Chapter 23

Value-added seafood products processing through novel enzyme

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1. Introduction

Aquaculture is one of the greatest and quickest trade foods that provide essential local food items and holds significant offers in the world economic system. Seafood defines as several groups of biological animals prominently including fish and shellfish consumed and distributed around the globe. Shellfish are categorized as crustaceans and molluscs. The crustacean includes crab, shrimp, and lobster whereas molluscs include octopus, pila, and clams. Aside from drinkable yogurt and fresh soup, the quickest growing are fresh fishes and seafood products ranked third most of the diverse meal classes (Abhimanyu et al., 2020).

Seaweeds are one form of seafood that is consumed directly or is used to produce various products including pharmaceuticals and nutraceuticals. Seafood may be very much less in saturated fats and sodium when in comparison to meat. Seafood gives macronutrients in the proper way which includes omega-3-long-chain polyunsaturated fatty acid (ω-3-LC-PUFA), beta-amine, guanine imitative such as histidine, and some miscellaneous compounds like purines, urea, and free amino acids (Harshani et al., 2020). Particularly, nitrogenous compounds play a vital part because they are major responsible for the color, flavor, rheological characteristic, and biological value of the products. Seafood enzymes are also one of the essential products in industrial food processing. Seafood enzyme may help to develop further methods on good preservation quality. The effective role of the native enzyme in the seafood has great attributes of texture, flavor and coloration (Kennedy and Turan, 2001).

The most important part of food processing is to add value to the products which helps to increase the taste, texture, color, and economic level. The activity to increase the culinary attributes usability or economic viability of the food items is known as value addition. Nowadays, the processing of converting the seafood into value-added products has increase in demand and that are ready to consume or some products need quite a preparation before serving. There are five valuable reasons for adding values to the seafood:

i. To improve process utilization
ii. To keep pace with consumers
iii. For the highest profit
iv. To control postharvest losses
v. Continuous supply of fish during off season (Kyule et al., 2014)

Many species of fish, crustaceans, and esoteric molluscs, for example, salmon, lobster grouper, sturgeon, crab, cuttlefish, and abalone, are very much value-added products due to their superior eating quality.

Crab is the one kind of seafood wherein the human being is eager to take and it will additionally allow in the dietary nutrient. The main reason where the people turn from fish products to crab products is that it provides a tremendous supply of proteins and contains long-chain omega-3 fatty acids, selenium, riboflavin, copper, and phosphorous. It additionally provides several impressive health benefits such as it has the ability to increase cognition, has to protect from the heartache,

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to reduce inflammation, strengthening the bones, to enhance the immune power, to enhance the circulation throughout the body, and to detoxify the body. *Portunus pelagicus* L. (also known as blue swimming crab) 1766 is an economically vital species with exclusive market demand. *P. pelagicus* has a natural diet and it will be beneficial for developing successful farming techniques for this species in the future (Ikhwanuddin et al., 2014).

Seafood has to be processed carefully before and after harvesting. It undergoes for some primary processes before the main process takes place to ensure its safety and quality to produce value-added seafood. Few primary processes are gutting, shucking, filtering, washing, etc. The processing of seafood mainly focused to eliminate the microbes that result in extension of shelf life and also assures food safety. Chilling, supercooling, and freezing are the methods widely used to preserve value-added seafood products. Irradiation is one kind of nonthermal method that applies high pressure in processing seafood (Boziaris, 2014).

Overall, this chapter gives the importance of seafood in human diet, seafood processing and preservation technique, value-added seafood products enzyme and its application, *P. pelagicus* process and preservation techniques, and the role of an enzyme in seafood products.

2. Importance of seafood in human nutrient, diet, and health

Marine organisms provide many beneficial nutrient supplements to our bodies. The nutrients and health supplements obtained from marine organisms mainly protect humans from heart diseases and help to function our internal organs effectively. A subchapter explains the nutrients provided by marine organisms.

2.1 Omega-3 fatty acids

In seafood, two important fatty acids, namely, eicosapentaenoic acid (EPA) and docosahexaenoic acid (DHA), play a major role. EPA and DHA are found in marine phytoplankton with a high ratio. Marine organisms like mackerel, herring, and salmon contain a high quantity of n-3-PUFA in their muscle than lean fish like cod and halibut (Shahidi, 2011). Hence, the EPA and DHA are majorly found in seafood because the plant converts alpha-linolenic acid (ALA) to EPA and DHA at a lower rate whereas in seafood the conversion is highly effective. n-3-PUFA has a high impact on maintaining brain and mental health, lowers the risk of coronary heart disease, and acts as antithrombosis (Ruxton et al., 2005).

2.2 Proteins

The high amount of protein found in marine organisms maintains the body structure, glucose metabolism, cell signaling, maintaining and regulating body composition (Millward et al., 2008). Fish proteins are rich in lysine, threonine, and sulfur-containing amino acids. Studies showed seafood consumption acts as an anticancer agent for certain cancers (McManus et al., 2009). Proteins in seafood help in low serum cholesterol levels, antihypertensive and have antiobesity properties.

2.3 Vitamins

Vitamins are important to the growth of tissues, developing the immune system, and repair the cellular damage. Seafood are good sources of vitamins like vitamin D, B_{12}, E, and A. Seafood is a righteous source of vitamin D and calcium as they help in maintaining bone mineral density in women, and oily fish consumption helps to prevent vitamin D deficiency. Mostly shellfish and fishes like clames, octopus, fish roe, fish, and oysters are a good source of vitamin B_{12}. This helps in the development of plasma B_{12} in human (Vogiatzoglou et al., 2009). Oily fish have high level of vitamin E which acts as a protective coat of vitamin A and C by inhibiting oxidation (Ekweagwu et al., 2008). Carotenoids are the important compound to form vitamin A. Seafood derives two carotenoids, namely, astaxanthin and fucoxanthin. Carotenoids act as oral supplements which reduce inflammation and hypercalcemia (Cicero et al., 2007). Fucoxanthin is a functional supplement found in seaweed that has medicinal properties used to treat various diseases.

Seafood plays a vital role to maintain micro- and macronutrients in the human body. The most commonly consumed seafood around the world is fish. The consumption of ω-3-LC-PUFA linked to fish, seafood, or fish oils reduces the risk of chronic disease (McManus et al., 2009). Fish as a whole food provides many nutritional benefits. Intake of seafood is important for pregnant or lactating women in order to maintain the good neurological system of an unborn child and young children. Dietary seafood shows the good result of reduced blood pressure and low risk of cardiovascular diseases. Hence, marine organisms are preferred to be healthier than meat or egg because of their rich nutrients.

3. Seafood processing

Research studies on food processing have attracted more because of the huge demand−supply of healthy and safe food products. The most important factor that drives the entire food industry was nutrition, healthy, and convenience. While comparing other seafood products, fishes gave excellent attention as a source of a larger amount of nutrients like PUFAs, high-quality proteins, vitamins, and minerals to the human diet. It also encompasses an equal amount of spoilage chance.

Proper processing techniques will help in maintaining and eating the high-quality fishes and also extend their shelf life. Worldwide, a system of processing methods was followed:

1. Retort pouch processing
2. Irradiation
3. High-pressure processing

3.1 Retort pouch processing

Retort pouch processing was carried under standardized time and temperature with an overpressure retort depending on the product. Retort pouches show as an excellent substitute for metallic cans. When comparing retort to cans, retort pouches are more flexible in saving energy and of total cost including warehousing, energy, and shipping, the pouches are even more favorable.

The processing time consumed by retort pouches is about 30%−40% less than the cans and warehousing is also about 85% lower.

3.2 Irradiation

The direct exposure of electronic or electromagnetic rays that are applied to increase the shelf life of the product is known as irradiation.

International Atomic Energy Agency (IAEG) suggests three ways of ionizing radiation to help to process the food products. Three ways of irradiations are:

- Gamma-ray: The common most radio nucleotides Cobalt-60 [^{60}Co] and Cesium 137 are used for processing.
- Electron beam: Linear acceleration or Van de Graaff accelerator was used at the near speed of light and blow quantum energy was used, i.e., 10 MeV.
- X-ray: Maximum quantum energy does not exceed 5 MeV.

Based on the requirements of processing, the irradiation process was categorized as three viz.

1. Radurization: method to expand the food shelf life
2. Radicidation: used to eliminate the target pathogen
3. Radappertization: used for sterilization

Irradiation doses range from 2 to 7 KGy can reduce the important food spoilage pathogens such as *Salmonella, Listeria,* and *Vibrio* sp., likewise fish-specific spoilers like Pseudomonadaceae and Enterobacteriaceae which will be significantly decreased (Mohan et al., 2018).

3.3 High-pressure processing

High-pressure processing has a great role in expanding the product's shelf life. It is one of the innovative and emerging techniques in the food processing industry. Castor oil, sodium benzoate, water, silicone oil, and ethanol or glycol are used as the medium in high-pressure processing with low or without temperature. Hence, it is also known as a nonthermal technique to treat seafood in a large pressure vessel.

The specific high-pressure system is being used based on the food product processing temperature range and its viscosity is the factor involved in picking the medium. It can preserve the organoleptic in seafood.

High-pressure processing technique is performed as a batch process (both solid and liquid foods) operation of the thermal processing in a retort system. The following are typical components of batch high-pressure equipment:

1. Thick-wall cylindered pressure vessel
2. Two end closures are there to close the pressure cylinder

3. Yoke
4. High-pressure pump and intensifier
5. Instrumentation and process control system
6. Handling system

To achieve the desired process, the action of combining of a pump and intensifier along with compression of pressure-transmission fluid. During this processing, the product vessel is pressurized in desired time, after the end depressurized, and the product is removed (Balasubramaniam et al., 2015) (Tables 23.1 and 23.2).

4. Preservation techniques of seafood

The increasing population leads to food scarcity across the globe. To overcome food scarcity, we are in need to store and transport food from one area to another. Preservation of food is important to increase shelf life and maintain flavor, texture, and nutritional value. Seafood gets spoiled by mechanisms such as enzymatic spoilage, microbial spoilage, and chemical spoilage.

Seafood products are considered a most perishable commodity. To increase the shelf life of seafood, traditional seafood preservation techniques followed up by chilling (0−1°C), freezing (<1°C), drying, smoking, salting, fermentation, canning, and brining have a great result. However, the most recently used methods include natural preservation, salting, drying, canning, and freezing. Some industries also use pressure treatment, packing with the help of freezing or refrigeration, and some chemical techniques (Erkan et al., 2014; Wu et al., 2014).

4.1 Natural preservation

Natural preservation has properties such as nontoxic, acts against the spectrum of bacteria and fungi, cost-effective, and is isolated from plants, animals, and microorganisms. Some of the natural preservatives in seafood include chitosan and bacteriocins (Mei et al., 2019).

4.1.1 Chitosan

Chitosan (CS) plays a major role in antioxidation, i.e., strong oxidation of CS acts against lipid oxidation and protects it. CS is the bioactive compound used for the preservation of food. CS is the second most commonly available polysaccharide in crustacean. Approximately, 75% of the total weights of crustaceans are wasted and chitin from shells of crabs, prawns, lobsters, and krills are extracted. CS is a deacetylated derivative. Studies show CS coating only resulted in browning activity and higher sensory scores. Lipid and protein oxidation was also controlled and inhibited. CS coating was also controlled for fish preservation (Kontominas et al., 2021).

TABLE 23.1 Some seafood processing technologies by category and its purposes (Jeebhay and Lopata, 2012).

S.No.	Seafood processing technologies	Category	Purpose of technology
1	Modified atmospheric packaging	Nonthermal luminescence	To protect fresh food by reducing its exposure to oxygen leading to discoloration, spoilage, and off-flavors and textures
2	Minced processing	Nonthermal luminescence	To get an additional 8%−12% flesh can be separated from the filleting wastes and to offer greater control over flavor, and keeping quality by the additions of additives
3	Retort pouch processing	Thermal luminescence	It allows the sterile packaging of variety of food and drink by aseptic processing, and is used as an alternative to traditional industrial canning methods
4	Irradiation	Nonthermal luminescence	To improve the safety and extend the shelf life of foods by inhibiting or eliminating microorganism
5	Ozone [O_3] treatment	Nonthermal luminescence	Application of ozone on fish targeted product shelf preservation
6	Microwave processing	Thermal luminescence	To preserve fish products by applying electromagnetic waves range from 300 MHz−300 GHz

TABLE 23.2 Common processing techniques employed for seafood products (Okpala, 2017).

S.No.	Seafood products	Processing techniques	Source of exposure to seafood products
1	Crabs, lobsters, crawfish, crustaceans	Streaming, cracking, cutting, scrubbing, grinding, washing, and cooling	Intake of wet aerosols from tailing lobsters, crab cracking, scrubbing, washing, and cleaning process
2	Prawns	Prawns blowing (compressed air or water jets)	Cutaneous contact from unprotected handling
3	Mussels, scallops, finfish, molluscs, oysters	Washing, shucking, depuration of shellfish, dicing, chopping, and slicing	Intake of wet aerosols from shucking Cutaneous contact from unsafe handling
4	Other kind of species	Degutting, skinning, mincing, filleting, frying, bagging	Intake of wet and dry aerosols from fish heading, degutting, and fishmeal bagging Cutaneous contact from unsafe handling

4.1.2 Bacteriocins

Lactic acid bacteria (LAB) are a major used biopreservative. Bacteriocins are produced by LAB. *Lactobacillus, Lactococcus, Pediococcus, Leuconostoc,* and *Streptococcus* are important LAB used for food preservation (Francoise, 2010). Bacteriocins are small peptides synthesized in the cell's ribosome with a bacteriostatic action (Cotter et al., 2005). Bacteriocins are grouped as classes 1 and 2, namely, lanthionine and large unmodified linear peptide antimicrobials. An important role of bacteriocins in preservation technique is to enhance safety and good quality of seafood, enlarge the shelf life of seafood while long-term storage, and cell signaling. LAB produces organic acids that enhance the safety role of the product, increase shelf life, and inhibit unwanted flora growth. These are some of the natural techniques involved in seafood preservation.

4.2 Technique of salting

The ancient method of food preservation is the salting method. More intake of salt causes less percentage of chances for spoilage of fish. The most commonly used methods are as followed (Fig. 23.1).

4.2.1 Wet salting

4.2.1.1 Brining

Brining is a process where salt is added continuously until the salt stops dissolving in the solution. 4:1 ratio of water and salt must be added. If the size of the fish is large, it must be cut into pieces and then it should be brined. Usually, brining requires $\geq$ 30 (in min) for small range salting and >24 (in h) for medium salting. Brining technique is usually preferred for the fish which used to undergo canning, smoking, and drying.

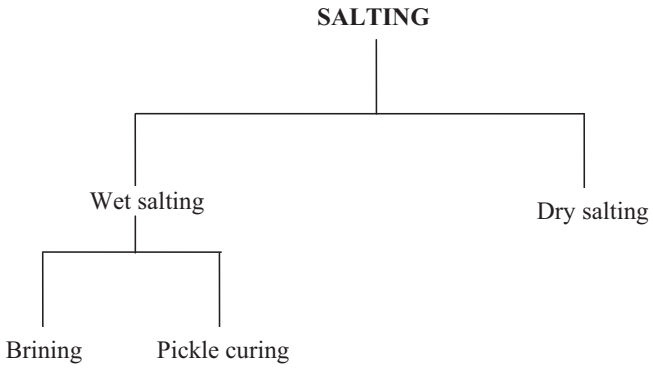


FIGURE 23.1 Types of salting techniques.

4.2.1.2 Pickle curing

Pickle curing is done in a watertight container where 50 Kg of fish requires at least 3 or 4 kg of dry salt. If the salt content is less, then fish will be spoiled. After packing, the fish is kept in a position where fish in salt facing flesh to flesh or skin to skin, water forms from fish and the salt dissolves in water. This process is known as pickling. This process requires duration of 36–40 h for small fish and 3–4 days for large fish. This is known as pickle curing.

4.2.2 Dry salting

Dry salting may also be referred to as kench curing. Here size of the salt crystal is very important. In this method, fish is salted and allowed to drain. Mixing both the fine salt crystals and large salt crystals is approached. This method encourages interchanging the fish position either by repacking or by restoring for every 24 h. This interchanging helps to equalize salt content and ensures a uniform supply of pressure and so the water molecules are removed off from fish. This process needs 3 days to 1 week depending on the fish size and type of fish used.

4.3 Drying

Drying is a thermal technique used to preserve seafood. The drying process is the natural method where the dehydration process takes place. One of the commonly used drying processes is sun drying (Flemming et al., 2014). Sun drying is an ancient technique and the cheapest preservative method of fish and fish products. In the process of drying, the amount of water released is calculated by moisture ratio (MR) according to *Saciliket* et al. studies described as the following equation:

$$MR = (W - W_e)/(W_0 - W_e) \rightarrow \quad (23.1)$$

The drying process dehydrates water and slows down the mechanism and action of bacteria, enzymes, yeast, and molds. Sun drying takes place by analyzing certain conditions like temperature, humidity, and airflow. The heat produced from the sun is accepted by fish and then allowed to dry and air currents excrete water molecules. This is the drying process by the sun. The major disadvantage of this method is a loss of quality and quantity of fish (Van Nguyen et al., 2014).

4.4 Freezing

Freezing is one of the good preservative techniques where the guts of fish are removed, cleaned, and stored at 0°F or lower. Due to freezing, the fish may lose some nutrients; so fresh food consumption is preferred more than frozen fish. Frozen fish is either processed on ship or land. Traditional freezing methods are:

1. Blast freezers – cold air stream at high speed is circulated in the speed of 2.5 to nearly 7.2–7.8 m/s over the fish
2. Contact freezing – shortest exposure between the fish and refrigerator
3. Cryogenic freezing – refrigerated liquid-like carbon dioxide or liquid nitrogen is sprayed over fish surface (Flemming et al., 2014) (Table 23.3).

4.5 Canning

Canning is a majorly used technique; the products are canned in airtight jars or tins and then they are treated with high temperatures. This method is also called a sterilization technique. Hence this process kills microorganisms and spores when treated at 121°C. Fisheries with a high-fat content like herring, mackerel, tuna, clams, oysters, shrimp, and crab are processed and canned seafood (Harshani et al., 2020).

TABLE 23.3 Some of the preservative techniques used to preserve seafood (Flemming et al., 2014).

S.No.	Seafood category	Preservation technique used
1	Crustaceans, crabs, lobsters, crawfish	Deep freezing, pasteurizing, sterilization, liquid freezing
2	Prawns	Deep freezing, drying
3	Molluscs, abalone, mussels, oysters, clams, scallops	Deep freezing, freezing, sterilization, smoking, Cooking
4	Other seafood	Deep freezing, drying, smoking, sterilization, Liquid freezing

5. Seafood enzymes and their applications

The enzyme is the key factor that is used potentially to increase or improve the good texture, flavors, and also act as an indicator in seafood to change the quality of products. By the process of hydrolysis, biocatalyst or synthesis may help for enzymatic reaction to produce food ingredients with the help of new and unique enzymes from seafood. The enzyme from seafood is directly related to the growth and ultimately to the nutrition diet value, shelf life, and tissue compositions. Tables 23.4 and 23.5 will give detail about seafood enzyme, remarks, and role (James et al., 1996).

TABLE 23.4 Enzyme, quality factors, and its remarks (Haard, 2000).

S.No.	Enzymes	Quality factors	Remarks
1	Gulonolactone oxidase	Nutrient	Primitive fish can be able to produce vitamin C
2	Thiaminase	Nutrition	Raw fish contribute to vitamin B deficiency
3	Polyphenol oxidase	Color	The integument of crustaceans may undergo enzyme browning
4	The enzyme involved in carotenoids synthesis	Color	Innovator species can be able to produce xanthophyll pigment such as astaxanthin
5	Amylase like enzyme	Texture	Rigorousness is influencing by the outlay of glycogen degradation
6	Proteinase	Texture	Texture softening in some species of fish
7	TMAO demethylase	Texture	Myosin cross-linkage in frozen fish
8	Inosine hydrolase and inosine phosphorylase	Texture	Accumulation of hypoxanthine in some fish species
9	Urease	Flavor	Urea →Ammonia in elasmobranch species
10	Antioxidant enzymes	Flavor	Faster lipid peroxidation

TABLE 23.5 Seafood enzymes and their role (Muzaddadi et al., 2016).

S.No.	Seafood enzymes	Role of the enzyme
1	Nucleotide degrading enzyme	The nucleic acid ATP breakdown process
2	Myosin ATPase	To associate with prerigor changes and the onset of rigor mortis in many species
3	Lactate dehydrogenase	The presence of nicotinamide adenine dinucleotide (NADH) catalyzes the reduction of pyruvate to lactate
4	Histidine decarboxylase	Several endogenous and exogenous decarboxylase leads to fish spoilage and histamine is produced, when not chilled properly will lead to spoilage
5	Lipoxygenase	To catalyze the introduction of O_2 at 5, 12, or 15 positions of eicosanoic acid to produce H_2O_2 imitative favors flavor formations of fresh and processed fish
6	Lipase and phospholipase	Degradation of lipase and phospholipase hydrolysis has the ability to improve the quality of diet in seafood
7	Trypsin enzymes	For the selection of salmon, genetic markers such as enzyme are used to improve the production of fresh and seawater
8	Polyphenol oxidase	Melanosis refers that which is responsible for discoloration or black spot in crustacean species

5.1 Role of seafood enzymes

Enzymes are an important factor involved in the growth, production, processing of many kinds of seafood and also had a great role in storage, and spoilage processes (Diaz-Lopez and Garcia Carreno, 2000). Nowadays, fishes and shellfish enzymes are used exogenously to improve the process of production including PUFA-enriched fish oils, fish scale removal process in cured roe production. Many enzymes are being used to produce products either of human consumption and/or other uses (Haraldsson, 1990).

5.1.1 Mince-based products

These products are mainly extracted from surimi and crabs. Transglutaminase enzyme is used to catalyze cross-linkage of several proteins and also make modifications in proteins that help to create textured based products such as meatballs, frozen meat, molded meat, hamburger, Surimi, krill paste, etc. (Kitabatake and Doi, 1993).

5.1.2 Enriched fish oils—PUFA

PUFA is an essential one in the human diet and takes about 1 g per day. However, fish and shellfish products produce approximately 0.2 g of n-3 PUFA per day, according to the FDA of the United Nations. It has a great commercial interest (Bjerve et al., 1992).

5.1.3 Seafood flavoring

Hydrolysis enzyme such as exogenous and endogenous proteolytic enzyme is used as flavoring factors of seafood extensively. Seafood flavor has a high demand (Diaz-Lopez and Garcia Carreno, 2000).

5.1.4 Meat tenderization

Due to tough texture, most of the consumers have a negative thought of taking the quality of squid products. The requirement for the removal of squid skin, pretreating them with 5% salt solution for 10 min at 45°C, will activate endogenous enzyme to cause softening of the skin. Then tenderized squid product was treated with commercialized bromelain and crude extract of bovine spleen (Raa et al., 1985).

5.1.5 Increase of shelf life

Many enzymes play a key role to improve the shelf life of fish and shellfish products. Some enzymes that help to maintain endogenous activity in seafood which includes superoxide dismutase, 3,4-dioxygenase, and O-methyltransferase (Ashie et al., 1996).

6. Crab species: *Portunus pelagicus* processing

Crabs occupy about 20% of marine crustaceans. Crabs are eaten as dishes in many countries and processed in several methods around the globe. About approximately 6700 crab species are living worldwide. Crab species comes under order Decapoda of Arthropoda phylum. Crabs have a thick exoskeleton with a high content of chitin. Crabs are omnivores with complex behavior patterns. Crabs help in retarded ATP consumption, rigor onset, and reduce the magnitude of muscle shortening (Infante et al., 1997). The commonly used crab is *P. pelagicus.*

P. pelagicus is an active swimmer and is adapted to live in warm water. They are commonly known as blue swimmers. They consist of five pairs of the leg where the first pair is claws, three pairs are for walking, and the last pair is for swimming. They are distributed throughout tropical regions of the western Indian Ocean and eastern Pacific (Kailil et al., 1993). The common process in processing crab is described as a flow chart in Fig. 23.2 (Junaidi et al., 2019).

P. pelagicus is high content CS meat. CS plays a major role in tissue engineering, biomedical, food industries, and textile industries. CS is isolated by three methods commonly demineralization, deproteinization, and deacetylation. Demineralization removes inorganic materials using dilute acids, protein separation is carried out by deproteinization method, and finally, deacetylation gives the final product CS. CS consists of 73.9% C, 12% N, and 14% H (Ahyat et al., 2017).

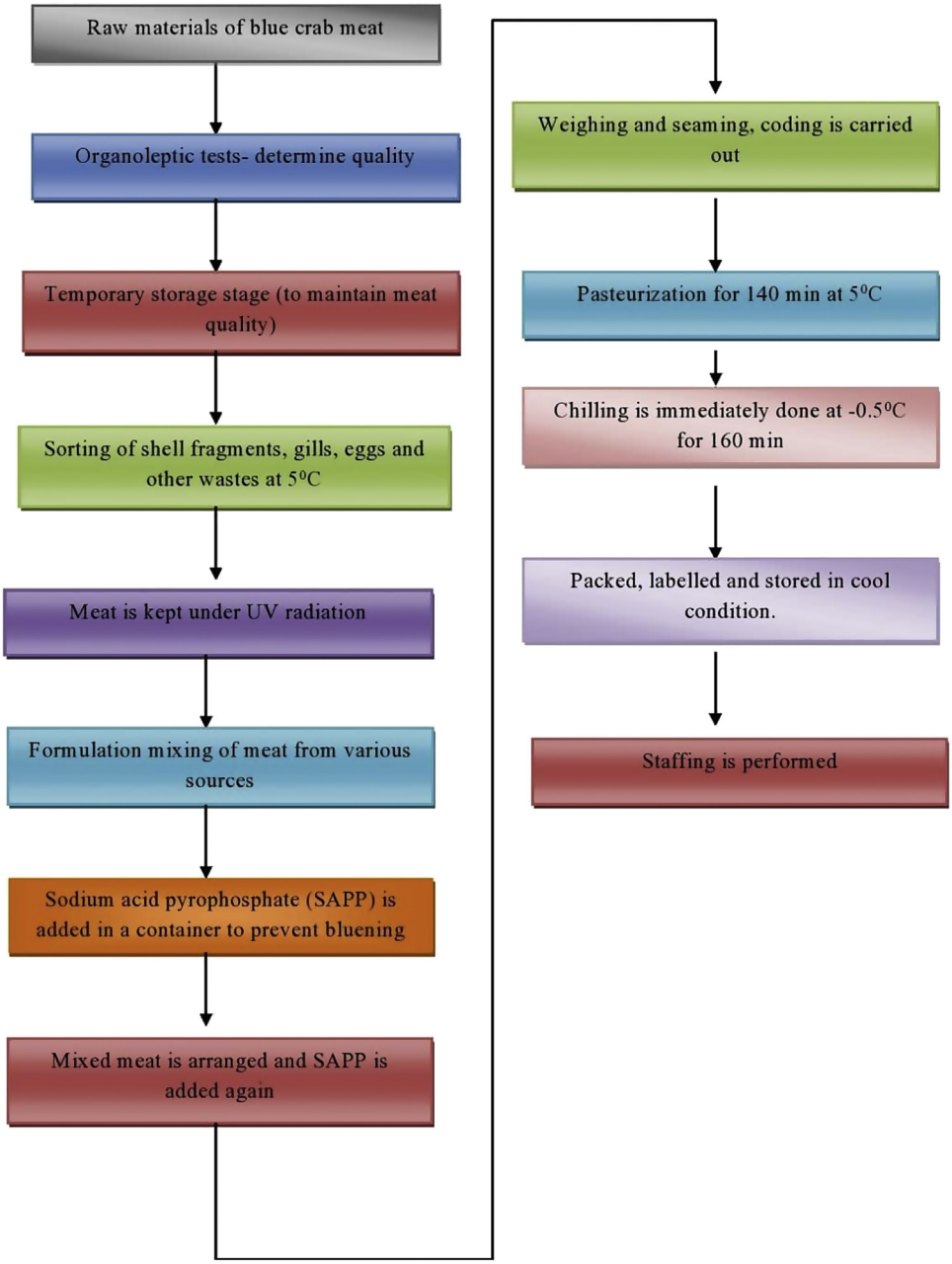


FIGURE 23.2 Steps involved in processing of blue crab.

7. Value-added seafood products

Value-added is the keyword to the seafood processing industry, especially in the fish preparing industry, primarily in light of the expanded chances, the movement presents for procuring unfamiliar trade. Furthermore, value-added is one of the potential ways to deal with raising the benefit of the seafood processing industry, which presently lays more prominent accentuation on quality confirmation. Countless value-added and expanded fish items both for exporting and inward market dependent on shrimp, lobster, squid, cuttlefish, bivalves, cultivated fish, and minced meat from low evaluated fish have been distinguished and talked about in the survey. A fundamental elucidation of a couple of the value-added fish and fishery items has been examined (Venugopal, 2003; Venugopal and Shahidi, 1995) (Table 23.6).

TABLE 23.6 A small elucidation on value-added seafood products (Venugopal, 2003; Venugopal and Shahidi, 1995).

S.No.	Value-added seafood products	Elucidation of the value-added products
1	Fish sausage	**1.** Surimi + salt + sugar + sodium glutamate + soy protein = fish sausage. **2.** Stuffing and heating (85–90°C for 40 min) followed by cooling to avoid shrinking of fish.
2	Fish fingers	**1.** Popular product of fish mince. **2.** Mince +1% salt = frozen with batter. **3.** Breading. **4.** Followed by flash fry in oil (180–200°C for 20 s). **5.** Fingers are cooled, frozen, and stored.
3	Shark fins/fin rays	**1.** Great delicacy food in Singapore and Hong Kong. **2.** Based on color, size, variety, and quality, the value of fins is dependent. **3.** White and black are the two varieties. **4.** The white fins are costlier than black.
4	Shark cartilage	**1.** Mucopolysaccharide (chondroitin sulfate) present in shark cartilage has therapeutic uses. **2.** It has a good effect on cancer-related tumors, inflammation, arthritis, psoriasis, and enteritis. **3.** Oral intake of shark cartilage is reported to be effective in the above cases.
5	Tuna eyes	**1.** Polyunsaturated fatty acids like docosahexaenoic have great medicinal properties. **2.** Tuna eyes are in high demand in combating atherosclerotic and thrombotic problems of chronic heart patients.
6	Squalene	**1.** Unsaponifiable fraction of fish oils has unsaturated hydrocarbon. **2.** Squalene contains unsaturated hydrocarbon widely used in pharmaceuticals and cosmetics.
7	Surimi	**1.** Surimi = deboned washed fish flesh + cryoprotectants. **2.** Above theory is based on Japanese terms. **3.** Concentration of myofibrillar protein can be increased by washing. **4.** Fabricated products like shellfish analogs can be developed.
8	Mince-based products	**1.** Minced meat is the meat separated from fish in the comminuted form free of bones, skin, etc.
9	Clam and other related products	**1.** Boiling, depurations of live clams are carried out. **2.** Meat is shucked out. **3.** Blanching is carried out in boiling brine, cooled and battered, breaded, flash fried for 20 s, frozen, and then packed.
10	Shrimp products	**1.** Wild and cultured shrimp are used to prepare breaded shrimp. **2.** Peeled, deveined, butterfly, round tail-on, cooked, and peeled are coated with batter and bread crumbs flash fried (20 s at 180°C).

8. Conclusion

Seafood is a source to enrich our body health. Seafood is also known as health-promoting food sources that have a high content of proteins, vitamins, and mineral. Even though it is a portion of economically rich food, seafood consumption has a high advantage in bringing to heart-related disease, bone-related disease, obesity, diabetes, etc. Raw seafood is processed by various techniques to increase consumption rate of seafood and preserved by common methods like salting, canning, freezing, etc. Marine product enzymes are unique and play a vigorous role in maintaining mammalian health. Marine organisms are edible and have been tested for many beneficiaries in human health.

The World Bank calculated by 2030 about 62% of fish is available for human consumption. Fish is an important source of protein in several countries throughout history. Aquatic foods are known to be good and best but they are globally marked as economic-rich food sources. In the future, the blue economy plays a major role by making effective way of oceans resources.

Hence, seafood maintains a good value and value-added products around the globe because of its several goodnesses. Due to several benefits, humans are keenly interested to consume value-added seafood products throughout the world.

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