oztops.com.au/
- www.mrbeeruk.com/Oztops1.htm
- www.mrbeer.co.uk/home.htm
- www.yourhobby.com/homebrewing/
- www.milehidistilling.900footalien.com/yeast.htm
- https://bne022u.server-secure.com/vs41823_secure/ssl.htm
- www.info.product-finder.net/homebrew/OzTops.html

if you need other sources, simply do a Google search on the terms [OzTops OR Oz-Tops homebrew]

Cubitainers

Many homebrew supply shops, including the Flying Barrel, which as listed above, offer Cubitainers and spigots. Please be aware that you often need to order Cubitainers and spigots separately.

One additional source of Cubitainers follows. At one time, I tried a few local distributors of Cubitainers recommended by Hedwin/Hedpak (who is the manufacturer), but these distributors were not interested in handling small-lot orders, and it was obvious that they knew nothing about Cubitainers at all, nor did they care. I eventually found one online/phone vendor of Cubitainers to supplant the earlier-mentioned homebrew supply shops, as follows:

BA-Industrial (in Oklahoma, USA)

phone: 918-696-5998

website: www.ba-industrial.com/hedpak.htm

For many sizes of Cubitainers, you will need to order the box, the plastic sack and the spigots separately.

Of course, you can also just order your EM culture in 1 gallon or 5 gallon Cubitainers and then re-use them for your own batches of AEM and brews!

Hotbox/Incubator Supplies

Rigid Plastic Insulated Picnic Coolers

Rigid insulated picnic coolers with hinged top lids are available in various sizes from 25 quart to 200 quart. They are sold seasonally in discount stores and department stores, and year-around in sporting good and outdoor stores.

Igloo Brand Picnic Coolers

Many folks end up using the Igloo coolers labeled as 54 quart, 55 quart, 56 quart or 57 quart (really all the same model, but I suspect that the marketing person who designs the labels has some attention-span deficits!) These coolers work well, are well-insulated, and cost under \$20. Best, the two most common sizes of ExoTerra terrarium substrate heaters fit easily in the bottom or near the bottom of these coolers.

Igloo also makes a larger model cooler, usually labeled at about 96 to 110 quarts, which they claim is even better-insulated, and which, of course, has even greater capacity than the 56 quart model.

Terrarium Substrate Heaters

Remember to keep them from direct contact with liquids, and to protect them from leaks and spills via using dishpans or splash pans above the heater element! These terrarium substrate heaters do operate on 120 VAC, so exercise prudent care to prevent shock and fire!

These heaters may be purchased from any brick-and-mortar or online pet supply shop which sells aquarium or terrarium supplies. Some examples follow:

ExoTerra (Exo-Terra) Heat Wave

Terrarium Substrate Heater

12" x 11", (flat, less than 1/8" thick)

16 Watts, 120 VAC

This size usually fine for 26 quart thru 65 quart Igloo coolers and similar well-insulated brands of picnic coolers. Also fine for use in bottom of 20 gallon to 36 gallon trash pails, if well-insulated.

ExoTerra (Exo-Terra) Heat Wave

Terrarium Substrate Heater

12" x 18", (flat, less than 1/8" thick)

25 Watts, 120 VAC

This size usually fine for 50 quart thru 60 quart Igloo coolers and similar well-insulated brands of picnic coolers, if located in a very cool room, or for 70 quart to 130 quart picnic coolers in warmer rooms.

(I suggest that you sandwich a terrarium heater between two 12" x 12" ceramic flooring tiles, tape tiles together with duct tape. The tiles protect the heater and act as thermal reservoir,)

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Frankly, as mentioned in the text, I often use one or two of these heaters even on insulated 55 gallon barrels, either taped to the side near the bottom, or even placed under the barrel (with suitable precautions taken to protect the plastic feed for the AC line cord.)

Aquarium Heaters

For large areas to be heated, such as an insulated 6 foot by 6 foot by 5 foot box, or an insulated closet or room, some folks choose to use a thermostatically-controlled 100 watt aquarium heater in a 5 gallon bucket of water, or even two or three such buckets. The heater warms the water in the bucket, which then heats the room. Such aquarium heaters are sold in all pet supply stores and aquarium stores. Many brands will not allow temperatures to go above 88 F, so be sure to pick a brand which allows temperatures of up to at least 94 degrees F, and preferably up to 102 degrees F (about the highest which any models reach...)

Heat Belts

Many homebrew supply stores sell 25 watt and 50 watt lengths of heat belts – designed to be wrapped around the exterior of a large (10 gallon or larger) barrel.

By the way, many heat tapes sold for wrapping pipe which are sold in the plumbing aisles for keeping pipes warm in cold weather contain an integral thermostat which allows them to operate only when the ambient air temperature is below 35F. You do not want to purchase those models.

pH and ORP Meter Supplies, Calibration Solution

Combination pH/ORP meters

These combination meters are often the best buy, and a number of models are quite robust and reliable, and best, many models are portable and will handle quite a bit of abuse. Again, as I have warned in the main body of the book, I strongly suggest that you avoid the small inexpensive pen-style or pocket sized (much like a fat rectangular pen) digital models. Yes, they are very inexpensive, but they are usually so poorly made that they will not last nor stay accurate for more than two months. In general, try to avoid most portable models sold by swimming pool supply companies.

Whether you are looking at bench-top meters or portable meters, I feel that I have always had the best successes with meters from Hanna. Two excellent portable models which they make are the *Hanna Waterproof pH/ORP and Temperature Meter* (about \$340) and the

Hanna HI8424 Multifunction Meter (3 in 1 meter; about \$240.)

If you wish to purchase a meter, I recommend you research the available models a bit on Google, and then use either Google or their Froogle service to find vendors.

pH Meters

As I have warned in the main body of the book, I strongly suggest that you avoid the small inexpensive pen-style or pocket sized (much like a fat rectangular pen) digital models. Yes, they are very inexpensive, but they are usually so poorly made that they will not last nor stay accurate for more than two months. About the only pen-style model in this style

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which I have encountered which seems quite robust and hardy is the *Hanna pHep 5 pH meter*. And, in general, try to avoid most portable models sold by swimming pool supply companies.

Whether you are looking at bench-top meters or portable meters, I feel that I have always had the best success with meters from Hanna.

If you wish to purchase a meter, I recommend you research the available models a bit on Google, and then use either Google or their Froogle service to find vendors.

pH calibration solution

Thousands of vendors of supplies for farming, gardening, aquariums and hydroponics, as well as all laboratory supply houses, sell pH calibration solution (see also *Appendix D* for more notes on sources), both in pre-measured 10 ml to 50 ml pouches (aka sachets) and in half-liter and one liter bottles, and the pH calibration solution is commonly available for pH 4.0 (or 4.01), 7.0 (or 7.01), and 10.0 (or 10.01). For our needs, the 4.0 (or 4.01) pH and 7.0 (or 7.01) pH calibration solutions will be needed; the 10.0 less so.

Since pH calibration solution is inexpensive and is carried by many thousands of vendors, the easiest way to purchase it is to go to Google and use their Froogle shopping service, entering [pH calibration solution] in the search box. I personally recommend purchasing the solutions in sachets (pouches); usually a box of a dozen sells for about \$15.

Inert Gases Such as CO₂, Nitrogen, For Purging Headspace

A few sections in the text mentioned the possibility of using an inert gas such as food-grade carbon dioxide (CO₂) or nitrogen gas (N) to purge headspace of fermentation containers (which are doubling as storage containers) from which liquid is being slowly removed, or from storage containers which have developed a large headspace as contents have been removed.

Homebrew Supply Shops

Many homebrew supply shops – including *Flying Barrel* homebrew supply listed above -- sell cylinders of CO₂ gas in varying sizes – some even sell small cylinders of nitrogen gas, for use in purging and flushing. These homebrew shops also sometimes sell the regulators, but most commonly, you will need to go to your nearest tank air and gas supplier to purchase the appropriate regulator for the tank. These air and gas vendors are where you will also go to get your tanks refilled. They also sell flexible plastic tubing for use in feeding the gas.

By the way, if your needs for inert gas are very small volume, such as an occasional 2 gallon headspace, some homebrew supply shops also sell small disposable CO₂ (and nitrogen) cylinders of the type used in soda machines and air guns, along with small inexpensive trigger devices which attach to them and allow feeding the gas via tubing to where it is needed. Indeed, *Flying Barrel*, listed earlier in this Appendix, offers such devices.

Air and Gas Tank Suppliers

All air and gas suppliers which sell various types of gases in tanks offer CO₂, nitrogen and other inert gases (helium, argon, etc.) in food-grade quality, along with regulators.

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Usually they will lease you the tanks for a small fee up front and a small monthly fee, while you will need to purchase regulators outright.

Testing Laboratories

Antioxidant Testing Labs

Contact Information for Brunswick Labs – Sending Samples

Brunswick Laboratories is located in Massachusetts in the USA.

Phone: 508-291-1830

e-mail address: info@brunswicklabs.com

website: www.brunswicklabs.com/

They offer a complete list of tests, services and pricing in a PDF file available for downloading via their website – download the **Ordering** file.

Note: If you plan to send samples to Brunswick, please contact them via phone first to arrange permission to ship, exact pricing, and to arrange payment!

Appendix E - Table Percent by Volume: Ingredients to Common Measures

Percent by Volume of Brew to Measure Equivalences															
	<i>tsp</i>	<i>tbsp</i>	<i>tbsp</i>	<i>tbsp.</i>	<i>tbsp</i>	<i>tbsp</i>	<i>tbsp</i>	<i>oz.</i>	<i>oz.</i>	<i>oz.</i>	<i>oz.</i>	<i>oz.</i>	<i>oz.</i>	<i>oz.</i>	<i>pints</i>
<i>% by</i>	<i>per</i>	<i>per</i>	<i>per</i>	<i>per</i>	<i>per</i>	<i>per</i>	<i>per</i>	<i>per</i>	<i>per</i>	<i>per</i>	<i>per</i>	<i>per</i>	<i>per</i>	<i>per</i>	<i>per</i>
<i>Vol-</i>	<i>one</i>	<i>one</i>	<i>4</i>	<i>5</i>	<i>6.5</i>	<i>15</i>	<i>55</i>	<i>one</i>	<i>one</i>	<i>4</i>	<i>5</i>	<i>6.5</i>	<i>15</i>	<i>55</i>	<i>55</i>
<i>ume</i>	<i>gal.</i>	<i>gal.</i>	<i>gal.</i>	<i>gal.</i>	<i>gal.</i>	<i>gal.</i>	<i>gal.</i>	<i>quar</i>	<i>gal.</i>	<i>gal.</i>	<i>gal.</i>	<i>gal.</i>	<i>gal.</i>	<i>gal.</i>	<i>gal</i>
								<i>t</i>							
0.01	0.08	0.03	0.10	0.13	0.17	0.38	1.41	0.00	0.01	0.05	0.06	0.08	0.19	0.70	0.088
0.02	0.15	0.05	0.20	0.26	0.33	0.77	2.82	0.01	0.03	0.10	0.13	0.17	0.38	1.41	0.176
0.03	0.23	0.08	0.31	0.38	0.50	1.15	4.22	0.01	0.04	0.15	0.19	0.25	0.58	2.11	0.264
0.04	0.31	0.10	0.41	0.51	0.67	1.54	5.63	0.01	0.05	0.20	0.26	0.33	0.77	2.82	0.352
0.05	0.38	0.13	0.51	0.64	0.83	1.92	7.04	0.02	0.06	0.26	0.32	0.42	0.96	3.52	0.440
0.06	0.46	0.15	0.61	0.77	1.00	2.30	8.45	0.02	0.08	0.31	0.38	0.50	1.15	4.22	0.528
0.07	0.54	0.18	0.72	0.90	1.16	2.69	9.86	0.02	0.09	0.36	0.45	0.58	1.34	4.93	0.616
0.08	0.61	0.20	0.82	1.02	1.33	3.07	11.26	0.03	0.10	0.41	0.51	0.67	1.54	5.63	0.704
0.09	0.69	0.23	0.92	1.15	1.50	3.46	12.67	0.03	0.12	0.46	0.58	0.75	1.73	6.34	0.792
0.10	0.8	0.3	1.0	1.28	1.7	3.8	14.1	0.0	0.1	0.5	0.64	0.8	1.9	7.0	0.9
0.20	1.5	0.5	2.0	2.56	3.3	7.7	28.2	0.1	0.3	1.0	1.28	1.7	3.8	14.1	1.8
0.40	3.1	1.0	4.1	5.12	6.7	15.4	56.3	0.1	0.5	2.0	2.56	3.3	7.7	28.2	3.5
0.60	4.6	1.5	6.1	7.68	10.0	23.0	84.5	0.2	0.8	3.1	3.84	5.0	11.5	42.2	5.3
0.80	6.1	2.0	8.2	10.24	13.3	30.7	112.6	0.3	1.0	4.1	5.12	6.7	15.4	56.3	7.0
1	7.7	2.6	10.2	12.80	16.6	38.4	140.8	0.3	1.3	5.1	6.40	8.3	19.2	70.4	8.8
2	15.4	5.1	20.5	25.60	33.3	76.8	281.6	0.6	2.6	10.2	12.80	16.6	38.4	140.8	17.6
3	23.0	7.7	30.7	38.40	49.9	115.2	422.4	1.0	3.8	15.4	19.20	25.0	57.6	211.2	26.4
4	30.7	10.2	41.0	51.20	66.6	153.6	563.2	1.3	5.1	20.5	25.60	33.3	76.8	281.6	35.2
5	38.4	12.8	51.2	64.00	83.2	192.0	704.0	1.6	6.4	25.6	32.00	41.6	96.0	352.0	44.0
6	46.1	15.4	61.4	76.80	99.8	230.4	844.8	1.9	7.7	30.7	38.40	49.9	115.2	422.4	52.8
7	53.8	17.9	72	89.60	116	269	986	2.2	9.0	35.8	44.80	58.2	134.4	492.8	61.6
8	61.4	20.5	82	102.40	133	307	1,126	2.6	10.2	41.0	51.20	66.6	153.6	563.2	70.4
9	69.1	23.0	92	115.20	150	346	1,267	2.9	11.5	46.1	57.60	74.9	172.8	633.6	79.2
10	76.8	25.6	102	128.00	166	384	1,408	3.2	12.8	51.2	64.00	83.2	192.0	704.0	88.0
11	84.5	28.2	113	140.80	183	422	1,549	3.5	14.1	56.3	70.40	91.5	211.2	774.4	96.8
12	92.2	30.7	123	153.60	200	461	1,690	3.8	15.4	61.4	76.80	99.8	230	845	106
13	99.8	33.3	133	166.40	216	499	1,830	4.2	16.6	66.6	83.20	108.2	250	915	114
14	107.5	35.8	143	179.20	233	538	1,971	4.5	17.9	71.7	89.60	116.5	269	986	123
15	115.2	38.4	154	192.00	250	576	2,112	4.8	19.2	76.8	96.00	124.8	288	1,056	132

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16	122.9	41.0	164	204.80	266	614	2,253	5.1	20.5	81.9	102.4 0	133.1	307	1,126	141
17	130.6	43.5	174	217.60	283	653	2,394	5.4	21.8	87.0	108.8 0	141.4	326	1,197	150
18	138.2	46.1	184	230.40	300	691	2,534	5.8	23.0	92.2	115.2 0	149.8	346	1,267	158
19	145.9	48.6	195	243.20	316	730	2,675	6.1	24.3	97.3	121.6 0	158.1	365	1,338	167
20	153.6	51.2	205	256.00	333	768	2,816	6.4	25.6	102.4	128.0 0	166.4	384	1,408	176
21	161.3	53.8	215	268.80	349	806	2,957	6.7	26.9	107.5	134.4 0	174.7	403	1,478	185

**Appendix F - Table
Brix to Specific Gravity (SG) Scale Conversion**

Brix to Specific Gravity (SG) Scale Conversion						
SG = (B/(258.6-((B/258.2)*227.1)))+1						
if formula correct, 12 Brix = 1.04838 SG						
	SG	Brix		SG	Brix	
	1.004	1.0		1.239	51.0	
	1.008	2.0		1.244	52.0	
	1.012	3.0		1.250	53.0	
	1.016	4.0		1.256	54.0	
	1.020	5.0		1.262	55.0	
	1.024	6.0		1.268	56.0	
	1.028	7.0		1.273	57.0	
	1.032	8.0		1.279	58.0	
	1.036	9.0		1.285	59.0	
	1.040	10.0		1.292	60.0	
	1.044	11.0		1.298	61.0	
test value	1.048378	12.0	test results okay	1.304	62.0	
	1.053	13.0		1.310	63.0	
	1.057	14.0		1.316	64.0	
	1.061	15.0		1.323	65.0	
	1.065	16.0		1.329	66.0	
	1.070	17.0		1.336	67.0	
	1.074	18.0		1.342	68.0	
	1.079	19.0		1.349	69.0	
	1.083	20.0		1.355	70.0	
	1.087	21.0		1.362	71.0	
	1.092	22.0		1.369	72.0	
	1.096	23.0		1.376	73.0	
	1.101	24.0		1.382	74.0	
	1.106	25.0		1.389	75.0	
	1.110	26.0		1.396	76.0	
	1.115	27.0		1.403	77.0	
	1.120	28.0		1.411	78.0	
	1.124	29.0		1.418	79.0	

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	1.129	30.0		1.425	80.0		
	1.134	31.0		1.432	81.0		
	1.139	32.0		1.440	82.0		
	1.144	33.0		1.447	83.0		
	1.149	34.0		1.455	84.0		
	1.154	35.0		1.462	85.0		
	1.159	36.0		1.470	86.0		
	1.164	37.0		1.478	87.0		
	1.169	38.0		1.486	88.0		
	1.174	39.0		1.494	89.0		
	1.179	40.0		1.502	90.0		
	1.184	41.0					
	1.189	42.0					
	1.195	43.0					
	1.200	44.0					
	1.205	45.0					
	1.211	46.0					
	1.216	47.0					
	1.222	48.0					
	1.227	49.0					
	1.233	50.0					

Appendix G - Table Volume/Percentage for Common Ingredients

Brew Ingredients - Volume, Mass, Percentage Equivalences												
Version: % by volume of brew to % by mass												
Percent by Mass												
		<i>Black-strap Molass</i>	<i>Barley Malt Ext. Syrup</i>	<i>Cherry Juice Conc.</i>	<i>Blueberry Juice Conc.</i>	<i>Pomegran Juice Conc.</i>	<i>Elderberry Juice Conc.</i>	<i>Elderberry Raspb. Syrup</i>	x	x	x	x
% by	Brix	79.5	87.0	68.0	65.0	32.0	64.0	69.0	60.0	50.0	40.0	30.0
Volume	SG	1.421	1.478	1.342	1.323	1.139	1.316	1.349	1.292	1.233	1.179	1.129
0.0010		0.0014	0.0015	0.0013	0.0013	0.0011	0.0013	0.0013	0.0013	0.0012	0.0012	0.0011
0.0025		0.0036	0.0037	0.0034	0.0033	0.0028	0.0033	0.0034	0.0032	0.0031	0.0029	0.0028
0.0050		0.0071	0.0074	0.0067	0.0066	0.0057	0.0066	0.0067	0.0065	0.0062	0.0059	0.0056
0.0075		0.0107	0.0111	0.0101	0.0099	0.0085	0.0099	0.0101	0.0097	0.0092	0.0088	0.0085
0.01		0.0142	0.0148	0.0134	0.0132	0.0114	0.0132	0.0135	0.0129	0.0123	0.0118	0.0113
0.02		0.028	0.030	0.027	0.026	0.023	0.026	0.027	0.026	0.025	0.024	0.023
0.03		0.043	0.044	0.040	0.040	0.034	0.039	0.040	0.039	0.037	0.035	0.034
0.04		0.057	0.059	0.054	0.053	0.046	0.053	0.054	0.052	0.049	0.047	0.045
0.05		0.071	0.074	0.067	0.066	0.057	0.066	0.067	0.065	0.062	0.059	0.056
0.06		0.085	0.089	0.081	0.079	0.068	0.079	0.081	0.078	0.074	0.071	0.068
0.07		0.099	0.103	0.094	0.093	0.080	0.092	0.094	0.090	0.086	0.083	0.079
0.08		0.114	0.118	0.107	0.106	0.091	0.105	0.108	0.103	0.099	0.094	0.090
0.09		0.128	0.133	0.121	0.119	0.103	0.118	0.121	0.116	0.111	0.106	0.102
1		1.42	1.48	1.34	1.32	1.14	1.32	1.35	1.29	1.23	1.18	1.13
2		2.84	2.96	2.68	2.65	2.28	2.63	2.70	2.58	2.47	2.36	2.26
3		4.26	4.43	4.03	3.97	3.42	3.95	4.05	3.88	3.70	3.54	3.39

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4		5.68	5.91	5.37	5.29	4.56	5.26	5.40	5.17	4.93	4.72	4.52
5		7.11	7.39	6.71	6.62	5.70	6.58	6.75	6.46	6.17	5.90	5.65
6		8.53	8.87	8.05	7.94	6.83	7.90	8.09	7.75	7.40	7.07	6.77
7		9.95	10.35	9.39	9.26	7.97	9.21	9.44	9.04	8.63	8.25	7.90
8		11.37	11.82	10.74	10.58	9.11	10.53	10.79	10.34	9.86	9.43	9.03
9		12.79	13.30	12.08	11.91	10.25	11.84	12.14	11.63	11.10	10.61	10.16
10		14.21	14.78	13.42	13.23	11.39	13.16	13.49	12.92	12.33	11.79	11.29
11		15.6	16.3	14.8	14.6	12.5	14.5	14.8	14.2	13.6	13.0	12.4
12		17.1	17.7	16.1	15.9	13.7	15.8	16.2	15.5	14.8	14.1	13.5
13		18.5	19.2	17.4	17.2	14.8	17.1	17.5	16.8	16.0	15.3	14.7
14		19.9	20.7	18.8	18.5	15.9	18.4	18.9	18.1	17.3	16.5	15.8
15		21.3	22.2	20.1	19.8	17.1	19.7	20.2	19.4	18.5	17.7	16.9
16		22.7	23.6	21.5	21.2	18.2	21.1	21.6	20.7	19.7	18.9	18.1
17		24.2	25.1	22.8	22.5	19.4	22.4	22.9	22.0	21.0	20.0	19.2
18		25.6	26.6	24.2	23.8	20.5	23.7	24.3	23.3	22.2	21.2	20.3
19		27.0	28.1	25.5	25.1	21.6	25.0	25.6	24.5	23.4	22.4	21.5
20		28.4	29.6	26.8	26.5	22.8	26.3	27.0	25.8	24.7	23.6	22.6
21		29.8	31.0	28.2	27.8	23.9	27.6	28.3	27.1	25.9	24.8	23.7
22		31.3	32.5	29.5	29.1	25.1	29.0	29.7	28.4	27.1	25.9	24.8
24		34.1	35.5	32.2	31.8	27.3	31.6	32.4	31.0	29.6	28.3	27.1
26		36.9	38.4	34.9	34.4	29.6	34.2	35.1	33.6	32.1	30.7	29.4
28		39.8	41.4	37.6	37.0	31.9	36.8	37.8	36.2	34.5	33.0	31.6
30		42.6	44.3	40.3	39.7	34.2	39.5	40.5	38.8	37.0	35.4	33.9
32		45.5	47.3	42.9	42.3	36.4	42.1	43.2	41.3	39.5	37.7	36.1
34		48.3	50.3	45.6	45.0	38.7	44.7	45.9	43.9	41.9	40.1	38.4
36		51.2	53.2	48.3	47.6	41.0	47.4	48.6	46.5	44.4	42.4	40.6
38		54.0	56.2	51.0	50.3	43.3	50.0	51.3	49.1	46.9	44.8	42.9
40		56.8	59.1	53.7	52.9	45.6	52.6	54.0	51.7	49.3	47.2	45.2

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Appendix H

Related Information Products: Books, E-Books, etc. Including E-Newsletters

Up-to-Date Online Listing

For an up-to-date listing of the various informational products offered by Vinny, please go to the "***Books, Quick Tutorials, Newsletters Offered by Vinny***" page on my main website, at:

www.vinnypinto.us/products-informational-1.html

and, if all that web link above is a bit too much to type in your browser (if this book is off-line or printed), then simply go to:

www.vinnypinto.us

and then click on the link in the left-hand column entitled:

"Books, Quick Tutorials, Newsletters Offered by Vinny"

Some of the current or soon-to-be-released offerings:

EM Advanced Topics E-Newsletter – distributed about 12x/year

Are you an advanced EM user or technician, or trying to get to that level but experiencing frustration? Are you looking for more and late-breaking information about EM and its uses? Are you finding that the public e-mail list groups are primarily useful for elementary EM-related issues and questions? Are you having difficulty accessing the high-quality posts buried among the chaff in the archives? To address these and similar frustrations, I have started an electronic EM topics newsletter. This newsletter will be delivered at least 12 times per year (12 issues per year) to your e-mail in-box, containing high-quality high-end information on using EM and brewing/making various EM products, and EM and health, including both human and animal use. This EM Advanced Topics newsletter will enable me to get into more advanced topics and in more detail and complexity than is possible on the public-access list groups, and will offer more of the feel of being an insider at one of my trainings. You get far more of the benefit of my own research in my laboratory here and my network of contacts in the EM world. Further, subscribers will be able to send me newsletter questions by e-mail, and I will answer at least one, and sometimes up to three, relevant questions in each issue.

A one-year subscription price is \$22 US dollars. Publication date for first issue is estimated to be around Sunday, August 8, 2004. Further details plus payment information available on the **www.vinnypinto.us** website. Simply click on the link for books and other information products.

Advanced Guide to Fermentation with Syntropic EM Microbes

New E-Book: Applications of EM in Human and Animal Health

I have been asked by a number of folks to also create a book on the uses and applications (and properties) of EM brews and other EM products in human health -- kind of a guide to using EM in the realm of human health. The first edition of the e-book version should be released by mid-October 2004. Publication date for first issue is estimated to be around Sunday, August 8, 2004. Further details plus payment information available on the www.vinnypinto.us website. Simply click on the link for books and other information products.

Possible New Book in Works: Introduction to EM and Basics of EM

A number of folks have asked me to compile an introductory and basic work on EM, including some typical applications and basic hints. I have tentatively agreed to do so; I will try to keep it below 54 pages and thus to keep the price below \$16. I will release more info as I have it... any details and updates will also appear on the page linked above as well! I do appreciate the demand for my work and writing; it is now just a matter of juggling all my other writing and research commitments!

Please note that there is no Appendix I -- the letter "I" is too confusing in many fonts.

Appendix J

Details on Consulting Services Offered by Vinny Pinto

As you may imagine, I receive numerous requests each day from folks wishing me to answer a few questions in the areas of the primeval hydrogen antioxidants, Paleo diets, raw foods diets, raw animal foods, alternative healing, EM fermented antioxidant nutrientals, and health and well-being. To answer each question and each questioner would consume all my time, and thus, I simply cannot afford to do so unless such folks pay my normal consulting rates. Imposing these fees on such casual questions is a convenient and easy way of both setting limits on the volume of questions which I answer, while allowing folks to demonstrate their sincere support and appreciation for my work. It is also a way of ensuring that insincere, silly or uncivil folks do not bother me with silly and trivial questions. There is a notice posted prominently about these limits and about my consulting on all of my educational websites. This policy seems to be working out for everyone; I have a bunch of satisfied consulting clients, and I now no longer feel overwhelmed by too many questions.

Telephone Consulting

I prefer to offer consulting by telephone, and so I charge less for that than for e-mail consulting. I offer phone consulting for \$20 per 10 minute block, in 10 minute increments and 10 minute minimum. Phone number is:
10 AM to 10 PM Eastern USA time.

Please see www.vinnypinto.us for further details, but briefly:

First-time clients are asked to prepay the amount they estimate their first call will take. Most folks prepay using the Paypal links on my sites (below...). There are also breaks in rate for pre-purchasing larger blocks of time, as noted below. For example, a typical caller may estimate that their call will likely take just under 20 minutes, which rounds up to two 10 minute blocks, at \$20 per block, for a total of \$40. And, by extension, a one hour consultation costs \$120. The rate drops to \$100 per hour if you pre-purchase a block of 3 hours or more of my time (any pre-purchased blocks of over 1 hour may be used over next 12 months, in chunks, or all at once). My rate per hour drops even further for larger pre-purchased (usable over next 12 months; non-refundable) blocks of my time. For example, a large stepwise rate break occurs at the 48-hour mark, and thus, some client nutritional companies which use my consulting and research services prepay a 48 hour block of time up front, at a rate of \$58 per hour, for a total of \$2,784. All rates and fee breaks cited above are for phone consultation and research. On-site consulting services command a somewhat higher rate, plus expenses.

As noted above, if you do purchase a block of 1/2 hour or longer prepaid, there is no need to use up all the time in one phone call. The time may be divided over multiple calls spanning many months; each prepaid block of an hour or more may be used over the next 12 months.

E-mail Consulting

This is not my preference; offered only because some few persons request it. If a person insists upon e-mail questions and answers: I charge \$15 (US dollars) per simple question, \$35 or more per complex technical question; no guarantee of "perfect" answers.

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Payment, and More Information on Terms, Contact Info, etc.

For information on payment, for further information on terms, and for contact information, please see the appropriate pages on my main Directory website, at:

<http://www.vinnypinto.us>

Appendix K

Brief Course Syllabus for Vinny's Seminars on Brewing

May Cover AEM or Human EM Brews or Both

Intermediate Classes on Brewing Human and Animal EM-fermented Antioxidant Brews, Elixirs and Related Products

version: 1.5
version date: 12/08/2003

Note: this document may serve as a rough guide to topics to be covered in the 8 to 20 hour live seminars and classes. However, highest priority is placed upon the unique needs, requirements and questions specific to a particular client, and thus questions and lists of questions or topics are welcomed, and all relevant matters will be addressed.

- brewing high-quality EM brews and elixirs for human use
- using other sugar sources: fruit juices, malt, honey, etc; cautions, guidelines, prohibitions
- possibilities of skipping molasses and using only other sugar sources
- which type of molasses to use
- optimal mix ratios of molasses/sugars/EM culture/water
- maximal ratios of sugar-sources to water
- optimal ratios of EM or AEM to sugars
- fermentation temperature
- fermentation period length
- assessing fermentation progress:
 - smell and taste
 - color
 - ORP
 - pH
 - rH or relative hydrogen score
- cycles and trends which should or will be noted during fermentation
- a few tricks for accelerating fermentation
- how to awaken a stuck or frozen fermentation
- how to allow fermentation to become dormant
- how brew can become overly yeasty or alcoholic; steps to prevent this
- using salt, minerals and rock dusts in brews
 - which rock dusts to use
 - how much rock dusts to use
 - when to add minerals
 - which type of salt to use
 - how much salt to use

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- when to add salt
- other trace mineral additives
- other “secret” ingredients which may be used to optimize brews
- how to make brews with high ormus (aka monatomic) mineral content
- using ingredients such as kelp, bran, etc.
- using light irradiation, such as visible light to increase activity of phototrophs
- UV irradiation to increase levels of antioxidants
- ozone stressing to increase levels of low molecular weight antioxidants
- brewing an EM-X simulacra, but raw and unfiltered, two versions:
- simple version, with no secondary fermentation
- complex, full fermentation, with secondary “oxidative challenge” or “oxidative stress”
fermentation cycle: aerobic, with bubbled ozone cycles, followed by mild filtering after finish
- brewing human EM brews in volume for production purposes
- brewing and marketing EM fermented antioxidant brews and other products for the nutritional supplement market (usually requested by small or medium companies wishing to extend their product line by brewing and offering high-quality EM fermented antioxidant products)
- brewing high quality EM brews and products for animal and livestock use
- secrets, hints, tips for making excellent or specialized EM nutritional brews and products
- Making Specialized EM-fermented or em-treated Nutritional Products:
- making elixirs, such as turmeric elixir
- making EM sea salt
- bottling:
- bottle types, amber glass versus amber PET beer bottles versus clear PET soda bottles
- antioxidant shelf lifetime considerations re bottle types
- bottle sizes
- how to allow fermentation to become dormant prior to bottling
- bottling methods to prevent re-awakening fermentation
- labeling any of the above:
- label information, ingredients, claims, etc.
- labels: sources, inkjet printer vs. commercial labels
- getting waterproof labels from home office inkjet printers
- essential label information and statements
- importance of stating “Naturally acidic fermented product from lactic acid fermentation, high in lactic acid. Final equilibrium pH 3.6 or below (acidic).”
- expiration date (dependencies and variables)
- labeling for export – getting the brews thru Customs in “picky” countries, such as Canada, UK, and South Africa
- disclosing alcohol content (which may be up to 0.5%, or, at times, up to 0.99%)
- label storage recommendations
- label “after opening” recommendations
- marketing considerations for any of the above
- claims, labeling, website info, flyers -- what to say and what not to say

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- how to approach the whole matter of dealing with the FDA and similar sister agencies in foreign countries
- various options for bottling brews and elixirs: glass, plastic, PET plastic, etc. , versus antioxidant and culture shelf lifetime (may have been covered above)
- shelf life of brews
- sources for ingredients
- managing relationship with vendors of EM culture
- testing such products to derive antioxidant and nutrient scores and quantities
- using commercial independent testing labs for the above tests
- broad antioxidant assays such as ORAC, ORAC HO, TEAC, FRAP
- specific antioxidant level assays
- specific nutrient assays
- antioxidant lifetime tests
- laboratories
- testing such products for mineral content
- awareness of actual FDA requirements for any production facility for preparing/brewing nutritional supplements or foodstuffs for public marketing
- pros and cons of using outside independent FDA-approved production and bottling facilities to brew and bottle your products
- for very small or new companies:
- how to handle orders and payments online
- how to handle domestic shipping and handling, and how to determine charges thereof
- how to handle shipping to foreign countries: customs considerations, customs declaration, disclosure, invoices, how to ship, cost for overseas shipping
- pros and cons of using commercial services (call centers, fulfillment houses) to take phone orders and/or to warehouse, pack and ship products

End of Sample Syllabus

Appendix L

Some Online (Web) Resources on EM

Websites

EM Information Website

Until 7/20/2004:

www.rawpaleodiet.org/em/

(mini website has been phased out to allow shift to new EMInfo.info domain!)

After 7/20/2003:

www.eminfo.info

Antiox Brew Website (about human EM brews and products)

www.antioxbrew.com

EMTrading site (information on uses and applications)

www.emtrading.com

EM Technology Network database (information on uses and applications)

www.emtech.org

E-mail List Groups

EM-Ag list group

<http://groups.yahoo.com/group/EM-Ag/>

or send an e-mail to: EM-Ag-subscribe@yahoogroups.com

EM-Health list group

<http://groups.yahoo.com/group/EM-health/>

or send an e-mail to: EM-Health-subscribe@yahoogroups.com

EM-Ormus list group

<http://groups.yahoo.com/group/EM-ormus/>

or send an e-mail to: EM-Ormus-subscribe@yahoogroups.com

Appendix M

Care, Storage, Use and Cleaning of ORP and pH Electrodes (Probes)

Here are some fairly complete instructions for care, use and cleaning of pH and ORP electrode probes; they should also work for conductivity probes as well.

Caveat

I make and offer no guarantees as to the accuracy of usability of this information, although it has worked well for me. The author, publishers and distributors accept no responsibility for any results or lack of results, or any harm or injury from any caustic substance used in these procedures. Frankly and bluntly, if you are stupid, you should not be using pH or ORP probes in the first place, much less trying to clean them!

Origins of Instructions and Procedures

These procedures seem to be fairly standardized in the various lab equipment fields, although many equipment manufacturers will not call the cleaning compounds or solutions by their simple names, but rather will want to sell you the same stuff under their own brand name for a thousand times the price of what you could purchase it for under its generic name. Your choice...

I have listed sources for all materials at the end of the post.

Storage

First, however, let us talk about how to store pH and ORP probes (and conductivity) between uses, since that is even more critical than occasional cleaning.

Guidelines for storage and maintenance of probes after each use:

- 1) After each use, probes should be dipped in clean tap water and agitated to remove any contaminants or stray substances.
- 2) Then, the probes should always be stored wet, that is in water, and the water must never be distilled or (fully) de-ionized water (both of which are too "hungry" and will steal critical ions from the channels of the pH and ORP probes), but rather, only in plain tap water. Even better is to add a few percent (about 5% to 8%) of hydrochloric acid (HCL) to the storage soak water (keep away from kids and pets.) In any case, probe soak water should be emptied and refreshed occasionally, perhaps once per week or two or three.
- 3) Unless you have a specialized probe for which the manufacturer has suggested otherwise, ORP and pH probes should never be stored dry.

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Cleaning of Probes

Here are basic steps for cleaning:

1) Make sure probe has been wetted with tap water. Looking at probe area, clean the probe surfaces lightly with a soft or medium-soft brush; a small, soft toothbrush will do. Then rinse. Sometimes this step alone will remove enough of visible and invisible contaminants to restore probe to "good" (usable) use. However, at least once per month or two or moderate to heavy use, it will be necessary to go on to one or more of the next steps as well:

2) Soak probe in a 25% to 80% solution of chlorine bleach (aka Clorox) in water (keep soak water away from kids or pets) for at least 15 minutes. Agitate or swirl probe at times to help circulate cleaning solution and remove contaminants. Sometimes this step and the preceding step alone will remove enough of visible and invisible contaminants to restore probe to "good" (usable) use. (For ORP probes, a good sign is if and when the ORP reading [of the solution] goes above +800, or better, even higher.)

Rinse in tap water when finished.

If readings are still funky or slow, it will be necessary to go on to one or more of the next steps as well:

3) Soak probe in a 10% to 30% solution of HCL in water for at least 5 to 15 minutes. Be sure to observe the usual precautions about mixing these substances, and please wear eye protection when mixing. BE SURE to keep any such acids or pre-mixed storage bottles of water/acid solution covered and away from kids and pets. (For pH probes, a good sign of cleanliness is if and when the pH reading [of the solution] goes down to about 1.1 or less, or better, even lower.)

Sometimes this step and the preceding steps alone will remove enough of visible and invisible contaminants to restore probe to "good" (usable) use.

Rinse in tap water when finished.

If readings are still funky or slow, or "stuck" in one area, or if pH readings now seem too stuck in the acid range, it will be necessary to go on to the next step as well:

4) Soak probe in a 10% to 30% solution of potassium hydroxide (KOH) or sodium hydroxide (NaOH) in water for about 2 to 4 minutes. Be sure to observe the usual precautions about mixing these substances, and please wear eye protection when mixing. BE SURE to keep any such alkalis or pre-mixed storage bottles of water/alkali solution covered and away from kids and pets.

5) Rinse in tap water when finished.

This will usually take care of any remaining gunk or contaminants.

Calibration of pH Probes

PH probes are far less susceptible to major error than ORP probes, if only because the pH scale is logarithmic, and thus error magnitudes are relatively smaller. Nonetheless, any and all pH probes in regular use not only need to be cleaned at times, but also must be calibrated regularly. Luckily, thousands of vendors of supplies for farming, gardening,

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aquariums and hydroponics, as well as laboratory supply houses, sell pH calibration solution (see also *Appendix D* for more notes on sources), both in pre-measured 10 ml to 50 ml pouches and in half-liter and one liter bottles, and the pH calibration solution is commonly available for 4.0 (or 4.01), 7.0 (or 7.01), and 10.0 (or 10.01). For our needs, the 4.0 pH calibration solution is most important, followed by the pH 7.0 solution. I usually purchase the 4.0 and 7.0 pH calibration solutions in small pouches. By the way, once you have opened a pouch and used its contents, you may store the liquid – so long as it is still clean -- in a small covered labeled jar for up to about 20 days before its pH drifts at all significantly, and so the same calibration liquid may be used again and again over about 3 weeks.

Use of pH Probes

Please note that for greatest accuracy, a pH probe should remain in the substance to be tested for about 3 minutes or longer, and even gently swirled or swished in the beginning of test. However, for pH readings, even the readings after 30 seconds will be fairly accurate unless the probe has some contaminant layers. Then, longer will be necessary.

Use of ORP Probes

Please note that for greatest accuracy, an ORP probe should remain in the substance to be tested for at least 15 to 30 minutes or longer, and even gently swirled or swished at the beginning of test. For ORP readings, even the readings after 3 minutes will be fairly accurate unless the probe has some contaminant layers (and most do!). Then, the full 15 to 30 minute soak will be necessary. See Warning About ORP Probes below!

Warning About ORP Probes

Please realize that almost all ORP probes which have been in use for more than a few hours without fanatical cleaning will usually have a thin layer of oxidized material on the electrode surfaces. Almost invariably, this thin contaminant layer will usually result in ORP readings which "pull" or regress, the readings toward the moderate oxidized range, usually toward the +300 to +450 mv. range. Further, these deposits will also slow settling time, making it take longer for the probe to yield a fairly stable reading (which may still be too high, or pulled toward the positive range. For several reasons, this is often not much of a problem when measuring oxidized samples in the range of +150 mv and above. However, for liquids with an ORP below +150, and particularly those in the reduced range, with an ORP below about -050, this phenomenon can result in very serious distortion or pulling of resultant ORP readings toward the positive or oxidized ranges.

Sources for supplies

Sources and suggestions for pH and ORP Meters

Please see *Appendix D*

Sources and suggestions for pH calibration solution

Please see *Appendix D*

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Sources for cleaning supplies

- Chlorine bleach: supermarket. Be careful handling and storing it.
- Hydrochloric acid: most hardware stores and home improvement stores. Often sold for scrubbing scale from toilets or for scrubbing concrete. Be careful handling and storing it.
- Potassium hydroxide: lab supply house. Be careful handling and storing it. Usually easier to use Sodium hydroxide, below...
- Sodium hydroxide: hardware store, often sold as lye crystals or pellets. Read label to be sure it is pure NaOH. Be careful handling and storing it.
- PH calibration liquid: search on Google or Froogle (at Google) for vendors of your choice.

Notes

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End