



Avoiding Customer Complaints

Origins of Food Taints and Off-flavours

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The presence of compounds causing taints and off-flavours in food is a major concern to the food industry. If the organoleptic properties of a food are not as expected, this results in a lack of consumer confidence and a perception of poor quality, leading to consumer complaints, brand damage and potentially a costly product recall. A taint in food results from contamination by a foreign chemical from an external source and there is potential for introduction of such chemicals in all parts of the global food supply chain. Off flavours, which result from internal deterioration of the food, can also originate from poor control in food production, including processing parameters, hygiene controls or packaging integrity.

In each part of the food supply chain as practices and processes are changed or developed, additional sources of compounds with the potential to cause taints or off-flavours may emerge. Some of the more common taints and off-flavors associated with raw materials, micro-organisms, processing, packaging and storage are discussed below.

Raw materials

It may seem obvious that the source of raw materials used in a food product should not be tainted, but some raw materials may be more susceptible than others. Water is one such raw material and various treatment processes are available to remove off-odours from water. One of the more common taints observed in water is an 'earthy-musty' taint, originating from the presence of geosmin, 2-methylisoborneol and haloanisoles which are associated with certain micro-organisms.

A less obvious origin of tainting compounds in food is animal feed. For example, taints in fish from the aquatic environment and 'transmitted' off-flavours in dairy products due to transfer of substances from the cow's feed or environment. Cows grazing on weeds, such as wild garlic and onion, can produce a 'weedy' off-flavour in milk. A taint observed particularly in boars attributed to the presence of indole and skatole and described as 'faecal' is thought to be produced in the digestive system of animals and has been linked to the presence of 5- α -androst-16-en-3-one (a pheromonal steroid) and also to levels of the amino acid tryptophan in the diet.

Chemical changes/Lipid oxidation

The lipid content of foods is the main source of off-flavours, primarily due to oxidation and dairy products are particularly susceptible. Common compounds associated with the rancid off-flavours produced include aldehydes, ketones, lactones and furans, carboxylic acids and hydrocarbons.

The inclusion of more unsaturated (healthier) fats in foods means that they may be more readily oxidized and better protection (though the use of additives, processing or storage conditions) is needed.



Some Maillard reaction products have a role to play in preventing lipid oxidation, due to their antioxidant properties, but the Maillard reaction can also be a source of off-flavours. A typical example is the browning and off-flavour produced in fruit juices during storage, due to the formation of compounds such as substituted furfurals and furans

Micro-organisms

In any part of the supply chain, hygiene controls are vital for food safety and can also introduce food taints from certain micro-organisms. In fact, certain off-flavours can often be the first indication of microbiological spoilage of food. For example, sulphur compounds are principally responsible for the 'putrid' odour associated with spoiled meats, whereas, the most common compound associated with spoiled fish is trimethylamine, which is formed by the bacterial reduction of trimethylamine oxide, a natural constituent of fish muscle.

Fruits and vegetables have more microbial resistance than high protein animal products and therefore are less prone to produce taints from microbial contamination. Those reported included off-flavors in orange juice due to diacetyl and acetoin and fruit containing penicillium species producing an earthy odour due to the presence of geosmin.

Several off-flavours in food can be related to micro-organisms, such as bacteria, yeasts and fungi, as and the growth of such micro-organisms is dictated by the physical environment and chemical composition of the food key parameters include water activity (a_w), pH and temperature, as well as storage conditions. The addition of preservatives can control the growth of some organisms, but may also act as precursors for some taints.

Trans-1,3-pentadiene has been reported to be responsible for a kerosene like taint in dairy products originating from the decarboxylation of sorbic acid, used as a food preservative by micro-organisms, particularly the penicillium species. The production of styrene in foods has also been linked to the action of a specific yeast on cinnamaldehyde and the production of guaiacol from vanillin and ethyl vanillin has led to smoky/phenolic off-flavours in yoghurt and ice cream.

Microbial methylation of halophenols to haloanisoles can produce compounds that cause taints at extremely low concentrations in food products. For example, chloroanisoles have been reported as being responsible for musty taints in eggs and poultry where wood shavings containing chlorophenols were used as bedding and methylation occurred due to endogenous fungi.

Cleaning products and environment

A large number of reported taints each year originate from cleaning product or disinfectants. In particular, disinfectants based on active chlorine or oxygen can react with food components (such as phenols) to form compounds that can produce a taint (eg chlorophenols). The particularly low sensory threshold of 6-chloro-o-cresol has also led to several taints through its use in certain disinfectants and premises handling food should avoid using cleaning products containing this compound.

The location of food processing plants has also been the cause of taints due to air borne pollutants, for example, from nearby agrochemical plants. Foods with a high lipid content or large surface area are the most susceptible to volatile compounds from the environment and air purification systems should be installed where necessary.



Packaging

The move to minimize packaging has led to a rise in taints originating from both primary and secondary packaging – either through transfer of volatiles, or direct migration. There are a wide variety of materials used in food packaging, including not only the principle components, but impurities, additives, adhesives, inks and varnishes, which can migrate from outer surfaces if no suitable barrier is present.

Odours originating from paper and board packaging may be due to bacteria, moulds, oxidation of residual resins or degradation of processing chemicals. Decarboxylation and oxidation of lignin can produce vanillic acid, which subsequently can degrade to guaiacol, a compound responsible for a taint described as smoky. Other volatile compounds present in pulp which may also be responsible for taints in food, include aldehydes, alcohols and esters for example hexanal, which is often present in paper and board at low levels. Although mostly these compounds are not present at a high enough level to give rise to a taint, some paper and board can become more odorous on storage.

The use of recycled materials for food contact applications needs to be strictly controlled to minimize potential contaminants, from inks or previous usage that may cause a taint in the packaging and therefore potentially the packaged food product.

Storage

As discussed, taints and off-flavours caused by reactions, in particular oxidation, can worsen due to inappropriate storage conditions. Taints in food may also originate from the storage environment itself, such as a building or container. One of the most common taints reported in foods is due to the presence of halophenols and haloanisoles originating from treatment of wooden storage pallets. Airborne contamination of products or ingredients either during storage or transportation can also cause taints. New floors, diffusion within warehouses or transit containers have all been reported as sources of tainting compounds.

Analysis and future prevention.

Following the occurrence of a food taint, it is imperative that robust analytical procedures are followed to enable identification of the compound(s) responsible and identify root cause, to ensure risk management decisions can be taken rapidly. If analysis is required, care must be taken at all stages to avoid any possible contamination from external sources, during transportation or once within the laboratory. The compound(s) responsible for the taint may be present at extremely low levels (sub ppb) and in some cases specialist techniques may be required to enable detection.

Analytical methods employed will depend on many factors and a flexible approach needs to be taken. An understanding of the limitations of current analytical methods and expertise in data interpretation are crucial in providing the rapid response required by the food industry.