

A Review on Catering Technology and Use for Seafood

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Abstract It is well-known fact that developing technology has contributed to life standards. As technology has made time valuable, the concept of time has been foregrounded in life, then which has highlighted economical use of time. Since people has tended to consume catering food the time spent for preparing food has gained importance in private and professional life. The most significant phases in catering are providing raw material and preventing microbiological contamination, physical and chemical decomposition while transforming raw materials into foods. The pre-conditions of these are personal hygiene and full application of freezing-cooling systems. The raw material which adaptation is the easiest to catering technology is seafood. As they have very easy preparation by eviscerating and filleting, technologies used for meat products (such as sausage and salami) can also be used for seafood.

Keywords: *seafood, catering, production technology, packaging*

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1. Introduction

One of the most important issues in today's world in change is to ensure the production of healthy foods in an adequate and qualified way. The most important factors shaping the development of food industry can be summarized as technological developments, conditions of competition and changing tendencies of consumer [1,2].

Technology has entered almost every field of human life, including food. Through technological developments, catering foods are produced in different flavors, aromas and appearances from various raw materials such as seafood, meat, fruits and vegetables etc. Also, it is provided for people to use their time in preparing food for other subjects [3].

Seafood has also taken its place in developing food technology. In this study, catering technology, the place of seafood in catering technology ready-to-eat commercial products made of seafood were dwelled on.

2. Catering Industry

Many units such as hotels, schools, factories, military, air and rail companies need standard, healthy and nutritious systems. Catering food production and delivery to consumers made for this purpose is known as "catering" [4].

"Catering" means "production of catering food, food service" and nowadays is mostly used for characterizing the companies providing institutional catering. Generally, today's companies get food service from companies providing catering to save time and provide healthy nutrition for employees at the lowest cost. Catering is not only a food service as it is used in daily language, but also

provides organization service for events such as birthdays and cocktails. In most countries, catering is an organization business rather than catering [5].

Catering is a multifaceted sector of the food service industry. Catering method can be defined as planning, organizing and controlling tasks. Each action affects the preparation and distribution of food-related services with a competitive and profitable price. All actions are performed in integrity to meet and exceed customers' perceptions of value [6].

Catering industry includes a wide range of operations which can basically be divided into two groups as commercial or profit-oriented and non-commercial or cost-oriented. The profit-oriented group is the companies providing food service to hotels, restaurants, fast-food outlets, café bars, social facilities and voyages (during flight or in train etc.). Most organizations providing public catering can be shown in the cost-oriented group, for instance, hospitals, schools, social services, military forces (land, air and naval), nursing homes etc. Each subdivision in these two fundamental groups can be counted as a sector [7].

2.1. Application of Catering Systems

Catering technology includes the stages of long-term preserved storage of foods to be prepared and presented to the consumer after pretreatments and cooking process or after application of different storage methods and reheating before consumption.

Catering foods, which convenient processing and protection techniques are applied to, have a certain life time, they can be consumed directly or by being heated up to the eating temperature and are considered as food on itself or in combination with certain substances [1].

Seafood, meat, vegetable dishes, soup, salad, pastries and frozen food can be given as an example to the

products produced by using catering technology. In catering food production, generally raw materials such as various seafood, meat, egg, cheese, vegetable, potato, pasta and rice are used [8].

It is very important to be careful not to have microbiological contagion during the pretreatments such as picking, washing, slicing or peeling. High level of caution is needed especially for seafood since they tend to spoil much easily than the other foods. While cooking is the process used mostly during the preparation of these products, temperature, water activity and pressure of the cooking media are crucial parameters for this process [9].

The main contagion sources in a catering system are:

1. Unawareness of kitchen staff about hygiene and sanitation,
2. Using raw material having low microbiological quality,
3. Incompatible relation of cooking temperature and time,
4. Storing and transferring the food under improper conditions.

The important factors affecting the quality in catering system are the processing techniques, packing and the way it is presented to consumption. With the right choice of packing during production, it is possible to preserve the food's quality for a long period of time. A proper packing provides the food to preserve its quality and protects it from light, oxygen, off odors etc. In the stage of consumption, it is important to serve it after warming it up before the consumption and to consume it immediately. Otherwise, keeping the temperature above 60-70°C due to microbiological reasons is needed to be provided [4].

3. Catering System

Catering is a profit-oriented or cost-oriented food production for human consumption. While the variety of catering methods is infinite, it is possible to mention some important systems that are frequently used in catering service (Table 1) [7]. The classic and preferred method of the catering is to buy, prepare and cook directly before serving the fresh raw material. In other words, there is no time-dependent difference between the temperatures while the food is cooked and served. Although it is a preferable technique, it is not possible to apply it to the most of the catering operations due to the required space for storing, preparing and cooking, and the required number of manpower to maintain the operation [7].

Alternative methods have been developed in the last centuries to address these problems and the need for commercial firms to make profits. The precooked and frozen or cooled foods which are described as catering foods and the cooking-reheating techniques are widely used nowadays. The first one is based on the storage of a partially prepared dish, which can be quickly ready in a

plate. The second involves the preparation of the dish and keeping it at high temperature until it is served to prevent the growing of microorganisms [7].

Both methods have disadvantages. Catering foods can be expensive and their preparation and cooking is out of control of the firm. The reheating method is particularly vulnerable to temperature control and reheating of unused food. This application causes low microbiological and nutritional quality products in terms of taste, texture and appearance. Lastly, it is uncontrolled and risky to allow the cooked food to cool while it is on display and to reheat it for service [7].

For this reason, many catering companies have met with new methods to improve the structure of their operations and to optimize the labor force and equipment they use. Fast food type catering foods have been developed with the emergence of cooking-freezing and cooking-cooling methods which can carry out large-scale operations.

3.1. Cooking-Freezing Systems

Cooking-freezing is a food production and distribution system specialized on extending the shelf life of the cooking process applied catering foods through freezing at temperatures below -18°C, storing at -18°C and reheating before service [10].

Catering foods prepared with this system can be subdivided into two different approaches, one being frozen, and the other being reheated after being thawed (cooking-freezing-thawing) [7].

Under similar process conditions, the operating cost of the cooking-freezing system is higher than that of the cooking-cooling system. More energy is spent in each of the steps indicated:

- Freezing food and storing frozen food at very low temperatures,
- Moving the product from where it was produced to the sales points,
- Reheating the food for service [11].

This system requires storage in the freezer. For example, it is necessary for places where it is important to deliver food warmly, such as in hospitals. This system allows service to a wide audience and requires the use of experienced staff [12].

The strictest hygiene standards must be applied in cooking-freezing systems. Throughout the production, in portioning and packaging processes hygiene is very important. Within 30 minutes, portioning and packaging of foods should be completed and care should be taken not to keep the food in the danger zone of 5-63°C, where the bacterial growth is very rapid. In cases where hygiene rules are not observed, harmful bacteria that are still present in food after cooking or contaminated in food during portioning and packaging stages will stay alive at freezing temperatures, and when food is reheated, their numbers will reach dangerous levels.

Table 1. Some Important Systems Used in Catering [7]

Cooking-Serving	Cooking				Serving
Cooking-keeping warm	Cooking	Keeping warm			Serving
Cooking-freezing	Cooking	Freezing (-30/40°C)		Storing (min.18°C)	Reheating (min.70°C)
Cooking-freezing-thaw	Cooking	Freezing (-30/40°C)	Storing (min.18°C)	Thawing	Reheating (min.70°C)
Cooking-cooling	Cooking	Cooling (3°C)		Storing (0-3°C)	Reheating (min.70°C)
Fast Food	Reheating the catering products→cooking→				Serving

The cooking-freezing system is generally established in large settlements such as hospitals, state institutions, schools, which provide a large number of catering foods. Therefore, there is a large mass that may be affected by inappropriate food processing or poor hygiene practices. Most central cooking-freezing operations operate in the light of rigorous guidelines on hygiene and food processing rules [10].

3.2. Cooking-Cooling Systems

The cooking-cooling ready meal system is a system based on the rapid cooling of the food after cooking, reheating before the service and stored at temperatures below 3°C (near the freezing point).

It is important to understand the differences between the conditions of cold storage and refrigerator used in catering technics made with cooking-cooling. Commercial and household refrigerators do not always work below 4°C. However, the coolers used for the storage of food in the cooking-cooling catering food system should preferably be operating at around 1-2°C. These precise specifications relate to the inhibition of unwanted chemical changes in the food, mainly to slowing the development of harmful microorganisms [7].

A small increase in temperature may cause bacterial growth, so the system should be checked carefully [12].

The points needed to be considered for cold served catering food:

1. The cooking process should be applied sufficiently to prevent the growth of the bacteria that make the food risky.
2. The cooling process should start within 30 minutes after cooking and the food should be cooled up to 3°C within a 1.5-hour period.
3. Chilled food should be stored under controlled temperature conditions (between 0°C and 3°C).
4. In heating, the food should be heated to at least 70°C and consumed as quickly as possible after heating.
5. If the product temperature rises above 10°C in storage, distribution or service, food should be discarded.

When compared to the cooking-freezing catering system, it is possible to do much wider and different menu planning with the cooking-cooling system. In contrast to frozen foods, the cooled ones are more flexible and therefore can be easily divided into portions without the dissolution process which must be applied to frozen foods [7].

3.3. Fast Food Type Catering Foods

In this system, the product is heated or cooked immediately after deciding on consumption. Foods that are suitable for this are naturally limited to foods that can be heated in a short time. Examples of this system are foods that are portioned, more suitable for household consumption [1,12].

4. Catering Food Production Technology

The main purpose of the food production technology is to produce high sensory and nutritional quality products.

However, the term quality also requires a high level of microbiological and hygienic properties. Microorganisms are one of the most important factors in the spoilage of catering foods. In order to prevent their development, four primary methods are used.

-Freezing: Frozen products should be stored at -18°C and below, it should be noted that microorganism development depends on temperature and a_w (water activity) values. Inadequate freezing and unsuitable thawing are the most important factors in food spoilage.

-Cooling: In order to prevent the development of microorganisms that cause food poisoning, the product should be stored at 3°C and below, even as close to 0°C as possible. Microbial risk is due to the application of insufficient cooling temperatures in such products and the inadequacy of packaging.

- a_w (water activity) and adjusting pH: Microbial reliability in products such as sausages is mainly based on adjusting the pH and a_w values of the product.

-Sterilization: In order to ensure the stability of these products, it is needed to be careful about pH, a_w , Eh, additives and storage temperature. Microbial risk in this type of products is usually due to improper processing of products and not hermetic seal [1,13].

Sterilization technique is one of the most important methods for delaying the consumption of catering foods by making them more durable [14].

4.1. Investigation of Consumable of Produced Catering Foods

In order to produce a successful catering food and offer it to the market, it is not enough to produce it only in a healthy way. It is also of great importance that this is an acceptable product for the company and the consumer. When a new catering food is developed to put on the market, the main eleven steps must be taken into account.

1. Specific company objectives should be developed.
2. In order to fulfill the objectives of the company a strategy should be determined and operational plans should be drawn.
3. New concepts and products should be created.
4. New concepts and products should be grouped, tested and sorted according to priorities.
5. New concepts and products should be tested as prototypes in the pilot plant.
6. Prototypes should be tested with the help of sensory tests with consumers (Table 2) [15].
7. The production of the pilot plant must be adapted to the commercial operation.
8. Consumption in homes should be tested.
9. The product should be tested by providing the customer's tasting in the markets.
10. The new product line (from production to consumer) should be tested.
11. The product line must be introduced to the distribution system in the country [16].

One Sample Evaluation; it is used to determine consumer preferences. Foods find a place in the market when they are produced in accordance with consumer requirements and specifications. Therefore, sensory evaluations are made to consumers in order to develop new products and formulations and to increase market

share and diversity in the product. Only the sensory characteristics of food can be controlled by consumers. Consumers' reactions to the appearance, taste and texture of food are identified in the operations of determining of consumer preferences.

Hedonic Scala Method; hedonic scales are mostly applied to consumer tests and uneducated panelists. Hedonic scales can be used to evaluate the preferences of the panelists or their liking/disliking situations about the product. Hedonic scales can be prepared as verbal, facial expression, graphic (linear).

Paired Comparison Test; the panelist is given both a standard sample and a trial sample at the same time and is asked to evaluate it. About the given product, the panelist is asked whether the two samples are the same or which are better in terms of sensory properties such as flavor, appearance, odor (such as which is juicier, which is sweeter etc.).

Texture Profile; it's a sensory analysis method that evaluates the mechanical, geometrical, texture, fat and moisture properties of foods and the density and changes of these properties from the moment of taking the food into mouth until swallowing it. Texture profile analysis is performed with 5-7 trained panelists and panelists evaluate the textural properties of foods with standard grading scales.

Flavor Profile; it is the technique in which all food-related properties are evaluated in detail with the best trained panelists. Taste profile analysis is performed to: Increase sales, raise market share, develop or re-formulate formula in products, develop new products that meet consumer specifications [15].

Table 2. Appropriate Methods for Sensory Testing of the New Product Developed [15]

The Purpose of Sensory Testing	Appropriate Sensory Testing Method
Developing New Product	One sample
	Hedonic (verbal of facial expression)
	Paired comparison test
	Quality rating
Consumer acceptance	Texture and flavor profile
	One sample
	Hedonic (verbal of facial expression)
	Paired comparison test

5. Packaging of Catering Food

5.1. Packaging of Frozen Catering Food

Low and medium density polyethylene laminates can be used as packaging material for the storage of catering foods by freezing. As the most common packaging material, polyethylene, which is used as packaging material, has positive properties such as its good adhesion with thermal effect, clearness, tear resistance, low water vapor permeability and considerably protect their flexibility at low temperatures.

If frozen foods are to be cooked with their packages, packaging with bags made of high density polyethylene (HDPE), polyamide/low density polyethylene (PA/LDPE), polyamide/medium density polyethylene (PA/MDPE)

or polyethylene terephthalate/low density polyethylene (PET/LDPE) laminates accompanied by a vacuum process can be recommended.

If no heat treatment is to be carried out in the package, the carton/LDPE material is sufficient. For catering foods that can be eaten after being cooked in its package, aluminum containers with lid and combinations of polypropylene (PP) or PET with cardboard for both convection (thermal convection) and microwave ovens can be used. Cardboard containers coated with 20µm PP on both sides can be heated to 120-130°C and PET coated to 225-250°C. The pot pans to be heated in hot blast stove should be resistant up to 150-160°C, the ones to be heated in the kitchen stove to 225-250°C. The deep drawing pit containers made of PA/LDPE can be used up to 100°C, PP or PP/cardboard/PP containers to 150°C, PET/carton/PET containers to 225°C and aluminum containers to 250°C [17].

5.2. Packaging of Sterilized Catering Foods

For the packaging of foods in this group, tin box, lacquered aluminum box or glass containers are used. Considering that these foods will be stored for a long time, it is necessary to ensure that the top of the package is as low as possible and hermetic seal is applied. Nowadays, new alternative packaging materials resistant to sterilization for such products have been developed and studies have been carried out on the use of heat resistant, sterilizable plastic based packaging (retort pouch). Retort bags are usually produced with 3 layers; polypropylene or polyethylene (PE) in the interior, aluminum foil in the middle and polyester in the outer part. Polypropylene is preferred due to its non-toxicity, polyethylene due to its adhesion with heat treatment, foil due to being gas-water vapor and light proof and polyester due to its high mechanical resistance. Catering foods placed in retort pouches are sterilized in a similar way as in canning technology. Plastic bags are filled with raw or half-cooked food, then sealed under vacuum and sterilized under high pressure in autoclave. Sterilization process provides long shelf life to the product. Catering food packages can be used for military purposes or in natural disaster situations such as earthquakes and floods [18].

6. Storage of Catering Foods

For the success of storage techniques of catering foods, compliance of product and preservation technique is considerably important. For example; spices, stabilizers, fat content, the amount of the additives such as fish, meat and vegetable, pH of the product, pretreatments of the material and sauce content in the prescription of the products to be sterilized are among the main factors affecting quality, The quality, shape and size of the package, the sterilization technic, the values of F, E (enzyme inactivation factor) and C (nutritional value loss factor), hygienic conditions during filling are also among the factors having important effect on quality [14].

Table 3. Preservation of Catering Foods [19]

Preservation Technic	Stages of Process	Approximate Shelf-life
Cooling	Preparation, packaging, cooling, and storing at 3°C and below	A few days
Pasteurization/Cooling	Preparation, packaging, pasteurization, cooling, cold storage	A few weeks
Freezing	Preparation, packaging, freezing and storing at -18°C and below	A year
Sterilization	Preparation, packaging, sterilization, storage	Three-five years for conserved catering foods, seven years for catering foods in retort pouches
Dehydration	Preparation, dehydration, packaging, storage	A few years

Various storage possibilities of catering foods and their approximate shelf-life can be provided in this way are shown in the [Table 3 \[19\]](#).

7. The Place of Seafood in Catering Technology

In addition to being processed with various products, fish is also offered as catering food itself. When fish are presented to the consumer without being subjected to any treatment, they are prepared either as sliced vertically or fillet, or with head, fins, tail and internal organs removed. The type of cooking of fish is significantly dependent on the type and mainly types of baking, grilling, baking in bag, frying in pan and deep frying are used [\[20\]](#).

In addition to fillets, pieces of fish meat are also benefitted. Fish meat can be stored by being made pasty to be put in various products. The fish mince without bone and skin can be obtained either from divided and skinless fillets or fish without bone, skin and scale. In this case, however, the mince may contain scale, skin and bone pieces. Also, there is another type of mince obtained from minced fish after its internal organs being removed, but again, it includes scale, skin and bone pieces. Recently, new reasons for the use of such homogenized products can be summarized as follows:

- Not being able to obtain a whole fillet made of fishes in various shapes and sizes by using machines,
- Almost impossible to fillet with small fish from the machine,
- Use of fish parts due to high cost of whole fish,
- Production of imitations similar to original products which are very expensive through developments in surimi technology.

Various advantages and disadvantages of homogenized fish meats prepared for being used in catering are shown in [Table 4 \[21\]](#).

Table 4. Advantages and Disadvantages of Homogenized Mid-product [21]

Advantages	Disadvantages
Unused fish are made processable with industrial methods	Advanced muscle structure is spoiled
A homogeneous pumpable mass can be obtained in the desired amount of charge continuously	The characteristics of the fish are spoiled
The defects of the fish are camouflaged	Risk increases in terms of hygiene
Ease of operation is provided (forming, mixing with additives etc.)	The possibility of classification according to the product is limited as a constant texture structure is obtained (for meatball or fry etc.)

Table 5. The Main Additives Used in the Processing of Finely Processed Fish Meat and Their Effects [21]

Additive	Flavor	Effect obtained in texture	Effect obtained in water binding
Salt	X	X	X
Polyphosphate		X	X
Hydrocolloid		X	X
Spice	X		
Fat (liquid/solid)	X	X	
Water		X	

The flavor, texture and water binding properties are improved by mixing some additives to this minced meat. The main additives and their effects are shown in [Table 5 \[21\]](#).

Meat-borne proteins and milk, commonly used as hydrocolloids, support texture by gel formation and bind water. In this way, the flavor improves, but an unpleasant structure like pudding occurs in case of excessive use. Presenting the processing plant residues to consumption by reusing them to be a different tasted food can be preferred due to its contributions to producer and economy [\[1,21\]](#).

8. Conclusion

Nowadays, with the changing living conditions due to the number of people living alone and the increasing participation of women in business life, the products offered by catering industry help make life easier with being prepared and consumed in a short time. In terms of industry, it is known that food service is taken from related food establishments (catering firms) in many places such as public institutions and organizations, schools and workplaces. Considering the necessity of nutritious and healthy catering products, which also serve to mass feeding with such intense consumption potential, fishery products are considered to be an important raw material that can serve the sector.

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