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A REVIEW OF TRADITIONAL FISH PROCESSING METHODS PRACTICED IN BANGLADESH

Murshida Khan*, Maisha Afrin, Maliha Anjum, Abida Khatun, Mst. Sabekunnahar, Ifrat Jahan Tannisa and Md. Monirul Islam

Department of Fisheries Technology, Bangabandhu Sheikh Mujibur Rahman Agricultural University, Gazipur 1706, Bangladesh.

***Corresponding e-mail:** murshida.fish2014@gmail.com

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ABSTRACT

Fish processing method for the long-term preservation of fish is very common practice throughout the world. Different traditional fish preservation techniques, such as drying, salting, smoking, and fermentation, are practiced in Bangladesh near the harvesting area. Due to the perishable nature of fish, lack of storage facility and poor transportation during the glut period, traditional fish processing methods are practiced in Bangladesh. This paper reviews different processing methods practiced traditionally in Bangladesh and the nutritional and microbiological status of processed fishery products. Drying, salting, and smoking are performed on the curing method and fermentation, breaking down organic substances into simpler compounds by enzymatic and microbial action. A higher amount of protein content is found in processed fishery products. Total Volatile Basic Nitrogen (TVBN) value was within 3mg to 20mg, except for some marine fish species exceeding the acceptable limit. The most commonly found bacteria are *Salmonella, Vibrio,* and *Escherichia. coli*. Fungal counts have not been well studied until now except for some dried species and salted hilsha. The higher value in proximate composition and microorganism number from acceptable limit due to poor quality raw materials, unhygienic processing conditions, insufficient packaging and improper storage, use of unsafe insecticide, no well-established marketing channel, and lack of knowledge and awareness. Proper hygiene and sanitation should be maintained from handling to the storage of all the products. This review aims to update the motive for traditional fish processing methods, nutritional, chemical and microbiological composition and limitations of these four types of traditional fish products.

Keywords: Fish processing, dried fish, salted fish, smoked fish, fermented fishery products

Introduction

Fish is one of the most significant natural resources in Bangladesh. Bangladesh is now one of the world's leading fish-producing countries, with a total production of 42.77 lakh MT, where aquaculture production contributes 56.24 percent of the total fish production (DoF 2018). Fish is a highly perishable food item, especially in the hot climate of Bangladesh, where an unsanitary environment, poor handling practices and poor storage facilities worsen the situation. Many artisanal catches fail to reach the markets due to inadequate transportation facilities. Different traditional fish preservation and processing techniques are practiced to avoid such problems. Drying, salting, smoking, and fermentation are Bangladesh's traditional fish preservation methods from ancient times (Nowsad 2010, Rasul *et al.* 2019). Drying, salting and smoking are performed on the principle of curing. In the process of fermentation, enzymatic and microbial action takes place to develop the product. Now Bangladesh earns a good quantity of foreign exchange by exporting these fishery products. In 2017-18, Bangladesh earned 42.6 crores Taka by exporting 3143.9 MT of dried fish and from salted products earned 26.6 cores Taka by exporting 213.6 MT (DoF 2018). The nutritional composition of these four types of traditionally preserved fishery products seems to be higher than fresh fish except for the moisture content as it is reduced to inhibit, destroy or inactivate microbial growth and autolytic enzyme (Mukit *et al.* 2016, Sultana *et al.* 2008). These methods are easy to perform, low cost, a variety of fish species, can be used, and nutritional quality remains intact, which makes the fishers and producers interested in these traditional fish preserving methods.

Reasons for traditional fish processing methods in Bangladesh: In Bangladesh, the transportation and handling of fish and fish products are poor; thus, a vast quantity is spoiled during product transportation from one end of the country to the other. Moreover, fishers do not get decent returns for their harvest during the peak harvest period due to the vast seasonal supply of fish and the lack of preservation facilities in Bangladesh. This unavailability of adequate fish handling, preservation, transportation, and storage facilities contributes significantly to low-quality fish's quality loss and supply (Nowsad 2010, Rasul *et al.* 2019, Mukit *et al.* 2016, Sultana *et al.* 2008). Therefore, on-spot post-harvest fish processing methods are essential to minimize fish spoilage and wastage and improve the storage for proper consumption. All these methods are easy, simple, require less capital, have fewer ingredients and availability of materials and don't require a skilled workforce (Nowsad 2010). Furthermore, practicing different types of preservation method have some specific importance. The process of sun-drying is versatile. Almost all fish species can be sun-dried as immense sunshine, airflow is available throughout the year, nutritional quality remains intact, and essential nutrients are higher in dried fish than the fresh fishes (Rasul *et al.* 2019). Dried fish has a considerably longer shelf life and requires no refrigeration facilities for storage. Salting is one of the famous traditional methods performed for preserving fatty fish due to its ability to reduce the growth of microorganisms by lowering the water activity of the fish muscle (Mukit *et al.* 2016). During glut catch seasons, only those spoiled or partially spoiled fish that cannot be sold in the fish market are used for salting (Nowsad 2010). The salting method can be done throughout the year, especially during monsoons when another low-cost preservation like sun-drying is not possible. Moreover, salt is readily available, can be done everywhere, does not require any equipment or machinery, reduces the quality loss of fresh fish at the landing area, and salted-dehydrated fish contributes to the foreign exchange. In 2017-2018 the quantity of exported dried fish products and salted dehydrated fish was 3143.9 Metric Tons, valued 42.59 Cores taka and 214 metric tons and valued 26.60 cores taka. (DoF 2018). When the sun doesn't shine for several days, the method of smoking is performed. The smoking of fish is an efficient processing method where the retention of protein percentage and a significant reduction in the moisture percentage occurs (Akinwumi *et al.* 2014). However, smoking is a preferable method because of the availability of the wood to produce smoke in the rainy season, which makes characteristics of flavor, color and taste; natural wood contains chemicals like tars, phenols and aldehydes those have powerful bactericidal and antioxidant action against microorganisms on the flesh of fish. Fermentation is one of the oldest economic methods for producing and preserving food in Bangladesh (Nahar *et al.* 2017). Semi fermented products such as shidhal, nga-pi, and salt fermented hilsha are indigenous food items in some districts and some tribal communities. People love the flavor, aroma, and changing the texture of these products which reduce the duration of cooking and thereby fuel requirement (Nowsad 2010). This method is performed to properly use the underutilized fish, a source of animal nutrition and income for some poor and tribal people in Bangladesh. Almost 100% of revenue comes from the nga-pi business; no other income sources for tribal nga-pi producers of Bandarban and Cox's Bazar (Shikha *et al.* 2020). These methods are economical for preserving the extra catch.

Processing methods: The people of Bangladesh admire various types of processed fishery products because of their characteristic color, flavor and taste. The three most popular and traditional fish processing techniques in Bangladesh, namely drying, salting, and smoking, are performed on the single principle of reducing the moisture content to create a hurdle for microbial growth and thus slower spoilage. The drying method is classified based on the size of the fish, and salting is based on the process of salt application and activity (Mustafa *et al.* 2012, Reza *et al.* 2005). Dry and pickle salting yield fish with a relatively high salt concentration, while brining is commonly applied for products with a lower salt concentration. Fermentation, another traditional processing method developed on the principle of breaking down organic substances into simpler compounds with enzymatic and microbial action.

The principle of drying is the removal of water from fish by the action of sunlight, airflow and suitable humidity. Mainly marine fish are used for drying and some freshwater fishes are also used for drying (Nowsad 2010, Majumdar *et al.* 2017). The drying method is classified based on the

size of the fish. For large-sized fish, after dressing, the fish are split while keeping attached at the head and tail, bamboo ring placed between splitting muscle and drying takes 3-7 days (Nowsad 2010). For elongate fish, 2-5 fishes are tied by the tail or joined two fishes with jaws and drying takes 3 to 5 days (Nowsad 2010). And for small fish and shrimp, fishes are placed on bamboo-made racks or on sand, and drying takes 3 to 5 days. The principle of salting is the removal of water by the penetration of salt and *Hilsha* is the main species that is used for salting in Bangladesh. Generally, three types of salting are practiced namely dry salting, wet salting and brine salting (Nowsad 2010). In dry salting, the salt fish ratio is 1:3, pile salt and fish in a container, and allow drainage and maturation for 7-10 days. In wet salting, fish soak in a brine solution for a long time; however, in brine salting, immerse fish in brine water for a few minutes. Maturation time of salted hilsha is 7-12 days. The principle of smoking is the reducing of moisture content by smoke. Generally, two species, shrimp and Hilsha are smoked in Bangladesh. Shrimp are semi-dried by sun and then smoked by wood for 2-3 hours. On the other hand, hilsha is smoked at first 4-5 hours after 3-6% salt treatment where hilsha is placed in a triangular frame. After 2-3 days of first smoking, again smoked for approximately 2 hours (Nowsad 2010). Generally, 4 types semi-fermented and fermented products are produced in Bangladesh namely Shidhal or chepa, shidil, nga-pi and fermented hilsha. For shidhal or chepa, punti fish (*Puntius sophore*) are dried for 2-7 days, washed, placed fish an oil polished earthen pot or motka by pressing bare leg foot to remove any air, covered by polythelyne and keep sealed motka in a hole with shed or dark room for 4-6 months.

Shidil is prepared by dried small fish with the addition of semi-dried esculent stem or leaf, turmeric powder, garlic and mustard oil. Grounding all to paste, shaping the paste to small round cakes and dried in the sun for 2-3 days under cover with a cotton cloth (little anaerobic fermentation) (Nowsad 2007). Commonly *Acetes* and *Mysids* shrimps are used for nga-pi. After sun-drying a whole day, the semi-dried shrimp with salt was grinded at the night and sun-drying at day up to three days. Then the final paste is shaped, wrapped by Moshpata, packing 20 kg in one bamboo basket and Keep the basket 7 days for fermentation. For, salt fermented hilsha, fish cut longitudinally from base of the dorsal fin to abdominal cavity parallel to surface to intact the fish with ventral line. After applying salt, fish are placed in a hold (digging a hole under a shed in the ground, covering around the inside hole with a bamboo mat and polythene) and are kept in the hold sequentially with salt between layer. Covering the final layer with salt where the top surface are covered with 1 feet clay layer and heavy objects and keeping 1-1.5 month underground. Then final product obtains (Nowsad 2007).

Nutrient composition: Proximate composition is the term usually used to assess the amount of various components (e.g., moisture, crude protein, fat, ether extract, crude fiber, crude ash, nitrogen-free extracts etc.) expressed as the percentage value (%) in the feed, respectively. The composition of a particular species often appears to vary from one habitat to another and season to season. Still, changes in this composition are usually caused by the variation in the amount and quality of food fish eat and the amount of movement it makes (Rasul *et al.* 2019). Different processing operation causes a considerable change in this composition.

In comparison to fresh fish, the different processing resulted in a significant decrease in moisture (%) for the fish, as shown in Figure 1 (Rana *et al.* 2019, Mansur *et al.* 2013, Siddique *et al.* 2012, Paul *et al.* 2018, Majumdar *et al.* 2017, Hasan *et al.* 2018, Nurullah *et al.* 2006). A low amount of moisture reduces spoilage organisms and the chemical activities of the products. Moisture contents of the dried, salted, smoked and fermented products ranged between 15.66 to 35.5%, 17.0 to 6%, 6.2 to 40.6% and 14.2 to 57.2%, respectively. Other nutritional components, such as protein, lipid, and ash, were increased in different processed products (Figure 1). The highest protein percentage is studied in smoked mirror carp 67%, dried shark 68.09% and brine salted taki (Spotted snakehead) 62% (Mustafa et al. 2012, Farid et al. 2016, Nahid *et al.* 2016). And highest ash was found in the dry salted taki 26%, smoked guchi baim 22%, chepa of Rangpur district 21.9% and lalchoukya 32.2%. The reason for increased ash in salted products is the minerals present in salt used for salting (Rasul *et al.* 2019). These high nutrient percentages in processed fishery products are beneficial for human health.

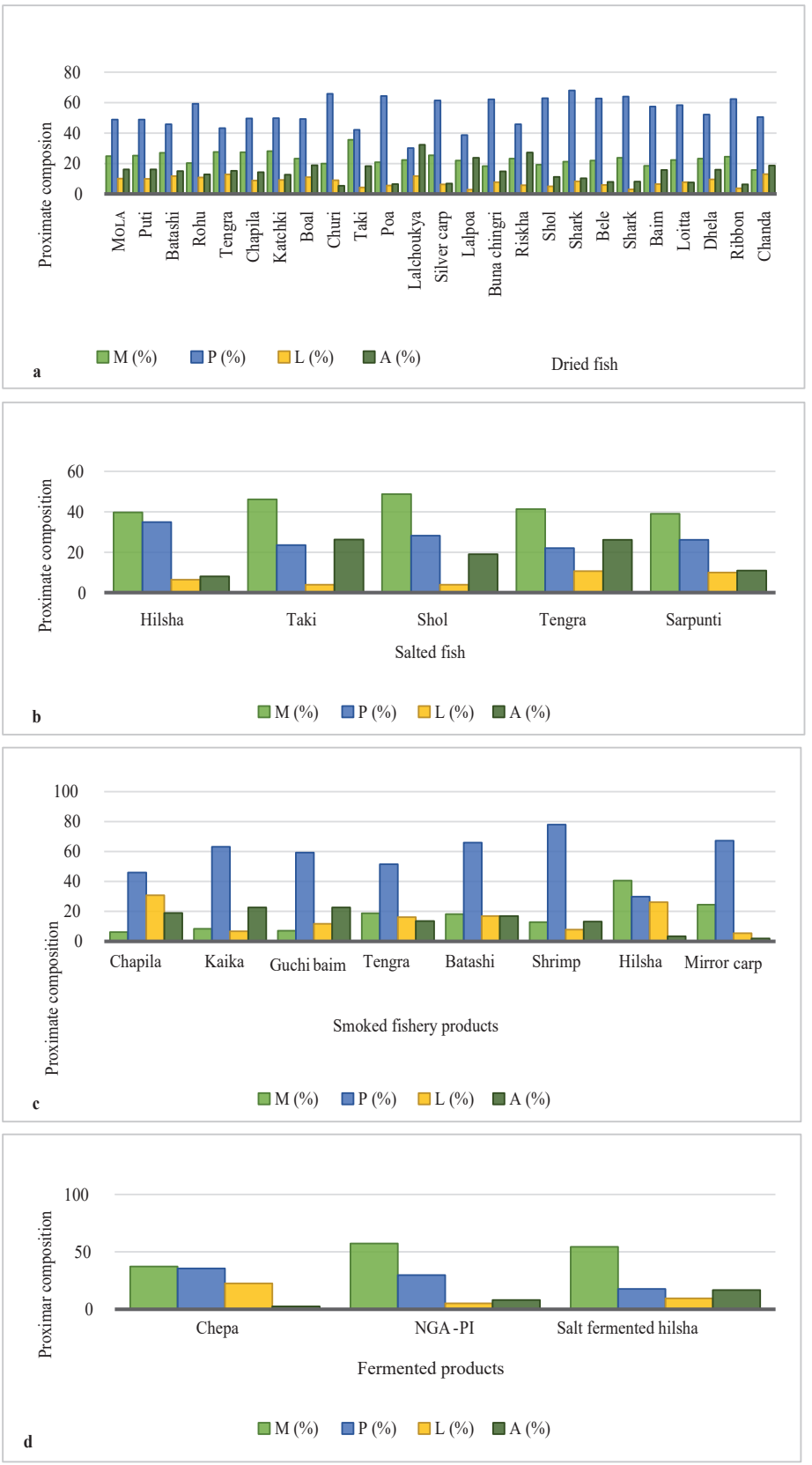


Figure 1. Proximate composition: a. dried fish b. salted fish c. smoked fish d. fermented fishery product

Tvbn and microbial composition: Chemical and Bacteriological quality is of public health importance as it relates to fish spoilage and becomes the cause of food poisoning outbreaks (Nilla *et al.* 2012). Among many indicators, Total volatile base nitrogen (TVBN) and total plate count (TPC) are the most common indicator. TVBN is a fish spoilage indicator measured from muscle extracts that researchers widely use. The limit of acceptability of TVBN in fish and fishery products is 20 to 30 mg N/100 g, and the acceptable limit of the bacterial colony is less than $5x10^5$cfu/g (Nowsad 2010).

Figure 3 shows the TVBN value for most of the processed fish products within 3mg to 20mg, indicating the good condition of the products. However, some marine species like shrimp, hilsha, Silver pomfret, Ricksha fish, Silver jewfish, Ribbon fish, and Red snapper showed a higher TVBN value exceeding 30mg/100g, which may be due to the higher essential amino acids percentage that contributes nitrogen.

Except for the marine species, TVBN of the dried, salted and smoked products is found to be low, which is an excellent indicator for preserving the products for an extended period. The total plate count of the bacterial colony is also shown in Figure 2 for different products, which reveals versatile information. For dried fish, some of the species were loaded with a higher bacterial count than 6-7 Log 10 CFU/g, while some others showed an acceptable limit. But for salted products, only hilsha was found to have a higher bacterial count of 2.34×10^6 cfu/g, which might be due to the lipid oxidation facilitating significant bacterial growth in it. And for fermented products, only chepa showed a higher bacterial count than the acceptable limit, which might be due to the fermentative bacteria required and enzymatic activity might facilitate the bacterial growth in the products. But all the smoked fisher showed a good range of TPC, which is very suitable for human consumption.

Percentage distribution of various pathogenic bacteria and fungi is listed in table 1 and table 2. The most commonly occurring bacteria are *Salmonella* and *Vibrio* following *E. coli* and coliform. Also, *Staphylococcus and Pseudomonas spp* are evident in dried and salted products.

The incidence of *E. coli* in dried products is 100% and 76-100% in salted products. The frequency of *Salmonella* in dried products ranged from 36-44% in the Sylhet region and 100% in the Dhaka region.In salted hilsha, 36-76% *Salmonella* was present. Smoked products from Noakhali and Khulna showed no presence of *Salmonella,* and nga-pi was found to facilitate *Salmonella* growth during the storage period (Table 2). *Vibrio's* presence ranged between 24-40% in dried Jatputi of Sylhet market but 100% in dried Chanda of Dhaka. Salted hilsha from the different market of Dhaka showed no *Vibrio,* but Majumdar and Rashid (2017) found 24-64% of *V. cholerae* in salted hilsha. *Vibrio* growth was not much significant in smoked and fermented products during storage. Nur *et al.* (2020) studied *Pseudomonas, Klebsiella* and *Staphylococcus* in various dried fish from Karwan Bazar, Dhaka. *Staphylococcus spp.* is also present in salted hilsha ranging as low as 10.7% (*S. epidermidis)* and 18.8% (*S. aureus),* and the amount counted within acceptable limit.

The presence of *Staphylococcus sp.* suggests a higher level of environmental contamination, and its presence indicates a possible risk of food poisoning. Salted Hilsa thus seemed free from the harmful effects of *Staphylococcus* but are usually spoiled by various microorganisms and by their metabolic activities that lead to the formation of gases and foul-smelling compounds and eventually deteriorate fish quality. Though the spoilage of salted fish is less severe, it is usually contaminated with harmful bacteria like *Bacillus* spp*., Staphylococcus* spp*., Micrococcus varians, Micrococcus luteus, Pseudomonas mallei,* and the fungi like *Aspergillus niger, Aspergillus flavus* and *Rhizopus* spp. (Sultana *et al.* 2008).

Fungal counts of fishery products are not been well studied till now. Only some dried species and salted hilsha were studied for fungal count (Hossain *et al.* 2012; Sultana *et al.* 2008). The total fungal count of dried Chepa and Chingri was found 3.60 and 3.78 log cfu/g, respectively and the total fungal count of salted Hilsha was found to be 2.3×10^2 and 5.5×10^4 cfu/g (Sultana *et al.* 2008). Fungal growth is facilitated when the moisture content rises up than 25% during storage and in salted products radiation reduces fungal and bacterial load significantly (Mansur *et al.* 2013, Sultana *et al.* 2008). To avoid such microbial growth in various fisheries products, the use of good

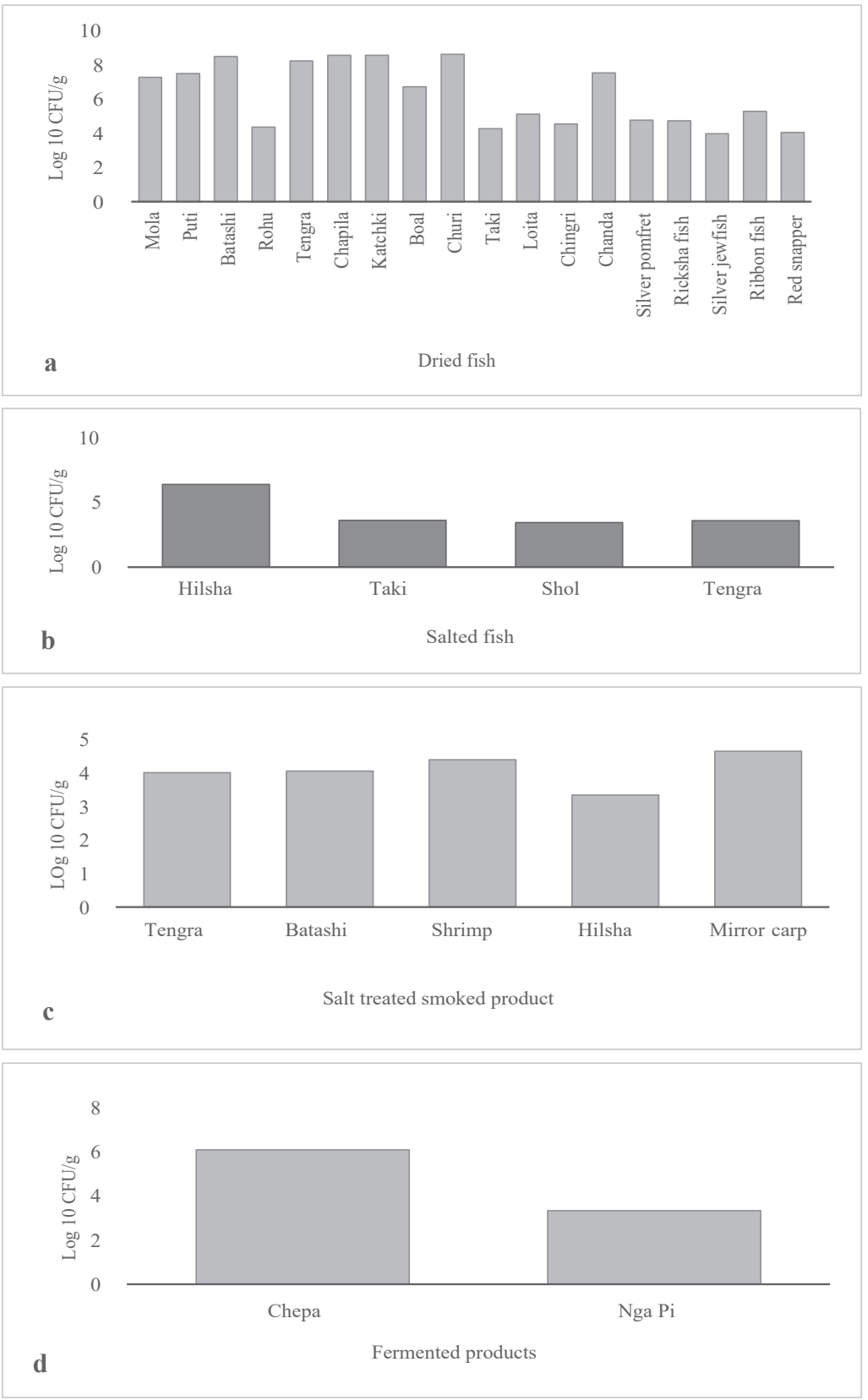
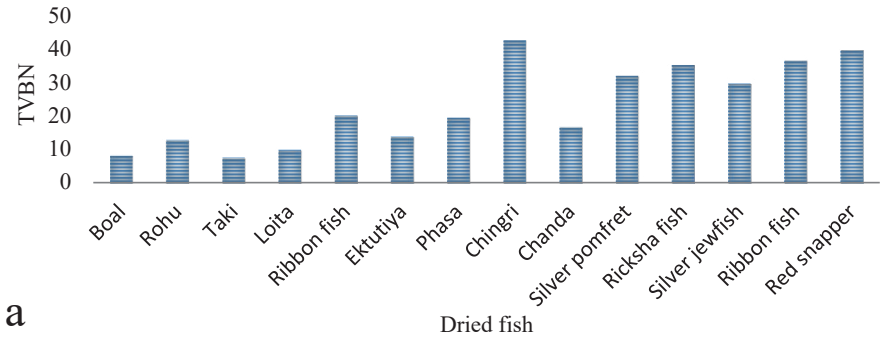


Figure 2. Total plate count: a. dried fish b. salted fish c. smoked fish d. fermented fishery product



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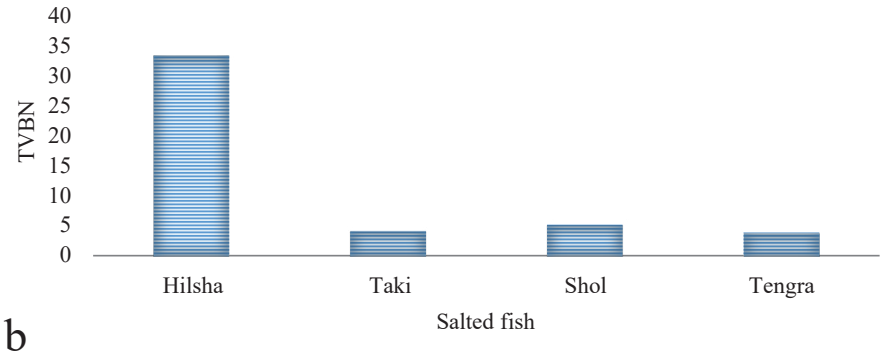

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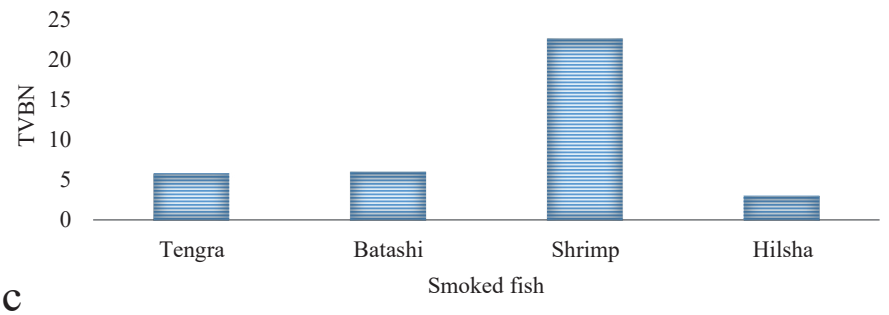

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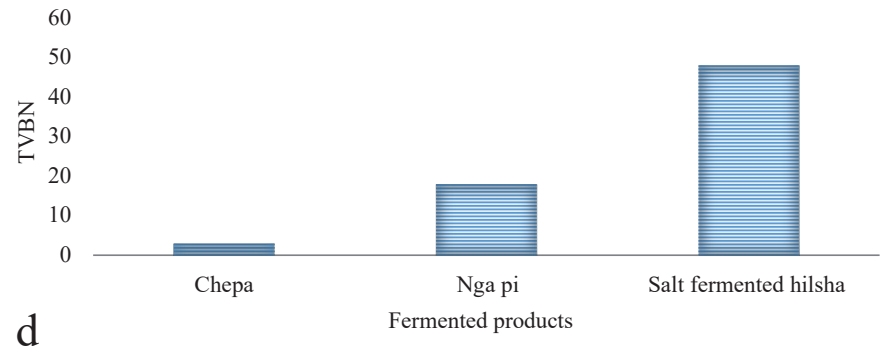

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Figure. 3. Total Volatile Basic Nitrogen (TVBN): a. dried fish b. salted fish c. smoked fish d. fermented fishery product

Table 1. Status of microorganisms in various dried products

Type	Micro organism	Scientific Name	Fish	Location	Sources
Drying	Bacteria	*E. coli*	Baim, Jatpunti, Punti, Buna chingri, Mola, Chanda, Loitta	Bondorbazar, Lamagaji, and Mahtabpur, Sylhet Tuker Bazar, Sylhet Dhaka	Akter *et al*. 2018 Hussain *et al.* 2016 Nur *et al*. 2020
		Salmonella	Baim, Jatpunti, Punti, Buna chingri, Chanda	Bondorbazar, Lamagaji, and Mahtabpur, Sylhet Tuker Bazar, Sylhet Dhaka	Akter *et al.* 2018 Hussain *et al.* 2016 Nur *et al.* 2020
		Vibrio	Jatpunti Chanda	Mahtabpur, Tuker Bazar, and Local Market Sylhet, Dhaka	Hussain *et al.* 2016 Nur *et al.* 2020
		Pseudomonas	Puti, Mola, Chanda	Dhaka	
		Staphylococcus	Chanda, Buna chingri	Dhaka	
		Klebsiella sp.	Puti, Buna chingri	Dhaka	
	Fungi	*Aspergillus sp.*	Baim	Bondorbazar, Sylhet	Akter *et al*. 2018
		Fuserium sp.			
		Rhizopus sp.			

Table 2. Status of microorganisms in various salted, smoked and fermented fish products

Type	Micro-organism	Scientific Name	Fish	Location	Sources
Salting	Bacteria	*Escherichia coli*, *Salmonella*, *Vibrio cholerae*	Hilsha	Chandpur, Chittagong, Narsingdi	Majumdar and Rashid 2017
		Salmonella-Shigella Vibrio, Staphylococcus aureus, S. epidermidis, Bacillus cereus, B. subtilis, B. megaterium, Micrococcus luteu	Hilsha	Dhaka	Rohomania *et al*. 2014 Sultana *et al*. 2008
		Coliform	Hilsha	Dhaka	Sultana *et al.* 2008 Rohomania *et al*. 2014
	Fungi	*Aspergillus niger A. flavus Rhizopus Spp.* Yeast	Hilsha	Dhaka City	Sultana *et al*. 2008
Smoking	Bacteria	*Vibrio spp Salmonella* Fecal Coliform	Hilsha Shrimp	Noakhali Satkhira, Khulna	Dutta *et al*. 2018, Hassan *et al*. 2013
	Fungi	Mold	Hilsha		
Fermentation	Bacteria	*Salmonella spp. Vibrio spp.* Coliform Fecal Coliform	Shrimp (*Acetes* and *Mysid* spp.)	Cox's Bazar	Chakma *et al.* 2015
	Fungi	Yeast and molds spp.			

quality raw material, good quality salt, hygienic handling practices, potable water, and good quality packaging material is recommended (Majumder and Rashid 2017).

Problems associated with traditional processing methods: In developing countries like Bangladesh, where all the required sophisticated preservation and storage equipment is unavailable, these traditional processing methods are feasible for preserving fish for a longer period and keeping them edible. Such as, salting of hilsha provides a possible application of salt as an efficient method of hilsa fish preservation as the use of salt enriches the flavor with good texture in the product (Tabassum *et al.* 2018). But the quality of the product largely depends on the freshness of the raw fish, removal of water during drying, salting, period of maturation, and brine concentration (Rohomania *et al.* 2014). These factors are not always significantly considered by the processors of Bangladesh.

Raw materials processing: Poor quality fish are used, dried directly on sand or soil or in unhygienic conditions, fish are not always washed before being cut and unclean water is used for washing (Rohomania *et al.* 2014). Cheap and unknown quality crude salt is used during salting (Rohomania *et al*. 2014) which helps to grow some halophilic microorganisms like *Pseudomonas spp., Stephlyococcus aureus* etc. (Hosen *et al*. 2018). In case of smoking, limitations are uses of unhygienic smoking kilns, scarcity of proper dry wood, using unclean and semi-green woods or leaves to produce smoke and repeated use of unclean pot in each operation(Nowsad 2007).In case of nga pi, mixed raw materials (spawn, fry, fingerlings, juvenile, arthropods, unwanted mollusks, penaid) and other shrimps are used where the raw materials are not finely crushed or pasted. Animals like dogs, cats have easy access to go on the mat used for drying of nga pi raw materials.

Processing conditions and hygiene: The final dried product becomes blackish due to inadequate process, use of low-quality solar salt with lots of impurities and contaminants, improper handlings during processing (Rana *et al.* 2019), unhygienic conditions (Rohomania *et al*. 2014). During smoking, green wood with improper drying cannot develop bright red color which reduced the price of the final products. In case of shidhal, uncontrolled fermentation occurs, pressing the fish within motka in bare leg is very unfair and unacceptable (Nowsad 2007). Adequate ripening time are not maintained for nga pi, during salt fermentation of hilsha, underground holds are not well protected from insects, and rain water can enter into the hold (Nowsad 2007).

Packaging and storage: The processed fishery products are stored and transported in polythene sacs or bamboo baskets. As storage and transportation happen at ambient temperature, the product quality quickly deteriorates. Poor packaging and improper storage of final products, unhygienic packaging result in poor microbiological condition. Harmful insecticides Dichloro-diphenyl-trichloroethane (DDT), Basudin are used for storage (Majumdar and Rashid 2017, Hosen *et al*. 2018).

Market conditions: Due to the presence of more intermediaries in supply chain, unhygienic condition (Rohomania *et al.* 2014), poor packaging and storage facilities, products available in the wholesale and retail markets are mostly contaminated with sand, dirt, filth, dust and presence of insects around the products are very common (Hosen *et al*. 2018). No well-known and well-categorized market for smoked fishery products, the local producer get the minimum profit compare to the whole seller and retailer.

Knowledge and awareness: The people involved with the fish processing business are not much aware about the quality management systems (Hosen *et al.* 2018). The lack of proper knowledge and carelessness of the fish processor and retailers about sanitation, hygiene and microbiological quality make processed fishery products unsafe to eat (Rohomania *et al*. 2014, Shikha *et al*. 2020).

Researches: In Bangladesh, very few work has been performed on smoked large fish species such as Thai pangus, Ilish, Tilapia, Silver Carp, common carp, Grass carp (Bhattacharjee *et al*. 2012). Furthermore, work based on specific microbiological profile on chepa sutki

and salt fermented hilsha are needed. Specific remedial measures should be taken to eliminate such issues and their consequences as soon as possible.

Recommendations: Limitations of the usage of Dichloro-diphenyl-trichloroethane (DDT) and other insecticides and pesticides should be strictly maintained as its hazardous to human health. Netting and neem (*Azadirachta indica*) leaves can be used to minimize this problem. Moreover, to protect from insect infestation, a mixture of red pepper and turmeric can be used in dried fish (Nowsad 2010). The solar tunnel drying method can be applied as it is easily accomplished with locally available materials and does not require any power from an electrical grid (Nowsad 2010). Although, a close relationship possesses between the moisture content and the bacterial load in fish products, and it is reported that when the water content of fish falls below 25% of wet weight, bacterial action stops and when the water content further reduces to 15%, mold ceases to grow (Mansur *et al.* 2013), and this can be applied in dried products. In the case of salted products, sufficiently dried good quality solar salt should be used, and in wet salting, the pieces of fish should be kept submerged in the salt solution. Among the different types and concentrations of salt, NaCl at 25% of the fish body weight was appropriate for preparing quality salted hilsa (Mukit *et al.* 2016). Although the increased bacterial load is found in storage for different salted hilsha, the bacterial contamination and fungal attack can be decreased by radiation treatment at various doses (Sultana *et al.* 2008). In the case of smoked products, an improved kiln should be made to reduce the wastage of fire and the cost of production. Proper dried and clean wood must be used for producing smoke. In the case of chepa, soaking time and fermentation period should be adequately maintained to prevent uncontrolled fermentation. Instead of bare legs, gloves with hands or heavy poles tied up with cloth may be used. For nga-pi, sorting of raw material is very much necessary. For fermented hilsha, the underground hold should be well protected by using a polythene cover properly. For all types of fermented products, drying should be done in an elevated rack, and storage should be done with air-tight boxes or high-density polythene. If the storage period, shelf life and quality of fermented products can be improved, there will be a great opportunity to export these products. Besides all these, good quality fresh fish, sufficient chilling method, proper hygienic maintenance, clean utensils, durable, airtight and sustainable packaging like polypropylene coated polythene, polyester polyethylene copolymer should be used. The fishermen, processors and allied personnel should be trained on public health. Therefore, control measures such as ensuring the scientific method of fish salting, training the fisher folks, and increasing the awareness of mass people about food safety should be taken (Majumdar ánd Rashid 2017). Government should take necessary initiatives such as ensuring market facilities, a quick transportation system, providing loans to the dried fish processors and sellers, and policies related to reducing the number of intermediaries for the further development of this sector.

Conclusion

Dried, salted, smoked and fermented fishery products play an essential function in the economy of Bangladesh, contributing to multiple and diversified food production of the economic system and providing a livelihood for many fishermen, processors and traders. To avoid post-harvest spoilage of fish due to lack of preservation and transport facility, these four-type traditional preservation techniques can be an effective approach. The quality of these products is not good in our country due to unhygienic conditions during processing, use of low-quality raw materials, use of spoiled fish, indiscriminate use of unsafe insecticides, improper packaging and improper storage. These products have higher commercial potential if these existing drawbacks can be removed. The government should take the necessary steps to overcome these problems and establish proper laws and rules for using insecticides.

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