10 Off-flavours in alcoholic beverages

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10.1 Introduction

Alcoholic beverages are drunk by the consumer with a certain level of expectation, based upon the brands’ reputation. Up until the point of consumption they should have a consistent flavour, remain stable and be microbiologically sound. If this expectation is not met, the commercial implications can be significant.

The expected flavour (e.g. aroma, taste and late-palate) of any alcoholic beverage is a complex but fine balance of hundreds of different chemical compounds. Over 1300 volatile compounds have been identified in alcoholic beverages such as beer, wine and whisky (Nykanen and Suomalainen, 1983). If this balance of flavours is perturbed, for example, through lack of process control, off-flavours will arise. Such atypical flavours can be differentiated from taints that result from chemical or microbiological contamination of the product. The latter can occur directly, as when a beverage is spoiled by microbial contamination, or indirectly, when raw materials are used that are themselves tainted. For example, 1-naphthol, a hydrolysis product of Carbaryl® (a pesticide applied to barley), gave a harsh, astringent, somewhat medicinal taint to beer brewed from malt made from the treated barley (Jones et al., 1988).

A wide range of off-flavours have been identified in alcoholic beverages, many of which seem common to more than one beverage type. Musty flavours in beer (Bell et al., 1994) and the corky flavour of wine (Rapp et al., 1992) have both been attributed to chloroanisoles. Further examples are the ‘sunstruck’ flavour most commonly found in beer that has also been identified in champagne (Tucknott, 1978) and saké (Takahashi and Akiyama, 1993), and ‘mousiness’, which is found in both wine (Peynaud and Domerq, 1959) and cider (Tucknott, 1977).

Whether a flavour is regarded as undesirable will depend upon several factors: (i) the beverage type or style; (ii) the sensitivity of the taster; and (iii) the consumer expectation. Some flavours are regarded as positive under one circumstance but negative in another; while others, such as chlorophenol, are always unacceptable. For instance, the ‘clove-like’ spiciness that is characteristic of wheat beer is also typical of the undesirable flavour generated by a wild yeast infection in a pils lager beer. Diacetyl is a good example of a flavour that is acceptable at different levels in different products. In lager beer and saké it is regarded as an off-flavour when present at levels greater than 0.05 ppm and
0.1 ppm respectively (Takahashi and Akiyama, 1993). In red wine, however, a level of 0.2–0.4 ppm is acceptable (Tucknott, 1978) and in some ciders a level of 2 ppm is considered part of the normal flavour. However, these levels should only be regarded as guidelines since the concentration at which an individual compound becomes unacceptable depends very much on the background flavour of the product. An off-flavour will become apparent at a lower concentration in more subtly flavoured products. For example, English ales are generally characterised by malty, toffee notes and can tolerate a much higher level of diacetyl (which has a butterscotch aroma and taste), than a lightly flavoured American lager.

The human palate and nose are extremely sensitive, detecting some undesirable notes such as the compound responsible for the ‘lightstruck’ flavour in beer at the parts per trillion (ppt) level (Irwin et al., 1993). However, people differ in their sensitivities and, while the number of people within the population sensitive to a particular flavour may be small, they should not be discounted as consumers. If a significant number of people find the flavour unacceptable then a brand’s reputation can be damaged, particularly if the problem is associated with a possible or perceived threat to health. What constitutes a significant number of the population is difficult to define. As Tucknott (1978) wrote ‘it may be a large number of less vociferous people or one journalist with a large audience’.

Social and ethnic practices will also influence whether a flavour is regarded as acceptable or not. Amerine (1980) observed that, within the USA, the foxy flavour that can arise when grapes of the variety Concord are used for winemaking, is not appreciated in California but is accepted in New York.

The producer of an alcoholic beverage obviously wants the flavour of his or her product to meet the expectation of the consumer. However, as Dalgliesh (1977) observed, the flavour the consumer associates with a particular beer may well not be that which the brewer had originally intended. If sales of beer sold in green or clear glass bottles are an indication, consumers would appear not to find the ‘lightstruck’ flavour objectionable, whereas a brewery taste panel would reject beer with such a flavour.

Once an off-flavour has been identified, the process of establishing the cause and chemical compound that is responsible begins. Since the problem is most often discovered once the product is in trade, this can be equated with ‘looking for a needle in a haystack’ and may well involve a considerable amount of detective work. An example of one such investigation is that made by Cosser et al. (1980) in order to establish how a ‘ribes’ off-flavour had developed. It was eventually found that the malt used to make the beer had been produced in a maltings where one vessel had been painted while the barley was germinating in a contiguous vessel. Mesityl oxide, an impurity in the ketonic solvent-based paint, contaminated the malt and subsequently reacted with hydrogen sulphide (from fermentation); as a result 4-methyl-4-mercapto-pentan-2-one was generated, giving the beer a ‘ribes/catty’ off-flavour.

It is obviously far better to prevent flavour problems in the first place than to cure them later. Nevertheless, immediate problems must be dealt with: the