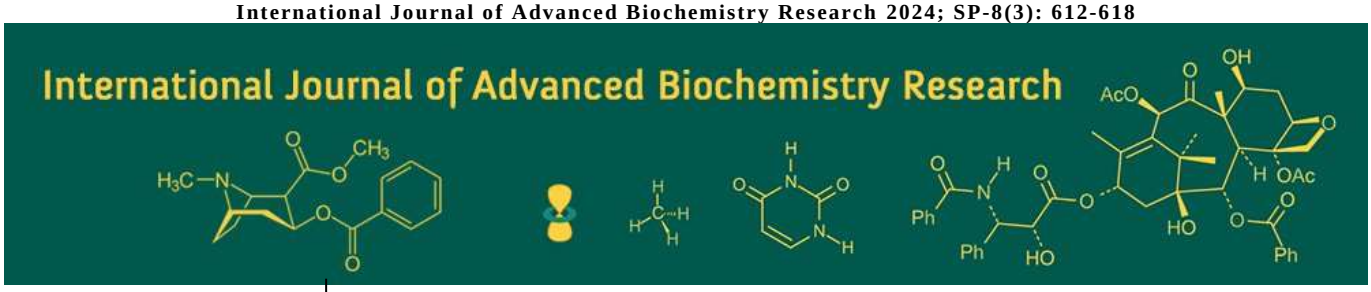


**ISSN Print:** 2617-4693
**ISSN Online:** 2617-4707
IJABR 2024; SP-8(3): 612-618
www.biochemjournal.com
Received: 25-12-2023
Accepted: 29-01-2024

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# Preparation of ready-to-cook fish balls from Bombay duck fish meat stored in frozen storage

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**DOI:** https://doi.org/10.33545/26174693.2024.v8.i3Sh.829

**Abstract**
The study was undertaken on preparation of ready to cook fish balls from Bombay duck (*Harpadon nehereus*) fish meat. The study aimed at various treatments to Bombay duck fish balls, treatments include control(only meat), fish meat added with cornstarch, fish meat added with cornstarch + ingredients, fish meat added with egg white powder, fish meat added with pectin and all treatments were stored in frozen storage(-18 °C) for 60 days. During frozen storage, samples were evaluated for TVB-N, TMA-N, TBARS, AAN. At the end of storage, it was concluded that among all the treatments the Bombay duck fish meat added with cornstarch + ingredients in frozen storage(-18 °C) were accepted as the best. In frozen storage the Bombay duck fish balls was acceptable upto 60 days of storage.

**Keywords:** Bombay duck, fish meat fish balls, frozen storage

## Introduction
Bombay duck (*Harpadon nehereus*), is a common food fish and condiment in northern estuaries. The Bombay duck is tiny, dark-speckled, dull, transparent gray bird that reaches a maximum length of 41cm. its massive pectoral and pelvic fins, forked tail and mouth are all prominent features. (Thiley, 2018) [29]. Bombay duck is a fantastic fish for eating. Known by its common name, "*Bombil*," in Maharashtra is the Bombay duck (*H. neherus*). The majority of the total landing is dried for both domestic and foreign markets, with only a tiny portion being consumed in fresh form. Bombay duck's chemical composition and the alterations in the dried duck's nutritional value after preservation have been examined. (Nazir and Magar, 1965) [16].

The consumption of fresh Bombay duck will rise with improvements in cooking quality and storage features. Globally, there is a growing trend towards the manufacture of fake analogue products made from white flesh. A sufficient ability of fish flesh to gel is one of the requirements for manufacturing goods (Rupsankar, 2010) [26].

Fish balls are a common dish in Malaysia, however consumers are becoming more concerned about the nutritional content of these fish balls. Additionally, customers like real meat over processed meat in items. Numerous studies on the nutritive value and quality of fish balls have been carried out. Yamprayoon *et al*., (1991) [32] examined how ingredients impacted the quality of fish balls. Huda *et al*., (2000) previously published a research on the chemical makeup and quality of commercial Malaysian fish balls. In Southeast Asia, fish balls are a highly well-liked seafood product. The product's preliminary market testing revealed that consumers seemed to like it and that this was positive (Nowsad *et al*., 2000a) [19].

The global health organisation recommends 11 kg of fish per year, however the average person only consumes 9 kg of fish annually (Pagarkar *et al*., 2011) [21]. Seafood is an essential component of a balanced diet and is also an inexpensive source of animal protein. There are several opportunities to promote consumption through the creation of items with value. There is a high demand for seafood-based products, particularly value-added items and ready-to-eat convenience forms. The category of battered and breaded products stands out among them.

Due to its capacity to alter the texture, enhance stability while stored in a refrigerator or freezer, and be added for practical purposes, starch also known as fish mince or surimi is one of the main components added to surimi-based goods. (Yang and Park, 1998) [34].

It was stated that by strengthening the finished product's gel, the starch addition would enhance the texture of surimi goods. The enlarged starch granules contained in the protein gel matrix exert pressure upon heating, which is primarily responsible for the enhanced gel strength (Kim *et al*., 1986; Zhang *et al*., 2013) [13, 35].

It has also been demonstrated that the Alaska Pollock surimi combined with potato and tapioca starch has a superior tongue feel than maize starch (Niwa *et al*., 1990) [18]. It has been discovered that tapioca starch enhances the textural qualities and water-holding ability of goods like low-fat pork sausage (Lyons *et al*., 1999) [14]. Tapioca flour has been reported to be used as a filler in comminuted beef products by Annor-Frempong *et al*., (1996) [2].

The objective of present study was to prepare ready to cook fish balls using Bombay duck fish meat. To improve the palatability of the fish balls with regard to addition of condiments and additives. To study the storage characteristics of pre-cooked fish balls during chilled storage (0 to 2 °C) and frozen storage (-18 °C) condition.

## Material and Method

The research experiment on preparation of ready to cook fish balls from Bombay duck (*Harpadon nehereus)* fish meat was conducted during the year 2022-23 at the Department of Post-Harvest Technology and Management, Killa-Roha, Dist- Raigad, Maharashtra, India. This chapter describes the supplies and tools utilized, the process used to measure the proximate, biochemical parameters of Preparation of ready to cook fish balls from Bombay duck (*Harpadon nehereus)* fish meat for 2 months. The chemical analysis was carried out in the PHM of MPF laboratory. The experiment was laid out in a Completely Randomized Design (CRD) with three replications. There were five treatments viz, $T_1$- Control, $T_2$- Cornstarch, $T_3$- Cornstarch+ Ingredient, $T_4$- Egg white powder, $T_5$- Pectin under frozen storage -18 °C for 2 months storage.

### Preparation of raw material

Fresh Bombay duck (*Harpadon nehereus)* was procured in iced condition from local fish market of Roha, Raigad (Maharashtra) for making fish balls.The length of fish ranged from 25 to 28 cm and weight ranged from 90 to 100 gm.

### Formulation of fish balls

**Table 1:** Preparation of fish balls from Bombay duck fish meat using olfactory ingredients with proportionate combination using minced fish meat.

| Ingredients and additives | $T_1$ | $T_2$ | $T_3$ | $T_4$ | $T_5$ |
|---|---|---|---|---|---|
| Bombay duck fish meat | 100 g | 100 g | 100 g | 100 g | 100 g |
| Cornstarch | - | 30 g | 30 g | - | - |
| Egg white Powder | - | - | - | 2 g | - |
| Pectin | - | - | - | - | 2 g |
| White sugar | - | - | 5 g | 5 g | 5 g |
| Salt | 4 g | 4 g | 4 g | 4 g | 4 g |
| Baking powder | - | - | 2 g | 2 g | 2 g |
| White chopped onion | - | - | 15 g | 15 g | 15 g |
| Garlic chopped | - | - | 4 g | 4 g | 4 g |
| Black pepper | - | - | 0.1 g | 0.1 g | 0.1 g |
| STPP | 0.1 g | 0.1 g | 0.1 g | 0.1 g | 0.1 g |
| Water | 20 ml | 20 ml | 20 ml | 20 ml | 20 ml |

**Table 2:** Preparation method for preparation of coated fish balls

| Sr. No | Ingredients (Coated fish balls) | Quantity (g) |
|---|---|---|
| 1 | Cornstarch | 50 |
| 2 | Chilly powder | 30 |
| 3 | Salt | 5 |
| 4 | Ingredients: water | 1:2 |

Breading and battering of fish balls: Batter mix was prepared by mixing ingredients cornstarch (50 g), Chilly powder (30 g), Salt (5 g). With the ratio of ingredients to water 1:2.after mixing. Breading used for coating include breadcrumbs were brought from the market. After the fish balls were dip into the thin batter mixed prepared followed by rolling in the bread crumbs to coat the fish balls thoroughly.

### Processing of Bombay duck fish balls

The fish was washed in potable water then beheaded, gutted and again washed. Then the fish were cut into fillets for easily removal of bones. Chopping of fish meat and then all ingredients were added and continue grinding making a homogenous paste. Making a fish balls of 10 g each from the mixture. Add a fish balls in luke warm water at temperature 40 °C for 20 minutes. Then put the fish balls in simmering water at temperature 90 °C for 20 minutes. Then the fish balls are cooled at room temperature and keep in cooled water overnight for improving gel quality. After that the fish balls are packed in polythene bags and stored separately in chilled storage 0 to 2 °C and frozen storage -18 °C.

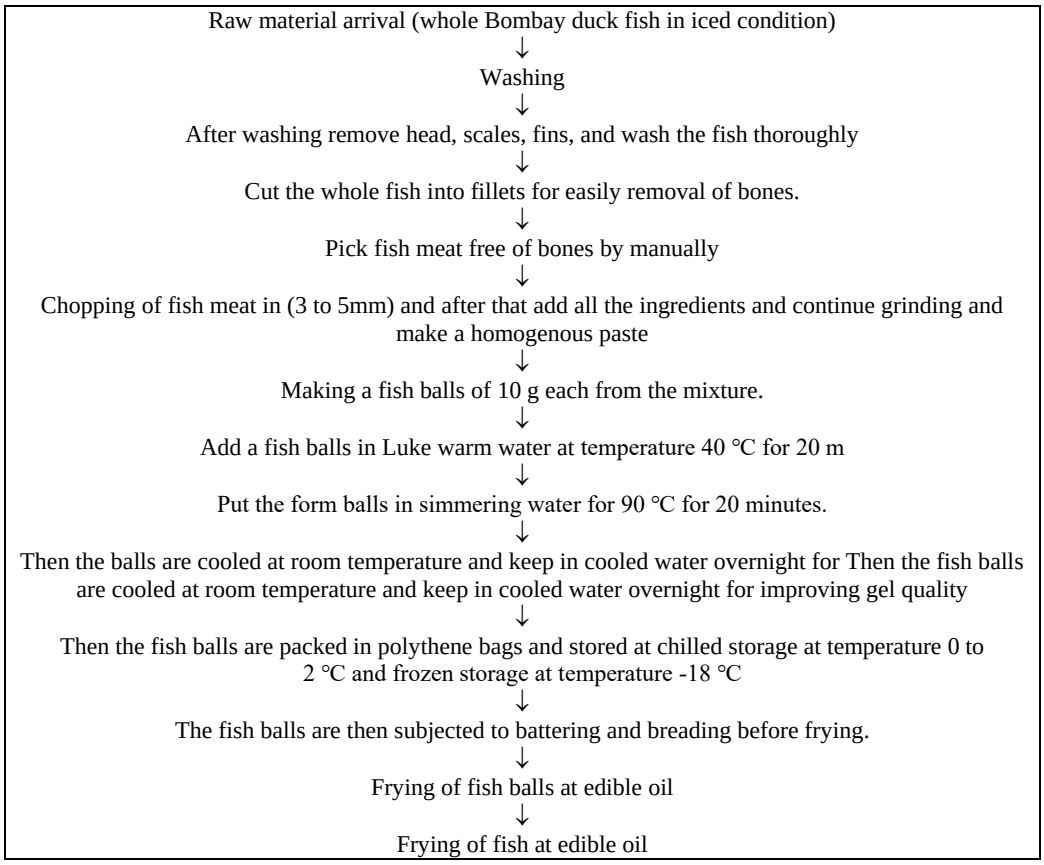


**Fig 1:** Flow diagram for preparation of Bombay duck fish balls

**Physiochemical Analysis**

The proximate composition i.e. moisture, protein, fat, ash content of fish balls was determined by AOAC, 2005 [1]. The TVB-N and TMA-N content of fish balls was determined by Beatty and Gibbons, 1937 [5]. The TBARS content of fish balls was determined by the method suggested by Tarladgis *et al*., 1960 [28] and Alpha Amino Nitrogen content of fish balls was determined by method suggested by Pope and Steven, 1939 [22].

**Statistical Analysis**

The data generated by repeating the experiments for different quality characteristics were complied and data were analyzed using of variances (ANOVA) tool with completely randomized block design.

**Result and Discussion**

**Changes in the proximate composition of Bombay duck fish balls during frozen storage (-18 °C).**

The data on changes in moisture content in all samples ($T_1$ to $T_5$) of Bombay fish balls during frozen storage is presented in (Table 3). Moisture content of Bombay duck fish balls during frozen storage was showed highest in sample $T_1$ (80.02% to 74.96%) which is followed by sample $T_4$ (74.56%to 71.48%) and lowest moisture content showed by the sample $T_3$ (68.21% to 64.26%) which is followed by sample $T_2$ (69.11% to 65.81%). The sample $T_1$ with highest moisture content contained Bombay duck fish meat and sample $T_3$ with lowest moisture content contained Bombay duck fish meat with cornstarch as binding agent added with additives and condiments. Reddy *et al*., (2012) [25] reported a decrease in moisture content in fish cutlet prepared from reef cod mince. He mentioned the decrease in moisture content may be due to the addition of rice powder and starch to the fish paste. In the present study it was noticed that the moisture content showed decreased trend in all treatments of that the Bombay fish balls during frozen storage(-18 °C). The similar decreased trend was observed in the findings of Duman and Peksezer, (2016) [9] reported that moisture content of *Alburnus mossulensis* raw fish was determined as 76.6 ± 1.06% but after the process, it decreased to 58.25 ± 1.48% in the cooked fish meat balls, respectively.

The data on changes in protein content in all samples ($T_1$ to $T_5$) of Bombay duck fish balls during frozen storage is presented in (Table 3). Protein degradation of Bombay duck fish balls during frozen storage was statistically significant in treatment $T_1$ (12.61 to 11.06%) maximum protein which is followed by $T_4$ (12.81 to 11.02%) and minimum degradation showed by treatment $T_3$ (9.6% to 8.28%) which is followed by treatment $T_2$ (10.25% to 9.26%). As $T_1$ sample with maximum protein content contained Bombay duck fish meat and sample $T_4$ with minimum protein content contained Bombay duck fish meat and pectin as a binding agent added with additives and condiments. The decrease in protein can be attributed to the leaching out of the water soluble nitrogenous components, during storage along with moisture (Praneetha *et al*; 2016) [23]. In the present study it was observed that the protein content showed decreased trend in all treatments of Bombay duck fish balls during frozen storage(-18 °C). The similar decreased trend was observed in the findings of Talab *et al*., (2022) [27] that the crude protein content of common carp fish fingers stored at -18 °C there was a significantly decrease.

The data on effect of frozen storage on fat content in all samples ($T_1$ to $T_2$) of Bombay duck fish balls is presented in (Table 3). Fat content in Bombay duck fish balls during frozen storage was increased significantly as showed highest $T_4$ (1.83% to 1.93%) fat which is followed by $T_1$ (1.84% to

1.80%) and lowest fat showed by $T_3$ (0.91% to 1.12%) which is followed by $T_2$ (0.93% to 1.17%). As $T_1$ sample with highest fat content contained Bombay duck fish meat and sample $T_3$ with lowest fat content contained Bombay duck fish meat and cornstarch as a binding agent added with additives and condiments. The increment of fat content was explained due to reducing the fish balls total solids (Davidson *et al*., 2005) [8]. In the present study it was noticed that the fat content showed increased trend in all treatments of Bombay duck fish balls during frozen storage (-18 °C). The similar increased trend was observed in the findings of Reddy *et al*., (1992) [24] observed a significant increase in the fat content of frozen fish fingers prepared from croakers during the frozen storage at -20 °C for 22 weeks. Mahmoudzadeh *et al*., (2010) [25] reported the initial fat content of brush tooth lizard fish burger as 5.45% during the frozen storage for 5 months. Ninan *et al*., (2010) [17] reported the initial fat content of tilapia fish cutlet as 2.14% during the frozen storage for 21 weeks.

The data on effect of frozen storage on ash content in all samples ($T_1$ to $T_2$) of Bombay duck fish balls is presented in (Table 3). Ash content of Bombay duck fish balls decreases during frozen storage was statistically significant in treatment $T_4$ (3.55% to 3.77%) maximum ash content which is followed by $T_2$ (2.78% to 2.54%) and minimum ash content showed by treatment $T_1$ (1.7% to 1.16%) which is followed by treatment $T_3$ (2.47% to 1.94%). As $T_4$ sample with maximum ash content contained Bombay duck fish meat and pectin as a binding agent added with additives and condiments and sample $T_1$ with minimum ash content contained Bombay duck fish meat. Ash reduced with increase in storage time observed by the Ayeloja *et al*., (2020) [4]. In the present study it was observed that Bombay duck fish balls showed decreased trend ash content in all treatments during frozen storage(-18 °C). The similar decreased trend was observed in the findings of Beklevik *et al*., (2005) [36] that there was decrease in ash content for sea bass filets during 60 days of storage under frozen condition.

**Changes in the biochemical composition of Bombay duck fish balls during frozen storage (-18 °C).**

The data on effect of frozen storage on Total Volatile Base-Nitrogen (TVB-N) content in all samples($T_1$ to $T_2$) of Bombay fish balls is presented in (Table 4).TVB-N content of Bombay duck fish balls during frozen storage was significantly showed highest TVB-N value in $T_1$ (15.26 mg N/100 g to 32.42 mg N/100 g) which is followed by $T_4$ (12.36 mg N/100 g to 25.35 mg N/100 g) and lowest TVB-N value showed by $T_3$ (9.28 mg N/100 g to 18.55 mg N/100 g) which is followed by $T_2$ (10.31 mg N/100 g to 20.85 mg N/100 g). As $T_1$ sample with highest TVB-N content contained Bombay duck fish meat and sample $T_3$ with lowest TVB-N content contained Bombay duck fish meat and cornstarch as a binding agent added with additives and condiments. The volatile base nitrogen compounds used to measure of fish decomposition (Beatty and Gibbons, 1937) [5]. TMA-N in fish is mainly composed of ammonia and primary, secondary and tertiary amines. TVB-N and TMA-N serve as bio-chemical quality indicators and are widely used to estimate freshness of fish and fishery product. TVB-N is one of the most widely used for evaluation of the degree of spoilage in seafood. TVB-N was usually used as a determine of the degree of freshness of fish products during storage. TVB-N includes measurement of TMA-N, DMA, ammonia, and other nitrogen compounds associated with seafood spoilage progresses (Ocano- Higuera *et al*., 2011) [20]. In the present study, it was noticed that the TVB-N values showed increased trend in all treatments of Bombay duck fish balls during frozen storage (-18 °C). The similar increased trend was observed in the findings of Duman and Peksezer, (2016) [9] reported that TVB-N values increased gradually in *Alburnus mossulensis* fish balls in all samples during frozen storage (-18 °C). An increases in TVB-N value in frozen storage is due to the breakdown products of nucleotides and deamination of amino acids by micro-organisms resulting in formation of ammonia, TMA-N further accumulation of these product increases the TVB-N content during frozen storage (Contreras-Guzman, 2002) [7].

The data on effect of frozen storage on Trimethylamine-Nitrogen (TMA-N) content in all samples ($T_1$ to $T_2$) of Bombay fish ball is presented in (Table 4). TMA-N content of Bombay duck fish balls during frozen storage was significantly showed maximum in sample $T_1$ (2.28 mg N/100 g to 3.78 mg N/100 g) which is followed by $T_4$ (0.5 mg N/100 g to 3.21 mg N/100 g) and minimum value in sample $T_3$ (0.5 mg N/100 g to 3.07 mg N/100 g) which is followed by $T_2$ (2.16 mg N/100 g to 3.13 mg N/100 g). As $T_1$ sample with maximum TMA-N content contained Bombay duck fish meat and sample $T_3$ with minimum TMA-N content contained Bombay duck fish meat and cornstarch as a binding agent added with additives and condiments. In the present study, it was observed that the TMA-N values showed increased trend in all treatments of Bombay duck fish balls during frozen storage(-18 °C). The similar increased trend was observed in the findings of Hassanin, (2013) [10] reported that the initial TMA-N values in catfish fish fillets were. There was an increase in TMA-N concentration with increasing storage time.

The data on effect of frozen storage on Thiobarbituric Acid Reactive Subustances (TBARS) content in all samples ($T_1$ to $T_5$) of Bombay duck fish balls is presented in (Table 4)TBARS content of Bombay duck fish balls during frozen storage was significantly showed a highest in $T_4$ (0.36 mg MDA/g to 1.87 mg MDA/g) TBARS which is followed by $T_1$ (0.33 mg MDA/g to 0.87 mg MDA/g) and lowest in $T_3$ (0.16 mg MDA/g to 0.53 mg MDA/g) which is followed by $T_2$ (0.17 mg MDA/g to 0.55 mg MDA/g). As $T_4$ sample with highest TBARS content contained Bombay duck fish meat and pectin as a binding agent added with additives and condiments and sample $T_3$ with lowest TBARS content contained Bombay duck fish meat and cornstarch as a binding agent added with additives and condiments. Asgharzadeh *et al*., (2010) [3] they reported that the increase in TBA during freezing may be due to lipid hydrolysis and also to ice crystals formation in tissues which could injure the cell and cause the release of prooxidant enzymes (lipoxygenases and peroxidases) and chemical pro-oxidant molecules (hemoproteins and metal ions) which caused lipid oxidation. In the present study, it was observed that TBARS values showed increased trend in in all treatments of Bombay duck fish balls during frozen storage. The similar increased trend was observed in the findings of Duman and Peksezer, (2016) [9] in the pre-cooked fish balls of Mosul bleak. This observation on the increase of the TBA value during frozen storage is in agreement with the results of Yanar and Fenercioglu, (1998) [33] for fish balls made from carp, and by Tokur *et al*., (2006) [30] for fish fingers made from mirror carp.

The data on effect of frozen storage on Alpha Amino Nitrogen (AAN) content in all samples ($T_1$ to $T_2$) of Bombay duck fish balls is presented in (Table 4). AAN content of Bombay duck fish balls during frozen storage was statistically showed maximum in $T_4$ (251 mg/100 g to 166 mg/100 g) which is followed by $T_1$ (201 mg/100 g to 151 mg/100 g) and $T_3$ (253 mg/100 g to 151 mg/100 g) and minimum AAN showed by $T_2$ (257 mg/100 g to 147 mg/100 g). As $T_4$ sample with maximum AAN content contained Bombay duck fish meat and pectin as a binding agent added with additives and condiments and sample $T_2$ with minimum AAN content contained Bombay duck fish meat and cornstarch as a binding agent. Samples $T_5$ was discarded after 30 days due to sensory quality was unacceptable. The sweet taste of cuttle fish fillets can be attributed to the high amount of alpha amino acids. Alpha amino throughout the frozen storage and the sweet taste of the sample decreased proportionally. This indicated the possibility of high leaching of amino acids which contributed to sweet taste. (Joseph *et al*., 1988) [12]. Leaching of free amino acid to the surrounding media can also contribute to the reduction in AAN content (Viji *et al*., 2015) [31]. In the present study, it was discovered that AAN content showed decreased trend in all treatments of Bombay duck fish balls during frozen storage. Similar decreased trend was observed in the findings of Joseph *et al*., (1988) [12] observed during storage at -20 + 1 °C the salt soluble nitrogen of the cuttle fish fillets of alpha amino nitrogen decreases from 252 mg/100 g to 140 mg/100 g.

**Table 3:** Changes in the proximate composition of Bombay duck fish balls during frozen storage (-18 °C).

| | Treatment | 0 Days | 15 Days | 30 Days | 45 Days | 60 Days |
|---|---|---|---|---|---|---|
| Moisture | $T_1$ | 80.02 | 78.38 | 76.03 | 75.86 | 74.96 |
| | $T_2$ | 69.11 | 68.77 | 67.16 | 66.16 | 65.81 |
| | $T_3$ | 68.21 | 67.32 | 66.36 | 65.93 | 64.26 |
| | $T_4$ | 74.56 | 74.41 | 73.28 | 72.65 | 71.48 |
| | $T_5$ | 75.94 | 75.26 | 74.46 | SD | SD |
| Protein | $T_1$ | 12.61 | 12.16 | 11.91 | 11.26 | 11.06 |
| | $T_2$ | 10.26 | 10.06 | 9.86 | 9.57 | 9.26 |
| | $T_3$ | 9.6 | 9.26 | 9.08 | 8.93 | 8.28 |
| | $T_4$ | 12.81 | 12.31 | 11.97 | 11.26 | 11.02 |
| | $T_5$ | 11.36 | 11.05 | 10.76 | SD | SD |
| Fat | $T_1$ | 1.84 | 1.85 | 1.867 | 1.88 | 1.91 |
| | $T_2$ | 0.93 | 0.97 | 1.07 | 1.13 | 1.17 |
| | $T_3$ | 0.91 | 0.94 | 0.98 | 1.07 | 1.12 |
| | $T_4$ | 1.83 | 1.85 | 1.87 | 1.89 | 1.93 |
| | $T_5$ | 1.41 | 1.58 | 1.63 | SD | SD |
| Ash | $T_1$ | 1.7 | 1.58 | 1.47 | 1.36 | 1.16 |
| | $T_2$ | 2.78 | 2.73 | 2.67 | 2.58 | 2.54 |
| | $T_3$ | 2.47 | 2.34 | 2.23 | 2.08 | 1.94 |
| | $T_4$ | 3.55 | 3.44 | 3.26 | 2.86 | 2.26 |
| | $T_5$ | 3.26 | 2.97 | 2.37 | SD | SD |

SD-Sample discarded $T_1$=Control, $T_2$= Cornstarch, $T_3$ = Cornstarch + Ingredients, $T_4$ = Egg white powder, $T_5$= Pectin.

**Table 4:** Changes in the biochemical composition of Bombay duck fish balls during frozen storage (-18°C).

| | Treatment | 0 Days | 15 Days | 30 Days | 45 Days | 60 Days |
|---|---|---|---|---|---|---|
| TVB-N | $T_1$ | 15.26 | 22.43 | 28.63 | 30.67 | 32.47 |
| | $T_2$ | 10.31 | 12.65 | 14.83 | 16.83 | 20.85 |
| | $T_3$ | 9.28 | 11.28 | 13.93 | 15.75 | 18.55 |
| | $T_4$ | 12.36 | 15.97 | 20.33 | 22.68 | 25.35 |
| | $T_5$ | 18.93 | 27.83 | 32.46 | SD | SD |
| TMA-N | $T_1$ | 2.28 | 2.58 | 3.27 | 3.56 | 3.78 |
| | $T_2$ | 2.16 | 2.36 | 2.46 | 2.77 | 3.13 |
| | $T_3$ | 0.5 | 2.23 | 2.37 | 2.56 | 3.07 |
| | $T_4$ | 0.5 | 2.38 | 2.56 | 3.06 | 3.21 |
| | $T_5$ | 0.5 | 3.26 | 5.83 | SD | SD |
| TBARS | $T_1$ | 0.33 | 0.46 | 0.52 | 0.68 | 0.87 |
| | $T_2$ | 0.17 | 0.26 | 0.33 | 0.44 | 0.55 |
| | $T_3$ | 0.16 | 0.23 | 0.36 | 0.42 | 0.53 |
| | $T_4$ | 0.36 | 0.47 | 0.56 | 0.68 | 1.87 |
| | $T_5$ | 0.23 | 0.37 | 0.46 | SD | SD |
| AAN | $T_1$ | 201 | 187 | 171 | 156 | 151 |
| | $T_2$ | 257 | 211 | 186 | 153 | 147 |
| | $T_3$ | 253 | 216 | 191 | 176 | 151 |
| | $T_4$ | 251 | 236 | 208 | 181 | 166 |
| | $T_5$ | 208 | 187 | 172 | SD | SD |

SD-Sample discarded $T_1$=Control, $T_2$= Cornstarch, $T_3$ = Cornstarch + Ingredients, $T_4$ = Egg white powder, $T_5$= Pectin.

## Conclusion

From the results of present studies, it can be concluded that treatment $T_3$ with cornstarch + ingredients was best treatment of Bombay duck fish balls in frozen storage(-18 °C). In frozen storage Bombay duck fish balls was acceptable up to 60 days based on physiochemical analysis. Frozen storage preserved Bombay duck fish balls at low temperature significantly prolonging shelf life by inhibiting bacterial growth and enzymatic reactions.

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