

## CHAPTER VIII

# *The Principles and Practice of Perry Making*

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“*Pears* should not be too mellow when they are ground, for they are then so pulpy, that they will not easily part with their Juice. If *Crabs* be mixed with *Pears* in grinding, it very much improves the *Perry*; the proportion must be used with discretion, according as the sweetness of the *Pear* requires. *Perry*, if well made, and of good *Pears*, will keep equally with *Cider*. The *Bosbury-Pear* is esteemed the best to yield lasting *Perry*.”

*J. Worlidge, Vinetum Britannicum, 1676.*

Although the two products are as dissimilar in character as the fruits from which they are made, the early writers have usually included the manufacture of perry with that of cider. Even so, it was realised that perry presented certain problems not found in cider making: the condition of the fruit at the time of milling was seen to be important, perries did not always clear as readily as ciders, and even when they did clear they often became turbid on storage.

In the writings of John Evelyn (1729, p. 104) it is stated, “let not the fruit be too ripe, those of hard flesh, stoniest core, and harsh taste, are best”. Later authors also stress that the attributes of harshness and astringency of flavour in the fruit are associated with good vintage quality. Thomas Andrew Knight (1801, p. 147-148) is even more specific, “the juice of the best perry pears is so harsh and rough, as to occasion a long continued heat and irritation in the throat, when the fruit is attempted to be eaten; yet in the process of grinding it becomes rich and sweet, without more roughness than is agreeable to almost every palate”. He further states that perries seldom clear like ciders, and advocates fining with isinglass (p. 163): “It has a chemical action on the liquor. It combines with, and carries down, the tanning principle, and hence, during the process of fining, the liquor loses a larger portion of its astringency.” This difficulty in clarification seems to have been a continual problem in perry making, for Hogg and Bull, writing much later (1876-1885, p. 146), find it usually necessary to filter the perry after fermentation by the tedious process of passing it through bags of a coarse flaxen material. Although this removed much of the “mucilage”, fining with isinglass was often needed in addition.

These observations have been confirmed by later experience and advances in scientific knowledge. Many of the differences in technique necessary in the preparation of cider and perry are now seen to be the result of inherent differences in the chemical composition of the fruits themselves: they will be discussed in the following section.

#### *The composition of perry pears*

Cider apples fall conveniently into the four categories Sweet, Bittersweet, Sharp and Bittersharp, according to their content of acid and tannin (Barker and Burroughs, 1953, p. 48). The most important class, the Bittersweets, comprise varieties low in acid and high in tannin. By contrast, few perry pears could be classed as Bittersweets, for two thirds of the common varieties described in the earlier pages of this book have low to medium acidities (0.2–0.6% as malic acid) and fairly low tannin contents (below 0.15%). They would be classed as Sweets or Medium Sharps. Those with high tannin are usually fairly high in acidity and come into the class of Bittersharps. The penetrating flavour of these perry pears is particularly striking, for the tannin is astringent rather than bitter, and the term Astringent-sharp would be more appropriate. Very few varieties with tannin contents above 0.2% have acidities below 0.45% and could be classed as Bittersweets by analogy with cider apples.

*The tannins.* The tannin fraction of apple juices is made up of a number of phenolic components including chlorogenic acid and related compounds with D-catechin, epicatechin and leucoanthocyanins (Williams, 1958). The over-all effect on flavour is to give bitterness with some astringency. By contrast, astringent leucoanthocyanins predominate in perry pears and can amount to 1% of the juice: the catechins are present only in traces. The leucoanthocyanin of pears appears to be more complex than that found in cider apples; it is colloidal in nature and is now known to be responsible for the heavy precipitates and hazes characteristic of perry (Kieser *et al.*, 1953). It is closely related to cyanidin, present in the pigments of many red and blue flowers. The leucoanthocyanin has been isolated in fairly pure condition and its optical rotation measured: it is probably a polymer of 5, 7, 3, 4-tetrahydroxyflavan-3, 4 diol (Burroughs and Whiting, 1961).

*The sugars.* Many perry pears give juices higher in sugar content than those from cider apples, and some pear juices have exceptionally high specific gravities in the region of 1.090 or higher. This is in part, however, due to the presence of unfermentable material, as shown by the high residual specific gravity at the end of fermentation. This residual gravity, often between 1.010 and 1.020, or occasionally even higher, is mainly due to the presence of sorbitol (Whiting, 1961). In high-tannin juices the leucoanthocyanins present can also make a significant contribution to the specific gravity reading. The sorbitol makes no contribution to the alcohol content of the perry, but confers a slight sweetness and will increase the fullness of flavour.

*The acids.* The acid composition of perry pears again often differs from that of cider apples, for whereas many components such as quinic acid and the minor acids are common to both fruits, the main acids may differ (Phillips *et al.*, 1956; Whiting

and Coggins, 1960; Tavernier and Jacquin, 1948). The predominating acid in apples is malic acid and only traces of citric acid are found. Many perry pears, however, contain appreciable amounts of citric acid and in some it is predominant: in others malic acid is found in the greatest amount as in the apple. The presence of citric acid in appreciable concentration gives the juices a sharper taste than they would have with the equivalent amount of malic acid. As will be shown later, it can also make the perry subject to undesirable microbiological changes.

An indication of the amounts of citric acid that have been found in some pear varieties at Long Ashton is given in Table II (Whiting, unpubl.).

TABLE 11. THE CITRIC ACID CONTENT OF SOME PERRY PEAR VARIETIES

<i>Absent or trace amounts</i>	
Arlingham Squash	Moorcroft
Blakeney Red	Red Pear
Butt	Rock (Brown Huffcap)
Clusters	Thorn
Hendre Huffcap	Winnal's Longdon
Judge Amphlett	
<i>Low to medium (0.03—0.3%)</i>	
Barland	Pine
Holmer	Rumblers
Parsonage	
<i>Medium to high (above 0.3%)</i>	
Brown Bess	Taynton Squash
Gin	Yellow Huffcap
Oldfield	

*Other components.* The juices of cider apples and perry pears show some other important differences in composition. Pear juices are lower in soluble pectin, and the pectin left in the residual pomace after pressing is of poor quality as compared with that of the apple. Consequently, pear pomace is of little value as a source of pectin.

The soluble nitrogen content of pear juices tends to be lower than that of apple juices (Burroughs, 1957, 1958). Many amino acids are common to both, but in pear juices the levels of asparagine and aspartic acid, both readily assimilable by yeasts, are lower, and proline is more prominent. Some perry pear juices also contain an uncommon amino acid, amino-cyclopropane-carboxylic acid (Burroughs, 1957). The over-all effect of these differences is that the juices of perry pears do not support the growth of yeast as well as do those from cider apples, and fermentation is often sluggish.

The volatile aroma constituents of juices naturally have a great effect upon the flavour of the final fermented products, although they are then supplemented by the process of fermentation. These components of the juice are highly complex mixtures and are as yet incompletely studied: certain points of difference between the apple

and the pear have, however, already been noted (Kieser and Pollard, 1962). Many higher alcohols and esters are common to both, but in perry the range and amounts seem to be smaller. Consequently the aroma of perry is, in general, less intense than that of cider and any faults in processing are the more readily apparent. Further, some perry pears contain appreciable amounts of acetaldehyde and of ethyl acetate. Both these compounds can be objectionable if present in excess in a perry, since they are normally associated with acetification and other disorders. In practice this trouble is best overcome by blending with other varieties.

### *Special problems of perry making*

It would be true to say that to make a good perry is more difficult than to make a good cider. In the first place, the vintage quality of the fruit is very dependent upon the season, consequently the highest quality can only be attained in certain years. Other factors concerned are related to the chemical composition of the juice, in particular, to the behaviour of the organic acids and tannins.

*Acid changes in perry.* In cider making, if a juice is sulphited before fermentation the desirable yeasts present are encouraged and the lactic acid bacteria are kept in check until the end of fermentation. At this stage, the activity of the bacteria in breaking down malic acid may be harmless or—in acid juices—desirable (Beech and Pollard, 1956). In perry making two problems immediately occur. Some perry pear juices contain large amounts of acetaldehyde that combine with sulphur dioxide and render it ineffective: the amount needed may thus be greater than in an apple juice, and it may even exceed the permitted maximum for the final perry. The blending of such juices with those from pears low in acetaldehyde is one solution.

The second problem is raised by the presence of citric acid in many pear juices, including some of good vintage quality. This acid can be attacked by certain lactic acid bacteria to produce acetic acid. Since the bacteria grow anaerobically, the perry can acquire a vinegar taint although air is excluded. The production of even small amounts of acetic acid in this manner will intensify any taint produced by acetic acid bacteria during storage. This latter, more usual, type of acetification must therefore be most rigorously avoided.

It is fortunate that a bacterial breakdown of citric acid does not invariably happen since the bacteria concerned are not as widespread as those that only break down malic acid. Nevertheless, it is essential that perries in store should be kept under close observation and sterile filtered at the first sign of undesirable bacterial change.

These problems can be avoided by an initial flash-pasteurisation of the juice followed by inoculation with a pure yeast culture. The presence of acetaldehyde then no longer presents difficulties, for sulphiting is unnecessary, and the bacterial breakdown of citric acid should not occur.

*The behaviour of the pear tannins.* It has long been known that the tannins confer peculiar properties on perry, and this was appreciated by the early writers. They can give it an excessive astringency and also make clarification difficult. The main

problem at that time, as also in later years, has been the unpredictable behaviour of the tannin. The juice may clear before fermentation—when the tannin is thrown out as a gelatinous mass—or it may clear during fermentation. At other times much tannin may persist in the final perry and the liquor may throw hazes or deposits in the bottle at a much later stage.

In the early days prolonged milling was found beneficial, for the tannin decreased during the process. This can be attributed to the method of milling then in use, for at that time the stone mill was commonly employed, and it can still be found in operation on isolated farms in the West Midlands. The mill consisted of a stone wheel or “runner” in the shape of a corn mill stone running on its edge in a circular stone trough or “chace”. The runner was usually turned by a horse harnessed to a frame and milling was prolonged until the fruit was reduced to fine pulp. In the modern mill the fruit is rapidly disintegrated, and there is little opportunity for oxidative or other chemical reactions to occur in the pulp before the juice is pressed. The alternative now used is to allow the milled pulp to stand for a period before pressing.

The effect of milling the fruit or of allowing the milled pulp to stand before pressing (maceration) is shown by some recent figures.

	Tannin (as ml. $\text{KMnO}_4$ )
Whole fruit pressed	6.3
Milled fruit pressed, 1st run juice	4.0
Milled fruit pressed, bulk juice	3.6
Macerated pulp pressed after 4 hr.	2.3
Macerated pulp pressed after 24 hr.	2.0

The process of milling the fruit gives a reduction in the tannin content of the juice and this is reduced still further as pressing is delayed. It is evident that the juice loses its tannin when it is allowed to remain in contact with the milled pulp.

Although we now know that the tannin concerned in these changes is a leucoanthocyanin of established constitution, our knowledge of the mechanisms governing its behaviour has not advanced far beyond work carried out at the turn of the century in Switzerland by Kelhofer (1908). In fact, the behaviour of the tannin has been confused in some later writings with changes in pectin. The work of Kelhofer was concerned with the behaviour of the pear tannins in perry making; it extended over many years and was as detailed as the chemistry of the time permitted. As the work never seems to have been adequately described in English, a brief account will be given here of those aspects that are relevant.

Kelhofer isolated and studied the tannin, which we now know to be a leucoanthocyanin, by precipitation and purification methods still in use at the present day. Difficulties were similarly encountered during extraction which he attributed to oxidation and condensation reactions occurring during the manipulations. His purified material was evidently identical with preparations made in recent years, although its

constitution was less well known. He considered that the tannin had a molecular weight in excess of 2000, which would correspond to a polymer of some ten or more molecules of leucoanthocyanin.

Kelhofer studied the reduction in soluble tannin that occurs in the milled pulp and found that both oxidation and adsorption of tannin were concerned. Some oxidation appeared to be associated with the enzymes of the pear tissue but other, non-enzymatic oxidation, also occurred. Tannin also appeared to be precipitated by the proteins of the pulp and this effect was held responsible for the fall in soluble tannin when the pulp was macerated.

In the juice itself the precipitation of tannin was found to depend upon a number of factors, and to be favoured by a high tannin level, by the presence of oxygen, high acidity and low temperatures. An increase in alcohol content had the reverse effect, as did the addition of sulphur dioxide which was considered as combining with the tannin: the formation of sulphonic acid derivatives would in fact increase its solubility.

Both Kelhofer and the early English writers emphasise that to give the best results, the pears should be ripe without being over-mellow (see foreword to this chapter). Whereas ripe fruit gives relatively clear juice, unripe pears give juices that throw down deposits during and after fermentation. Over-ripe pears, although giving juices of lower tannin content than those from mature fruit, produce perries that are difficult to clear and which throw down copious deposits made up of tannin, protein and pectinous material.

One may thus summarise our present knowledge of the pear tannins by saying that the main component is a polymer of a leucoanthocyanin that readily undergoes oxidation and further condensation to give bulky insoluble precipitates. The material combines readily with any protein that may be in solution or that is added as a fining agent and this is also carried down with it. The main problem in perry making is that these changes can continue over a period of time so that it is often difficult to ensure that a perry will remain clear throughout storage. Present day methods are designed to overcome this as far as possible.

### *The production of perry*

The farm perry maker can still follow the traditional methods, for single varieties of known vintage quality will be available to him in the orchard and the fruit can be harvested and pressed at the optimum stage of maturity. The factory perry maker, on the other hand, will be obliged to use a mixture of varieties in varying stages of maturity; his fruit will have been collected from scattered orchards involving much transport, and leading to fruit damage, especially with early varieties whose harvesting has been delayed. Although high tannin varieties are still used by the smaller maker, the bulk of the fruit reaching the factory is of low to medium tannin content and needs less specialised methods of processing.

Whereas cider apples mature relatively slowly, most perry pears ripen rapidly and the perry maker must be prepared to press the fruit at short notice. If pressed unripe,

the juice will lack flavour, and clarification difficulties may be exaggerated if high tannin sorts are used. If over-mature, pressing will be difficult, for the pulp will be slimy, tannin may be excessively reduced, and the flavour can be spoiled by undesirable micro-organisms from any rotten fruit.

Pears of medium or low tannin content may be treated like cider apples, that is, milled and pressed immediately, and any tannin stabilisation needed can be deferred until a later stage. High tannin pears which, as described earlier, require special methods of juice extraction, are passed through the modern type of grater mill and the pulp held for a period before pressing. Whether the pulp is held for 4 hours or overnight will depend largely upon the facilities for storing pulp in bulk. The optimum holding period can usually be assessed empirically by observing when clear juice begins to separate from the mass.

Numerous vintage trials of individual perry varieties made at Long Ashton have shown that the micro-flora must be adequately controlled throughout fermentation, if quality is to be maintained. The effects of any undesirable bacterial action are particularly noticeable in perries for, not only can off-flavours be produced as in ciders, but citric acid, if present, can be converted anaerobically to acetic acid, giving vinegary taints. The addition of sulphur dioxide to the juice at a level of 100 to 150 p.p.m. is usually effective in suppressing bacteria and film yeasts during fermentation: problems are only likely to arise if a juice contains excessive amounts of acetaldehyde which combines with the sulphur dioxide and renders it ineffective. In such an event blending the juice with that of other varieties would be the simplest solution.

An alternative method of controlling fermentation is possible in a factory by adding a pure yeast culture to flash-pasteurised juice. This procedure has many advantages and gives a greater standardisation of production. It is most suitable where large bulks of juice are pressed from a range of varieties chosen to give a desirable level of acid and tannin. If too many sharps are included the final perry will be too acid and require adjustment. The acidity can be reduced by a controlled fermentation with a suitable strain of lactic acid bacteria, and this method has been used at Long Ashton on a semi-commercial scale. If used as a routine the method would, however, entail a good deal of supervision in the factory.

The fermentation of juices from pears of low or medium tannin content usually proceeds normally. If heavy precipitates separate from the juices of high-tannin pears the yeasts naturally present may be physically occluded within the bulky deposit. There will then be an excessive lag period before fermentation begins and yeasting will be necessary, but this is less likely to occur in juice from macerated pulp. Juices low in nitrogen can also give protracted fermentations, whether yeasted or not, allowing the growth of undesirable micro-organisms. In such cases the addition of yeast nutrients will encourage normal fermentation, the amounts usually necessary being 1 gram thiamine hydrochloride per 1000 gallons with 8 oz. ammonium sulphate (B.P. quality) for each 10 degrees drop in specific gravity required (Burroughs and Pollard, 1954).

It must be remembered that many pear juices, particularly after hot summers, contain appreciable amounts of non-fermentable material. A perry may therefore

show a specific gravity well above 1·000 although fully fermented. Only a determination of sugar content will distinguish such perries from those that have incompletely fermented.

High-tannin perries will probably have lost much of their astringency by the time fermentation is complete, but they may still show some tannin instability. A period of bulk storage is therefore essential to give an opportunity for any further precipitation. Blending should be done at this stage so that mutual reactions between the perries, leading to the formation of hazes or deposits, can take place before final filtration. For some varieties or blends the necessary period of storage may be protracted before the perry reaches stability. Perries lower in tannin usually give less trouble, but blending before storage is again advisable.

Before storage the blended perry should be centrifuged or racked to remove the lees and thereby prevent the development of unpleasant flavours. The vats must be filled completely and all possibility of acetification rigorously excluded by adequate closure and topping up as necessary. If the perry shows a haze when required for bottling, or it is found slightly too astringent, it can be fined with an appropriate amount of gelatine. This will remove the excess tannin and simplify filtration.

To determine whether or not a clear perry is in fact stable, a sample can be chilled in a refrigerator for 24 hours. If no haze develops the perry will probably remain clear in bottle. The stored perry, fined if necessary and sweetened as required, is now filtered ready for bottling. At this stage a small addition of sulphur dioxide is useful as a stabiliser against any later clouding in bottle (Grove, 1931), but the total amount present must not exceed the statutory maximum (200 p.p.m.). The actual bottling procedure will follow the methods used for cider.

Naturally sparkling perry, made by the traditional champagne process in bottle, is rarely seen, for the problem of tannin deposition would interfere with the process of disgorging the yeast deposit. When such perries are made in bulk by fermentation in pressure tanks, this problem is avoided by the use of filtration before bottling. Unless the juice is flash-pasteurised or adequately sulphited it is also an advantage to select pear varieties low in citric acid, for lactic acid bacteria grow readily under high pressures of carbon dioxide. At the end of fermentation the perry is chilled to reduce the pressure before filtration and bottling: it helps, at the same time, to precipitate any unstable tannin that may be present.

#### *The use of dessert pears*

In many fruit growing areas overseas there are appreciable surpluses of dessert pears for which extra outlets are required: the possibility of using these for perry has been explored at Long Ashton. Such pears give a product very different from that made from the traditional perry varieties, for they are different in flavour and they lack tannin. Some possess aroma components that are undesirable in the fermented beverage and they can also present problems in pressing and juice clarification.

Tests made over a number of years have shown that certain special procedures are needed if a palatable product is to be made from dessert pears alone. Pressing problems

can be overcome by the addition to the milled pulp of Kieselguhr, wood pulp or similar aids to prevent the "cheese" from slipping. Where the pears give juices possessing undesirable aromas, the volatile material can be removed by stripping the juice rapidly at high temperature (as before concentration) or by treatment with charcoal.

Although the leucoanthocyanin of perry pear tannin is largely absent from ripe dessert pears, other less well-defined components of the juice can make clarification difficult. Fining with gelatine and treatment with pectolytic enzymes usually overcome the problem. The treated juice should then be sulphited, or flash-pasteurised and yeasted. Of the fermentation treatments so far tested pressure fermentation has given the best results. The products given by dessert pears lack the distinctive character of the traditional perry. At their best they bear somewhat the same relation to it that ciders made from cull apples bear to cider made from vintage cider varieties. This may not be a disadvantage if the beverage is consumed in areas where perry made from the traditional pear varieties is unknown.