

# BOTTLES - PET vs. Glass

I have for several years used glass bottles with crown caps for my naturally conditioned *sweet* ciders (made by keeving) and recovered soft-drink PET bottles for my naturally conditioned *dry* ciders. Both seemed fine. But I'd never used PET for sweet naturally conditioned cider. I knew well from my professional life that PET bottles are gas permeable but I didn't anticipate any problem from that fact - they'd certainly always held the CO<sub>2</sub> pressure very well.

In spring 2000, I had so much keeved cider that I was in urgent need of about 750 new litre bottles. I looked at the price of champagne bottles but they were about 40 pence each and would weigh literally a ton! The Bristol Bottle Company offered me 750 ml glass bottles or 1 litre PET bottles for 14 pence each. Unfortunately the glass bottles are delivered palletised, they require a forklift to take them off the lorry, and they weigh half a ton! Since I'm a hobby cidemaker with no forklift and very difficult vehicle access, I chose the PET bottles. These came prepacked in cardboard outers each of sixty bottles which were featherlight to handle. I duly filled them with keeved cider at an SG of about 1.015 for natural conditioning. I also filled a much smaller number of regular crown-capped glass bottles with exactly the same cider.

After about a month (April 2000), the PET bottles had developed the normal turgor due to the internal pressure of naturally generated CO<sub>2</sub>. But when I came to tasting and comparing it with the glass, it seemed noticeably dryer and less well balanced than the glass-bottled version. At six months, the difference was extremely marked. All the PET bottles had become effectively naturally conditioned *dry* ciders, and only the glass bottles retained the naturally conditioned sweetness I was aiming at (and, incidentally, the subtle spicy bittersweet aroma character). The PET bottles also carried a much more pronounced yeast deposit and a greater degree of carbonation than in the glass. After nine months, the differences were still marked, but the PET ciders had begun to lose some carbonation perhaps due to diffusion. In some way they'd almost regained their balance, but it was a different balance from their glass contemporaries and without the complexity of flavour. And there was a slight hint of volatile acidity - not enough to be objectionable - but detectable all the same.

All these facts can I think be explained as follows:

PET is gas permeable while glass is not. This means that the yeast in the PET bottles can continue to draw in oxygen from outside, through the walls of the bottle, while simultaneously generating a positive pressure of CO<sub>2</sub> inside the bottle. Hence the yeast in PET continues to metabolise the residual sugar by **aerobic respiration** during storage, leading to a dryer cider with a heavier yeast deposit. In glass, the oxygen from air is limiting. Once it's used up, the yeast is effectively starved and can metabolise more sugar in the keeved cider only with great difficulty. This **anaerobic fermentation** proceeds very slowly and leads to a different (and more desirable) balance of flavour compounds, with greater retained sugar and less carbonation.

Although this is almost certainly true it's also counter-intuitive! Because the PET bottles develop a nice positive pressure of CO<sub>2</sub> inside them, one then assumes that no other gas such as oxygen can diffuse back in. Unfortunately this simply isn't the case - the laws of physics here are all about partial pressures, and the partial pressure of oxygen is higher outside the bottle than in, so it can diffuse through. This is despite the fact that the partial pressure of another gas (CO<sub>2</sub>) is higher inside than out! Bizarre but it fits the facts.

Of course this does not apply to sweet artificially carbonated commercial bottled ciders, since they have no yeast inside to metabolise the diffusing oxygen, so they stay sweet. They do suffer in the long term from this oxygen diffusion, and also from carbonation loss, which is beginning to happen to mine after nine months too!

The 'take-home' message for craft cidemakers making **sweet naturally conditioned** ciders is simply that glass is the best. PET is OK, but it ain't so good!

Be warned!

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*Andrew Lea 23rd September 2000 (revised 20 February 2001)*