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Utilization of *Pangasius* Mince in the Development of Ready to Eat Snacks and its Storage Study

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A B S T R A C T

The demand for ready to eat and ready to cook products are gradually increasing because of their convenience. Considering the demand for ready to eat fish products especially in developing countries like India, there is an instant need to diversify our fish based products. *Pangasius* is a candidate species for inland aquaculture but the yellow discoloration problem in its fillet has restricted its production recently. Therefore, an attempt has been made in the present investigation to utilize *Pangasius* mince for making a ready to eat snacks product i.e. fish *Sev* and its storage study at room temperature. The results suggested that the fish mince quantity can be kept around 50% of the total composition. This not only helped in maintaining the textural properties of *sev* but also improved the nutritional quality and overall acceptability. The storage stability of fish *Sev* at room temperature was assessed based on the changes in proximate composition, quality indices and sensory analysis of the fish *Sev* during 90 days of storage at room temperature. From the results, it was observed that freshly prepared fish *Sev* had moisture, protein, fat, ash and carbohydrate as 1.89%, 13.89 %, 24.58%, 3.40% and 56.24% respectively at day 0. It was observed that the protein content of the product decreased slightly from 13.89% to 13.37% during 90 days of storage. However, moisture content was increased and fat content was decreased gradually at the end of 90 days storage. Lipid oxidation products like peroxide and TBARS values increased gradually but found within acceptable limit at the end of 90 days and pH value reduced significantly. The product prepared was found acceptable up to 90 days of storage at room temperature based on the sensory evaluation by the trained panelists.

Introduction

Value addition in general means adding value to the low cost raw material by any means of processing which changes the overall appearance and quality of the product resulting in increased consumer acceptability and price of the final product which can

benefit both producers as well as consumer. Looking at the present world scenario where both men and women are working for their livelihood and hardly gets time to cook the food, such ready to eat value added products is now becoming one of the best options. Several meat based and starch based value added products are available in the market. However fish based value added products are very less in the Indian market (Hina *et al.,* 2017). Fish is considered as one of the best sources for good quality proteins and health beneficial poly unsaturated fatty acids i.e. EPA and DHA along with other minerals and fat soluble vitamins. Therefore fish based value added products will not only provide an alternative to plant based proteins but also provide essential fatty acids which increase the nutritional value of the end product. There are several fish species available in the local markets of India which fetches very good price in the fresh form and has an established market. However there are some fish species which has very high production potential but fetches less price in the market and categorized as low cost fish. Such low cost fish, which has equally good protein and fat content as high priced fish, can be utilized for value addition which will benefit both fish farmers as well as consumers.

Pangasianodon hypophthalmus, an exotic catfish that is endemic to the waters of Mekong basin in south-east Asia, belongs to the family Pangasiidae and commonly known as river or silver stripped cat fish, sutchi catfish and iridescent shark. Total *Pangasius* production in India during 2014-15 was 3.63 million MT (FAO, 2014). *Pangasius*is being cultured, mainly in the Krishna, West Godavari, East Godavari, Guntur and Nellore districts of Andhra Pradesh. *Pangasius* farming in Andhra Pradesh represents the fastest growth of a single species farming recorded so far in the aquaculture sector of India. *Pangasius* meat has high nutritive qualities and excellent sensory properties (Praveen *et al.,* 2017). The fish can be filleted easily due to the absence of intra-muscular pin bone. Nevertheless *Pangasius* has following major problems which has restricted its production

Yellow discoloration of fillets

India with its current aquaculture potential can compete with the south east Asian countries, but the main factor leading to the less demand of Indian fillet export is the yellow discoloration. The root cause for this yellow discoloration and overall quality loss of cat fish meat is due to the carotenoid content from the food (Lovell, 1998). Literatures also suggest that natural feed of *Pangasius* also imparts yellow discoloration to the fillet to a large extent.

High fat content

Fillets are moderately high in fat, mainly saturated fat, a type of fat that can increase cholesterol. Dietary fat is high in calories but it is vital for optimal health, as it helps body to absorb vitamins and aids in proper growth and development. Fillets are relatively high in cholesterol, increases the risk of heart disease. The amount and composition of the fat content will be influenced by the feed used in aquaculture operations (Hassan *et al.,* 2018).

Low price

Market demand and associated product prices for different *Pangasius* species reflect consumer preferences. Basa is the preferred imported variety of *Pangasius* due to mild to sweet flavor, white meat colour and are thinner with a more coarse texture. Consumer preferences are usually influenced by price or intended recipes. Due to above problems *Pangasius* is less exported from India ((Hassan *et al.,* 2017).

In the market, there are many kinds of snack products available such as *chakli*, *sev*, *bhujia* etc. These are rich in carbohydrate content with protein content of 12-13%, fat 43-44% and shelf life is 3-4 months with the price for 100g is Rs 40/-. There is no information available on the preparation of fish *Sev* from *Pangasius* mince and its storage study at room temperature. Therefore an attempt has been made in the present investigation to prepare a value added product i.e. fish *Sev* with standardized recipe and protocol from *Pangasius* mince and its storage stability at room temperature. The outcome of this research will help in giving an alternative for utilization of *Pangasius* in the form of value added product i.e. fish *Sev* which will help fish farmers across the India in earning additional income.

Materials and Methods

Pangasius fish was procured from local fish market of Mumbai and brought to the laboratory in iced condition in an insulated container. The fish samples were gutted and washed properly with portable water to make it free from sand and any other impurities and then processed in a meat-bone separator (Baader694, Germany) under chilled condition (Hina *et al.*, 2017). The mince obtained was then packed in polythene pouches and kept in deep freezer (-18^{o}C) until further use.

Protocol for making fish *Sev*

The recipe and protocol for the preparation of dough for extraction of fish *Sev* was taken from the earlier work of Hina *et al.*, (2017) in making fish *chakli* with slight modification. The slightly modified recipe of fish *Sev* was achieved by varying the composition of different ingredients with mince and the standardized recipe for the same is given in Table 1. The protocol for making fish *Sev* is almost similar to that of making fish *chakli* (Hina *et al.*, 2017) where in the soft dough was prepared by mixing standardized quantities of all the ingredients as mentioned in Table 1. The dough was then given a round shape manually, smeared with oil and fed to a hand operated extruder with a diameter of 10 mm and fed directly into frying pan containing 1 L refined oil (175 ± 5^{o}C). The product was then fried by gently shaking up to 3 to 5 min till it turned golden brown. The product was then removed in another perforated tray to drain the excess oil and allowed it to cool at room temperature (Plate 1). For the storage study of 90 days at room temperature, 700g of fried *Sev*was packed in a 200µ polyethylene packets. Samples were drawn at 15 days of intervals and analysed for chemical and sensory parameters.

Analyses

Proximate composition

Proximate composition was analysed according to AOAC (2005) method. Ash content was determined in muffle furnace (Phoenix, SEM, USA) by weight loss after 5-6 hours of burning at temperature of 600^{o}C until white ash was obtained. Total protein content of the sample was analysed by using Kjeldahl method with the help of Pelican, Kelpus-KES12L VAI/Classic DXVATS apparatus. Fat content was determined by using Sohxlet method using petroleum ether. Carbohydrate content was calculated by subtracting the values of all the above from 100.Moisture content was determined by direct heating method using hot air oven at temperature 100±5^{o}C for 16-18 hours.

Biochemical analysis

TBARS value of the sample was determined according to the method described by Tarladgis *et al.*, (1960). TBARS expressed as mg malondialdehyde/ kg sample was

calculated by using Spectrophotometric method. Peroxide Value (PV) of stored sample was analyzed by AOAC, (2005) standard method.

Sensory quality evaluation

To a sensory panel of 10-12 trained members the samples were served in random order in blind trials and were evaluated on an intensity scale ranging from 1 (no intensity) to 9 (maximum intensity) for parameters viz. color, appearance, texture, odour, taste and overall acceptability.

Statistical analysis

One-way analysis of variance was performed by using the SPSS (version 16.0, Chicago IL USA). Comparison of means was carried out by Duncan's multiple range tests (Steel and Torrie, 1980). All the experiments were carried out in triplicate.

Results and Discussion

Standardization of recipe for fish *sev*

The commercially available *sev* or *bhujia* in the market is generally made from starch base material. However when *sev* is to be prepared from fish mince then it becomes little challenging as fish protein will be added into it which may affect the textural properties of *sev*, especially the crispiness. Therefore it becomes very important to carefully standardize the amount of fish mince along with other common ingredients to be added into it. Accordingly the different combinations of fish mince and other ingredients were tried and a recipe of fish *sev* was standardized as mentioned in Table 1. From the table, it can be seen that when fish mince of 1Kg is added with rice flour (500g), Bengal gram flour (500g), red chilli powder (25g), sodium bicarbonate(10g), salt (25g) and oil (1 lit), it resulted in the preparation of good quality *sev* (Table 1). The results also suggested that the fish mince quantity can be kept around 50% of the total composition. This not only helped in maintaining the textural properties of *sev* but also improved the nutritional quality and overall acceptability. Hina *et al.*, (2017) also reported almost similar composition for the preparation of fish *chakli*.

Nutritional value of fish *Sev*

The nutritive value of any product is determined based on the quantity of protein, fat, minerals, vitamins and carbohydrates present in it. The fish *sev* prepared in the present investigation has 13.89% protein, 24.58% fat, 3.40% ash (minerals and vitamins) and 57.59% of carbohydrates. Some of the traditionally prepared *sev* have the protein content in the range of 8 to 10%. However in the present investigation the protein content in *sev* was higher (13.89%) due to the addition of fish mince into it. Nevertheless the quantity of fish mince could not be increased beyond 50% as it made the texture of fish *sev* more hard.

Changes during storage of fish *sev*

The shelf life study of fish *sev* was conducted for 90 days at room temperature to check the acceptability of the product based on changes in the proximate composition, biochemical quality indices and sensory quality parameters

Proximate composition

Changes in moisture content

The changes in moisture content of fish *sev* are depicted in Figure 1 (a). From the figure, it can be seen that the moisture content of fish *sev* increased gradually from 1.89% to 4.74% during 90 days of storage period at room temperature. The gradual increase in the

product may be due to variation in atmospheric relative humidity of the packed material and outside relative humidity which might have resulted in the absorption of moisture from the surrounding. The results in the present investigation are in agreement with some of the reports where in the similar increase in moisture content of the snacks products were observed. Yu *et al.,* 1981; King, 2002; Nurul *et al.,* 2009, 2010 and Neiva *et al.,* 2010 were also observed the great variations in moisture content in the deep fried snacks prepared from rice flour and *Colocasia Sevian* stored at room temperaturefor60 days. Similar increase in moisture content was also observed by Kaur and Aggarwal, 2015 in potato rice based *chakli* and Waghray and Gulla (2010) in fried *Sev* and *Boondi*. Hina *et al.,* (2017) also observed gradual increase in the moisture content of fish *chakli* when stored at room temperature for 90 days.

Changes in protein content

The changes in protein content of fish *sev* during 90 days storage at room temperature is shown in Figure 1(b). From the results, it was observed that the protein content was decreased from 13.89% to 13.37%. This reduction in protein content might be due to increase in moisture content and some protein also degraded due to oxidation. These results are in agreement with Agbemafle *et al.,* (2014) who reported decrease in protein content of cream-skinned sweet potato during storage. The gradual decrease in protein content of fish *chakli* was also observed by Hina *et al.,* (2017) during 90 days storage at room temperature.

Changes in fat content

The fat content of fish sev reduced insignificantly from initial value of 24.58% to 24.39% at the end of 90 days storage at room temperature (Fig. 1c). These slight variations may be due to the fat absorbed by the *Sev* during frying and factors such as type of raw material, fish species and inclusion levels of the ingredients (Nural *et al.,* 2010). Agbemafle *et al.,* (2014) also observed the similar values for fat content. The slight reduction in the fat content of the product in the present investigation might also be attributed to the oxidation of fat during storage which also correlates very well with the increase in PV and TBA value of the product in the present investigation. The insignificant reduction in fat content was also observed by Hina *et al.,* (2017) during 90 days storage of fish *chakli* at room temperature.

Changes in ash content

The ash content of the fish *sev,* which mostly represents the presence of minerals and vitamins was analyzed during 90 days storage and the results are depicted in Figure 1(d). The initial value of ash content in the product was 3.40% which was decreased to 2.84% at the end of 90 days storage. The ash content of the fried *Sev* is similar to those found in other types of fish snack (Siaw *et al.,* 1985; Yu *et al.,* 1994; King, 2002; Nural *et al.,* 2010; Neiva *et al.,* 2011 and Netto and Filho, 2014). Hina *et al.,* (2017) also observed the reduction in ash content of fish *chakli* during storage at room temperature.

Changes in carbohydrate content

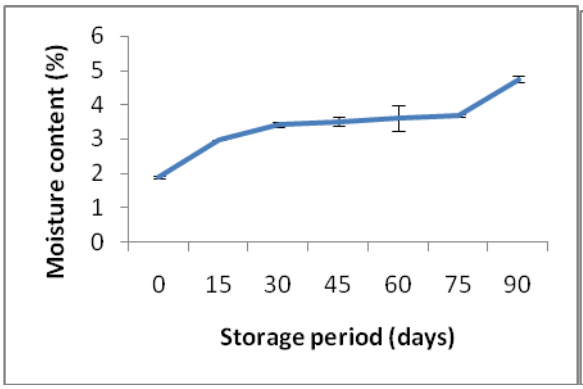
Among all the constituent reported in *sev*, carbohydrate content was higher (57.59%) in the product and this may be attributed to the addition of almost 50% starch based material i.e. rice flour and Bengal gram flour in to the product. From the results, it was observed that the carbohydrate content decreased gradually from initial values of 57.59% to 55.70% during 90 days of storage at room temperature. This might be attributed to increase in moisture content of *Sev*.

Table.1 Standardised recipe of fish *Sev*

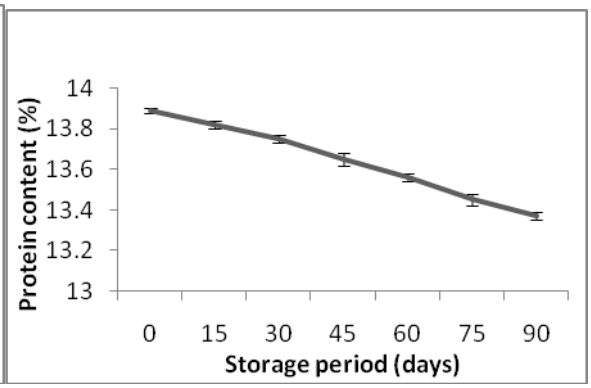
S. No.	Ingredients	Quantity
1.	Fish meat (boiled)	1000g
2.	Rice flour	500g
3.	Bengal gram flour	500g
4.	Red chilli powder	25g
5.	Sodium bicarbonate	10g
6.	Salt	26g
7.	Oil	1 lit

Plate.1 Fish *Sev* from *Pangasisus* mince

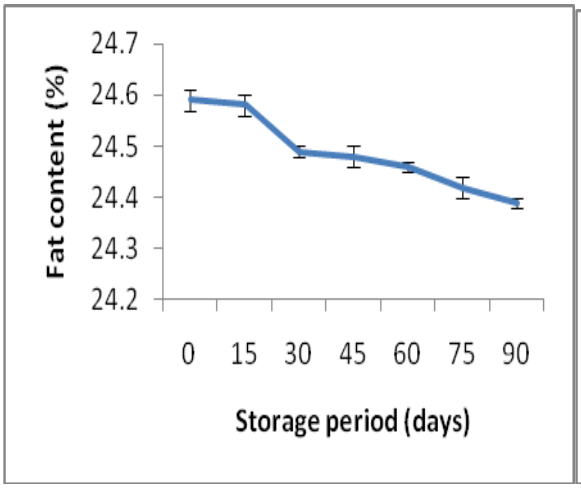
Fig.1 (a, b, c and d) showing proximate composition of *Sev*



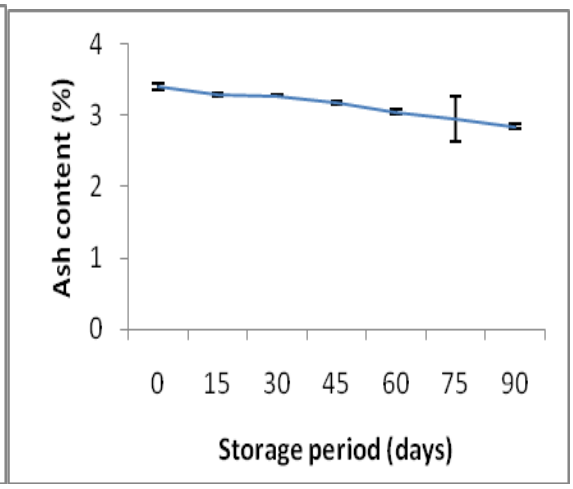
1(a)



1(b)



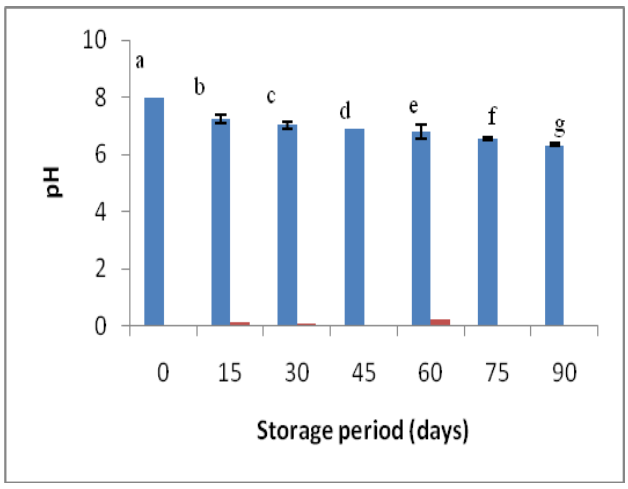
1(c)



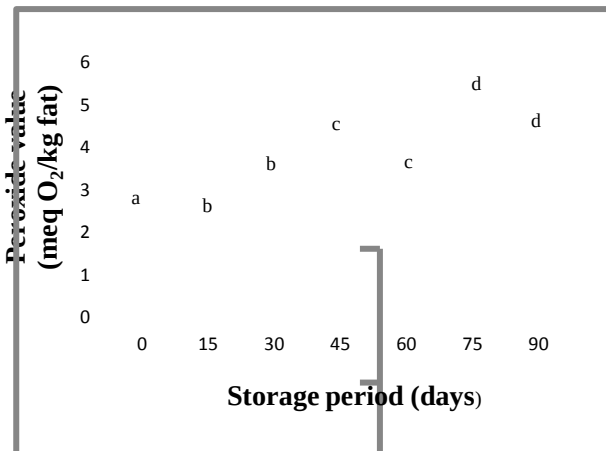
1(d)

Bars represent standard deviation of means (n=3)

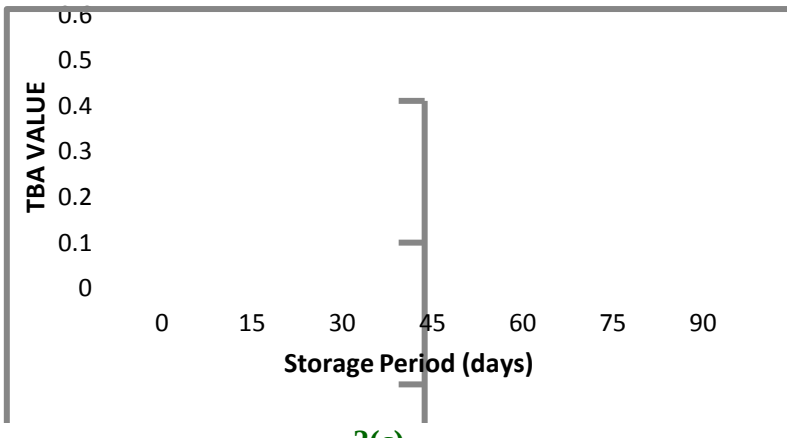
Fig.2 (a, b and c) Biochemical parameters of *Sev*



2(a)



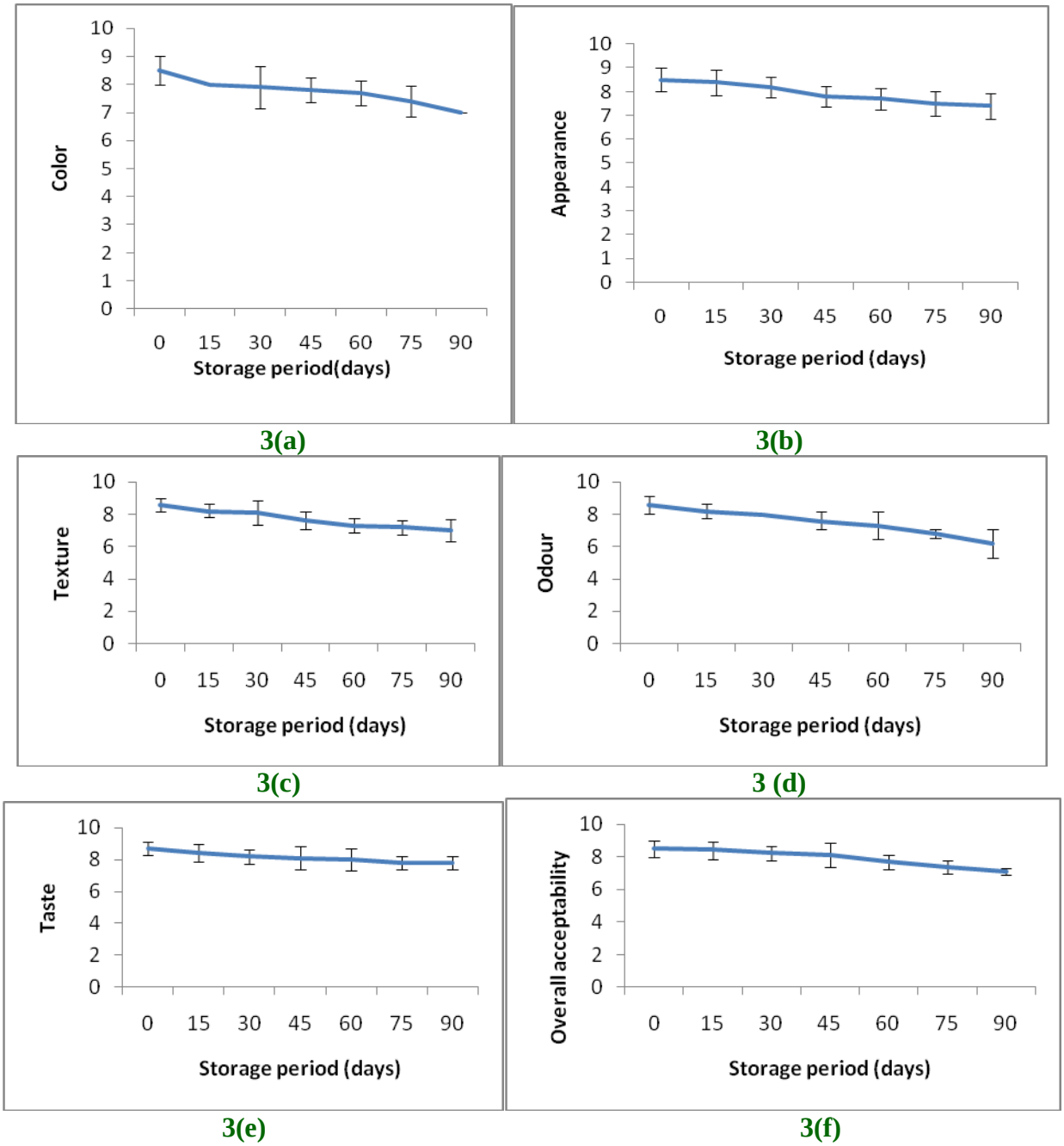
2(b)



2(c)

Bars represent standard deviation of means (n=3)

Fig.3 (a, b, c, d, e and f) Sensorial quality evaluation of *Sev*



Bars represent standard deviation of means (n=3)

Similar results were obtained by Agbemafle *et al.,* (2014) and Hina *et al.,* (2017).

Changes in quality indices

The products get spoiled mainly due to enzymatic and bacterial activity on the major constituents of the product i.e. protein, fat and carbohydrate which results in the breakdown of those constituent to free fatty acids or bases. This leads to formation of off colour and odour to the product. The oxidation of the fat results in the formation of peroxides and aldehydes which give the rancid smell to the

product. The quality indices like pH, PV and TBARS values of the products were checked during 90 days of storage study at room temperature.

Changes in pH value

The changes in the pH value of the fish *sev* were recorded and shown in Figure 2(a). From the figure it can be seen that the pH of the product decreased gradually from an initial value of 7.23 to 6.63 at the end of 90 days storage period.

This decrease in pH can be attributed to the formation of free fatty acids by the lipolytic enzymes. It is an established fact that a decrease in pH is usually attributed to the metabolic activity of bacteria (Jay, 1996). Breakdown of carbohydrate by bacteria results in the formation of lactic acid leading to reduce the pH (Incze, 1992). Hina *et al.*, (2017) also reported gradual reduction in the pH of fish *chakli* during 90 days storage at room temperature.

Changes in Peroxide values (PV)

Changes in Peroxide values during 90 days storage of fish *sev* are shown in Figure 2(b). The values for PV increased significantly ($P<0.05$) throughout the storage and reached to 5.08 meqO_2/kg fat on 90^{th} day of storage from initial value of 2.05 meqO_2/kg fat. Fish *sev* contained high fat (24.58%) and the oxidation of that fat might have resulted in increased PV in the present investigation. Kulkarni *et al.*, (1994) reported an increased PV in stored *bhujia* prepared from different cereal legume mixtures. Similar observations of increased PV were reported by Berry *et al.*, (1986) in deep fried potato snacks and by Kaur and Aggarwal (2015) for fried Potato rice based *sev*. Hina *et al.*, (2017) also reported increased PV in fish *chakli* during 90 days storage period.

Changes Thiobarbituric Acid (TBA)

The changes in TBA values of fish *sev* during 90 days storage period is mentioned in Figure 2(c). From the results it is evident that the TBA values for fish *sev* was increased gradually form 0.15 to 0.51. The malonadldehydes are formed as end products of secondary oxidation reaction of lipids and the same reacts with the TBA reagent indicating the formation of aldehydes. Aubourg and Medina (1999) has reported that unstable primary oxidation products i.e. hydroperoxides are decomposed rapidly into secondary oxidation products such as aldehydes and ketones. The results obtained in the present investigation are in agreement with the findings of Nikoo *et al.*, (2010) and Zakipour and Baker (2011). However, the values of TBA were within the acceptable limits at the end of 90 days storage.

Sensory quality evaluation

The fish *sev* was served to the trained panelist at regular intervals up to 90 days of storage and the changes in the panelists scores for various sensory attributes i.e. color, appearance, texture, odour, taste and overall acceptability of products are given in Figures 3a, 3b,3c, 3d, 3e and 3f respectively. It was observed from the figures that there was continuous decrease in all the sensory parameters throughout the storage period of 90 days. The changes in sensory properties of any food products are directly related to the chemical reactions taking place in it due to enzymatic and microbial activity. This is very well correlated with the increased PV and TBARS values of the fish *sev* in the present investigation. However the scores for all the parameters were within the rejection limit i.e., 4 for fish *sev* at the end of 90 days.

The product prepared from *Pangasius* mince i.e. fish *sev* has got good acceptability by the

panelists with protein content of 13.89%. The fish mince up to 50% can be incorporated into this product without affecting its textural properties. This type of snack product can be a good alternative not only for the traditional starch based products available in the market but also it can be an alternative for the proper utilization of *Pangasius*. This will not only help the *Pangasius* farmers in India but also will be helpful for the fish processing industries of India.

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