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Qualitative Evaluation of Fish Fingers Prepared from Tilapia (*Oreochromis niloticus*) and Pangasius (*Pangasius pangasius*) Stored at -18±2°C

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ABSTRACT

Background: The fish being highly perishable food item consumed in all strata of people. The production of freshwater fish is on the rise and need to be processed in a variety of forms to make them available for people. Nowadays, numbers of value added fish products are available in the market for consumption to achieve health beneficial effect and to cope up with malnutrition. However, consumers are unaware of the quality of the products available in the market. Therefore, the present work was undertaken to evaluate the quality of fish fingers produced from tilapia and pangasius during storage at -18±2°C.

Methods: The fresh tilapia and pangasius were purchased from local market to prepare fillets. The fingers were prepared from tilapia and pangasius fillets and par fried at 180°C for 30 seconds. The fried fingers were cooled at once at room temperature and stored in deep freeze at -18±2°C for shelf-life study during November 2019 to March 2021.

Result: The results indicated that the fish fingers prepared from tilapia could be stored for 33 days and pangasius fingers had a shelf-life of only 27 days. All biochemical parameters *viz.* pH, TVB-N, PV, FFA and TBA were found increasing as the storage study progresses. The sensory score of the fish fingers produced from both the fishes were got drastically reduced at the end of deep freeze storage at -18±2°C. Overall study indicated that tilapia and pangasius fish can be successfully utilized for the preparation of various value added fish product such as fish fingers and would have sufficient shelf life at deep freeze storage at -18±2°C.

Key words: Deep freeze storage, Fish finger, Pangasius, Shelf-life, Tilapia, Quality.

INTRODUCTION

Fisheries and aquaculture is a weapon to fight poverty and reduce inequality has received renewed attention in recent years. Fish and fish products are easily digestible source of balance protein which provide 10% calories hence its role in nutrition is predictable. In adult human diet, 60% protein intake came from fish and fish products (FAO, 2016).

On a global basis, tilapia (*Oreochromis niloticus*) has become the second most commonly consumed farmed fish after the carps. The number and variety of value-added forms (breaded, seasoned, stuffed, *etc.*), fish paneer Sarojini *et al.* (2020) can be prepared and marketed from tilapia. These processed tilapia products offer many advantages to the producer country (Fitzsimmons, 2008). Another farmed freshwater fish species, pangasius (*Pangasius pangasius*) is produced mainly in Asian countries. It has been a good source of valuable proteins, micronutrients and essential fatty acids.

The fish is very important for diversified and healthy diet and it has good demand for preparation of value-added products such as sausages Ozpolat and Patir (2017), analogue shrimp products Hema *et al*. (2021) in restaurant (FAO, 2012). These value-added products prepared from tilapia and pangasius are now served in virtually all multi-national casual dining chains along with cruise ships, most dedicated seafood restaurants and increasingly at schools and hospitals.The enhanced acceptability and market value of the tilapia and pangasius fish is seen after its processing into different value-added fish as assessed from the sensory attributes of the products. The value addition of fish and fisheries products in terms of processing techniques, specialized ingredients and good packaging are used to increase the shelf life, nutritional value, sensory attributes and convenience of fish products Pagarkar *et al.* (2011).

The Nagpur and neighboring districts of Vidarbha region of Maharashtra are enriched with varied fisheries resources including catfishes, carps, tilapia, murrels and pangasius *spp*. *etc.* All these locally available fresh water fishes offer tremendous scope for the development of more number of value-added products. So that fish can be utilized in profitable manner.

The aim of the present work was to study the changes in quality of fish finger prepared from tilapia (*Oreochromis niloticus*) and pangasius (*Pangasius pangasius*) during deep freeze storage at -18±2°C.

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MATERIALS AND METHODS

Materials

Fresh tilapia (*Oreochromis niloticus*) and pangasius (*Pangasius pangasius*) fish with an average weight of 0.5 - 0.7 kg and 1.5 - 2.0 kg respectively were procured from Mayo fish market, Nagpur, Maharashtra and brought to the laboratory of Fish Processing Technology, College of Fishery Science, Nagpur in iced condition (1:1 ratio of fish:ice). After arrival, fish were processed for dressing (deheaded, descaled, gutted) and washed with tap water. Finally fillets were prepared by hand with help of food grade stainless steel knife. The study was carried out during the period from November 2019 to March 2021 in College of Fishery Science, Nagpur, Maharashtra.

Preparation of fish fingers

Fish fingers were prepared as per the standardized recipe (Table 1) and method (Fig 1). Samples of fish fingers prepared from tilapia and pangasius were regularly drawn at three days interval from deep freezer for biochemical and organoleptic analysis.

Table 1: Ingredients used in the preparation of fish fingers.

Ingredient	Quantity
Fish fillet	500 gm
Salt	25 gm
Chili powder	30 gm
Ginger - garlic paste	25 gm
Cinnamon powder	2g (to taste)
Pepper powder	3 g (to taste)
Clove powder	3 g
Turmeric	5 g
Corn floor	25 gm
Eggs	4 Nos
Breadcrumb	200 g
Oil	500 ml (for frying)

Tilapia and pangassius fillets
↓
Cut into fish finger (5 cm × 2 cm)
↓
Addition of ingredients in fish finger and mixed well
↓
Marination at refrigerator (1 hr)
↓
Coating
↓
Par frying at 180°C (30 sec)
↓
Cooling at room temperature
↓
Storage (-18±2°C)

Fig 1: Flowchart of preparation of fish finger.

Biochemical analysis

Proximate composition of fresh and prepared fish fingers was determined at the beginning and end of storage by the method of AOAC (2005). The digital pH meter was used to record pH value. A TVB-N of finger was determined by the procedure given by (Beatty and Gibbons, 1937). TBA value was quantified using the method of Tarladgis *et al.* (1960). Peroxide value and Free Fatty Acid of samples were analyzed and expressed as milli equivalent of O_2/kg fat and % of oleic acid respectively (AOAC 2005).

Organoleptic analysis

Fingers prepared from tilapia and pangasius stored in deep freezer at -18±2°C were subjected to organoleptic evaluation. The fingers prepared from tilapia and pangasius were deep fried in oil until they were cooked before being presented to the panelist. Various sensory characteristics like colour, texture, odour, taste, appearance and overall acceptability were evaluated by a group of 5 trained panelists using a 9- point hedonic scale.

Statistical analysis

The data of the present study were tested by one-way analysis of variance (ANOVA). The means were compared using Duncan's multiple-range test. The Statistical Packages for Social Science (SPSS 8.0 for Windows developed by SPSS Inc., Chicago, IL) was used to perform statistical analysis.

RESULTS AND DISCUSSION

Quality of fresh tilapia and pangasius fish

The biochemical, microbiological and organoleptic parameters are usually used for assessing quality of fresh fish. Generally, fresh fish having good organoleptic score are used for processing. The biochemical, microbiological and organoleptic quality of fresh tilapia and pangasius fish is presented in Table 2 and indicated that good quality of fish is utilized for the development of fish fingers. The similar results were obtained by Lithi *et al*. (2020) for various biochemical, microbial and sensory parameters for tilapia mince. The comparable values for quality parameters were also observed for pangasius (*Pangasinodon hypoptthalamus*) steak Viji *et al*. (2014).

Proximate composition of tilapia fillet and its fingers during storage

The commercial value of fish and fishery products are often related to their biochemical composition, as they contribute to their nutritive value. The proximate composition of tilapia fillet and its fingers is depicted in Table 3. In the present study, the significant difference ($p<0.05$) in compositional analysis of fresh tilapia fillet and fingers during storage at deep freeze was noticed. The similar value of proximate composition of fresh water fish was recorded by Vanitha *et al.* (2013). The moisture and protein content of tilapia finger was decreased during storage which might be due to dehydration of fingers during storage Ninan *et al.* (2008).

Similarly Pandey and Kulkarni (2007) also reported decrease in the moisture content of grass carp cutlets and fish fingers during frozen storage at -18±2°C for 6 months. The decreased protein content in fingers of different fish species was also reported by Cakli *et al*. (2005). However, increase in percentage of crude fat and ash content was observed in tilapia fish fingers during storage at -18±2°C due to the loss in moisture. The increase in fat and reduction of moisture of fish cutlet might be due to dehydration during storage Ninan *et al*. (2008). Lakshminatha *et al.*, (1992) and Raju *et al*. (1999) also found increased fat and ash content of fish finger during frozen storage.

Proximate composition of pangasius fillet and its fingers during storage

The proximate composition of pangasius fillet and prepared fingers during deep freeze storage at -18±2°C is given in

Table 2: Quality of fresh tilapia and pangasius fish.

Parameters	Tilapia	Pangasius
pH	6.26	6.38
TVB-N (mgN/100g)	10.7	10.92
PV (meqO^2/kg fat)	2.82	3.12
FFA (% Oleic acid)	0.96	1.06
TBA (mg MDA/ kg)	0.58	0.76
TPC (cfu/g)	4.86×10^2 (2.68)	5.32×10^2 (2.72)
Pathogens (*Staphylococcus, E. coli, Salmonella, Streptococcus*) (cfu/g)	ND	ND
Overall acceptability (9 point hedonic scale)	8.5	8

Data (n=3) are expressed as mean.

Table 3: Proximate composition of fresh tilapia fillet and its fingers during storage.

Parameter (%)	Tilapia fillet	Initial storage (Fingers)	Final storage (Fingers)
Moisture	76.01 ± 0.06^{b}	59.16 ± 0.48^{a}	58.39 ± 0.02^{a}
Crude protein	18.73 ± 0.03^{b}	18.74 ± 0.15^{b}	16.16 ± 0.36^{a}
Crude fat	3.023 ± 0.01^{a}	17.02 ± 0.01^{b}	19.12 ± 0.22^{c}
Ash	0.98 ± 0.02^{a}	3.04 ± 0.03^{b}	3.86 ± 0.02^{c}

Data (n=3) are expressed as the mean ±SD. Different superscripts in the same row signify statistical difference (P<0.05).

Table 4: Proximate composition of fresh pangasius fillet and its fingers during storage.

Parameter (%)	Pangasius fillet	Initial storage (Fingers)	Final storage (Fingers)
Moisture	80.17 ± 0.02^{c}	60.9 ± 0.06^{b}	58.26 ± 0.01^{a}
Crude protein	13.42 ± 0.06^{a}	16.58 ± 0.0^{c}	14.51 ± 0.02^{b}
Crude fat	5.06 ± 0.04^{a}	18.86 ± 0.02^{b}	19.65 ± 0.01^{c}
Ash	0.92 ± 0.04^{a}	3.14 ± 0.003^{b}	3.90 ± 0.01^{c}

Data (n=3) are expressed as the mean ±SD. Different superscripts in the same row signify statistical difference (P<0.05).

Table 5: Changes in biochemical parameters of fish fingers prepared from tilapia and pangasius during deep freeze storage at -18±2°C.

Storage day	pH		TVBN (mgN/100g)		FFA (% of oleic acid)		PV (meqO_2/kg fat)		TBA (mg MDA/kg)	
	T	P	T	P	T	P	T	P	T	P
0	6.15 ± 0.01^{a}	6.52 ± 0.00^{b}	11.82 ± 0.07^{a}	12.46 ± 0.08^{b}	1.2 ± 0.01^{a}	1.82 ± 0.03^{b}	3.15 ± 0.01^{a}	3.18 ± 0.00^{b}	0.46 ± 0.01^{a}	0.68 ± 0.01^{b}
3	6.32 ± 0.01^{b}	6.84 ± 0.00^{c}	12.47 ± 0.05^{b}	12.98 ± 0.05^{c}	1.47 ± 0.02^{b}	2.42 ± 0.01^{c}	3.68 ± 0.00^{b}	3.96 ± 0.01^{c}	0.58 ± 0.01^{b}	0.84 ± 0.02^{c}
6	6.48 ± 0.04^{c}	6.96 ± 0.01^{d}	13.02 ± 0.08^{c}	13.15 ± 0.05^{d}	1.86 ± 0.02^{c}	2.96 ± 0.01^{d}	3.94 ± 0.02^{c}	4.18 ± 0.01^{d}	0.66 ± 0.01^{c}	0.96 ± 0.00^{d}
9	6.86 ± 0.01^{d}	7.01 ± 0.01^{e}	14.16 ± 0.01^{d}	13.82 ± 0.03^{e}	2.12 ± 0.01^{d}	3.13 ± 0.01^{e}	4.12 ± 0.01^{d}	4.57 ± 0.10^{e}	0.94 ± 0.01^{d}	1.08 ± 0.00^{e}
12	7.02 ± 0.01^{e}	7.17 ± 0.01^{f}	15.64 ± 0.04^{e}	14.96 ± 0.03^{f}	2.90 ± 0.01^{e}	3.84 ± 0.00^{f}	4.86 ± 0.01^{e}	4.91 ± 0.01^{f}	1.02 ± 0.01^{e}	1.25 ± 0.01^{f}
15	7.14±0.01f	7.22 ± 0.01^{g}	15.88 ± 0.04^{f}	15.68 ± 0.04^{g}	3.46 ± 0.00^{f}	4.96 ± 0.00^{g}	5.12 ± 0.01^{f}	5.03 ± 0.01^{g}	1.18 ± 0.01^{f}	1.46 ± 0.00^{g}
18	7.46 ± 0.00^{g}	7.41 ± 0.01^{h}	16.12 ± 0.00^{g}	18.46 ± 0.03^{h}	3.89 ± 0.01^{g}	5.68 ± 0.01^{h}	5.68 ± 0.01^{g}	6.24 ± 0.00^{h}	1.26 ± 0.00^{g}	2.42 ± 0.00^{h}
21	7.68 ± 0.00^{h}	7.96 ± 0.01^{i}	18.24 ± 0.04^{h}	20.12 ± 0.06^{i}	4.43 ± 0.01^{h}	6.12 ± 0.01^{i}	5.97 ± 0.01^{h}	7.19 ± 0.00^{i}	1.34 ± 0.01^{h}	2.67 ± 0.00^{i}
24	7.90 ± 0.01^{i}	8.13 ± 0.01^{j}	19.46 ± 0.02^{i}	21.68 ± 0.05^{j}	4.72 ± 0.13^{i}	6.90 ± 0.01^{j}	6.08 ± 0.01^{i}	8.96 ± 0.00^{j}	1.46 ± 0.01^{i}	2.96 ± 0.01^{j}
27	7.98 ± 0.01^{ii}	8.26 ± 0.01^{k}	20.12 ± 0.01^{j}	22.04 ± 0.03^{k}	5.17 ± 0.00^{j}	7.86 ± 0.01^{k}	6.96 ± 0.01^{j}	10.12 ± 0.01^{k}	1.68 ± 0.00^{j}	3.03 ± 0.01^{k}
30	8.02 ± 0.01^{ij}	-	20.96 ± 0.03^{k}	-	5.96 ± 0.02^{k}	-	7.60 ± 0.01^{k}	-	1.83 ± 0.01^{k}	-
33	8.2 ± 0.06^{k}	-	21.12 ± 0.02^{l}	-	6.12 ± 0.01^{k}	-	7.84 ± 0.01^{l}	-	1.96 ± 0.00^{l}	-

Data (n=3) are expressed as the mean ±SD. Different superscripts in the same row signify statistical difference (P<0.05).

Table 4. The present results of proximate compoistion for fresh pangasius meat are in agrrement with Monalisa *et al*. (2013). This higher content of proximate compoistion may be due to feeding pattern, metabolism and absorption system of fishes. However, during deep freeze storage at -18±2°C, the significant difference (p<0.05) in proximate compoistion of pangasius fish finger was observed. The moisture and protein content of prepared fish fingers got significantly decreased during deep freeze storage of 27 days. The increase in crude fat and ash content was reported during the study Cakli *et al*. (2005). There is an inverse relationship between fat and moisture content of fish Monalisa *et al*. (2013). The similar observations were also noticed by Rathod and Pagarkar (2013) in cutlet made from catla during chilled and frozen storage due to deep frying and dehydration effect.

Changes in biochemical quality of fish finger

The changes in biochemical quality of fish finger prepared from tilapia and pangasius during deep freeze storage is shown in Table 5. In the present study, the pH of fish fingers prepared from tilapia and pangasius was increased significantly during storage. The increase in pH is caused by enzymatic degradation of fish muscle Vareltzis *et al*. (1997). Lithi *et al*. (2020) also found increased pH in tilapia burger during frozen storage. Rani *et al*. (2017) also found similar increased value of pH in frozen fish burger and finger prepared from mrigal fish during frozen storage.

The all volatile basic components are termed as Total Volatile Bases Nitrogen (TVB-N), which are mainly composed of ammonia and trimethylamine and is one of the most commonly used indices worldwide for determination of freshness of fish (Balachandran, 2001). In the present study, the TVB-N values in tilapia and pangasisus fish fingers were found increasing towards the end of storage of 33 and 27 days respectively. The bacterial spoilage, degradation of proteins in fish tissues and endogenous enzymes activity *etc.* might have resulted into increased TVB-N content during storage Chomnawang *et al*. (2007). Pandey and Kulkarni (2007) observed a significant increase in TVB-N value of grass carp cutlet and fish finger during frozen storage while, it was found in the range of 12.4 to 20.22 mg%N in tilapia fish cutlet Ninan *et al*. (2008).

The increased free fatty acid (FFA) content was observed in tilapia and pangasius fingers during deep freeze storage at -18°C±2°C. The enzymatic decomposition of fat during storage generally determines FFA value which may

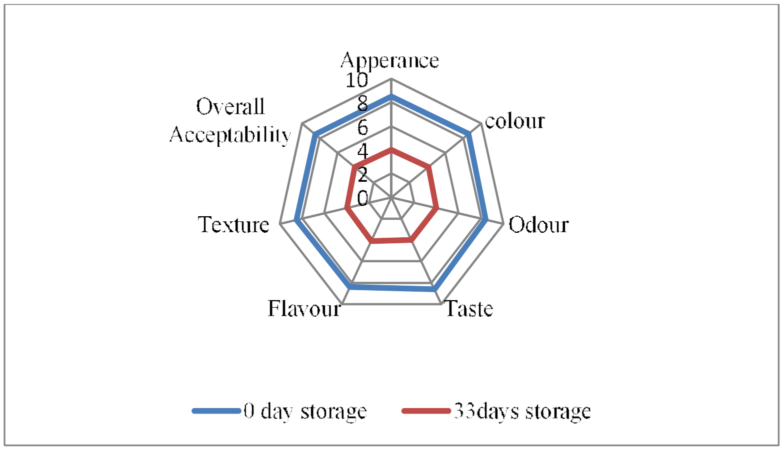

Fig 2a: Changes in sensory score of tilapia fish fingers during storage.

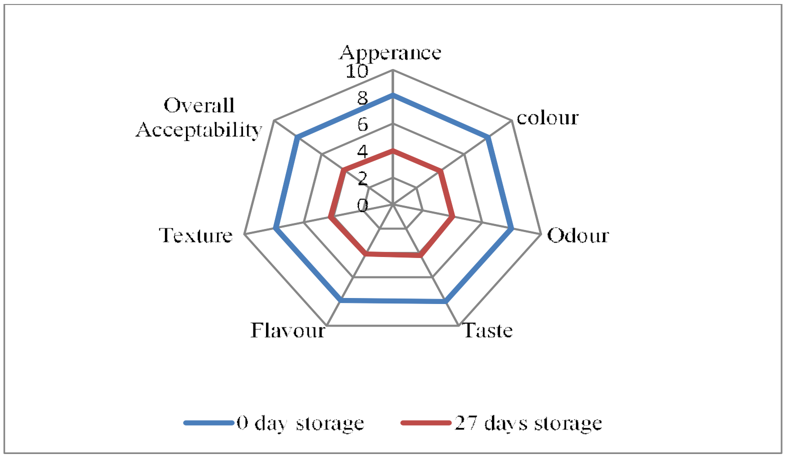

Fig 2b: Changes in sensory score of pangasius fish fingers during storage.

increase due to the lipase action (Gopakumar, 2002). The present results are in agreement with Tokur *et al*. (2004) who found increasing FFA values in fish burger during frozen storage upto 8 months. The increased value of FFA in fish cutlet prepared from tilapia minced meat stored at -20°C Ninan *et al.* (2010) and in value-added minced based products from catla during frozen storage Vanitha *et al*. (2013) were also reported. In line with the similar study conducted by Pandey and Kulkarni (2007) observed increased FFA concentration in fish cutlet and finger during frozen storage. Reddy *et al*. (1992) noticed increased FFA values in finger prepared from croaker and pink perch upto 6th week and 10th week of storage respectively, however, it was decreased slightly upto 14th week and remain stable at -20°C.

In the present study, the increase in PV values in tilapia and pangassius fish fingers were observed as the storage was progressed at -18°C±2°C. The similar increasing trend of PV value was noticed in the case of pangasius fingers during deep freeze storage at -18°C±2°C for 27 days. Similar observation was found by Rathod and Pagarkar (2013) in cutlets made from pangasius during storage in display unit at -15 to -18°C. Tokur *et al.* (2004) also observed increased value of PV in fish burger prepared from tilapia fish during frozen storage.

TBA value is commonly used as an indicator of lipid oxidation, particularly in meat and fish products. In the present study, fish fingers prepared from tilapia and pangasius showed increasing trend of TBA during storage at -18±2°C. Tokur *et al*. (2004) demonstrated TBA value of 0.028 mg MDA/kg in fresh burger made from tilapia and found slightly increasing during storage. The results of the present study are also in agreement with the Ninan *et al*. (2010), who observed increased value of TBA in fish cutlet prepared from tilapia mince stored at -20°C for 21 weeks. Similarly increased trend of TBA value during frozen storage was also observed in value-added products made from fresh water fish, mrigal Rani *et al.* (2017).

Organoleptic quality of fish fingers

Sensory qualities of fish fingers prepared from tilapia and pangasius were assessed in terms of appearance, colour, odour, taste, flavor, texture and overall acceptability (Fig 2a and 2b). All parameters of sensory quality of fish fingers prepared from tilapia and pangasius decreased significantly during 33 and 27 days of storage respectively in deep freeze storage. The reduction in sensory attributes may be due to formation of some volatile low molecular compounds, protein degradation and lipid oxidation during storage (Undeland and Lingnert, 1999). Pangasius finger showed less shelf-life than tilapia fish fingers which can be attributed to more water content in pangasius. Cakli *et al.* (2004) found decreased overall acceptability score for fish fingers prepared from whiting, sardine and pink perch during 8 months of frozen storage. A slight decrease in overall acceptability was observed for cutlet prepared from pangasius stored at -15°C to -18°C Rathod *et al*. (2013). Raju *et al.* (1999) also reported a shelf-life of 12 weeks for fish sticks prepared from pink stored at -20°C storage, whilst Rani *et al*. (2017) observed fish finger could be stored for upto 145 days at frozen storage. The fingers produced from pangasius fish found less crispy than fingers produced from tilapia fish.

CONCLUSION

The work of the present study can be concluded that fish fingers prepared from tilapia fish showed good shelf-life of upto 33 days and having good crispiness whereas fish finger prepared from pangasius fish accepted only for upto 27 days and are comparatively less crispy than the tilapia fish finger during deep freeze storage at -18±2°C. Therefore, it can be stated that tilapia and pangasius fish can be successfully utilized for the preparation of various value-added fish product such as fish fingers and would have good shelf-life at deep freeze storage at -18±2°C.

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