Microbiological Quality Control of Flavors

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Microorganisms are not autotroph but heterotroph organisms, that means they require organic compounds for growth and reproduction. In general, they need carbohydrates and proteins besides some vitamins and minerals. Furthermore, they need a certain water activity, an optimal temperature and a neutral pH value.

Growth and reproduction means cell division, a bacterium may divide once every twenty minutes under optimal conditions, that means eight cells out of one in one hour and two billion cells in 24 hours. A microorganism is active because of its enzymes. These enzymes are proteins and may be destroyed by heating.

Pasteurization at 65-80° C destroys 95 percent of all living microorganisms and the sterilization at 120 °C for at least 15 minutes kills even spores of bacteria. Other such methods use chemicals: Inhibiting growth is called preservation and destroying organisms is called disinfection.

Microorganisms Which May Occur in Food

Bacteria not Dangerous to Humans—From the toxicological viewpoint, only certain bacteria are dangerous to humans. However, every germ will spoil a food if the number is high enough.

Pathogens which Cause Non-Specific Food Poisoning—Some Streptococci and Enterobacteria like Coliforms may cause non-specific food poisoning if: (1) they occur in amounts of 10^5-10^7 per gram, or (2) the organism predominates the whole flora, or (3) the food has been kept within a certain temperature for a longer time.

Pathogens which Cause Infections—Food infections are diseases which show vomitting and diarrhea. The main organisms are the Enterobacteria Escherichia coli and Salmonellae. E.coli is also an indicator for fecal contamination in food.

Much more dangerous are the Salmonellae, as counts of less than 1,000 per gram may cause infections. Therefore, not only 1 gram must be examined, but inspection of at least 25 grams is required. Very often they are found in slaughtered poultry.

In recent years, food infections (especially milk products) caused by Listeriae have been reported. Listeriae are dangerous because they may grow even at temperatures below 10° C.

Pathogens which may Cause Food Poisoning—Food poisoning is caused by a toxin which is produced by a microorganism either in the food or in the human gut. The most important bacterium in this category is Staphylococcus aureus, very often found in protein-rich food. It forms a heat stable toxin.

Others are the Clostridia which are found in the ground because they grow anaerobic, that means free from oxygen; they also are spore formers. Frightening are Clostridium botulinum and perfringens. Further to be mentioned are Bacillus cereus and some Asperfilli which form mycotoxins.

Flavorings and Flavor Ingredients with Spoilage Potential from Microorganisms

All synthetic flavor ingredients are practically sterile or even bactericidal like eugenol and thymol. The same can be said for essential oils and oleoresins and for solvents like alcohol or propylene glycol.

None of them contain nutrients for microorganisms. Only a few germs are found in carriers like salt, sugar and maltodextrin. More often they are found in starch and whey powder.

A bigger problem from the microbiological viewpoint are emulsifiers like tragacanth, gum arabic and gelatine, which may have as high counts of microorganisms as natural spices.

Some other products that should be looked at carefully are yeast extracts and hydrolized vegetable proteins (HVP), because they are made from raw materials rich in sporeforms, i.e. Clostridia, and the spores may survive the manufacturing process.

Last but not least, fruit juice concentrates and fruit powders should be mentioned. Because of the

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smaller water activity yeasts cannot grow on them, but they may contain yeast cells which grow quickly if the products are diluted with water, so they should have been pasteurized.

It is helpful to notice that E.coli, Salmonellae and Staphylococci are found almost exclusively in protein-rich animal products; flavor ingredients of plant origin do not have to be tested for these bacteria in general. In contrast Clostridia, Bacilli and Asperfilli are microorganisms with origin in the soil, so they are found primarily in plant materials having had direct contact with the ground like roots, and those which are rich in carbohydrates like cereals or sugarbeets.

Hygienic Methods of Manufacturing Flavors

The procedure most often used in manufacturing flavors is blending. There are no problems with blending liquid flavors with natural and/or synthetic flavor ingredients and solvents without water. However, if water is added as in emulsions, these have to be preserved for two reasons: The emulsifiers may contain microorganisms as it was mentioned before and, also, the emulsion may be contaminated from equipment. Sometimes the flavor ingredients themselves are so bactericidal that you do not have to use other preservatives, but not in all cases.

The same problem occurs with pastes. These contain either starch (carbohydrates) or fat. Both are nutrients for microorganisms. If they have not been heated during manufacturing, they have at least to be pasteurized and sometimes preserved.

Some problems occur in dry blending of flavors. If you have a water activity of less than 0.9 in a powder, no microorganism will grow, but many survive in this medium and the microbiological status of a dry flavor depends on the status of the raw materials.

Most important is the cleaning of the blending equipment. When water or steam is used for cleaning, all traces of moisture and product must be removed. Otherwise you have an excellent source for contamination of the following batches.

If temperatures of more than 100°C are used during the production of process flavors, the result will be sterile products even if meat and meat products are used as raw materials.

Another process used to make flavor or flavor ingredients is fermentation. This is made with microorganisms or enzymes known from traditional processing (cheese, alcoholic beverages, etc.). Before these flavor ingredients are used for blending, they have either to be sterilized or purified to eliminate all viable cells or enzymes.

Legal/Other Microbiological Requirements

In general there are legal microbiological requirements for flavors. An exception is the EEC Flavour Directive 88/388 dated 22 June 1988, where it is said in Article 6 No. 3: "The following shall be adopted in accordance with the procedure set out in Article 10: Where necessary . . . the microbiological criteria applicable to flavorings, . . ."

In our opinion, it does not make sense to specify these criteria because the microbiological status of a flavor depends on the final food where it is used. A flavor for a canned food may have a much higher germ count than a flavor for an instant soup which has to be practically germ-free. Therefore, a general requirement that flavors should have no more than a special number of total viable counts would be unrealistic. It is not only expensive, but even more important, the unnecessary pasteurizing or sterilizing of a flavoring product will significantly degrade the flavor quality.

The microbiological standard of a flavor needs to be an important part of the specifications of every flavor that is arranged between the producer and buyer based on the ultimate application of that flavor.

References

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