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Review Article on; Traditional and Modern Techniques For Food Preservation

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Abstract

Food preservation refers to keeping foods with the desired features or nature for as long as feasible after being prepared. Proper preservation is important to store the foodstuffs for a longer period without spoilage. However, the preservative must not be toxic to humans. Different techniques are used widely, including traditional and modern methods, to eliminate microbial contamination and avoid the rancidity of fat. Food preservation has been practised for centuries, with salting generally recognized as the earliest form of preservation. Foods preserved using a combination of procedures remain stable and safe even when not refrigerated. They have high sensory and nutritional characteristics due to the mild processes used. Care must also be taken to preserve foodstuffs' nutritional value, texture, and flavour. Food can spoil due to environmental, enzymatic, or microbiological processes. In this mini-review, traditional techniques for preservation such as salting, freezing, sugaring, smoking, and many more, as well as modern techniques such as pasteurization, pulse electric, dehydration, antimicrobial agents, irradiation, high-pressure technology, and hurdle technology, and many more are used to preserve food items.

Keywords: Pickling; Canning; Sugaring; Hurdle Technology; Pasteurization; Food preservation; pulse electric; dehydration; antimicrobial agents; irradiation

1. Introduction

Food preservation is the process of handling and treating food to control its spoilage by stopping the attack and growth of food-borne disease-causing microbes; avoiding oxidation of fats (rancidity); and maintaining the nutritional value, texture, and flavour of the food. Food preservation is also known as food processing. (Lianou, Panagou, & Nychas, 2016; Necidová et al., 2019). It is commonly recognized that chemicals, bacteria from the surrounding area, and enzymes included in the food itself can cause food products to decay if they are exposed to them. In addition, food and food products must be carried from one location to another to be consumed. During transit, there are chances to deteriorate the food, loss or decrease in morphological attraction, and reduction in the nutritional value of the food. According to the World Health Organization (WHO), around 600 million people – roughly one out of every ten people on the earth – become unwell after eating contaminated food, and 420 000 people die each year, resulting in the loss of 33 million healthy lifestyles. Similarly, 2.2 million children in poorer countries die of diarrhoea each year[2018 food-borne disease outbreaks]. Inadequate sanitation, a lack of drinkable drinking water, insufficient food storage facilities, and food safety awareness make food-borne disease outbreaks in underdeveloped countries. It is the leading cause of morbidity and mortality all across the world. In many regions of the world, food-borne outbreaks caused by tainted food are becoming more widespread. Therefore, it is important to make efforts for food preservation for longer shelf life, stability in quality, maintaining the morphological attraction, and no change in taste (Sharif, Mustapha, Jai, Yusof, & Zaki, 2017).

Various foods have been gathered and processed all around the world over time. Every year, there is also food rotting and many ripening food effects. Today, several approaches are applied to extend its shelf life. Several traditional and modern ways now operate. However, current methods are increasingly preferred over conventional methods due to their greater efficiency and dependability. (Annis & Banks, 1993). With the flow of time, several modern methods have also been developed to protect different types of food for varying lengths of time. While some processes have certain drawbacks, others have advantages that are being displaced by other methods, allowing us to store our food articles for longer periods without losing their flavour, nutritional value, quality, aroma, taste, or freshness; some processes have advantages that are being replaced by other techniques. Numerous approaches have been evaluated that have been in use for several years.(Ashie, Smith, Simpson, & Haard, 1996; Benlloch-Tinoco, Igual, Rodrigo, & Martínez-Navarrete, 2015).

Conventional food preservation procedures such as drying, freezing, chilling, pasteurization, and chemical preservation are widely used worldwide and are becoming increasingly popular. Scientific advances and advancements contribute to the evolution of existing technologies and the innovation of new ones, such as irradiation, high-pressure technology, and obstacle technology. (Amit, Uddin, Rahman, Islam, & Khan, 2017; Blum, 2012)

At the moment, the global market for processed food items is valued at approximately 7 trillion dollars, and it is steadily growing over time. (Daviron & Douillet, 2013). Rapid globalization and industrialization are two of the most important elements driving the development of food processing industries in many regions throughout the world. The UNIDO Industrial Statistics Database (2005) revealed that food processing in developing countries is a profitable component of the manufacturing sector. The contribution of food processing industries to national GDP increases in direct proportion to the national income.(Kar, 2014; WILKINSON & ROCHA, 2008). Taking into consideration the necessity of food preservation to limit the likelihood of food poisoning and other ailments, numerous traditional as well as modern methods of food preservation have been outlined in this section, including:

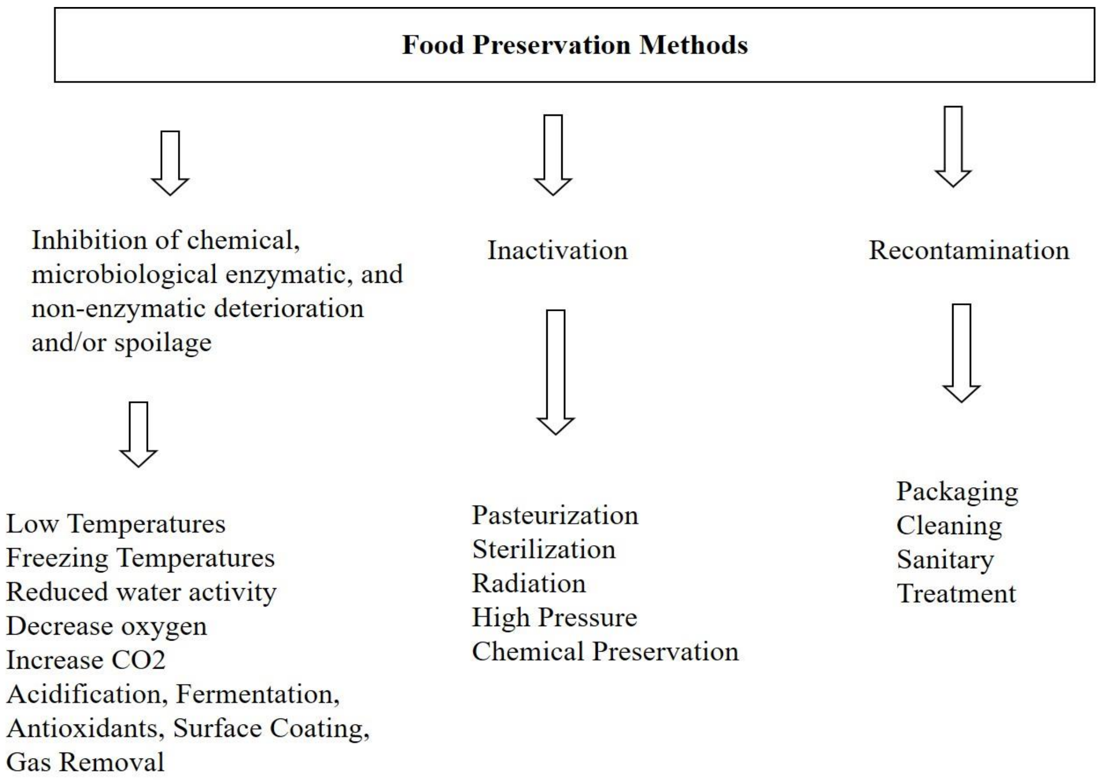

Fig 1. Major food preservation methods (Sadiku, Ashaolu, & Musa, 2019)].

2. Traditional Techniques

2.1 Canning

Canning In undeveloped countries, canned goods are rarely consumed by the population. This may be due to a high cost out of reach for the average customer. The high expense of canning results from the significant demand for energy and freshwater during the canning process. In contrast, various varieties' canned food is shipped from underdeveloped countries to their more developed counterparts in rich countries. Developing countries, for example, account for over 25% of the fruits and vegetables preserved in cans imported by European countries. A large quantity of foreign currency is generated by various varieties of canned fish, vegetables, and fruits for the benefit of low-income countries. Canning is a type of food preservation that is accomplished with a combination of processes, including heating and cooling. Canning inhibits the growth of microorganisms and inhibits the activity of enzymes. First, the raw materials must be properly treated because some foods, particularly fish, contain harmful microorganisms such as Clostridium botulinum, which can be fatal. In canning, all the foodstuffs must not be heated in the same manner(Van Berkel, Boogaard, & Heijnen, 2004).

On the other hand, the best quality can be achieved by ensuring proper heating conditions and employing fresh, healthy ingredients. The number of primary microorganisms present and the amount of internal water present are high in fish and meat. The pH of those foods, on the other hand, is virtually neutral. Once all present microbes have been eliminated, the challenge of creating a product that is safe to consume becomes extremely difficult. Permanent heating in a pressure sterilizer at temperatures that can reach more than 100 degrees Celsius, on the other hand, can be a risk-free choice. The pH of those foods, on the other hand, is virtually neutral. Once all present microbes have been eliminated, the challenge of creating a product that is safe to consume becomes extremely difficult. Permanent heating in a pressure sterilizer at temperatures that can reach more than 100 degrees Celsius, on the other hand, can be a risk-free choice. (Van Berkel et al., 2004). Protein-rich foods are sealed hermetically in cans or jars after being heated. Plant-based foods do not need to be heated before being packed in cans. Vinegar, acetic acid, or even oil is put in the can to limit microbial growth; finally, canned products can be stored for a long time without refrigeration.

2.2. Freezing

Freezing is an ancient and widely used method of preserving food. Unlike other methods, freezing preserves food's taste, texture, and nutritional content. Freezing is a low-temperature technique in which microorganisms cannot reproduce, chemical reactions are reduced, and cellular metabolic responses are hindered (Delgado & Sun, 2001). The preservation of food goods through freezing ensures that they retain their quality over an extended time. Canning and dehydration are also long-term preservation methods for food materials; however, freezing is generally considered preferable to these methods. (O. Fennema, 1977). Freezing has been efficaciously engaged for the long-standing preservation of many foods, providing an expressively prolonged shelf life. The process includes dropping the product temperature usually to −18 °C or lower than this(O. R. Fennema, Powrie, & Marth, 1973). The physical condition of food material is modified when energy is detached by cooling below freezing temperatures. However, if the temperature is extremely chilly, it slows down the chemical modifications that impact the qualities for which food spoils and slows down the increase of microorganisms. (George, 1993). Despite its outstanding preservation and quality assurance capabilities, frozen food has not been widely adopted in developing nations. On the other hand, domestic-level freezers are widespread among the wealthy and upper-middle classes in emerging countries. People in underdeveloped countries generally dislike frozen foods. Finally, it is one of the least industrialized food preservation strategies in developing countries. Freezing has been increasingly popular in recent years for preserving various foods, including fruits and vegetables. In both rich and emerging countries, deploying freezing techniques is comparable. (Barbosa-Cánovas, Altunakar, & Mejía-Lorío, 2005). Freezing has been increasingly popular in recent years for preserving various foods, including fruits and vegetables. In both rich and emerging countries, deploying freezing techniques is comparable. (Dave & Ghaly, 2011). Depending on the species, meat contains 50–75 percent water, and freezing turns the greatest amount of water into ice. (Heinz & Hautzinger, 2007). The phenomenon of meat freezing is very quick, and nearly 75% of tissue fluid freezes at −5 °C. While the temperature is decreased, the freezing rate is increased, and around 98% of water freezes at −20 °C. However, widespread crystal formation occurs at −65 °C (Dave & Ghaly, 2011; Rosmini, Perez-Alvarez, & Fernandez-Lopez, 2004).

Table No.1 Different quick-freezing techniques (fishery products) (Venugopal, 2005)

Criteria	Contact plate freezing	Air-blast freezing	Cryogenic freezing
Capital cost	Low capital investment	Economical to construct and operate	High capital costs
Operating cost	Low operating cost	Higher operating cost	Higher operating cost
Heat transfer	Controlled heat transfer	Efficient heat transfer	Efficient heat transfer
Product line	Generally bulk freezing	Flexible	Flexible
Required floor space	Large	Large	Small
Refrigeration plant	Required	Required	Not required
Maintenance cost	Low	Low	Minimum
Dehydration loss	High	High	Minimum
Product quality	Reasonably good product quality	Good product quality	Superior product quality

2.3. Smoking

Smoking is an old method of food preservation, and it continues to be used today for fish and meats. The smoke is obtained by burning hickory or similar wood, and it contains formaldehyde and phenolic compounds that have antimicrobial properties. The heat also dries the food, increasing preservation. Smoking of foods is currently used more for its unique flavour properties than for its preservative action(Joardder & Masud, 2019)

2.4. Refrigeration

Refrigeration is a method for short-term preservation of food quality as it may delay spoilage and growth of pathogenic microorganisms. Recent concern for several pathogenic or suspected organisms that will grow at refrigerator temperatures (< 6°C) has surfaced. These include C. botulinum type E, Vibrio parahaemolyticus, Yersinia enterocolitica, and Listeria monocytogenes(Lechowich, 1988). The refrigerated food industry increases the availability of fresh, refrigerated foods to consumers. The presence of delicatessens in supermarkets has increased this market. Products range from fresh salads of all types to entrees with 21 to 29 days (El-Hag, 1989). Two processes may be used for some of these new refrigerated products. The "sous-vide" process involves packaging in a vacuum pouch, cooking in the package, cooling rapidly, and refrigerating. Cooking may be in a pressure cooker, moist steam oven, or water bath. The "nouvelle carte" process differs concerning the type of package used. A plate is included in the pouch, and there is a sleeve with an overwrap. The rapid cooking methods used for these products are designed to minimize quality changes. As this industry grows, more problems associated with pathogenic organisms could occur. Problems can be prevented if handlers of these products in the food distribution chain, as well as in institutional settings and at the consumer level, do not allow temperature abuse to take place and if additional methods for ensuring inhibition of the growth of these microorganisms are employed in the production of the products. As precooked vacuum-packaged meat products become popular with consumers, concern for potential outbreaks of food-borne illnesses also will increase(Lechowich, 1988). Examined precooked beef and pork packages obtained from the retail market and a meat processor. Pathogenic and indicator organisms were not found in the samples. A storage study showed that storage at one °C resulted in a longer shelf life than at 5 or 10°C, emphasizing the need for careful control. The cook/chill system used in foodservice operations is a system that involves the use of refrigerator storage of precooked foods before reheating for consumption. Shelf life is not expected to be as long in this system as for the techniques previously described because vacuum packaging and cooking in the packaging are not employed. Many studies have reported the microbiological and sensory quality of foods in a cook/chill system(Anderson, Keeton, Acuff, Lucia, & Vanderzant, 1989). Reported that turkey slices taken from rolls cooked conventionally, held in the refrigerator for not more than 2.5 hr, and then reheated for 30 or 40 sec in a microwave did not have higher coliform or aerobic counts than freshly prepared slices. The investigators stressed the need to follow guidelines (HEW, 1978)for reheating to an internal temperature of at least 74°C. A critical point in the cook/chill system is cooling the product linger-Snyder and Matthews (1988)(Ollinger-Snyder & Matthews, 1988). round that 5 hr was required for cooling of 900-g loaves to 7°C. The use of slower cooling methods in a food service operation than in commercial production of refrigerated entrees (Lechowich, 1988) increases the need for careful handling to avoid post-cooking, prechilling contamination of productsBobeng and (Bobeng & David, 1978)

2.5. Salting

Salt is used in several food products to inhibit the growth of undesirable microorganisms. Inhibition is attributed to lowering the water activity as salt draws moisture from tissues. Several other salt effects have also been described(Raccach & Henningsen, 1997). Plasmolysis of cells may occur due to the high osmotic pressure caused by the salt. In addition, upon ionization, the chloride of NaCl has harmful effects on microorganisms. The chloride of KC1, which has been studied as a substitute for NaCl, would have the same effect. Sauerkraut production requires salt to serve as an inhibitor and add flavour. Salt draws water from the cabbage leaves. The brine formed provides a medium for the growth of lactic acid bacteria, which are responsible for the fermentation process. Undesirable microorganisms found on the cabbage leaves cannot tolerate the salt content of the brine (Marsh, 1983). Salt also inhibits the growth of unwanted microorganisms in cheese production and cured meat production.

2.6. Fermentation

The fermentation method uses microorganisms to preserve food. This method involves the decomposition of carbohydrates with microorganisms and enzymes (Amit et al., 2017). Bacteria, yeasts, and moulds are the most common groups of microorganisms involved in the fermentation of a wide range of food items, such as dairy products, cereal-based foods, and meat products (Battcock, 1998; Katz, 2001). Fermentation enhances the nutritional value, healthfulness, and digestibility of foods. This is a healthy alternative to many toxic chemical preservatives (Lewin, 2012).

Table No.2 Microorganisms used in food processing and flavour compounds produced

Food items	Microorganisms	Flavor compounds produced
Buttermilk	*Streptococcus lactis* *Streptococcus cremoris* *Lactobacillus bulgaricus*	Lactic acid, diacetyl, small amounts of acetaldehyde
Yoghurt	*Streptococcus thermophiles* *Lactobacillus bulgaricus*	Acetaldehyde and diacetyl acetoin
Alcoholic fermented milk	*Saccharomyces sp.* *Lactobacillus sp.*	Ethanol acetoin and diacetyl
Sauerkraut	*Mixed cultures of* *Lactobacillus brevis* *Leuconostoc mesenteroides* *Lactobacillus plantarum*	Acetate and small amounts of short-chain fatty acids
Soybean milk	*Lactobacillus sp.* *Streptococcus thermophiles*	Aldehydes including pentanal
Soya sauce	*Aspergillus oryzae* *Lactobacillus sp.* *Saccharomyces rouxii*	Organic acids, alkyl phenols, and pyrazines
Tempeh	*Rhizopus sp.*	Fatty acid
Bread	*Saccharomyces cerevisiae*	Ethanol
Swiss cheese	*Propionibacterium shermanii*	Propionic acid
Cocoa	*Saccharomyces sp.* *Lactobacillus sp.* *Acetobacter sp.*	Fatty acids and aromatic acids

2.7. Addition of Sugar: Jellies and Jams

Jellies and jams are preserved by their sugar content, which is high enough to prevent the growth of microorganisms, except for mould growth on the surface. Commercially, products are protected by a vacuum cap and maybe pasteurized after the containers are filled. Recommends that home-prepared jellies and jams be processed in a boiling water bath(Holmes, 1989). Because they are formed of fruit juice or a fruit extract in water, jellies are transparent things that may be seen through. On the other hand, Jams contain all or almost all of the insoluble solids of the fruit because they are made from whole, crushed, macerated, or pureed fruit, which is employed in their production. Technically, jams and preserves are the same things, with the exception that the term preserves is reserved for products that contain entire fruit. The gelation of pectin is caused by the addition of sugar in the presence of an acidic environment. Hydrogen bonding between hydroxyl groups and between hydroxyl and carboxyl groups is responsible, at least in part, for the rigidity of fruit jellies(Whistler & Dabiel, 1985). The interrelationships between the three key ingredients, pectin, sugar, and acid, are critical to the overall quality of the fruit preserve. When pectin or acid levels are inadequate, gel formation is prevented; a stiff jelly is produced when sugar levels are insufficient. (Luh, Kean, & Woodroof, 1986)

3. Modern Technology

3.1. Nanotechnology

Nanotechnology is a way of food processing in which we use nanoscale particles to process food. Even though this strategy is often employed, it is also ineffective. It is detrimental to both human health and the environment. This type of nanostructured substance can accumulate in the human body and lead to death. Through further investigation of the physicochemical and biological properties of these nano-sized particles, it may overcome these limitations. This ensures that the food retains its colour and that the solubility of vitamins is maintained throughout the production process. Active food packaging is also significant since it protects food from microorganisms.(Sahoo, Panda, Bal, Pal, & Sahoo, 2015). SIO2 is utilized as a scent enhancer in various foods, and beta carotene is used as a colouring agent. Still, it should be avoided in food preparation because it is highly unstable. Nanocomposites are made up of a variety of polymers, such as silicates, which are used to protect food from ultraviolet radiation when it is exposed to sunlight. Micro and nano biosensors are being utilized to detect food-borne infections and food rotting material in the food supply chain, among other applications. (Pradhan et al., 2015; Ronholm, Lau, & Banerjee, 2016). People are not interested in fully or highly processed foods; rather, they are interested in foods that have been little processed. However, minimum preparation of food shortens the shelf life of the product because it increases metabolic activity (respiration), which results in a high concentration of ethylene and, consequently, increased exposure to microbial agents. (Tola, Bayu, Fita, Agza, & Birkie, 2018). Mango, for example, is processed and is commonly available in tropical and subtropical regions. Improving the shelf life of such minimally processed foods in cutting slices has been accomplished using chemical dipping and forming a pectin coat, which does not result in the softening and browning of meat or other flesh. (Sharif et al., 2017)]. When combined with calcium, Alginate and Pectin form a gel-like covering that protects food against rotting and germs. Glycerol is a plasticizer (Silva, Finkler, & Finkler, 2018)

3.2. Hydrolysis

The process of reducing the activity of the pectinase enzyme is known as hydrolysis. If the pectin found in the cell walls of fruits begins to break down, the enzyme pectinase is produced, which results in food spoiling and softening as a result. The pectinase enzyme can also be activated by mechanical injury. The usage of Pectin methylesterase prevents the rotting of fruit and vegetables. Pectin and alginate are the most often used coatings on food, and they are generally used on minimally processed foods to extend their shelf life and maintain their freshness for a longer period. Other approaches, some of which are conventional, are employed, such as physical procedures, some chemical methods, and biological methods. (Silva et al., 2018),(Ashie et al., 1996).

3.3. Dehydration

Dehydration is a method of preserving food that is based on physical principles. Dehydration causes little water content and no microbial development. The process of evaporation is used to dehydrate the body. Because microorganisms and enzymes require specific water content to function, evaporation causes water loss, and microbes cannot damage food. However, this process also has limitations. After drying, some foods lose a lot of flavour and perfume. Drying depletes useful components such as vitamin C, thiamin, protein, and fat. (Amit et al., 2017; Benlloch-Tinoco, Igual, Rodrigo, & Martínez-Navarrete, 2013; Benlloch-Tinoco et al., 2015),

3.4. Pasteurization

Pasteurization is also used to keep food fresh for longer periods. The food item is heated in this procedure to kill the bacteria, extending the meal's shelf life. This approach kills all food spoilage bacteria; however, the temperature or heat duration should not be high enough to destroy vitamins and proteins. In most cases, the PEF treatment takes less than one second to complete. This technique was developed by the scientist Louis Pasteur, who was also responsible for developing the process of preserving milk and foods containing milk and other food. Modern procedures like PEF and HPP are also accessible.(Benlloch-Tinoco et al., 2015; Nasrullah, Yousaf, Atiq, & Iqbal).

3.5. Pulse Electric

A high-voltage pulse field is applied to food between two electrodes for less than a second, following which the food is withdrawn. This is known as the field pulse electric field approach. Other than that, it is effective in the killing of gram-negative bacteria. The presence of an electric field triggers the disintegration of bacteria's cell membranes. Because spores are resistant to this agent and therefore ineffectual against them, it is particularly effective against vegetative germs in particular. The electric field destroys the microorganisms' cell membranes. It kills vegetative microbes but not spores. Therefore it is useless.(Amit et al., 2017; Nasrullah et al.; Ronholm et al., 2016)].

3.6. High-Pressure Food Preservation

By modifying the shape of food particles, high-pressure food preservation is a procedure that solely changes the non-covalent bonds of food particles, therefore maintaining nutrition and preventing soiling. This method works by reducing the volume and enhancing the temperature (Ashie et al., 1996; Hyldgaard, Mygind, & Meyer, 2012).

3.7. Hurdle Technology

Hurdle Technology uses various chemicals to inhibit or slow down the metabolic activity of food, and it is a type of food processing technology. This mixture contains a small number of preservatives. Temperature, water, pH, and a variety of lactic acid bacteria are just a few of the factors that can prohibit food from fermenting successfully in the first place. Irradiation and extremely high pressures may also be a source of the difficulty.(Leistner & Gorris, 1995; Pundhir & Murtaza, 2015).

3.8. Antimicrobial Agents

Antimicrobial drugs, which work by limiting the growth of bacteria, have also been utilized in the food preservation industry. These can be obtained from some plants or even by animals in some cases. Antimicrobial compounds found in plants, such as bacteriocins, kill gram-positive and gram-negative bacteria(Hintz, Matthews, & Di, 2015). Lysozymes, found in eggs, are employed as antibacterial agents. Lactoferrin is an antibacterial agent. Animals are also a source of antimicrobial agents, as the Lysozymes found in eggs are used as a preservative in cheese production. Lactoferrin is also utilized as an antibacterial agent in some instances. (Ronholm et al., 2016).

3.9. Microwave Heating Technology

Microwave heating technology was used with the fruit to preserve kiwi puree to extend its shelf life while also maintaining its colour and bioactive ingredients. By using microwave heating, you can get better penetration power, a faster heating rate, and an increase in heating efficiency while simultaneously minimizing processing time compared to conventional heating methods, for example. As a result, compared to other conventional technologies, this technology is extremely successful in preventing microbial and enzyme degradation that causes harm to fruit plants while preserving the colour, bioactive chemicals, and antioxidants present in the fruit. As a result, this technique is used to produce safe, high-quality, and require minimal processing.(Benlloch-Tinoco et al., 2013, 2015).

3.10.Non-Thermal Technologies

When it comes to extending the shelf life of food and preserving the nutritional content of raw materials, non-thermal technologies are sometimes applied. Fish-eating has been increasingly popular in recent years, and items are increasingly being shipped to locations where seafood production is scarce. (Ronholm et al., 2016). In these circumstances, the preservation of seafood is critical to avoid the issues that may arise due to defective or rotten products from the seafood business. The following procedure is followed to preserve them:(Ashie et al., 1996).

3.11. Ozone Treatment

Treatment with ozone In the presence of harmful species of vibrios, the use of gaseous or dissolved ozone causes oxidation of their cellular components, resulting in the leakage of membranes and ultimately cell death. Because pathogenic vibrios are killed using this method (Ronholm et al., 2016). Cleaning seafood using water that has been treated with ozone can help to extend its shelf life. Due to the reduction in vibrios and other hazardous species, the shelf life of seafood can be extended significantly. It is possible to create ice slurries using ozonized water to keep seafood fresh for longer periods. It is used as a pre-cooling medium for fish and shellfish because it allows for faster chilling and reduces physical harm to the fish and shellfish.(Piñeiro et al., 2005; Ronholm et al., 2016).

3.12. Natural Organic Treatment

When essential oil, tea polyphenols, and organic acid are added to marine food products, natural organic treatment has been created that damages the pathogens and prevents their growth from occurring. Thyme, oregano, rosemary, turmeric, and shallots are some of the essential oils employed. (Hyldgaard et al., 2012)]. Polyphenols in tea, including catechins and epigallocatechin gallate (EGCG), epigallocatechin gallate (EGC), epigallocatechin gallate (EGC), epigallocatechin gallate, epicatechin gallate, and epicatechin, can be extracted and have been shown to have antioxidant and antimicrobial properties that damage the pathogen.(Peralta, Marrassini, Filip, Alonso, & Anesini, 2018). Organic acids like citric and lactic acid are utilized to extend shelf life and reduce pathogen impact. (Hintz et al., 2015).

3.13. Phage Treatment

Phage treatment involved two phage groups, siphoviridae phage PVP-I and VP phage isolated from V.P Arahaemolyticus helps in controlling the population of V.PARAHAEMOLYTCUS present in raw oyster (Sharif et al., 2017).

3.14.**Irradiation**

The irradiation results in the inactivation of organisms found in frozen food. When eliminating pathogenic microorganisms, Gamma radiation and x-rays are both effective methods. The gamer sterilization procedure uses cobalt 60 radiation to kill microorganisms. (Ronholm et al., 2016). A certain concentration of these radiations is needed for efficient

Table No. 3 Food irradiation technologies(Amit et al., 2017)

Factors	Electron beam	X-Ray	Gamma ray
Source	Accelerated electrons, typically 5–10 MeV	Induced by impingement of electron beam onto a metal plate. Conversion efficiency is 5–10%	Radioactive decay of Co-60 (2.5 MeV) or Cs-137 (0.51 MeV)
Processing time	Seconds	Seconds	Minutes
Penetration	6–8 cm, suitable for relatively thin or low-density products	30–40 cm, suitable for all products	30–40 cm, suitable for all products
Shielding for operator	>2 m concrete or 0.7 m steel/iron/lead	>2 m concrete or ~0.7 m steel/iron/lead	>5 m water or > 2 m concrete or 0.7 m steel/iron/lead

Conclusion

Considering food-borne diseases due to consumption of spoiled food, proper preservation of foodstuffs is very important. Although many existing techniques are used for food preservation, considering economic viability and social responsibility, more effective and safer techniques must be searched. Also concluded from the above review that people have been using different traditional methods since the very beginning. With time to preserve various food items for different durations, several modern methods have also been developed that are working efficiently even though some processes have certain disadvantages and are being replaced by some other methods. We can store our food articles for longer without losing their flavour, nutritional value, and freshness.

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