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BIOLOGICAL IMPACT ON STORING AND REHEATING FOOD

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Abstract

This review article examines how the quality of food goods varies when they are being frozen. The purpose of this study is to identify the important physical and chemical alterations that had taken place to the frozen foods. In fact, the quickest way to preserve food is by refrigeration storage. Based on the observation, it was shown that the kinetics reactions support the development of high-quality, computer-assisted prediction models. The detrimental effects of temperature on some food products demonstrated the necessity of a thorough assessment of the quality parameters of individual kinetics reaction. For the majority of frozen goods, a reasonable storage temperature that maintains the quality of commercial storage is -18 °C.

Keywords: Food allergy, frozen foods and storage

1. Introduction

Foods are organic compounds that are eaten to provide nutrition. Foods come from either plants or animals and are composed of moisture, protein, lipids, carbohydrates, minerals, and other organic compounds. Foods can get spoiled through microbiological, chemical, or physical processes. Foods are subject to spoiling in terms of their nutritional value, color, texture, and palatability. As a result, foods must be preserved if they are to maintain their quality over an extended length of time. The procedures or methods used to maintain both internal and exterior elements that could lead to food decomposition are referred to as food preservation. The main goal of food preservation is to prolong its shelf life while preserving its original nutritional composition, color, texture, and flavor. The practice of "food preservation" has a long history. It was initially practiced by a primitive group after they hunted a large animal that they were unable to consume all at once. The first and most crucial step toward creating civilization was learning how to preserve food. To preserve food, various societies throughout history and space have employed methods that are remarkably similar [1-3].

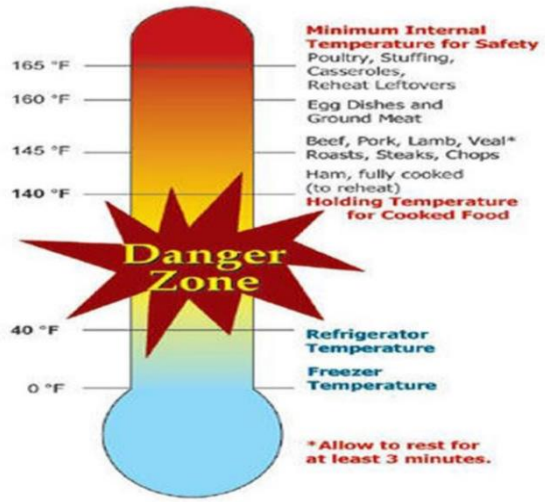

Figure 1: Effect of temperature on food

Classification of foods

Foods can be widely categorized based on their shelf life, uses, nutrient content, and processing methods. Shelf-life-based classifications of foods Food gradually loses its color, texture, flavor, nutritional value, and edibility as a result of food rotting, which is a natural process. Consuming rotten food can cause disease and, in the worst case scenario, death [4]. Food items can be divided into three categories based on how quickly they spoil: perishable, semi-perishable, and non-perishable [5]. Perishable Perishable foods are those with a short shelf life, typically between a few days and three weeks. Foods that spoil quickly include meats, poultry, eggs, dairy products, and shellfish. If specific preservation methods are not understood, food products may spoil immediately [6-10]. Semi-perishable When stored properly, a variety of foods can be kept fresh for a long period (about six months). Semi-perishable refers to these foods. Potatoes, cheese, fruits, and vegetables are a few examples of semi-perishable foods. Non-perishable Non-perishable food items are unprocessed and natural foods that have an endless shelf life.

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These foods can be kept for a number of years or even longer. Some examples of non-perishable foods are dry beans, almonds, flour, sugar, canned fruits, mayonnaise, and peanut butter.

Table 1 Food classification based on minerals and uses

Food functions	Sources
Body building and repairing Foods	Milk, meat, fish, pulses, vegetables, and nuts
Energy-giving foods	Oil, butter, sugar, cereals, dry fruits, and starch foods
Regulatory foods	Water, raw vegetables, citrus fruits, and beverages
Protective foods	Milk, whole grain cereals, meat, vegetables, and fruits
Nutrients Carbohydrate-rich foods	Rice, wheat, and starchy vegetables
Protein-rich foods	Milk, meat, fish, egg, and nuts
Fat-rich foods	Oils, butter, and egg yolk
Vitamin- and mineral-rich foods	Fruits and vegetables

Effect of heating up processed beef products after cooking, storing, and reheating on the production of cholesterol oxidation products

The link between diet and health has been extensively explored over the past 20 years, and consumers have been urged to adopt healthier eating practices. The American Heart Association's recommendations, which state that total fat intake shouldn't exceed 30% of total calories and saturated fat intake shouldn't exceed 10% of total calories, still apply to the amount of fats consumed, specifically saturated fats. Although a large number of people enjoy processed meat products very much, they are high in saturated fats, cholesterol, and lipids. Because they contain a high amount of saturated fatty acids and cholesterol, fats from animals are generally not regarded as being healthy [11]. Unwanted modifications brought on by thermal processing of meat and meat products include lipid oxidation and protein breakdown [12]. In tissues and meals, excessive oxidation of meat lipids can result in the precursors of extremely reactive aldehydes, which can cause oxidative stress [13-14]. These aldehydes may have a significant role in the development of a number of clinical disorders, including Alzheimer's, Parkinson's, arthritis, atherosclerosis, and inflammation [15].

Human plasma in good health contains 12.6 mg/L of COPs; eating meals high in COPs causes plasma levels to rise and has detrimental effects on health. A substance of biological significance, cholesterol is present in large quantities in foods from animals. Although the cholesterol content of meat and meat products varied greatly, in general, it was less than 70 mg/100 g, with the exception of edible offal, and it was assumed that meat and meat products made up one-third of daily intake. Although they have been shown to be cytotoxic, mutagenic, and carcinogenic, cholesterol oxidation products (COPs) are also thought to be a major factor in the development of atherosclerosis. COPs are created when meals produced from animals are heated and cooked, dehydrated, stored, and exposed to radiation. Cholesterol and its derivatives are evaluated using colorimetric, chromatographic, and enzymatic methods. According to Dominguez et al. among the several cooking techniques used to prepare foal meat, including roasting, grilling, microwaving, and frying, microwaved samples displayed the greatest levels of oxidation products. In a study by Lee et al. on the effects of different cooking and reheating techniques on the creation of COPs and total cholesterol in beef loin, they discovered a significant decrease in total cholesterol and a rise in COPs. When Hu et al. evaluated the effects of different cooking techniques on the digestibility of pig lipids and the production of COPs, they found that samples that had been microwaved produced much more COPs. In a recent study, Freitas et al. revealed that fish fillets cooked using various techniques had lower cholesterol content and higher COPs, particularly 7-ketocholesterol [16-19].

Effect of Frozen Storage on the Quality of Frozen Foods

Given the growing demand for fishery products, seafood quality and shelf life are crucial. But as soon as they are placed in frozen storage, the quality of the fishery products starts to steadily decline. According to Makarios Laham and Lee , when cod and haddock minces were stored in cold conditions, the toughening rate increased and other changes to the products' texture also took place. Fish species with higher levels of dimethylamine (DMA) and formaldehyde (FA), including red hake, were reported to have textural deterioration during frozen storage than those with lower levels of DMA and FA. It can be inferred from this that the interaction of FA with myofibrillar proteins may be one of the potential mechanisms resulting in the textural alterations in gadoids. No study has yet provided a comprehensive explanation of the deteriorating process of frozen shrimp over the storage term.

The operations of the microorganisms are the main cause of the degradation in fresh seafood quality over the storage period. Because of the high levels of soluble nitrogen compounds in fish muscles, as well as other seafood, they are frequently linked to rapid microbial deterioration. However, only a few types of bacterial species are to blame for the harm. When the seafood was refrigerated, it was found that a few psychrophilic bacteria were present and had already begun to multiply at 0 °C, which accelerated the rate of degradation. In general, it has been shown that the largest organisms in cold-water fish are Gram-negative, whereas the majority of organisms in tropical fish are Gram-positive. The degradation of seafood quality is caused by the action of enzymes originating from the tissues of fish and shellfish or by contaminating microbes like P. rotease, which alters seafood products in an unfavorable way. Shrimp quality declines as a result of endogenous en-

zymatic activity. The protease activity, according to Pornrat et al., caused considerable quality alterations in fresh shrimp and prawn. The texture of the fish flesh was soft during the heating stage, according to Crapo et al. Because of the protein's hydrolysis during the alkaline protease activity, the shear force value had decreased during the observation [20-22].

Protease that had been obtained from the obligately psychrophilic bacterium P7 has lowered the fish actomyosin at 5 °C. To increase its shelf life and stop microbiological and enzymatic activity that could lead to deterioration or a decrease in the product's quality, the seafood was stored in frozen storage and refrigerated. It is thought that a significant shortcoming in the product's application results from the product's attributes deteriorating, such as unfavorable changes in texture and appearance during the storage term. The reason for the decline in fish and seafood product quality throughout the period of refrigeration and freezing was still unclear, though. Cod and haddock minces' texture changed visibly while being stored frozen, according to Careche et al. Due to the action of the enzymes that had been liberated from the muscle cells during mincing, the texture was made tougher. De Koning and Mol discovered a significantly significant link between the textures of -18 °C-stored hake fillets and mince as well as the ratio of proteins that are soluble in an aqueous salt solution to the total amount of protein. Their discovery led them to develop a texture rating formula based on the total and soluble proteins for frozen fillets and frozen mince. By separating their units and significances, Singh and Wang presented the features of composites in order to ascertain the unit's level of acceptability and the caliber of the foods. Due to the fact that each component's qualities may be monitored and managed separately, the characteristics of the component might indicate the overall quality of the food. By delaying the occurrence of chemical changes, impeding the actions of the enzymes, and eradicating microbial development, the food's quality, such as the flavor, color, and texture, can be maintained.

However, the problem of food quality changes during the frozen storage period is still open because there is insufficient knowledge about the causes of deterioration. The data is necessary to forecast the property's condition or rate of degradation. With the help of food engineers, food technologists, chemists, and bacteriologists, it is now necessary to research how to preserve the quality of frozen food. Since then, earlier investigations had emphasized the quality alterations on the frozen goods. Reviewing the alterations that occur to the food during the frozen storage period is the main goal of this essay. Keep the fish muscle in frozen storage as one method of long-term preservation. However, there will be quality changes, such as alterations in its chemical and structural composition. The trimethylamine oxide demethylase (TMAOase) activity, partial dehydration of the protein during freezing, environmental changes caused by the freezing of inorganic salts, interactions between the protein and lipids, fatty acids, and products of lipid oxidation are just a few examples of the changes that can occur to the fish muscles during the frozen storage period [23-25].

Keep the following in mind the next time you store food:

• Always wash uncooked food thoroughly after purchase, including raw fruits and vegetables, meat and poultry, and cottage cheese. Make sure to thoroughly clean the food before storing it in the refrigerator.

• Another fact that may surprise some people is that proteins tend to spoil or become contaminated more quickly than other types of food. Therefore, it is important to always keep proteins like milk, eggs, chicken, meat, and cheese on top. This will maintain the nutritional value and freshness of the food.

• When storing food, be sure the temperature is set correctly. The recommended temperature for meat is 4-5 degrees Celsius. In addition, you should allow cooked food to cool completely before storing it in the refrigerator. Some individuals prepare food in the morning, then store it in the fridge until the evening when it has cooled. This must be prevented.

• There is a full process involved in freezing beef and fowl. Be very careful about where you acquire it, how the animal was cared for, and then store it properly.

The growth of psychrotrophic C. botulinum spores is affected by reheating and storage temperature in LTLT cooked meat.

In order to improve the eating quality of meat by lowering roughness and cooking loss, prolonged cooking of meat at a low temperature, less than 65°C (LTLT), is optimal. Both vegetative cells and psychrotrophic C. botulinum spores must be destroyed during the heat treatment in order to guarantee food safety and a lengthy shelf life, or the proliferation of the bacteria must be prevented. The reheating of food must be done in a manner that ensures food safety, as per the recommendations of the international organizations for food safety. Foods vacuum-packed and kept at 3–8°C should have a shelf life of no more than 10 days, according to the Food Standard Agency (FSA). Storage below 3°C or a heat treatment of 90°C for at least 10 minutes are required for products with a shelf life of more than 10 days [26-29].

Food Processing and Storage Changes in Biochemistry and Nutrition

In order to obtain the ideal texture and flavor, culinary raw materials are frequently processed to target certain compounds. For instance, milk is treated to cause the proteins to coagulate to form cheese, and then stored to allow the flavors to develop. In complex matrices like meat and vegetables, processing is likely to also affect other compounds, resulting in biochemical changes that could adversely affect the product's properties. Processing conditions can sometimes affect the formation of undesirable substances or safety concerns in meats. For example, polycyclic aromatic hydrocarbons can form during intensive specific smoking processes, heterocyclic aromatic amines

can form under specific heating/grilling conditions, and compounds that can affect flavor and texture from protein and lipid oxidation can release. The contrary is also true; one can support procedures that increase the availability of nutritionally beneficial components in meat products and/or ease digestion. In a range of fermented and aged meat products, for example, significant proteolysis can improve the creation of bioactive peptides with various bioactivities, such as antioxidant, antihypertensive, immunomodulating, antibacterial, prebiotic, and hypocholesterolemic characteristic. Highly esteemed nutrients like vitamins can be preserved more effectively with the use of gentle preservation techniques [30].

Conclusions

Low-acid, wet, and protein-containing foods are considered to be potentially dangerous. One technique for keeping potentially dangerous items, such meat, dairy, and some cut fruits and vegetables, safe to eat is temperature control using refrigeration. To prevent bacteria and other microbes from growing, refrigerated goods should be maintained at or below 41°F (5°C). Lunches brought from home should be kept at room temperature because the temperature of the food can rise throughout the day and perhaps exceed 62.6°F (17°C). Although ice packs are occasionally included in lunchboxes to keep food chilled, this may not be sufficient to maintain the temperature below 41°F (5°C). Only 22 out of 1631 (1.35%) potentially hazardous food items were found to be within the acceptable temperature range in a study carried out in six child care facilities in Texas. This included lunches with one ice pack, 8.2% of lunches with multiple ice packs, and 0.9% of lunches stored in the refrigerator. The lunch bags' composition, the length of time they spent at room temperature before chilling, or the refrigerator's internal temperature could all have an impact on these findings.

CONFLICT OF INTEREST: No Conflict of interest.

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References

[1] Flores, M.; Mora, L.; Reig, M.; Toldrá, F. Risk assessment of chemical substances of safety concern generated in processed meats. Food Sci. Hum. Wellness 2019.

[2] Gibis, M.; Kruwinnus, M.;Weiss, J. Impact of di_erent pan-frying conditions on the formation of heterocyclic aromatic amines and sensory quality in fried bacon. Food Chem. 2015, 168, 383–389.

[3] Arihara, K. Strategies for designing novel functional meat products. Meat Sci. 2006, 74, 219–229.

[4] Lund, M.N.; Lametsch, R.; Hviid, M.S.; Jensen, O.N.; Skibsted, L.H. High-oxygen packaging atmosphere influences protein oxidation and tenderness of porcine longissimus dorsi during chill storage. Meat Sci. 2007, 77, 295–303.

[5] Holman, B.W.B.; Kerry, J.P.; Hopkins, D.L. Meat packaging solutions to current industry challenges: A review. Meat Sci. 2018, 144, 159–168.

[6] Lee SO, Lim DG, Seol KH, Erwanto Y, Lee M. Effects of various cooking and re-heating methods on cholesterol oxidation products of beef loin. Asian Australas J Anim Sci. 2006;19:756–62.

[7] McCluskey S. Cholesterol oxidation products in whole milk powders. Ph.D. Thesis. Dublin: Dublin City University; 1997.

[8] Lee JI, Kang S, Ahn DU, Lee M. Formation of cholesterol oxides in irradiated raw and cooked chicken meat during storage. Poult Sci. 2001;80:105–8.

[9] Lillienberg L, Svanborg V. Determination of plasma cholesterol: comparison of gas liquid chromatography, colorimetric and enzymatic analysis. Clin Chim Acta. 1976;68:223.

[10] Dominguez R, Gomez M, Fonseca S, Lorenzo JM. Effect of different cooking methods on lipid oxidation and formation of volatile compounds in foal meat. Meat Sci. 2014;97:223–30.

[11] Hu SJ, Lee SY, Moon SS, Lee SJ. In Vitro effect of cooking methods on digestibility of lipids and formation of cholesterol oxidation products in pork. Korean J Food Sci An. 2014;34(3):280–6.

[12] Freitas MT, Amaral CAA, Coutrim MX, Afonso RJCF, Junqueira RG. Effect of cooking method on the formation of 7-ketocholesterol in Atlantic hake (Merluccius hubbsi) and smooth weakfish (Cynoscion leiarchus) fillets. LWT-Food Sci Technol. 2015;62(2):1141–7.

[13] Lee M, Sebranek JG, Olson DG, Dickson JS. Irradiation and packaging of fresh meat and poultry. J Food Prot. 1996;59:62–72.

[14] Park SW, Addis PB. HPLC determination of C-7 oxidized cholesterol derivatives in foods. J Food Sci. 1985;50:1437–41.

[15] Zubillaga MP, Maerker G. Quantification of three cholesterol oxidation products in raw meat and chicken. J Food Sci. 1991;56:1194–6.

[16] Folch J, Lees M, Sloan-Stanley GH. A simple method for the isolation and purification of total lipids from animal tissues. J Biol Chem. 1957;226:497–509.

[17] Badiani A, Stipa S, Bitossi F, Gatta PP, Vignola G, Chizzolini R. Lipid composition, retention and oxidation in fresh and completely trimmed beef muscles as affected by common culinary practices. Meat Sci. 2002;60:169–86.

[18] Du M, Ahn DU, Mendonca AF, Wesley IV. Quality characteristics of irradiated reday-to-eat turkey breast rolls from turkeys fed conjugated linoleic acid. Poult Sci. 2002;81(9):1378–84.

[19] Broncano JM, Petron MJ, Parra V, Timon ML. Effect of different cooking methods on lipid oxidation and formation of free cholesterol oxidation products (COPs) in Latissimus dorsi muscle of Iberian pigs. Meat Sci. 2009;83:431–7.

[20] Grau A, Codony R, Grimpa S, Baucells MD, Guardiola F. Cholesterol oxidation in frozen dark chicken

meat: influence of dietary fat sources, and atocopherol and ascorbic acid supplementation. Meat Sci. 2001;57:197–208.

[21] Ghiretti GP, Zanardi E, Novelli E, Campanini G, Dazzi G, Madarena G, et al. Comparative evaluation of some antioxidants in salame Milano and Mortadella production. Meat Sci. 1997;47:167–76.

[22] Serra A, Conte G, Cappucci A, Casarosa L, Melle M. Cholesterol and fatty acids oxidation in meat from three muscles of Massese suckling lambs slaughtered at different weights. Italian J Anim Sci. 2014;13(3):648–52.

[23] Monahan FJ, Gray JI, Boreen AM, Miller ER, Buckley DJ, Morrissey PA, et al. Influence of dietary treatment on lipid and cholesterol oxidation in pork. J Agric Food Chem. 1992;40:1310–5.

[24] El-Alim SSL, Lugasi A, Hovari J, Dworschak E. Culinary herbs inhibit lipid oxidation in raw and cooked minced meat patties during storage. J Sci Food Agric. 1999;79:277–85.

[25] Vicente SJV, Torres EAFS. Formation of four cholesterol oxidation products and loss of free lipids, cholesterol and water in beef hamburgers as a function of thermal processing. Food Control. 2007;18:63–8.

[26] 1. Almansour, F. D., Sweitzer, S. J., Magness, A. A., Calloway, E. E., McAllaster, M. R., Robert-Gray, C. R., Hoelscher, D. M., & Briley, M. E. Temperature of foods sent by parents of preschoolaged children. Pediatrics, 2011, 128 (3): e1-5.

[27] Centers for Disease Control and Prevention. Epidemiological notes and reports Bacillus cereus food poisoning associated with chicken fried rice at two day care centers—Virginia, 1993. Morbidity and Mortality Weekly Report 1994, 43 (10): 177-8.

[28] Food and Drug Administration. Food Code. (DHHS Publication no. PB2009-112613). Alexandria, VA: U.S. Department of Commerce Technology Administration, 2009.

[29] Food Safety and Inspection Service.How temperatures affect food. USDA. www.fsis.usda.gov/Factsheets/How_ Temp eratures_Affect_Food/index.asp, 2011.

[30] Fraser, A. Observational Study in South and North Carolina Child Care Facilities. (unpublished raw data) 6. Garland, J. S., et al. 1986. Airway burns in an infant following aspiration of microwave-heated tea. Chest 2012, 90: 621-622.