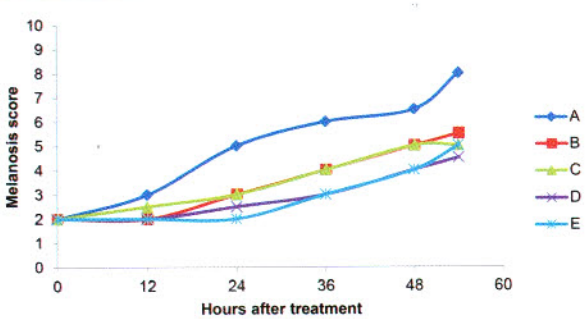

Fig. 2. Melanosis score of *L. vannamei* during iced storage

Melanosis scoring (0-10) (Nirmal and Benjakul, 2009): 0: Absent, 2: Slight (up to 20% of shrimp surface affected), 4: Moderate (20-40% of shrimp surface affected), 6: Notable (40-60% of shrimp surface affected), 8: Severe (60-80% of shrimp surface affected) and 10: Extremely heavy (80-100% of shrimp surface affected)

study indicated that pomegranate peel extract and chemicals like Sodium citrate and EDTA can be used as alternatives to control melanosis development in cultured shrimps. However, the use of proper concentration of the blends of chemicals and use of colourless pomegranate extract has to be further investigated.

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Protein isolate from Bombay duck mince: Ideal for value addition

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Bombay duck (*Harpodon nehereus*) is one of the most important pelagic fishery especially along the west coast of India. Due to its high moisture content (90%), it is unsuitable to use as mince for the development value added products. Generally, bulk of Bombay duck catch is consumed in fresh and sundried form. This study is aimed to explore the possibilities of better utilization of this fishery resource for the development of value added products. Fish protein isolate (FPI) is prepared from fish mince or shell waste by using pH-shift technology and it mostly contains myofibrillar proteins extracted from the fish muscle (Hultin *et al.*, 2005). FPI can be used as an ingredient for production of value added and ready-to-eat products based on minced fish or surimi (Shaviklo *et al.*, 2010).

Fresh Bombay duck were procured from Vashi fish market and brought to laboratory under iced condition. The average length and weight of fishes were 24.5 ± 0.5cm, 200 ± 1.5 g, respectively. Fish mince was used as raw material for preparation of protein isolate. Fish protein isolate was prepared by alkali solubilization method. The solubilization can be accomplished by adding 5-10 volumes of water followed by adjusting the pH approximately to 11 (Hultin *et al.*, 2005). The mixture was then centrifuged. This allows the light oil fraction to rise to the top of the suspension. At the same time the lipids of the membrane are removed due to density differences compared to the main protein solution. Other insoluble impurities are also sedimented at this stage. Then, the muscle proteins were precipitated by adjusting the pH to a value near the isoelectric point (pH - 5.5) and collected by a process such as centrifugation. Fish protein isolate (FPI) obtained from this process can be stored in frozen condition

or might be dried for further utilization.

In the present study, the recovered wet protein isolate was used for the preparation of restructured fish products by incorporating salt and sodium alginate followed by steam cooking (Fig. 1). Based on the preliminary sensory analysis, combination of 1% salt, 1% sodium alginate and 0.5% calcium was selected for the study. Products were kept under chilled condition (2°C). Biochemical and microbiological quality of the products were evaluated up to 16 days.

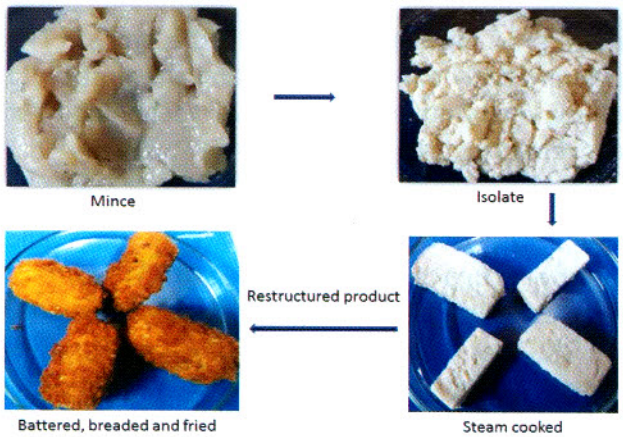

Fig. 1. Restructured product from Bombay duck isolate

Proximate composition of the mince, isolate and products are given in Table 1. pH of the Bombay duck mince, isolate and restructured product were 6.6, 5.7 and 6.2, respectively. Colour analysis revealed that higher *L** value for isolate (78.80) than the product (78.25) and mince (54.05).

Biochemical analysis showed increasing trend for pH, TVB-N, PV and TBA during storage. Initial TVB-N and peroxide value of the product were 4.2 mg% and 3.9 meq.O_2/kg, respectively and it increased to 5.3 mg% and 22.03meq.O_2/kg at the end of storage. A peroxide value of more than 20 meqO_2/kg for fish usually gives rancid taste (Romeu-Nadal *et al.*, 2006). Accordingly, in the present study, peroxide values of the products were within permissible limit up to 13th day (15.45 meq O_2/kg). Initial TBA value of the product was 0.37 mg MDA/kg and it increased to 1.02 mg MDA/kg. TBA values of 1-2 mg MDA/kg are usually regarded as the limit, beyond which fish will normally develop an undesirable odour (Adenike, 2014). Total viable counts increased gradually during storage. A 5 $\log_{10}$ is considered as acceptable limit for restructured product (Gilbert *et al.*, 2000). In the present study, total bacterial count reached 5 $\log_{10}$ on the 16th day. Sensory evaluation revealed that products were acceptable throughout the storage. It can be concluded that restructured product prepared from Bombay duck isolate had an acceptable level of TVB-N, TBA and total plate count during chilled storage. Since the fish has only limited scope for consumption in the fresh form, development of value added products is a better option for the utilization of the species.

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Table 1. Proximate composition

Sample Moisture	Protein	Fat	Ash	Unused steel
Mince	89.65 ± 0.25	12.25 ± 0.10	0.40 ± 0.02	0.55 ± 0.05
Isolate	80.14 ± 0.10	16.50 ± 0.05	0.35 ± 0.04	2.5 ± 0.02
Product	76.04 ± 0.15	17.8 ± 0.15	0.45 ± 0.05	4.5 ± 0.01

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Air frying - A healthy alternative for conventional frying

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Breaded and battered products are well established in both domestic as well as commercial practice. They often have high consumer value as convenient foods. The deep fat fried and pan fried products are palatable as well as highly desirable for consumers as snack foods. At the same time, excessive consumption of fried foods may cause health risks like cardiovascular diseases, hypertension, diabetes, obesity and even cancer. The estimates show that, about 20 million tons of frying fats and oils are used for frying purpose in restaurants, commercial and household practices annually. The high level of degradation products in reused oil causes major health concerns, rather than eating fat and oil fried products directly. Economic concerns like high oil requirements, oil price etc. is the main driving force behind the reuse and abuse of oil in the food processing sector. The introduction of new technology like air frying with less/no use of oil for production of fried foods pave a new dimension to the value addition of food sector. The current trend of the society to have fat-free convenient health foods also support the less oil/oil-free technology. At the same time, there exists a need to understand the technology in a scientific manner for the benefit of consumers, on health, economic and environmental aspects.

Air frying is an emerging convenient technology specially intended for domestic consumers. During the process, the product is in constant motion and contact with super-heated air flow in a frying chamber, thus the product get dehydrated and the typical crust of fried products gradually get developed. The constant motion of the product and air circulation enables the uniform cooking of ingredients from all the angles. The present study aims to understand the possibility of air frying as an alternative technology for conventional frying method.

The experiment was conducted to optimize the process parameters such as frying time, and temperature with a two factorial central composite design in Response Surface Methodology (RSM). The overall acceptability of air fried fish fingers prepared from Pangasius fish fillets were statistically optimized with 13 different combinations. The sensory characteristics of the products with different combinations were evaluated for its quality attributes like colour, taste, appearance, flavour and overall acceptability; on a 9-point hedonic scale keeping 9 for excellent and 1 for very poor as per the method of Murray *et al.* (2001).

The desirable optimum combination of temperature and time for air frying was found to be 190 °C for 16 min. (Fig.1). The product was then further compared with deep fat fried fish fingers with already established optimum conditions (180 °C for 3 min. - Tokur *et al.*, 2006, Zhang *et al.*, 2012, Sebedio *et al.*, 1993) and found that both products got similar acceptability as assessed by the sensory panellists.

The proximate composition analysis indicated significant difference in moisture and fat content of air fried and deep fat fried fish fingers. The higher moisture content (43.67%) in air fried fish fingers compared to deep fat frying (26.33%) may be due to longer frying time in air frying compared to deep fat frying. Lower moisture content in deep fat fried product in turn resulted in a higher fat