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Microbial Biodeterioration of Food

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Editorial Note

Biodeterioration essentially involves negative aspects of microbial activities and is often confused with biodegradation. Biodegradation is related to positive or useful activities of microorganisms, utilizing their breakdown abilities to transform wastes into useful end-products or more acceptable or less hazardous forms. The organisms involved and their activities are often the same as those associated with biodeterioration, but it is the location of the events that is different. In many instances, the biodeterioration of solid materials follows the formation of a surface biofilm, which may consist of a heterogeneous mixture of various microorganisms. The biofilm is initiated through the adhesion of microorganisms to a surface, usually aided by their secretion of extracellular polysaccharides, glycocalyx. Once established, the glycocalyx provides a protective physical barrier and also helps protect against chemical biocides.

Processed foods can be preserved by various treatments like drying, smoking, addition of salts or sugars, pickling, heat pasteurization or sterilization, freezing, use of chemical preservatives, etc. However, for stored unprocessed foods, losses are mostly limited by controlling the immediate storage environment by chilling or using inert gases and, more recently, by irradiation. Post-harvest biodeterioration by microorganisms can be especially problematical in tropical and subtropical regions. This is largely due to the higher temperatures and moisture levels, and often the storage facilities are poorer.

Cereals have a major advantage over crops such as potato, because they naturally have a low moisture content, which on further drying allows long periods of storage without deterioration. They are living, but even drying to 12% moisture does not affect their viability, which is important for the seed stock. Provided that storage conditions are suitable, losses during storage rarely exceed 5%. Losses of quality and quantity are predominantly due to fungi. The nature of the microbial damage includes: a decrease in viability, which is important for the seed stock; discoloration, particularly of the embryo, due to invasion by fungal mycelium; biochemical changes, such as the production of fatty acids, giving rancid odour and flavour; loss of mass and production of mycotoxins. The storage fungi involved in cereal biodeterioration are mostly xerotolerant species of *Aspergillus*, *Fusarium* and *Penicillium*. They mainly develop from dormant spores on the outside of the grain, or from dormant mycelium lying under the surrounding pericarp. Factors influencing fungal growth include moisture content of the grain, temperature, length of storage time, level of fungal contamination, quantity of foreign debris (broken seeds, plant fragments, soil), and the activities of insects and mites.

Mycotoxin levels tend to be higher in organically grown cereals than in those where fungicides have been used, and in developing countries where storage conditions are less rigorously controlled. Any mycotoxins produced are not destroyed by cooking or processing and their concentrations in stored cereals are directly related to levels of fungal growth. Consequently, contaminated cereals should be destroyed, not down-graded for animal feed. However, chemical degradation treatment of mycotoxins has been attempted in contaminated peanut meal destined for animal feed. Mycotoxins that may be generated include several aflatoxins from *Aspergillus* species such as *Aspergillus flavus*, aflatoxin B1. Many of these compounds have LD50 values of less than 50mg/kg. They cause liver damage and are considered to be carcinogenic. Fusarium toxins, such as T-2, F-2 and zearalenone, are also highly toxic, causing alimentary toxic aleukia in humans and oestrogenic syndrome in pigs. The *penicillium* toxins include the liver-damaging rubrotoxin from *Penicillium rubrum*, and penicillic acid, which produces haemorrhagic syndrome in poultry.

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