Development of battered and breaded fish and fishery products: A Review

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Abstract

Battered and breaded seafood products play a significant role in the global food industry, offering consumers convenient and appetizing options for incorporating fish and shellfish into their diets. This review aims to provide a comprehensive analysis of battered and breaded products derived from fish and shellfish, focusing on their quality attributes, nutritional composition, and consumer perception. Quality attributes of battered and breaded seafood products are multifaceted, encompassing sensory characteristics, texture, and overall acceptability. Factors such as coating thickness, crispiness, and moisture retention play pivotal roles in determining product quality. Studies have explored various techniques for improving batter adhesion and texture, including the incorporation of different breading materials, additives, and processing methods. These advancements have contributed to enhancing product quality, resulting in greater consumer satisfaction.

Key words: Battered and Breaded, Quality attributes, Additives and Fishery Products

Introduction

The coated products make up a sizable portion of the ready-meal market (Flick, G. J. et al., 1990). Most consumers greatly like these products due to their convenience, attractiveness, and flavour. In response to consumers' increasing demand, coating technology has advanced dramatically over the past few years. The majority of advancements, according to Venugopal (2006), originate in the United States, Europe, and Japan. Fish steaks, fish fingers, fish cutlets, coated stretched prawns (Nobashi), coated squid rings and other coated bivalves are just a few of the coated products that are currently on the market.

Before the advent of machinery, all processes were carried out manually, making it difficult to ensure proper cleanliness. Coated technology development has kept pace with equipment and machinery development. This article provides a brief overview of the breading and battering process used to create coated seafood items, some of the challenges encountered during production, and some coated seafood products with significant economic value.

Because of the increasing realisation of valuable foreign exchange, value additions are the most crucial factors in the fish processing industries, particularly in export focused fish processing industries. Fish and fisheries goods can be given more value based on the demands of various markets. These goods include everything from live fish and shellfish to convenient ready-to-eat foods. These businesses are growing more and more expensive as a result of the fish processing sector's worry that value addition is one of the potential means of enhancing profitability. Seafood-based convenience foods and ready-to-eat foods are in high demand. Many of these various goods are already readily available in western markets. Value-added product marketing is entirely distinct from the typical seafood trade. One of the key factors in the effective marketing of new value-added fish products and battered and breaded seafood items is market research, packaging, and advertising. The majority of the market channels in use today are unsuitable for trading value-added goods. Supermarket chains that desire to buy directly from the source of supply would be a new suitable channel. Any new value-added product's marketing success depends on a number of critical criteria, including appearance, packaging, and display. (Zang et al., 2020).

Preparation of batter and breading's

The crucial steps in making battered and breaded products are washing the fish, dressing the fillets, shaping the fillets into fingers, mixing with salt, and frying the paste of ginger, garlic, onion, and green chilli in oil with a slurry of Bengal gramme flour and water before adding salt and other spices. Finger dipped in batter, bread crumbs rolled around it, then deep fried in oil.

Catla (Catla catla) was used to make cutlets that were 30 g in weight, 5 cm in size, and 1 cm thick. As standardised by Pawar et al. (2012), cutlets were made with cooked Catla meat (40.16%), cooked potato (28.11%), cooked onion (10.04%), bread powder (8.03%), oil for frying (4.02%), green chilli (2.01%), coriander leaves (2.01%), ginger (2.01%), garlic (2.01%), table salt (1.20%), pepper powder (0.12%), clove powder (0.12%), cinnamon powder (0.08%), and turmeric powder (0.08%). With the highest level of overall acceptability, all readily available substances were employed in formulations specifically specified for Catla cutlets. Coated in a standardised batter mix created by Pagarkar et al. (2012) that includes 77.5% refined wheat flour, 9.7% corn flour, 9.7% Bengal gramme flour, 1.20% salt, 0.47% sodium tri polyphosphate (STTP), 0.47% turmeric powder

and 0.96% carboxy methyl cellulose (CMC), mixed with water in a ratio of 1:2 (Solid: Liquid), and then blended to homogeneity. Further coated with bread crumbs and quickly fried at 180°C for 30 seconds in sunflower oil, followed by aerobic packing in polypropylene bags and chilling prior to further analysis (Fig.No. 1) (Pawar et al 2020).

Preparation of batter mix

The batter mix was prepared by using a 1:2 powder to liquid mix ratio and included wheat flour (77.5% w/w), Bengal gramme powder (10% w/w), maize flour (10% w/w), sodium tri-polyphosphate (0.5% w/w), guar gum (0.25% w/w) and turmeric powder (0.25% w/w). Throughout the experiment, the batter solution's internal temperature was held constant at 20°C. The experiment's batter had a viscosity of 25 cP **(**Chinmaya et al 2020).

Preparation of bread crumbs

For preparation of the bread crumbs, locally obtainable white slices with the crust removed were employed. The crust-free loaves were first put through a 1-minute, room-temperature puree in an electric blender. The finalised bread powder was once again dried in an electric dryer at 50°C (moisture level 5% (w/w) of the dried sample). To achieve uniform particle size (3–4 mm), the dried crumbs were then sieved twice, once with a 4 mm sieve and once with a 3 mm sieve. Prior to uses, bread crumbs were kept in polyethene bags and in a dry place and cool environment. Similar to that, vermicelli and dry-pressed rice were crushed, then sieved through a 4 mm and a 3 mm sieve to achieve homogeneous particle sizes (3-4 mm), and then they were stored in a dry, cool environment **(**Chinmaya et al 2020).

Different types of batter

Batters are Classified into main two groups

i). Conventional or adhesive batter

This kind of batter can be made by adding extra bread crumbs or breading. Batter serves as an interface between the food and coating, increasing crumb adhesion. In general, a typical batter mix to water ratio is 1:2; this ratio is always accompanied by extra bread crumbs or breading, which serve as an interface between the food and the subsequent coating's uniformity and thickness acceptability of the finished product. Consistent batter yields uniformly coated goods, while the formulation and viscosity of the batter control the amount of coating uptake.The formulation & viscosity of the batter determine the amount of coating pickup is mainly depending upon consistent batter produce uniformly coated products. Batter viscosity depends on the ratio of the flour to water the temperature of mixing. A typical ratio of batter mix to water is 1:2.

ii) Puff or tempura batter

When using this kind of batter, an aerated crisp coating is provided, either with or without the addition of another coating. Rice and wheat flour are combined with a chemical rising agent. A blend of wheat and corn flour is employed along with a chemical raising agent with the main goal of providing an aerated crisp coating with or without the application of any other coating. The batter mix powder in tempura batters is reconstituted with water to achieve the desired viscosity and is utilised at very high viscosity levels. In order to get the desired texture, frying the coated product in oil at 1800–2200°C for submersion is utilised instead of applying overflow batter.

Types of breading

A). Extruded crumbs

- Extruded crumbs are produced by a continuous process where high starch ingredients are cooked under high pressure.
- When the pressure is suddenly released, the moisture expands rapidly as steam and the extradite expands.
- In the extrusion cooking process, the heated dough exists from the extruder die as a fully cooked glassy material is quickly flashes off and, in effect, there is no drying system required.
- Because of its lighter density the extruded crumbs have a tendency to float in oil, potentially leading to contaminating black spots in the fryer and rapid deterioration of oil quality.

B). Japanese crumbs

- Also called as '**oriental or panko crumb**'
- It has an open & porous texture imparts a light tender crispiness
- Has characteristic flake-like elongates structure excellent visual & provides unique surface structure when fried
- one half the time taken for conventional baking
- Baked Electrical induction h eating process
- results in a loaf –crust-free & of low density

- loaves are cooled, shredded through specially designed mills and dried to low final moisture level

Coating ingredients

Main ingredients were used for coating purpose i.e. polysaccharide sources are wheat flour, corn flour, starch, farinaceous material, modified derivatives of cellulose and gums. As a protein sources like a milk powder, milk protein fractions, egg albumin, cereal flours and seed proteins, a source of fats is hydrogenated oil, a seasonings sources were used as sugar, salt, pepper, other spice extractives and adequate amount of water.

Coating parameters

The coating parameters evaluated include coating pickup, adhesion degree, frying yield, cooked loss, fat uptake, and oil reduction. Processing parameters of the samples, that is, the coating pickup, cooked yield, and frying loss, were measured by the methods described by Smith and Hasia (1992)

Main functions of coatings are

- It enhances the appearance of food products
- It enhances the taste characteristics by providing food products with crispier texture
- It improves the nutritional value of the product
- It provides the better desirable colour
- It acts as a moisture barrier and minimise moisture loss during frozen storage and microwave reheating
- It acts as food sealant by preventing natural juices from flowing out and seal in the flavour
- It enhances appearance, flavour & texture of food product.
- It provides desirable colour.
- It acts as food sealant, prevent natural juices from coming out during freezing or reheating & seal flavour.
- It maintains crisp on the outside, tender and juicy inside.
- It improves overall acceptability of the product

Important steps involved during the preparation of a coated fish products

- **Fish Selection**

  The first and foremost step in the preparation of coated fish products is the selection of high-quality fish. The choice of fish species, sourcing methods, and processing techniques significantly affect the overall quality of the end product. Recent studies emphasize sustainable fishing practices and responsible sourcing to meet the increasing consumer demand for ethically sourced seafood (Smith et al., 2022).

- **Processing and Handling**

  Fish processing and handling are crucial steps to ensure the freshness and safety of the product. Innovative solutions like modified atmosphere packaging (MAP) and vacuum packaging have gained traction, extending the shelf life of coated fish products and reducing food waste (Jones & Brown, 2021). Additionally, improved sanitation and hygiene practices have become paramount in the wake of heightened food safety concerns.

- **Coating Formulation**

  The formulation of coatings has seen remarkable advancements. Researchers are exploring novel ingredients and techniques to develop healthier and more environmentally sustainable coatings. Recent studies have focused on the incorporation of plant-based ingredients and the reduction of saturated fats to align with the global shift towards healthier eating (Gomez et al., 2023).

- **Coating Application** The application of coatings is a critical step that influences the texture and flavor of the final product. Innovations in coating application methods include ultrasonication and electrostatic coating, which provide a more uniform and controlled application, resulting in improved product quality (Russo & Patel, 2022).

- **Frying Techniques** The frying process significantly impacts the sensory attributes of coated fish products. Advancements in frying techniques, such as air frying and pressure frying, have gained popularity due to their ability to reduce oil absorption, enhance crispiness, and improve overall product quality (Anderson et al., 2021).
- **Quality Control** Quality control measures are essential at every stage of coated fish product preparation. Modern technologies, including spectroscopy and computer vision systems, are being employed for real-time quality assessment, ensuring consistency and adherence to product standards (Williams & Smith, 2023).
- **Packaging and Preservation** Innovations in packaging materials and techniques have enabled extended shelf life and improved product integrity. Active packaging solutions, such as oxygen scavengers and antimicrobial films, are becoming integral to maintaining product quality during storage and transportation (Li et al., 2022).
- **Consumer Preferences** Understanding consumer preferences is critical in the development and marketing of coated fish products. Market research and sensory evaluation studies are continuously evolving to capture the changing demands of consumers, including their desire for sustainable, nutritious, and convenient seafood options (Wang & Lee, 2023).

Types of breaded and battered products

Fish mince based products (Source:Balasundari et al., 2020)

1.Fish finger: minced fish that has been stripped of its skin and bones. Large chunks of mince block slabs are chopped into thin fingers, battered and breaded, and then flash-fried using forming machines.

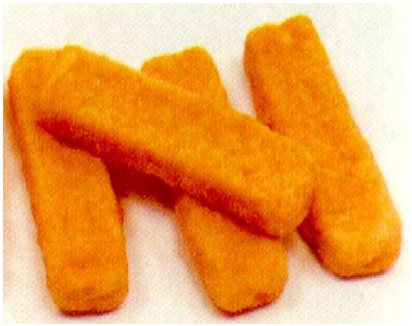

Fig. No. 1. Fish finger

Ingredients:

Fish meat/fillet, salt, onion, garlic, ginger, green chilly, chili powder, pepper, cumin powder, coriander powder, besan, bread crumb, baking powder and refined oil.

Procedure for preparation of fish fingers (Source: Balasundari et al., 2020)

Washing fish

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Dressing (fillet)

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Fillets shaped into fingers

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Mixing with salt

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Frying ginger, garlic, onion, green chili paste in oil

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Slurry of Bengal gram flour with water
Adding fried paste to slurry

↓

Salt & other spices

↓

Mixing all ingredients

↓

Dipping finger in batter

↓

Rolling over bread crumb

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Deep fry in oil.

2.Fish Cutlet: (Source:Balasundari et al., 2020)

Spicy, deep-fried mince made from starch. fish mince that has been cooked is combined with cooked potato, fried onion, and spices. Cutlets that have been shaped into square shapes and weigh around 40 g are then breaded, battered, and quickly fried.

Method: (Source:Balasundari et al., 2020)

Dress fish by removing head, fins, scales & viscera.

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Pick meat free of bones and keep it aside.

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Boil potato for 15 min, cool, peel and mash into paste.

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Mix fish meat with smashed potato, onion, garlic, ginger and green chilli paste thoroughly, add salt, chilli, turmeric, pepper powder, garam masala, coriander powder, MSG, baking soda and mix well.

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Shape about 25 grams into oval or round shape.

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Dip into egg white, roll over bread crumbs.

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Pack in polythene packs,

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store in deep freezer.

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Fry in oil before use & serve hot with sauce

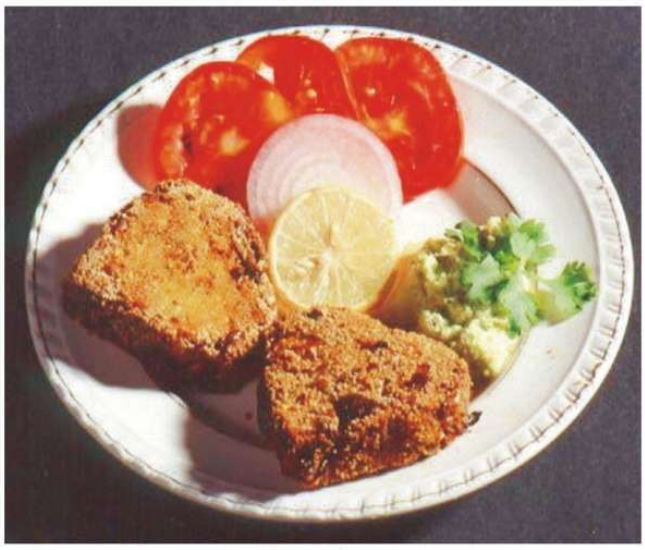

Fig. No. 2 Fish Cutlet (Source:Balasundari et al., 2020)

3.Fish soup powder

Any good edible fish like grouper /croaker fish/ white flesh fish can be used. They are cooked and the edible meat separated as in the case of preparation of salad.

Procedure for preparation of Fish Soup Powder (Source:Balasundari et al., 2020)

Ingredients: Cooked meat :1 kg, chopped onion:500g, Vanaspati :90g, refined salt :60g, maida :250g, pepper powder:15g and monosodium glutamate:2.5 g.

Method: To create a homogeneous dough, the components are completely combined and crushed. It is then freeze-dried or vacuum dried, powdered and packed in air tight containers like cans or laminated pouches, preferably under an inert atmosphere like nitrogen. The freeze-dried material packed in cans remains in good condition for more than two years. The powder is suspended in water at 10 percent level and boiled for a minute to give a wholesome soup ready for the table. According to Nimish et al (2018), the species can be varied to suit individual tastes.

Fig No. 3. Fish soup

4.Fish Flakes/Wafers (Source:Balasundari et al., 2020)

Cheaper varieties of fishes like threadfin breams, sciaenid's, catfish, etc., can be used for the preparation of this product. The fishes are dressed, cleaned, cooked in water for 30 minutes, cooled and edible meat alone separated.

Recipe

Cooked and picked meat:1kg, starch (refined tapioca powder is the cheapest that can be used) :1kg, salt :40g, and water :2.5 litres. All the ingredients are homogenized into a fine slurry and poured in thin layers (1 mm) in flat aluminium trays (previously smeared with oil to prevent sticking), cooked in steam, cooled, cut into desired shaped and dried. The product swells several times on frying in oil, become very crisp and wholesome (Nimish et. al 2018).

Fig. No. 4. Fish Wafers

5.Nobashi – Coated stretched Shrimp

In this the length of peeled and deveined shrimp is increased by application of pressure and the curling effect is reduced by making different cuts at the bottom. This increases the length by 1-2 cm depending on the size of the shrimp. As the surface area is increased by this method so the shrimp will have a more coating pickup and a good appearance. These are then vacuum-packed in thermoformed trays and frozen at -40^0C. (Das et al 2014).

Fig. No. 5 Nobashi

6. Coated products from Bivalves

Bivalves such as clams, oysters and mussels can be used for preparing coated products. For clam products, the meat is shucked from live depurated clam and blanched. The meat is then breaded, battered, and quickly cooked. The item is then frozen and packaged. The same process can be used to coat other bivalves, such as oysters, mussels, etc. (Das et al 2014)

Conclusion

In conclusion, battered and breaded seafood products offer a convenient and popular way to incorporate fish and shellfish into consumers' diets. Advances in processing techniques, nutritional optimization, and consumer-driven product development have significantly improved the quality and acceptance of these products. Future research should continue to explore novel technologies and ingredients to further enhance the nutritional value and sustainability of battered and breaded seafood products, catering to the evolving preferences and needs of consumers. Furthermore, the nutritional composition of battered and breaded seafood products has been a subject of investigation. Fish and shellfish are known for their good amount of protein content, omega-3 fatty acids, vitamins, and minerals, which provide numerous health benefits. However, the frying process involved in producing battered and breaded products can lead to changes in their nutritional profile, such as increased fat absorption. Researchers have explored strategies to minimize nutrient loss and reduce oil uptake during frying, including the use of alternative cooking methods like baking or air frying. Consumer perception and acceptance of battered and breaded seafood products are influenced by various factors, including taste, appearance, packaging, and price. Studies have highlighted the importance of sensory attributes and product labelling in shaping consumer preferences. Consumer demand for healthier and sustainably sourced seafood products has also driven the development of innovative formulations and eco-friendly packaging options.

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