
Food Spoilage by Bacterial Species

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Abstract

It is estimated that each year more than eighty three million people are affected by food borne illness every year. Illnesses such, as food spoilage are mainly becoming more common as our life styles changes, the habit consuming foods, especially junk foods is an emerging trend today. There are many people whom with lack of awareness are becoming a victim towards food poisoning majorly due to the consumption of microbial contaminated food (food spoilage). This paper garnes information regarding the bacteria's and other microbial agents that effect food spoilage.

Keywords: *Food spoilage, Microbial, Bacteria, People*

INTRODUCTION

In developing countries like India, Bangladesh, Sri Lanka, there is a record of people who have suffered largely from food spoilage. Between 12-25% in various types of foods, which adds to the problems of acute shortage of food supply in these countries. There is very less accurate figures on much food spoilage is the result of mishandling by the consumer. The principles of food safety are much easy to apply in the home, when eating in the outdoors, at your local shop when buying groceries, and even at a restaurant. Most food spoilage accidents mainly results due to mishandling food keeping it at the wrong temperature, incorrect rehandling cross contamination (Sharma et al., 1992). The important type of pathogenic bacteria invoved with foods are Salmonella, Clostridium per fringes, Staphylococcus aureus, Listeria monocytogens, Camphylobacter jejuni, Bacillus cereus and E coli. Escherichia coli is a member of the family Enterobacteriaceae, which comprises of many genera, such as Shigella, Salmonella and Yersinia. Most strains of E. coli are not considered as

pathogens that cause infections. Most pathogenic strains are categorized under the following virotypes: enteroinvasive, enter aggregative and enter hemorrhagic. *Bacillus cereus* causes mainly two different types of food spoilage: the 1 type and the emetic type, The 1 type of food spoilage is caused by an enterotoxin generated during vegetative growth of *Bacillus cereus* in the small intestine while emetic toxin is synthesized by the cells growing in the food. The organism is unable to grow below 10°C (Mahari et al., 1990).

TYPES OF SPOILAGE MICROORGANISMS

PSYCHROTROPHS

Psychrotrophic microorganisms are considered in a substantial percentage of the bacteria in raw milk, with *Pseudomonas* and related aerobic, Gram-negative, rod-shaped bacteria being quietly the predominant groups. 65–75% of the psychrotrophs isolated from raw milk are *Pseudomonas* species. Significant characteristics of pseudomonads are their abilities to grow at low temperatures (3–7°C) and to hydrolyze and use large complex molecules of proteins and lipids for growth. Other important psychrotrophs allied with raw milk include members of the genera *Bacillus*, *Micrococcus*, *Aerococcus*, and *Lactococcus* and of the family Enterobacteriaceae (Lyn, 1990).

MICROBIOLOGICAL SPOILAGE OF DAIRY PRODUCTS

Pseudomonas can decrease the diacetyl percentage of buttermilk and sour cream, thereby paving to a “green” or yogurt-like flavor from an imbalance of the diacetyl to acetaldehyde ratio. For cottage cheese, the typical pH is marginally favorable for the growth of Gram-negative psychotropic bacteria, with the pH of cottage cheese curd ranging from 4.5 to 4.8 and the pH of creamed curd being within the more favorable pH range of 5.0–5.4. The usual salt percent of cottage cheese is insufficient to limit the growth of contaminating bacteria; therefore, psychrotrophs are the bacteria that normally limit the shelf life of cottage cheese. When in raw milk at cell numbers of greater than 10⁷ CFU/ml, psychrotrophs can drastically reduce the yield and quality of cheese curd (Kon, 1992).

COLIFORMS

Like psychrotrophs, coliforms can also sporadically decrease the diacetyl content of buttermilk and sour cream, subsequently synthesizing a yogurt-like flavor. In cheese production, slow lactic acid production by starter cultures favors the growth and production of gas by coliform bacteria, with coliforms having very short generation times under such conditions. In soft, mold-ripened cheeses, the pH aggrandizes during ripening, which increases the growth potential of coliform bacteria (Kalogridou - Vassiliado u et al., 1992).

LACTIC ACID BACTERIA

Excessive viscosity can occur in buttermilk and sour cream from the progressive growth of encapsulated, slime-producing lactococci. Diacetyl can be decreased by diacetyl reductase produced in these products by lactococci growing at 8°C, resulting in a yogurt-like flavor.

Heterofermentative lactic acid bacteria such as lactobacilli and *Leuconostoc* can develop quite off-flavors and gas in ripened cheeses. These microorganisms metabolize lactose, thereby producing lactate, acetate, ethanol, and CO₂ in approximately equimolar concentrations.

Their growth is favored over that of homofermentative starter culture bacteria when ripening occurs at 15°C-16°C rather than 9°C. In case of homofermentative lactic acid bacteria fail to metabolize all of the fermentable sugar in a cheese, the heterofermentative bacteria that are often present complete the fermentation, producing gas and off-flavors, provided their populations are 10⁶CFU/g (Henry et al., 1997). Residual galactose in cheese is an example of a perfect substrate that many heterofermentative bacteria can metabolize and produce gas. In addition facultative lactobacilli can metabolize citric and lactic acids and produce CO₂.

Catabolism of amino acids in cheese by nonstarter culture, naturally occurring lactobacilli, propionibacteria, and *Lactococcus lactis* subsp. *Lactis* can produce small amounts of gas in cheeses. Cracks in cheeses can happen when there is excess gas by certain strains of *Streptococcus thermophilus* and *Lactobacillus helveticus* that form CO₂ and 4-aminobutyric acid by decarboxylation of glutamic. Metabolism of tyrosine by particular lactobacilli causes a pink to brown discoloration in ripened cheeses. This reaction is dependent on the presence of oxygen at the cheese surface. The racemic mixture of L(+) and (-)-lactic acids that forms a white crystalline material on surfaces of Cheddar and Colby cheeses is synthesized by the

concoction growth of starter culture lactococci and nonstarter culture lactic acid producers (Griffiths, 1982). The latter racemize the (+) form of the acid to the L (-) form, which form crystals.

SPOILAGE BACTERIA

Spoilage bacteria are microorganisms that cause quite a deterioration of food and develop unpleasant odors, tastes, and textures. A spoiled food has lost the original nutritional value, it lacks texture or flavor and can become harmful to people and unsuitable to eat (Gill et al., 1994). The microbial spoilage of food products comprises an important economic problem, as it results in high economic losses for the food industry, especially under incorrect refrigeration conditions.

There are unique different bacterial species that can cause spoilage in food products and the spoilage micro biota mainly depends in great proportion of the processing and preservation method. Storage temperature plays a crucial role in the growth of undesirable micro biota in food. Fresh foodstuffs such as fish and meat, stored at refrigeration temperatures can result in the growth of *Pseudomonas* spp., including spoilage species, such as *P. fragrans* and *P. putida*. A moderate preservation and change in the atmosphere, e.g. by vacuum-packaging, may significantly inhibit these bacterial species and favour the growth of other species, such as lactic acid bacteria (LAB), Enterobacteriaceae, *Bacillus* spp. and *Clostridium* spp. These last two genera are able to produce spores that can very much survive heat treatments and germinate after a pasteurization process, creating a significant issue in food safety. Spoilage species may be more food-specific and, thus, *Erwinia* spp. has been reported in products of vegetal origin. In addition, seafood products are commonly spoiled by species such as *Shewanella* spp. or *Photobacterium* spp. Generally bacteria can spoil different foods depending on the physical-chemical preservation profile (Bright et al., 2002).

PATHOGENIC BACTERIA

Foodborne diseases are mainly caused by agents that enter and engulf the body through the ingestion of food. Food can transmit disease from person to person contact, as well as serve as a growth medium for bacteria that can cause food poisoning. The global incidence of foodborne diseases is difficult to be estimated, but it has been reported that in 2006 alone 2.8 million people died from diarrheal diseases (Böhme et al., 2011b). A great proportion of

these cases can be attributed to the consumption of contaminated food and water. In industrialized countries, the percentage of the population suffering from foodborne diseases each year has been reported to be up to 32%. Pathogenic bacteria often do not change the color, odour, taste or texture of a food product, being hard to distinguish if the product is contaminated. Food-borne infection is mainly caused by bacteria in food. If bacteria become numerous and the food is consumed, bacteria may continue to grow in intestines and cause illness. Food intoxication results from eating of toxins (or poisons) produced in food as a by-product of bacterial growth and multiplication in food. In this case the toxins and not bacteria cause illness. Toxins may not exactly alter the appearance, odour or flavor of food. Common bacteria that generate toxins include *Staphylococcus aureus* and *Clostridium botulinum*. In certain cases, such as *Clostridium perfringens*, illness is mainly caused by toxins released in the gut, when large numbers of vegetative cells are eaten. Bacterial food poisoning is generally caused by bacterial pathogenic species ((Böhme et al., 2011a).

Emerging foodborne pathogens mainly refer to new pathogens, pathogens that emerge due to changing ecology or differing technology that connects a potential pathogen with the food chain or emerge de novo by transfer of mobile virulence factors. Emerging foodborne pathogens comprises *E. coli* O157:H7, *Aeromonas hydrophila*, *Aeromonas caviae*, *Aeromonas sobria*, *Mycobacterium* spp., vancomycin-resistant enterococci, non-gastric *Helicobacter* spp., *Enterobacter sakazakii*, non-jejuni/coli species of *Campylobacter*, and non-O157 Shiga toxin-producing *E. coli* the presence and multiplication of these micro-organisms in milk brings about changes in the properties of milk thus decreasing its quality (Gallardo et al., 2010). Like most food borne and water borne pathogens like *Aeromonas* sp (S. Sreeremya, 2017), *E. coli* (S. Sreeremya, 2018b), *Mycobacterium kansasii* (S. Sreeremya, 2018a). Even food miles also impact the spoilage of food (S. Sreeremya, 2018d). Even if it is dairy, non-dairy or fermented food (S. Sreeremya et al, 2018) if not processed correctly can cause serious health issue (S. Sreeremya, 2018c). Food must act as nutraceutical and not a toxin (Sreeremya Sasi, 2017).

In order to extend the shelf-life of milk for human consumption generally by preventing the growth of spoilage organisms as well as preventing the transmission of diseases via milk, this highly nutritious, versatile food is commonly pasteurized for a short time (Bizzini, et al., 2010). The International Dairy Federation delineates pasteurization as a process applied to

a product with the aim of avoiding public health hazards arising from pathogenic microorganisms allied with such products by heat treatment which is consistent with minimal chemical, physical and organoleptic variations in the product. Milk is pasteurized by heating at a temperature of about 64° C (144° F) for 32 min, rapidly cooling it, and then storing it at a temperature below 12° C (55° F). Pasteurization kills most, but not all bacteria in milk. The concoction of time and temperature availed for heat treatment of milk are however, designed to kill all pathogenic microorganisms (Bernardo et al., 2002). In general thermoduric bacteria are most numerous. These bacteria which are heat resistant and commonly survive pasteurization temperatures belong to the genera Bacillus, Clostridium, Mycobacterium, Micrococcus, Streptococcus and Lactobacillus. These organisms are therefore generally seen in milk when prevailing storage conditions permit their spores to germinate (for spore-formers), grow and subsequently spoil the milk or pose health risk to consumers (Barbuddhe et al., 2008). Milk is commonly processed in a variety of ways. Condensed, evaporated, and powdered milk are generated by evaporating some or all of the water in milk with the intention of extending the shelf-life of the milk. The removal of about 55% water from whole milk results in the production of a light brown milk product called unsweetened evaporated milk. However with this amount of water, the milk is still susceptible to microbiological spoilage so the evaporated milk is packaged in cans and typically heat-processed under steam pressure in an attempt to destroy all the microorganisms present (Ayyadurai et al., 2010). Thus maintaining quality of pasteurized milk depends both on the quality of heat treatment and on the extent of post – pasteurization contamination. This research was therefore aimed at evaluating the efficacy of the heat processing of three popular unsweetened evaporated milk brands sold in certain developed by investigating the incidence of spore-forming bacteria in them (Alm et al., 2006).

CONCLUSION

Spoilage bacteria are able to grow in large number in food, decompose the food and cause changes in the taste/smell, which affect the quality of the products. Spoilage bacteria normally do not cause illness; however, when consumed in high concentration, they can cause gastrointestinal disturbance. *P. fragi*, *P. putida*, *E. coli*, *Clostridium* sp, *Shigella* sp.

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