



Mini Review Paper

Psychrophilic Pathogens: Potential Risk for Food Borne Illness

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Abstract

Contrary to common belief that hot environment is the breeding ground of pathogens, refrigerator also favours growth of pathogens. Psychrophilic pathogens can be potential hazard for public health. One of the most neglected areas has been the issue of psychrophilic pathogens which are related with refrigerated items in our households. Several guidelines have been proposed regarding food handling, care during preparation of food at home, hotels, restaurants, street food vendors etc, but in the modern era there is increasing dependency on low temperature storage of food i.e refrigerating the food. In case of our society with the disintegration of joint family and the changing role of women in the family have resulted in a need for convenient food items which are well preserved having same taste, texture and enhanced shelf life. This has been made available due to better and advanced refrigeration technology. But, the traditional perception that it is only the higher temperature is blamed as the main factor for food spoilage. This stands challenge by the recent researches done on refrigerated food and psychrophilic bacteria (Psychro-Gk. Cold). If proper temperature and hygiene is not maintained for refrigerated food items then the texture, the taste, and other related aspects might be adversely affected, thereby resulting in health problems. An attempt has been made to study these microbes and the food they contaminate, also the mode of contamination and consequences and ways to prevent these pathogens are the focal points of present paper.

Keywords: Psychrophilic, Pathogens, Potential, Risk, Food, Borne Illness

Introduction

One of the important components of Swachh Bharat Abhiyan is food hygiene. Keeping this in view, it is important also to take care of the same in the household. One of the most neglected areas has been the issue of psychrophilic pathogens which are related with refrigerated items in our households. Several guidelines have been proposed regarding food handling, care during preparation of food at home, hotels, restaurants, street food vendors etc, but in the modern era there is increasing dependency on low temperature storage of food i.e refrigerating the food. In case of our society with the disintegration of joint family changing role of women in the family have affected the food habits resulting in a need for convenient food items which are well preserved having same taste, texture and enhanced shelf life.

This has been made available due to better and advanced refrigeration technology. But, the traditional perception that it is only the higher temperature is blamed as the main factor for food spoilage. This stands challenge by the recent researches done on refrigerated food and psychrophilic bacteria¹. If proper temperature and hygiene is not maintained for refrigerated food items then the texture, the taste, and other related aspects might be adversely affected, thereby resulting in health problems. The specific characteristics of psychrophilic bacteria that support them to survive at low temperature are—increased proportion of

unsaturated fatty acid in the cell membrane giving it more fluid, protein conformation is such that it is functional at low temperature. Their one or more essential cellular components are thermolabile which favours the growth at low temperature.

The degradative activities of these microorganisms cause food spoilage, which are pathogenic or toxinogenic for humans and animals. There are broad range of bacteria under psychrophiles like aerobic, anaerobic, sporulate and unsporulate form, bacillus, vibrio and coccobacillus Gram positive and Gram negative².

When the hygiene of refrigerator is not maintained properly, it becomes breeding ground for psychrophiles. There is a need to make people aware about refrigerator hygiene because prevention is better than cure and vigilance in this regard can promote public health.

Temperature is the most efficient means to control microbial growth. Based on their tolerance of broad temperature ranges, microorganisms are roughly classified as follows: i. Psychrophilic grow only at refrigeration temperature. ii. Psychrotrophs grow well at refrigeration temperature but better at room temperature. iii. Mesophiles grow best at or near human body temperature, but grow well at room temperature. iv. Thermophiles grow only at temperature about as hot as human hand can endure, and usually not at all at or below body temperature³.

Table-1
Minimum Growth Temperature (degree C) of selected Microorganisms⁴

Microorganisms	Minimum Growth Temperature
Acetobacter	5
<i>Clostridium botulinum</i>	3.3-10
<i>Clostridium putrefaciens</i>	0
E. coli	5-10
Listeria	1
Staphylococcus	5-10
Vibrio	4
Pseudomonas	4
<i>Yersinia enterocolitica</i>	0-4

Table-2
Pathogens able to survive in refrigerated foods⁵

Microorganism	Common food sources
Campylobacter jejuni	Raw chicken, foods contaminated by raw chicken, unpasteurized milk
Listeria monocytogenes	Ready to eat foods including raw milk, cheese, ice-cream, raw vegetables, raw and cooked poultry, raw meats
Yersinia enterocolitica	Raw milk, chocolate, milk, raw meats
Aeromonas hydrophila	seafoods
Pseudomonas spp.	Meat, fish and dairy products

Source: European manual for hygiene standards and communicable diseases surveillance on passenger ships (2011)

Mode of contamination and consequences

Stored raw and improperly packed foods, open refrigerated door, lack of hygiene are the sources of contamination for refrigerated food. Food borne illness resulting from consumption of these foods manifest in the form of diarrhea, dysentery, urinary tract infections, gastro intestinal infections, meningitis, food poisoning. Some of the mycotoxins and aflatoxins spreading through refrigerated foods are carcinogenic. *Listeria monocytogenes*, causes a disease Listeriosis can be deadly in vulnerable populations, such as pregnant women, fetuses, infants, the elderly and those with compromised immune system. *Clostridium botulinum* are a

particular pathogen of concern for vacuum packaged refrigerated foods with an extended shelf life capable of growing at temperature as low as 3.3 degree centigrade, produce Neurotoxin.

Meat and meat products

Relative humidity of the atmosphere is one of the factors promoting development of psychrophiles. This has been demonstrated by multiple studies. Some species of bacteria like Pseudomonas - Acinetobacter – Moraxella develop in the atmosphere having relative humidity above 95%. Human senses can detect the degradative metabolic activity of these microbes as the breeding surface becomes sticky emitting ammonia smell.

Milk and dairy products

There are many microorganisms that act strongly on milk proteins and their hydrolysis results in peptones, polypeptides, amino acids. Amino acids are decomposed in ammonia, indole, skatol, hydrogen sulphide. Following these bacterial activities, some modifications characteristic of milk and cheese may occur causing abnormal colors and odors. These 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. As a consequence of the lipolytic activity of bacteria on milk and dairy products leads to modifications of smell and taste ⁶.

Table-3
Expected shelf life of refrigerated foods Prevention of growth and spread of “psychrophilic pathogens” in the refrigerators

Refrigerated products (Food)	Expected shelf life in the home
Meat	3-5 days
Poultry	3 days
Fruit juices	7-14 days
Milk	5-7 days
Cream	5 days
Cheese	Variable (1-3 months)
Soft Cheese (camembert)	2-3 weeks
Cottage	10 days
Eggs	3-6 weeks
Butter	8 weeks
Oil and fat	Variable (6 months)

Ideal refrigeration temperature is $\leq 5^{\circ}\text{C}$. At this temperature growth of harmful bacteria gets slowed down. Cleaning the components of refrigerator is the best way for reducing bacteria. Refrigerator should be cleaned regularly. Spilled food should be wiped off. Hot air carrying bacteria can enter inside the refrigerator when the door is left open unnecessarily. Tight-sealed containers should be used to store foods in the refrigerator. This practice retains moisture and also foods do not spread to other foods. Suspected spoiled food should be removed. Cross-contamination of the food items can be prevented by separately storing the cooked and the dripping items like meat, poultry, or fish. Also by proper placement of both items on the shelf. Crowding of stored products in the refrigerator should be avoided; there should be good air circulation around each item. Bruised vegetables and fruits with damaged skin should not be kept in refrigerator as it will promote rotting. There is possibility of shrivelling and wilting due to water loss in case of leafy vegetables. Therefore, these items should be stored in perforated plastic bags in the refrigerator. Storage life of carrots, turnips and beetroots can be extended to many weeks or even several months in the refrigerator by removing leafy tops. Different varieties of fruits have different keeping qualities, so time to time injured and ripened fruits should be removed to prevent infection. Defrosting the refrigerator should be done regularly. Operation efficiency is reduced when there is excess of ice built up. But, with advanced technology now automatic defrost models are available. Refrigerator operates effectively when it is located in an area with adequate air space. Door seals should also be checked regularly. The best guide to storage life of a particular perishable food is the 'best before' date, but if the food has been stored correctly before it is purchased, then there is actual utility of 'best before' date.

Conclusion

Food hygiene is one of the important aspects of public health; there is a need to make people aware about the refrigerated foods and its health implications because modern lifestyle has made refrigerator, a mandatory home appliance. During storage, microbial population in the food is affected by many factors of which temperature and length of time plays a key role in food safety and quality. Control of the storage temperature is vital in maintaining the quality and safety of refrigerated foods throughout the food continuum (gate to plate)⁷.

References

1. Vasut R.G. and Mihaela Dima Robeci (2009). Food Contamination with psychrophilic bacteria. *Lucrari Stiintifice Medicina Veterinara*, 42(2).
2. Dalgaard P. (2003). Spoilage of Sea food. *Encyclopedia of Food Sciences and Nutrition*, eds. Caballero B., Trugo L., Funflas P., Elsevier Science Lts, Academic Press London, UK, 2462-2471.
3. Aggie Horticulture. (2016). Introduction to the Microbiology of Food. The Microorganisms <https://www.aggie-horticulture.tamu.edu/food-technology-foodprocessing-entrepreneurs/microbiology-of-food/> accessed on 28.04.2016.
4. Kraft AA. (1992). Psychrotrophic spoilage bacteria-meat spoilage. CRC Press, 5-10.
5. Eushipsan Trainet Project partnership (2011). European manual for hygiene standards and communicable diseases surveillance on passenger ships. <http://www.shipsan.edu> accessed on 21.04.2016
6. Samarzija D. et al. (2012). Psychrotrophic bacteria & milk quality. *Mljekarstvo*, 62(2),77-95.
7. Jol S, Kassianenko A. and Oggel J. (2016). Issues in Time and Temperature Abuse of Refrigerated Foods. <http://www.foodsafetymagazine.com/magazine-archive1/december-2005january2006/issues-intime-and-temperature-abuse-of-refrigerated-food> accessed on 26.04.2016.
8. Jackson V, Blair IS and McDowell DA, et al. (2007). The incidence of significant foodborne pathogens in domestic refrigerators. *Food Control*, 18, 346-351.
9. Behravesh C.B., Williams I.T. and Tauxe R.V. (2012). Emerging foodborne pathogens and problems: expanding prevention efforts before slaughter or harvest. Institute of Medicine (US), Improving Food Safety through a One Health Approach: Workshop Summary, Washington (DC), National Academies Press (US), A14. Available from: <http://www.ncbi.nlm.nih.gov/books/NBK114501/>.
10. Siegel L.J. (2001). Life on Ice. *The electronic Astrobiology Newsletter*, 8, 30.
11. Haddad N., Burns C.M. and Bolla J.M. et al. (2009). Long-term survival of *Campylobacter jejuni* at low temperatures is dependent on polynucleotide phosphorylase activity. *Appl Environ Microbiol*, 75, 7310-18
12. Rossvoll E., Ronning H.T. and Granum PE et al. (2014). Toxin production and growth of pathogens subjected to temperature fluctuations simulating consumer handling of cold cuts. *Int J Food Microbiol*, doi.: 10.1016.
13. Ingham S.C. (1990). Growth of *Aeromonas hydrophila* and *Plesiomonas shigelloides* on cooked crayfish tails during cold storage under air, vacuum and a modified atmosphere. *J Food Prot*, 53, 665-67.
14. De Jonghe V., Coorevits and Van Hoorde K. (2011). Influence of storage conditions on the growth of *Pseudomonas* species in refrigerated raw milk. *Appl Environ Microbiol*, 77, 460-70.
15. Sautour M. and Dantigny P., et al. (2001). A temperature-type model for describing the relationship between fungal growth and water activity. 67, 63-69.