LUCRĂRI ŞTIINŢIFICE MEDICINĂ VETERINARĂ VOL. XLII (2), 2009, TIMIŞOARA

FOOD CONTAMINATION WITH PSYHCROPHILIC BACTERIA

R.G. VASUT, MIHAELA DIMA ROBECI

Sanitary Veterinary for Food Safety Direction Vâlcea
Pandurilor Boulevard No. 9, Vâlcea, Romania

Summary

Psychrophile/psychrotrophic bacteria are a major interest particularity in food microbiology, defined as microorganisms that have complex skills to adapt to extreme conditions of life.

Using the data presented in this paper shows that foods of animal origin contaminated with psychrophile/psychrotrophic bacteria could present organoleptic change (appearance, color, consistency, smell and taste) even if there are kept at temperatures considered optimal for conservation.

Key words: psychrophilic bacteria, food contamination

Psychrophile or cryophile bacteria are defined as extremophile microorganisms that are able to grow and multiply at low temperatures. Psychrophile name has its origins in "psychro" from Greek, means "cold" (5). This is in contrast to the bacteria that manage to grow at extremely high temperatures. These bacteria growth every where on Earth representing a large fraction of the surface of our planet with temperatures below 15 ˚C. They are present in the lands of alpine and arctic soils at high altitudes and water depths in oceans, in arctic ice, ice age and the lands of snow.

Psychrophile uses a large variety of metabolic pathways, including photosynthesis, chemoautotrophism and various forms heterotrophism and robust communities. Psychrophile bacteria are characterized by fat cell membranes, chemical resistant cooling produced by extremely icy and often produce proteins "antifreeze" to protect the liquid from the interior and their DNA when the average water temperature reaches the frost point (5).

Psychrophile bacteria can be defined as a "subset" of the mesophile bacteria because optimum increase temperature is "moderately low" and they continue to grow as long as the temperature is below the maximum for most mesophile. Psychrophille include several bacteria such as Gram positive bacteria and Gram negative, aerobic, anaerobic and other organisms that sporulate and unsporulate forms, movable and immovable bacteria, bacillus, Vibrio and coccobacillus. Psychrotrophic bacteria can be found in food and other sources, being spread predominantly in cold periods in the environment (3).

Morita has made a study on the definitions used to describe psychrophile and their differentiation psychrotrophic. Many types of bacteria found in water at temperatures of +0.18 ˚C and +36˚C could be isolated only after incubation at 0 ˚C (they were considerate as psychrophile bacteria). Psychrophile grow faster than psychrotrophic to 10 ˚ C, the latter can grow in a high temperature range (1).

Microbiology of meat and meat preparations

Meat is the most requested food in most countries. Due to its composition and origin of meat is not only very sensitive to microbial alteration, but it is quite often involved in the spread of disease or trigger toxiinfection food.

Due to chemical composition, muscle is a very good multiplying many microorganisms, especially bacteria. Also, the content of carbohydrates in muscle is reduced, towards from nitrates compounds.

Altering microorganisms that contaminate meat

Pathogenic germs are very rare on the meat produced in hygienic conditions. The area of such meat is usually contaminated with various species of saprophytic organisms, especially coccobacillus or bacillus and Gram-negative micrococcus. Immediately after cutting, the microflora from the carcasses is composed mainly of different species of the genera *Micrococcus* (45-65%), *Pseudomonas* (30-50%), *Bacillus* (10-12%), *Acinetobacter, Aeromonas, Alcaligenes, Flavobacterium, Moraxella, Corynebacterium,* and different *Enterobacteriaceae.*

With storage at refrigeration temperature, when carcasses arriving in stores, the dominant microflora is represented by different species of *Pseudomonas* (70-80%), in particular *Ps. fragi* (50-60%) and *Acinetobacter* and *Moraxella, Micrococcus* proportion remaining insignifiant. This is primarily due to greater opportunities to multiply at low temperatures a species of the genera *Pseudomonas- Acinetobacter - Moraxella* than those of the family *Micrococcaceae*. If the surface of carcass is well dry, instead of bacteria will be taken by molds (1).

Microorganisms that contaminate the prepare meat

Preparations containing a minced meat have higher microbial load from these reasons:

- Meat from different parts of the carcass with high microbial charge
- Cutting and increasing surface and the number of germs/g;
- Contaminated equipment;
- Intestines used in different types of sausages.

Meat minced pork forms the main ingredient for most cooked meat products. The sausages may also present as chilled and fresh. The microbial flora of the fresh pork sausages was studied during several years and described in a report submitted by Sulzbacher and McLean (1, 6). Samples of the sausages produced from commercial processing plants during the production were analyzed in the same day. In approximately 59% of the insulation 316 have been found bacteria belong to the genus Bacterium in proportion of 20.6%, *Microbacterium* in proportion of 14.9%, *Achromobacter* 12.9% and *Pseudomonas* 10.8%. Also found *Bacillus* 8.9% and *Alcaligenes* and in proportion of 6.0%.

Development of psychrophile/psychrotrophicbacteria, depend on the relative humidity of the atmosphere of the store where the product is. Was demonstrated by multiple studies, the association of bacterial species *Pseudomonas - Acinetobacter - Moraxella* can not develop in the atmosphere with relative humidity below 95%. After a storage time of the products at the refrigeration temperature or higher temperature, the metabolic activity of microorganisms developed on their surface becomes detectable by human senses: their bleeding surface becomes sticky and emits an odor, ammonia smell (Fig. 1).

Fig.1 Psychrophile bacteria multiplication on the surface of meat preparations (surface with slime) (7)

Microorganisms that contaminate poultry

Immediately after obtaining, surface of carcasses is mainly contaminated with bacteria of the genera *Acinetobacter, Flavobacterium*, but superficial rotting is produced primarily by *Pseudomonas (fluorescens, putide, fragi*, etc.) and to a lesser extent by *Aeromonas, Acinetobacter* and *Moraxella. Pseudomonas* bacteria contaminate the carcasses during the cutting process, especially in the cooling water. Being a psychrotrophic bacteria, it becomes dominant on the surface of

carcasses stored at low temperatures. When the plate reaches 10^7-10^8/ cm^2 from skin, the odor appears and when it exceeds at $10^8/cm^2$ skin, it forms sticky mucus accompanied by color changes of the skin, which cause rejection of carcasses from the market (1,6).

Microorganisms that contaminate fish and seafood

Microorganisms are found on all surfaces (skin and gills) and in the intestines of live fish or fresh fish. The total number of microorganisms vary greatly, Liston (1980) establishing the normal 10^2-10^7 germs/cm^2 on the skin surface. The gills and intestines together, contain between 10^3 and 10^9 germs/g (2).

Microbial flora of fresh fish on the fishing depends on the environment in which it was caught more than fish species. Fish fishing in clear water and very cold, carries a small number of microorganisms compared with fish from the warm water which has a number of microorganisms a little higher. Many organisms (10^7) were found in fish from polluted warm waters. Multiple differences of the bacterial species can be found on the body surface of fish (1).

Over 80% of the microorganisms found in aquatic caught animals in temperate areas of the northern hemisphere, are Gram-negative bacillus belonging to the genera: *Pseudomonas, Aeromonas, Moraxella, Acinetobacter, Flavobacterium* and *Vibrio*. In crustaceans predominate *Moraxella* and *Acinetobacter*. Unlike marine animals, on the freshwater fish are often found bacteria family *Enterobacteriaceae* and the genus *Aeromonas* (2). Molluscs meat is contaminated with a large number of microorganisms (10^4-10^6/g), especially when it comes to animals caught in warm waters. Dominant microflora consists of Gram negative bacteria (*Vibrio, Pseudomonas, Acinetobacter, Moraxella, Flavobacterium, Cytophaga*) (3).

Psychrophile microorganisms in milk and dairy products

There are many microorganisms that acting strongly on milk proteins and their hydrolysis following result peptones, polypeptides, amino acids. Amino acids are decomposed in ammonia, indole, skatol, hydrogen sulphide. Following these bacteria activities, some modifications characteristic of milk and cheese may occur such peptonizing or proteolisis, abnormal colors and odors.

Species of the genus *Pseudomonas* - bacillus Gram-negative - (*Ps. fluorescens, Ps.alcaligenes, Ps. syncyanea*) are strictly aerobic, are peptonized and alcalized. The transformations suffered by milk after action of these bacteria not crossing by acidification and coagulation phases. Most of the times, especially

when acting *Ps. fluorescens*, milk becomes a liquid blear yellow-greenish, fluorescent, with the smell of ammonia, fish or urine. Sometimes peptonized milk is blue-violet (*Ps. syncyanea*). *Ps. fluorescens* often pollute water which contaminates machinery and equipment and the milk after pasteurization or sterilization processes.

There psychrophile bacteria that have the capacity to produce and liberate lipase in the environment, leads to the hydrolysis of fat with the formation of fatty acids and glycerine. Consequently of the lipolytic activity of bacteria on milk and dairy products is the occurrence of different modifications of smell and taste, the more commonly encountered like barrel, of pepper, salt, spicy, sour.

Yersinia enterocolitica (pathogenic bacterium) was isolated frequently in recent years in France, in the milk of domestic animals (goats). Cases of disease with *Yersinia enterocolitica* have been reported in several U.S. schools where students have milk for breakfast. Following investigations were identified source of contamination of milk-cooling tank milk (2).

Listeria monocytogenes (pathogenic bacteria). Serotypes of *L. monocytogenes* pathogenic to animals (cattle, sheep, and goats) are equally pathogenic for humans. Milk is considered one of the vehicles germs from animals to humans, although the oral route of infection was not yet sufficiently demonstrated. Moreover, listeriosis and the epidemiology of transmission of germs in humans and animals are not known. Germs are frequently identified in the udder and can sometimes cause the inflammation (mastitis) (4).

Conclusions

Psychrophile/psychrotrophic bacteria are widely spread around the globe - from one pole to the other.

Adaptation to extreme environmental conditions is achieved by altering of the ratio fatty acids saturated/unsaturated from the composition of cell membrane.

Some bacterial species are capable of association in order to use a substrate (*Pseudomonas-Moraxella-Acinetobacter*).

Contamination with psychrophile/psychrotrophic bacteria up the "cold chain" is possible if the rules are not imposed by hygiene (Good Manufacturing Practice - GMP).

In some situations, changes of smell and taste of food are more complex, difficult to define, as a result of the development of microorganisms with different actions and effects. Products with such defects are excluded from the market.

References

1. **Kraft, A.A.,** Psychrotrophic Bacteria in Foods: Disease and Spoilage, CRC Press, 1992.
2. **Barzoi, D., Apostu, S.**, Microbiologia produselor alimentare, Ed. Risoprint - Cluj-Napoca, 2002.
3. **Dalgaard, P.**, Spoilage of Seafood. In: Encyclopedia of Food Sciences and Nutrition, eds. Caballero B., Trugo L., Finglas P., Elsevier Science Ltd./Academic Press, London, UK. pp. 2462-71, 2003.
4. **El-Gazzar, F.E., Marth, E.H.**, Listeria monocytogenes and listeriosis related to milk, milk products and dairy ingredients: a review. II. Listeria monocytogenesand dairy technology. Milchwissenschaft, 1991, 46, 82-86.
5. **Siegel L.J.**, Life on Ice, The Electronic Astrobiology Newsletter, 2001, 8, 30.
6. **Rapuntean, G., Rapuntean, S.G**, Bacteriologie veterinara speciala, Ed. AcademicPres- Cluj-Napoca, 2005.
7. **Williamson, N.R. et al.**, The biosynthesis and regulation of bacterial prodiginines. Nature Reviews, Microbiology, 2006, 4, S.887-899.