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Biochemical, Microbial and Sensory Changes of Bombay duck (*Harpodon nehereus*) Fish Fingers during Chilled Storage

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Abstract

Bombay duck (*Harpodon nehereus*) is one of the important fishery species along Gujarat and Maharashtra coasts. Due to a very high moisture content (90%), it is unsuitable to use either in fresh or in frozen form and almost entire catch is consumed in sundried form. This study is aimed to explore the possibilities of better utilization of this species by development of battered and breaded fish fingers. Fish fingers were prepared from Bombay duck fillet and their qualities were evaluated under chilled storage up to 21 days. Fish fingers had 52.43% moisture, 12.25% protein, 10.17% fat, 2.03% ash and 23.12% carbohydrate. Results showed increasing trend in pH, TVB-N, FFA, PV and TBA values ($p<0.05$) during storage. Microbiological analysis revealed that total plate count of fish fingers was within the acceptable limit (1.29×10^4 cfu g^{-1} on 21st day) throughout the storage period. Sensory evaluation showed decrease in overall acceptability of fish finger during chilled storage. Results indicate that fish fingers from Bombay duck can be stored for 15 days in 4°C without change in sensory quality.

Keywords: Bombay duck, fish finger, chilled storage, quality

Introduction

During recent decades there is an increasing interest in ready to eat or convenient food. Ready –to- eat products from fish have been gaining popularity because the consumers demand for healthy products, which are easy to prepare (Cakli et al., 2005). Cakes, crackers, burgers, fish balls, fish fingers and marinated products made from fish or other seafoods are the most preferred ready-to-eat foods around the world (Wang et al., 2010). Fish fingers are produced either from fish fillets (Schubring, 2000) or from fish mince (Cakli et al., 2005). However, processing methods are shown to have a crucial impact on the final quality and the nutritional value of the product. Fish fingers contained about 50% fish, while the remaining part of the product consisted of a crumb made of wheat flour, vegetable oil, starch, sugar additives and spices. Beside the nutritional value, the shelf life and other quality factors as sensory attributes and texture are most important. The most popular species for the production of fish fingers are cod (*Gadus morhua*) and Alaska Pollock (*Theragra chalcogramma*) (Schubring, 2000). The possibility to use other species namely sardine (*Sardina pilchardus*), whiting (*Merlangius merlangus*) and pike perch (*Sander lucioperca*) were also evaluated (Cakli et al., 2005). Bombay duck (*Harpodon nehereus*) is an abundant marine species in North West coast of India. High moisture content (90%) along with high enzymatic and bacteriological activities in Bombay duck (*Harpodon nehereus*) meat is responsible for the short shelf life and disintegration of meat during cooking (Chakrabarti, 2010). Traditionally the demand of fresh fish is limited and major portion of landings are converted to rope dried product. Improvement in cooking quality and storage characteristics will increase the consumption of fresh Bombay duck. Battered and breaded products are a convenience food valued greatly by the consumers all over the world. The process of coating with batter and bread crumbs increases the bulk of the product, thereby reducing the content of costly fish thus reducing the product cost. Coating enhances the appearance, color, texture and taste of food products and also

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the nutritional value of the product (Rathod et al., 2012). Based on the above information, in the present study, value added battered and breaded product "fish finger" was prepared from Bombay duck and its quality characteristics were evaluated under chilled storage.

Materials and Methods

Bombay duck (150-250 g size) were procured from local fish market at Vashi and brought to the laboratory in iced condition. Fish were beheaded, gutted, washed and filleted. These fillets were used for preparation of fish fingers. Batter and breading materials were purchased from a local super market. The sample preparation and batter composition was followed by the method of Joseph (2009). The standardized batter mix contained 77.0% refined wheat flour, 10% corn flour, 10% bengal gram flour, 1.50% salt, 0.50% sodium tri polyphosphate (STPP), 0.50% turmeric powder and 0.5% guar gum. The batter was put into a kitchen blender with a cold water/batter flour ratio of 2:1 (w/w) for 2 min. Before battering, fish fingers were put in 5% salt solution containing 0.1% citric acid for 3 min. After draining, it was kept in a freezer (-20°C) for 1 h followed by pre-dusting and battering. After the batter application, it was covered with conventional breading crumbs and then flash fried in refined sunflower oil at 180°C for 30 sec. The weight of individual piece of fish fingers produced from Bombay duck fillet was 15 ± 1.9 g. Around 15-20 pieces of fish fingers were packed in low density polyethylene pouches and stored under chilled condition at 4°C for further analysis. Temperature of the chiller was digitally set at 4°C and monitored during storage.

Proximate composition of fish fingers was analyzed according to method of AOAC (2005). pH of homogenized samples was measured using a calibrated glass electrode pH meter (Cyberscan 510; Eutech Instruments, Singapore) by the method of AOAC (2005). Total volatile base nitrogen (TVB-N) was determined by micro-diffusion method (Conway & Byrne, 1950). Peroxide value was evaluated according to AOAC (2005) method. Thiobarbituric acid (TBA) value was determined as described by Tarladgis et al. (1960). Total plate count was determined according to FDA (1995). Sensory evaluations of fish fingers were done by six trained panelists according to a method described by Meilgaard et al. (1999). Panel members were asked to evaluate the products for acceptability based on their appearance, texture, taste, color, and overall acceptability using nine-point hedonic scale (1 = dislike extremely to 9 = like extremely). A high score (9-7) was given to product with no off-odors and a score below 5 was given to unacceptable quality.

Data obtained was analyzed by running one way analysis of variance (ANOVA) using Statistical Package for Social Science (SPSS) software version 16.0. (SPSS Inc, Chicago, Llinois, USA). All mean separations were carried out by Duncan multiple range test using the significance level of 95% ($p<0.05$).

Results and Discussion

Proximate composition of fresh Bombay duck showed 89.80% moisture, 12.70% protein, 0.48% fat and 0.69% ash. Chakrabarti (2010) also found higher moisture content (90%) in Bombay duck. Fish fingers produced from Bombay duck had 52.43% moisture, 12.25% protein, 10.17% fat, 2.03% ash and 23.12% carbohydrate. Praneetha et al. (2015) observed similar results for fish finger from rohu fish mince. Ninan et al. (2008) and Rathod et al. (2012) also observed similar results for fish cutlet and reported that the changes in moisture content of product may be due to deep frying as well as battering and breading of the product. Sehgal et al. (2008) reported that increase in fat content may be attributed to cooking of the product in oil. The higher amount of carbohydrate in the products might be derived from coating materials which contain carbohydrate rich ingredients such as bread crumbs, Bengal gram flour, corn flour etc. Since, the Bombay duck has higher moisture content, it might

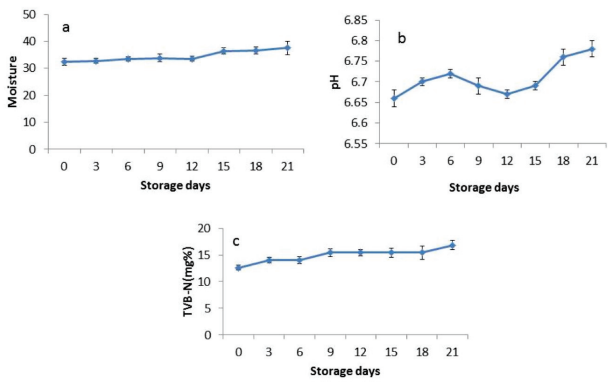

Fig. 1. Changes in a) Moisture b) pH c) TVB-N values of fish finger during chilled storage

have picked up the higher pre-dusting and batter coating. Moisture content of fish fingers increased during storage (Fig.1a). The present results are in agreement with previous reports for fish fingers stored under refrigerated condition (Emir, 2013). pH has been used as an index of quality of fish and fishery products. In the present study, fish fingers showed increasing trend in pH from 6.60 to 6.78 (Fig. 1b) which may be due to the release of basic components associated with the degradation of protein, lipid and carbohydrate substances. Emir (2013) and Ninan et al. (2008) also observed the increasing trend of pH in fish finger, minced based products during refrigerated and frozen storage.

Total volatile base nitrogen (TVB-N) is produced by decomposition of proteins into simpler substances (ammonia, trimethylamine, creatine, purine bases and free amino acids). In the present study, TVB-N values increased from 12.6 to 16.8 mg% during storage (Fig. 1c). The present results are in agreement with similar findings reported for fish fingers (Izci, 2010). The increasing TVB-N value is related with bacterial spoilage and activity of endogenous enzymes (Chomnawang et al., 2007). TVB-N level of 30–35 mg N 100 g^{-1} is generally regarded as the limit of acceptability for fish and fishery products. Accordingly, none of the samples crossed the rejection limit during chilled storage.

FFA is responsible for the textural changes, enhanced oxidation of lipids, and development of off flavors in the muscle food (Sequeira-Munoz et al. 2006). As the storage progressed, FFA showed an increasing trend from 0.14 to 0.43 % in fish fingers (Fig. 2a). A lower FFA value indicates that fish fingers have not undergone oxidation rapidly during storage. Peroxide value (PV) gives a measure of oxidative rancidity. Peroxide value usually gives a measure of the first stage oxidative rancidity which is not related with the sensory assessment of rancidity. Peroxide value below 5 meq O_2 kg^{-1} indicates that the fat is fresh or the hydroperoxides have degraded into ketones and between 5 and 10 meq O_2 kg^{-1} indicates the commencement of rancidity (Gracey et al., 1999). A peroxide value of more than 20 meq O_2 kg^{-1} oil for fish usually gives bad smell and rancid taste (Romeu-Nadal et al., 2006). In the present study, peroxide value showed increased trend during chilled storage (Fig. 2b) and were within acceptable limit (1.93- 4.75 meq O_2 kg^{-1}). Thiobarbituric acid value is a widely used method to detect oxidative deterioration of fat containing foods and also it indicates the degree of secondary lipid oxidation in food products. In the present study, the TBA value showed increased trend from 0.13 to 0.32 mg malonaldehyde kg^{-1} (Fig. 2c). TBA values of 1-2 mg of malonaldehyde kg^{-1} are usually regarded as the limit beyond which fish normally develops an undesirable odour (Connell, 1995). Accordingly, fish fingers had an acceptable level of TBA value during storage. Tokur et al. (2006) observed less TBA value of fish fingers made from washed fish mince and found that battering and breading of the products can act as oxygen barrier, which prevents oxidation.

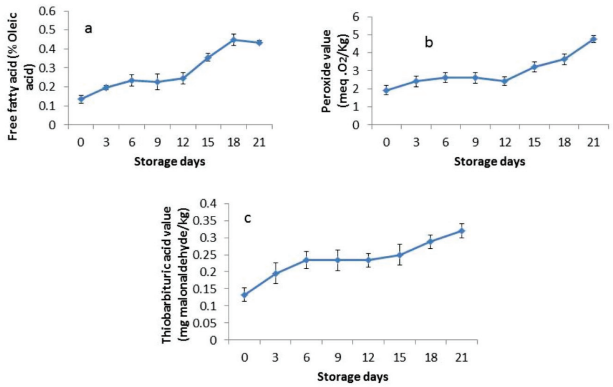

Fig. 2. Changes in a) FFA b) PV c) TBA values of fish finger during chilled storage

The acceptability of fish and fishery products depends on their sensory attributes. Gradual decrease in overall acceptability of fish fingers was observed during chilled storage (Fig. 3a). Emir (2013) observed a decreasing trend in sensorial scores of fish finger during refrigerated storage. Results indicated that fish fingers were highly preferred up to 15 days with the score of 6.9. It may be due to its desirable flavor, crispiness and texture. Texture of fish products is one of the primary quality attributes for consumer acceptability. It was observed that crispiness of the product decreased after the 15 days which reduced the sensory score of fish fingers. Fish and fishery products are unacceptable for human consumption when the sensory score goes below 5 (Meilgaard et al., 1999). Accordingly, in the present study, fish fingers had an overall acceptability score of 5.0 at the end of 21st day. However, the products became soft and lost characteristics of battered and breaded product.

The total aerobic plate count (TPC) is an important criterion for quality evaluation of fish and fishery

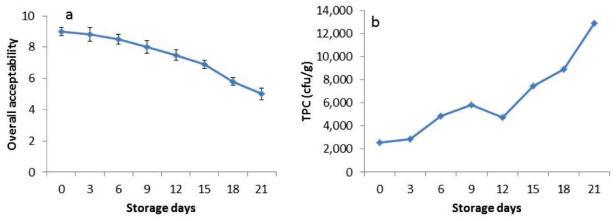

Fig. 3. Changes in a) Overall acceptability b) TPC values of fish finger during chilled storage

products. In the present study, the initial TPC of the fish fingers is very low i.e., 2.56 x 10^3 and it increased to 1.29 x 10^4 cfu g^{-1} by 21st day (Fig. 3b). It was observed that the rate of TPC growth is slower than during chilled storage. The recommended TPC for cooked products as per the guidelines is less than 1 x 10^5 cfu g^{-1} (DHAD, 2012). Accordingly, in the present study TPC for fish fingers have not crossed the rejection limit during chilled storage.

It can be concluded that fish fingers prepared from Bombay duck had an acceptable level of TVB-N, FFA, PV, TBA and total plate count during chilled storage. Sensory evaluation revealed that fish fingers were highly preferred up to 15 days and the crispiness of the product decreased after the 15 days which reduced the score of acceptability of fish fingers. Results indicated that fish fingers can be stored for 15 days at 4°C without affecting sensory quality. Since the fish has a limited scope for consumption in the fresh form, it is almost fully utilized as dry fish. However development of battered and breaded products is another option for the utilization of this species.

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