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Spoilage Non Spore-Forming Bacteria

Food spoilage causes not only economic loss, but also loss of edible foods. In countries where foods are produced and procured from many countries much more than the need, spoilage up to a certain level is not considered serious. However, in many countries where food production is not efficient, food spoilage can adversely affect the availability of food.

With the increase in world population, serious consideration needs to be given on not only increasing food production but also reducing food spoilage, because in some countries it could reach 25% or more. The acceptance qualities of a food can be lower because of infestation with insects and rodents, undesirable physical and chemical actions, and microorganisms' growth. Microbial spoilage occurs either because of microbial growth in a food or because of the action of some microbial enzymes present in the food..

The food microbiological profile is quite different from an unspoiled and non-sterile food, to the same food spoiled. The first case generally contains many types of microorganisms, such as bacteria, yeasts, and molds (also viruses) from different genus, maybe more than one species from the same genus, and even more than one strain from the same species. However, when the same food is spoiled, it is found to contain predominantly one or two types, and they may not even be present initially in the highest numbers in the unspoiled or fresh product. Among the different species initially present and capable of growing in a particular food, only those with the shortest generation time under the storage conditions attain the numbers rapidly and cause spoilage.

Theoretically, any microorganism (including microorganisms used in food fermentation and pathogens) that can multiply in a food to reach a high level (spoilage detection level) is capable of causing it to spoil. Yet, in reality, bacterial species from only several genera have been implicated more with spoilage of most foods. This is dictated by the bacterial characteristics, food characteristics, and the storage conditions.

The predominant non spore-forming bacteria, as representatives of the major groups associated with spoilage, are *Brochothrix thermosphacta*, *Carnobacterium* spp., *Lactobacillus* spp., *Lactococcus* spp., *Leuconostoc* spp., *Pediococcus* spp., *Streptococcus* spp., *Kurthia zopfii*, and *Weisella* spp. The main defects that these bacteria cause in foodstuffs are off-odors and off-flavors, discolorations, gas production, slime production, and decreases in pH.

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Here, we explore the main spore-forming bacteria involved in the spoilage of various processed foods. Due to changes in the design of industrial food processing and increasing international trade, highly thermoresistant spore-forming bacteria are an emerging problem in food production. This type of bacteria is considered a major threat in heat-treated foods.

Spore-formers causing food spoilage are particularly important in low-acid foods (pH 4.6) packaged in hermetically sealed containers, which are processed by heat. Certain spore-formers also cause various types of spoilage of high-acid foods (pH 4.6), while psychrotrophic spore-formers have also been recognized to cause spoilage of refrigerated foods. Both chemical and physical treatments used in the food-processing industry are not enough to eliminate the spores. Endospore formers may thrive in different parts of the food processing plant.

A number of agents cause spore activation, including low pH, some chemicals, and sublethal heat. Although spores are metabolically dormant and can remain in this state for many years, if they receive the proper stimulus and conditions, they return to active metabolism through the spore germination. The spore-forming bacteria can be divided into two major groups: the aerobic *Bacillus* species and the strictly anaerobic *Clostridium* species.

Thermophilic and acidophilic spore-forming bacteria such as *Alicyclobacillus* can also cause spoilage of acidic beverages. They grow without the production of gas and no changes in the appearance of the beverage containers are observed. Unfortunately, this type of spoilage is discovered only when the consumer opens and begins to consume the product.

The economic losses might be extremely high. Generally, bakery products are specifically spoiled by *Bacillus* species while different *Clostridium* species classically contaminate refrigerated vacuum-packed meats. There are three main differences between *Clostridium* and *Bacillus* genus. The first difference, as commented earlier, is that *Clostridium* is strictly anaerobic, while *Bacillus* is an aerobic bacterium.

The second difference is the spores. *Clostridium* forms bottle-shaped endospores, while *Bacillus* forms oblong endospores. The last difference is that *Clostridium* does not form the enzyme catalase, while *Bacillus* secretes catalase to destroy toxic byproducts of oxygen metabolism. Microbial spoilage of food is usually indicated by changes in texture or the development of off-flavors. The primary sources of food contamination are probably soil and air. Being a soil resident, *Bacillus* and *Clostridium* species are part of the microbiota of plant raw materials (used as ingredients for many foods), attached as vegetative cells or spores.

Adapted from:

Title: Main Groups of Microorganisms of Relevance for Food Safety and Stability: General Aspects and Overall Description.

Authors: Jose M. Lorenzo, Paulo E. Munekata, Ruben Dominguez, Mirian Pateiro, Jorge A. Saraiva and Daniel Franco

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