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Popular Article

Battered And Breaded Seafood Products: Technological Advances, Processing Methods, And Market Potential

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Abstract

The increasing demand for convenient, ready-to-eat foods has driven innovation in the development of battered and breaded seafood products. These coated items, such as fish fingers, squid rings, and shrimp (Nobashi), combine crispy textures with moist, flavorful centers, making them appealing to modern consumers. Battering and breading not only enhance sensory attributes like texture and taste but also add commercial value to underutilized fish species. The processing involves multiple stages: selection of raw materials, pre-dusting, battering, breading, pre-frying, freezing, packaging, and cold storage. Innovations in batter formulations—including the use of tempura and cornmeal variants—allow for reduced oil absorption and improved texture. Breading techniques range from traditional plain crumbs to panko and cornmeal for added crunch and flavor. Moreover, pre-treatment methods like pre-dusting and par-frying play crucial roles in improving batter adhesion and coating stability. Health-conscious consumers have spurred research into reducing fat content through ingredient modifications. Overall, battered and breaded seafood products reflect an evolving intersection of consumer preferences, food processing technologies, and nutritional considerations, offering vast market potential and functional diversity in both retail and foodservice sectors.

Keywords: Battered seafood, Breaded products, Coated fish products, Value-added seafood, Deep frying, Convenience foods, Coating technologies

1. INTRODUCTION

Recent trends in lifestyle and consumer preferences for finding a new taste and convenience in preparation have shifted the consumer interest towards ready-to-eat deep-fried products. Convenience food products that comprise ready-to-eat products require little preparation and are becoming increasingly popular (Barbut 2012). Because of the health benefits of fish and fish-based products,



more people are eating them. However, compared to pork and chicken, it's still less common to find battered fish products in stores. With cities growing quickly, people's eating habits are changing—they now prefer quick and easy meal options, like ready-to-cook or ready-to-eat foods. This shift is boosting the market for seafood snacks. Among these, battered and breaded products are especially popular because of their delicious qualities—a crispy outer layer with a soft, juicy center (Nasiri et al., 2012; Xavier et al., 2018). Coated products like., fish finger, squid rings, cuttlefish balls, fish balls and prawn burgers form one of the major fish and shellfish-based items of trade by the ASEAN countries (Chang et al., 1996).

Battering and breading are commonly used to add value to food products, as noted by Flick et al. (1990). These types of coated foods make up a large part of the ready-meal market. Many consumers prefer them because of their good taste, ease of preparation, and appealing appearance. In recent years, advances in coating technology have been made to meet the rising demand for these products. Coated foods not only look and taste better, but they can also have improved texture, color, and even nutritional value (Balachandran, 2001). The United States, Europe, and Japan were among the first to develop new types of battered and breaded foods (Venugopal, 2006). Today, a wide variety of coated items are available, such as squid rings, bivalves, stretched shrimp (Nobashi), fish sticks, and cutlets. Value-added oyster products are also gaining popularity among consumers nationwide. Around the world, fried, battered foods with a mix of crispy and soft textures are well-loved (Brannan et al., 2014; Oke et al., 2014; Oladejo et al., 2018).

The crispy outer layer (crust) formed during deep-frying often contains a lot of fat. Eating too many fried foods can lead to obesity and health issues like heart disease and high blood pressure (Dourado et al., 2019; Gadiraju et al., 2015). Because of these concerns, there has been growing interest in reducing the fat content in fried foods by changing the ingredients in the batter (Liberty et al., 2019). Batter is a complex mixture used in frying, usually made of flour, water, spices, and other components, and its behaviour depends on how these ingredients interact (Varela & Fiszman, 2011).

During frying, the outer crust forms as the starch in the batter gelatinizes and the proteins denature. This process helps trap moisture inside and changes the surface, which can lead to less fat being absorbed (Pongsawatmanit et al., 2018). Reducing fat absorption may be linked to how wheat starch and wheat protein interact, as this can influence the batter's thickness, flow behavior, heat response, and how much batter sticks to foods like fish (Ketjarut et al., 2015; Santillan et al., 2011).

Coatings for fried foods are often made by mixing flour with water. Sometimes, ingredients that make the coating puff up during frying—like those used in tempura—are added. In breaded foods, a sticky layer is used first, followed by flour-based breadcrumbs. Today, coating recipes have become



more advanced to meet customer needs for easy use, good looks, and great taste. Modern coatings can include ingredients like potato starch, baking agents, flavorings, spices, oils, eggs, and milk. These helps improve color, texture, and moisture while reducing the amount of oil the food absorbs when fried (Brannan et al., 2014; Loewe, 2011; Mallikarjunan, Ngadi, & Chinnan, 2010).

A coated food product is one that is covered with another layer of food, like batter or breadcrumbs. This coating improves the food's look, taste, and texture (Sreelekshmi and Ninan, 2018). Coating fish with batter or breadcrumbs also helps turn low-value fish into a more appealing and valuable product. When frozen in ready-to-cook form, such products offer the convenience of high consumer value and are called 'conveniencefoods. Fish fingers, fish fillets, and fish cake are the staple battered and breaded fish products. Breaded shrimp, scallops and oysters to the luxury market.

2. INGREDIENTS AND FUNCTIONALITIES

2.1. Pre-dust

Pre-dusting is a process where a dry substance, usually wheat flour, is lightly dusted over the wet surface of fresh or frozen food before coating. This helps absorb excess moisture, allowing batter to stick better and preventing it from slipping off during cooking. Pre-dusting also improves batter pickup and can help form a better structure. In addition to flour, ingredients like proteins, gums, and starches may be used for added functionality (Kuntz, 1997; Zhang, 2001). For extra flavor, more complex and expensive pre-dusts may include salt, spices, and seasonings. This step is commonly used before preparing fish and other coated foods.

2.2. Battering

Batters are liquid mixtures applied to food just before frying or breading. They usually consist of flours and/or starches mixed with liquids like water, milk, buttermilk, or beer. Ingredients such as salt, spices, eggs, gums, and leavening agents help the batter expand or puff during frying. Wheat flour is commonly used, providing around 10–11% protein, which adds to the batter's crispiness and thickness. Higher protein levels increase both viscosity and crunch. The thickness, or viscosity, of the batter is important for forming a consistent coating layer. Batter systems are generally divided into two types: adhesion batters and puff (or tempura) batters (Nambudiri, 2012).

Table 1.1 Adhesion batter recipe

Ingredient	Percent
Wheat flour	50–65
Modified starch (oxidized)	10–15



Corn flour	8–14
Salt	2–4
Seasonings	3–6

Table 1.2 Tempura batter recipe

Ingredient	Percent
Wheat flour	50–60
Corn flour	22–28
Modified starch (dextrin)	5–10
Salt	2–4
Dextrose	1–3

2.3. Breading

To prepare the breadcrumb coating, white bread loaves with the crusts removed were used. The bread was blended at room temperature for one minute using an electric blender. The resulting bread powder was then dried in an electric dryer at 50°C until the moisture content dropped below 5%. After drying, the crumbs were sieved through 4 mm and then 3 mm sieves to ensure a uniform particle size of 3–4 mm. The finished breadcrumbs were stored in polyethylene bags in a cool, dry place until use. Similarly, vermicelli noodles and dry-pressed rice were crushed, sieved through the same 4 mm and 3 mm sieves for consistency, and also stored in a cool, dry place.

According to Chinmaya et al. (2020), there are three main types of breading: Standard Breading Procedure (SBP), dry breading, and double breading. In SBP, the food is coated in flour, then dipped in egg wash, and finally covered with breadcrumbs or another coating.

Common breadcrumb coatings include:

- Plain breadcrumbs – provide a simple, crispy texture.
- Panko breadcrumbs – Japanese-style, light, and extra crunchy.
- Cracker crumbs – offer a salty, buttery flavor.
- Cornmeal – gives a sweet taste with a gritty texture.

2.4. Other Coating ingredients

- Polysaccharides-wheat, corn flour, starch, farinaceous material, modified derivatives of cellulose and gums.
- Proteins – milk powder, milk protein fractions, egg albumin, cereal flours & seed proteins.



- Fats and hydrogenated oil
- Seasonings– sugar, salt, pepper, other spice extractives.
- Water

3. PROCESS FOR PREPARATION OF BREADED AND BATTERED PRODUCTS

3.1. Selection and Preparation of Raw Material

- Choose fresh, high-quality seafood (fish, shrimp, squid, or bivalves).
- Wash thoroughly in clean water.
- Trim, devein (shrimp), or cut into desired portions.

3.2. Pre-dusting

- Lightly coat the seafood pieces with dry flour or a pre-dust mix (Kuntz, 1997; Zhang, 2001).
- Purpose:
 - Improves batter adhesion.
 - Reduces moisture on the surface.
 - Enhances coating texture.

3.3. Battering

- Dip the pre-dusted seafood into a prepared wet batter.
- Batter types:
 - Plain batter (flour + water/spices)
 - Tempura batter
 - Cornmeal batter
 - Beer batter
- Ensures a sticky layer for breadcrumbs to adhere to.

3.4. Breading

- Immediately roll or coat the battered seafood in dry coating materials such as:
 - Plain breadcrumbs
 - Panko (for extra crunch)
 - Crushed crackers
 - Vermicelli or crushed rice
 - Cornmeal
- Optional: **Double breading** can be done for a thicker, crunchier texture.

3.5. Frying (Pre-frying or Par-frying)

- Brief frying at 170–180°C for 15–60 seconds.



- Purpose:
 - Sets the coating.
 - Adds color and texture.
 - Reduces oil absorption in final cooking.

3.6. Freezing

- Quickly freeze the products using:
 - IQF (Individual Quick Freezing) or blast freezing.
- Target: core temperature of -18°C or below to maintain quality and safety.

3.7. Packaging


- Pack frozen products in moisture-proof, food-grade materials (Venugopal et al., 1995).
- Common options:
 - Polyethylene bags
 - Vacuum-sealed pouches
- Include labelling with product details, storage, and cooking instructions.

3.8. Cold Storage


- Store at -18°C or lower to preserve freshness and extend shelf life until distribution.

4. Types of Breaded and Battered Products


Coated product is one, which is coated with another foodstuff. Two types of coatings are in common use. They are batter and breadcrumbs. Seafood specialties, fish portions (raw and precooked), shrimp, fish fingers, scallops, fish balls, fillets etc are the principal seafood products which are battered and/or breaded. Most of these items are ready-to-cook and are processed frozen, although some may be processed fresh.

Product Name & Author	Ingredients	Methods of preparation
Fish Cutlet C. Nanda et al. (2020) 	Fish (250–300 grams, boneless, cooked, and shredded), potatoes (2 medium-sized, boiled and mashed), onion (1 medium, finely chopped), green chilies (2, finely chopped), ginger-garlic paste (1 tsp),	Cook Fish → Debone & Flake ↓ Boil Potatoes → Mash ↓ Chop Onion, Green Chilies, Coriander ↓ Sauté Onion + Ginger-Garlic Paste





	<p>turmeric powder (¼ tsp), red chili powder (½ tsp), black pepper powder (½ tsp), garam masala (½ tsp), salt (to taste), coriander leaves (a handful, chopped), egg (1, beaten), breadcrumbs (as needed), and oil (for shallow or deep frying).</p>	<p>↓</p> <p>Mix: Flaked Fish + Mashed Potatoes + Sautéed Mix + Masala + Salt + Pepper + Herbs</p> <p>↓</p> <p>Shape into Cutlets (Round/Oval)</p> <p>↓</p> <p>[Optional Battering] ← [Breeding Process]</p> <p>↓ ↓</p> <p>Prepare Batter 1. Dip in Flour (Flour + Water + Salt) 2. Dip in Egg</p> <p>3. Coat with Breadcrumbs</p> <p>↓ ↓</p> <p>Dip Cutlets in Batter (optional, if combining)</p> <p>↓</p> <p>Deep Fry at 170–180°C</p> <p>↓</p> <p>Drain on Paper Towels</p> <p>↓</p> <p>Serve Hot with Dip</p>
<p>Fish Fillet</p> <p>Rohani et al. (2009)</p> 	<p>Fish fillets (250–300 grams, boneless and skinless), salt (to taste), black pepper (to taste), lemon juice (1 tbsp, optional), all-purpose flour (¼ cup, for coating), egg (1, beaten), breadcrumbs or panko (as needed, for coating), garlic powder (½ tsp, optional), paprika or</p>	<p>Select & Wash Fish Fillets</p> <p>↓</p> <p>Pat Dry & Marinate</p> <p>↓</p> <p>Choose Preparation Method</p> <p> / \</p> <p>Breading Battering</p> <p>----- -----</p> <p>1. Dip in Flour Prepare Batter</p>




	chili powder (½ tsp, optional), and oil (for shallow or deep frying).	<p>2. Dip in Egg (Flour + Water + 3. Coat in Salt)</p> <p style="text-align: center;">↓</p> <p>Breadcrumbs Dip Fillet in Batter</p> <p style="text-align: center;">\ /</p> <p>Fry in Hot Oil (170–180°C)</p> <p style="text-align: center;">↓</p> <p>Drain Excess Oil on Paper</p> <p style="text-align: center;">↓</p> <p>Serve Hot with Dip</p>
<p>Fish Sticks</p> <p>Xavier et al. (2017)</p> 	<p>Boneless, cooked and shredded in a rectangular shaped fish fillets 250–300 grams, 2 medium-sized boiled and mashed potatoes, 1 finely chopped onion, 2 finely chopped green chilies, 1 tsp ginger-garlic paste, ¼ tsp turmeric powder, ½ tsp red chili powder, ½ tsp black pepper powder, ½ tsp garam masala, salt to taste, a handful of chopped coriander leaves, 1 beaten egg, ½ cup all-purpose flour, 2 tbsp corn flour, ½ tsp baking powder, breadcrumbs for coating, and oil for frying.</p>	<p>Select & Wash Fish Fillets</p> <p style="text-align: center;">↓</p> <p>Cut into Stick Shapes (1x1x5 cm)</p> <p style="text-align: center;">↓</p> <p>Pat Dry & Marinate (Salt, Pepper, Lemon Juice)</p> <p style="text-align: center;">↓</p> <p>Choose Coating Method</p> <p style="text-align: center;">/ \</p> <p>Breading Process Battering Process</p> <p style="text-align: center;">----- -----</p> <p>1. Dip in Flour Prepare Batter</p> <p>2. Dip in Egg (Flour + Water + Salt)</p> <p>3. Coat in Breadcrumbs ↓</p> <p style="text-align: center;">↓ Dip Fish Sticks</p> <p>Fry in Oil (170–180°C)</p> <p style="text-align: center;">↓</p> <p>Drain Excess Oil on Paper</p> <p style="text-align: center;">↓</p> <p>Serve Hot with Dip</p>




<p style="text-align: center;">Fish Balls</p> <p style="text-align: center;">Kamalakanth et al. (2013)</p> 	<p>Boneless, cooked and mince fish fillets 250–300 grams, 2 medium-sized boiled and mashed potatoes, 1 finely chopped onion, 2 finely chopped green chilies, 1 tsp ginger-garlic paste, ¼ tsp turmeric powder, ½ tsp red chili powder, ½ tsp black pepper powder, ½ tsp garam masala, salt to taste, a handful of chopped coriander leaves, 1 beaten egg, breadcrumbs for coating, ½ cup all-purpose flour, 2 tbsp corn flour, ½ tsp baking powder, and oil for shallow or deep frying.</p>	<p style="text-align: center;">Cook / Mince Fish Meat</p> <p style="text-align: center;">↓</p> <p style="text-align: center;">Mix with Onion, Garlic, Chilies, Spices, Binder</p> <p style="text-align: center;">↓</p> <p style="text-align: center;">Form into Balls</p> <p style="text-align: center;">↓</p> <p style="text-align: center;">Choose Coating Method</p> <p style="text-align: center;">/ \</p> <p style="text-align: center;">Breading Process Battering Process</p> <p style="text-align: center;">----- -----</p> <p>1. Dip in Flour Prepare Batter</p> <p>2. Dip in Egg (Flour + Water + Salt)</p> <p>3. Coat in Breadcrumbs ↓</p> <p style="text-align: center;">↓ Dip Fish Balls</p> <p style="text-align: center;">Fry in Hot Oil (170–180°C)</p> <p style="text-align: center;">↓</p> <p style="text-align: center;">Drain on Paper Towels</p> <p style="text-align: center;">↓</p> <p style="text-align: center;">Serve with Dipping Sauce</p>
<p style="text-align: center;">Fish Nuggets</p> <p style="text-align: center;">Cui et al. (2022)</p> 	<p>Boneless and cooked fish fillets and shredded in a small sized pieces 250–300 grams, 2 medium-sized boiled and mashed potatoes, 1 finely chopped onion, 2 finely chopped green chilies, 1 tsp ginger-garlic paste, ¼ tsp turmeric powder, ½ tsp red chili powder, ½ tsp black pepper powder, ½ tsp garam</p>	<p style="text-align: center;">Select & Wash Fish Fillets</p> <p style="text-align: center;">↓</p> <p style="text-align: center;">Cut into Nugget Shapes</p> <p style="text-align: center;">↓</p> <p style="text-align: center;">Pat Dry & Lightly Marinate</p> <p style="text-align: center;">↓</p> <p style="text-align: center;">Choose Coating Method</p> <p style="text-align: center;">/ \</p> <p style="text-align: center;">Breading Process Battering Process</p> <p style="text-align: center;">----- -----</p>



	<p>masala, salt to taste, a handful of chopped coriander leaves, 1 beaten egg, breadcrumbs for coating, ½ cup all-purpose flour, 2 tbsp corn flour, ½ tsp baking powder, and oil for shallow or deep frying.</p>	<p>1. Dip in Flour Prepare Batter 2. Dip in Egg (Flour + Water + Salt) 3. Coat in Breadcrumbs ↓ ↓ Dip in Batter Deep Fry in Hot Oil (170–180°C) ↓ Drain Excess Oil on Paper Towels ↓ Serve Hot with Dip</p>
<p>Nobashi Das et al. (2014)</p> 	<p>Large shrimp (peeled and deveined 250–300 grams), 2 medium-sized boiled and mashed potatoes, 1 finely chopped onion, 2 finely chopped green chilies, 1 tsp ginger-garlic paste, ¼ tsp turmeric powder, ½ tsp red chili powder, ½ tsp black pepper powder, ½ tsp garam masala, salt to taste, a handful of chopped coriander leaves, 1 beaten egg, breadcrumbs for coating, ½ cup all-purpose flour, 2 tbsp corn flour, ½ tsp baking powder, and oil for shallow or deep frying.</p>	<p>Select Fresh Shrimp ↓ Peel (Leave Tail) & Devein ↓ Make Belly-Side Slits to Prevent Curling ↓ Stretch the Shrimp (Nobashi) ↓ Pat Dry & Season (Salt & Pepper) ↓ Choose Coating Method / \ Breading Process Battering Process ----- 1. Dip in Flour Prepare Batter 2. Dip in Egg (Flour + Cold Water + Salt) 3. Coat in Panko ↓ ↓ Dip in Batter</p>



		<p>Deep Fry in Oil (170–180°C)</p> <p>↓</p> <p>Drain on Paper Towels</p> <p>↓</p> <p>Serve Hot with Sauce (Ebi Fry / Tempura)</p>
<p>Squid Ring</p> <p>Bandre (2018)</p> 	<p>Squid rings (cleaned 250–300 grams), 2 medium-sized boiled and mashed potatoes, 1 finely chopped onion, 2 finely chopped green chilies, 1 tsp ginger-garlic paste, ¼ tsp turmeric powder, ½ tsp red chili powder, ½ tsp black pepper powder, ½ tsp garam masala, salt to taste, a handful of chopped coriander leaves, 1 beaten egg, breadcrumbs for coating, ½ cup all-purpose flour, 2 tbsp corn flour, ½ tsp baking powder, and oil for shallow or deep frying.</p>	<p>Clean and Wash Squid</p> <p>↓</p> <p>Remove Head, Innards & Skin</p> <p>↓</p> <p>Cut into Rings (1–1.5 cm)</p> <p>↓</p> <p>Pat Dry & Lightly Marinate</p> <p>↓</p> <p>Choose Coating Method</p> <p style="text-align: center;">/ \</p> <p>Breading Process Battering Process</p> <p>-----</p> <p>1. Dip in Flour Prepare Batter</p> <p>2. Dip in Egg (Flour + Ice Water + Salt)</p> <p>3. Coat in Breadcrumbs ↓</p> <p>↓ Dip in Batter</p> <p>Deep Fry in Oil (170–180°C) for 1.5–2 min</p> <p>↓</p> <p>Drain on Paper Towels</p> <p>↓</p> <p>Serve Hot with Dips or Lemon</p>



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