International Journal of Current Advanced Research
ISSN: O: 2319-6475, ISSN: P: 2319-6505, Impact Factor: 6.614
Available Online at www.journalijcar.org
Volume 9; Issue 05(A); May 2020; Page No.22077-22081
DOI: http://dx.doi.org/10.24327/ijcar.2020.22081.4350

Research Article

NUTRITIONAL, MICROBIAL AND SENSORY QUALITIES OF CUTLETS, NUGGETS AND FINGERS PREPARED FROM *SCOMBEROMORUS GUTTATUS*

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A R T I C L E I N F O

Article History:
Received 14th February, 2020
Received in revised form 29th March, 2020
Accepted 05th April, 2020
Published online 28th May, 2020

Key words:

Scomberomorus guttatus, value added products, fish cutlets, fish nuggets, fish fingers, sensory quality.

A B S T R A C T

Fish muscle is very important because of its distinctive composition and hence considered quality food for human consumption. High-protein contents, as well as essential amino acid profile and less stroma make it easily digestible. It is an important raw and good quality material to make different food products. Fish products are very important for human nutrition, however, its economic value is not that much high according to the current situation. A quality evaluation and shelf life studies were conducted for fish value added products named as cutlets, nuggets and fish fingers prepared from edible marine fish *Scomberomorus guttatus* under room and chilled storage. The organoleptic, chemical and microbiological quality attributes were evaluated for the ready to eat products (fish cutlet, fish nuggets and fish fingers) from under chilled storage. Form the present results fish cutlets, nuggets and fingers showed a decrease trend in moisture and protein content and increased trend in pH and ash content. Total viable count of ready to fry products showed an increasing trend during the storage period. In the present result, fish cutlet was in acceptable condition up to 15 - 25 days; fish nuggets up to 18 - 20 days and fish fingers up to 8- 12 days. Scores for sensory parameters such as appearance, colour, flavour, odour, mouth feel, texture and overall acceptability of ready to eat products were determined during the storage period; it showed a decreasing trend but was within the acceptable limits.

INTRODUCTION

In India, about two-third of the total landed fish are consumed in fresh condition, and the remaining is preserved by various methods. All over the world, food technologists are focusing much attention on the development of products based on consumer acceptance (Joseph, 2003). Throughout the world, among the non vegetarian eaters, the demands for the fishery products become increasing day by day. Value addition means any addition activity that in one way or the other change the nature of a product thus adding to its value at the time of sale. The present day consumer particularly urban consumers are showing more and more interest in food products which are available in ready-to-eat or ready-to-cook form such as fish fillet, fish pickle, fish muruku, fish fingers, cutlet, patties, burger, sausages and fish balls. These food items are called convenient products. The global demand for such products is increasing rapidly. Present trends marketing reflect a rapidly growing demand for such processed foods that are more convenient to handle, store and prepare.

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Value added fish products may be i) mince or mince based products ii) battered and breaded or coated products and iii) surimi based products. Fish mince or minced fish is the flesh separated from the fish in a comminute form free from scales, skin and bones. The fish is often gutted and washed before preparation of mince. The fish mince finds application in processing several 'convenience foods'. Battered and breaded product is 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 and thus reducing the cost product, coating enhances the appearance, colour, texture and taste of food products and also the nutritional value of the product (Rathod *et al*., 2012). Batters are covered on the surface of food products to form the crust during deep-fat frying. The crusts of fried products can provide the crisper texture, golden yellow colour and can act as a barrier against the loss of moisture by protecting the natural juices of foods (Mohamed *et al*., 1998).

Battered and breaded fish products can undergo undesirable changes during frozen storage time due to microbial contamination from various sources and rapid spoilage as a result of protein denaturation (Benjakul *et al*., 2005) and lipid oxidation leading to loss of quality. Sensory evaluation is used to assess the degree of freshness based on organoleptic

characteristics such as colour, odour and texture of the product. So it is necessary to assess the nutritional and microbial quality of ready to eat fish products. The aim of this study was to produce ready to eat fish products such as fish cutlets, fish nuggets and fish fingers from *Scomberomorus guttatus* and to investigate the biochemical, microbiological and sensory quality changes during refrigerator storage.

MATERIALS AND METHODS

Sample collection and preparation

Freshly landed *Scomberomorus guttatus* were collected from Pamban (Landing centre) at Rameswaram, South east coast of India. The samples were transported to the laboratory and preserved in a deep freezer at -20°C until examination and analysis. Upon arrival, fish samples were washed thoroughly with potable water then beheaded, gutted and again washed meat was separated and minced or filleted by hand.

METHOD

Fish cutlet

Ingredients and method for preparation

Based on the highest average organoleptic scores for all attributes, the best recipe was selected with the ingredients of fish mince 100g, potato - 4 medium size, onion - 1 medium size, ginger - half inch, garlic -3 piece, green chilli - 1 large size, turmeric powder- half spoon, pepper powder -1 tsb, cumin - 1 g, coriander leaves - as per need, curry leaves - as per need, common salt - as per need, bread crumbles-100g, egg - 2 nos, oil - 200ml, vinegar -1ml.

METHOD

The minced fish were boiled for 10 minutes with the addition of turmeric and vinegar. Flesh was separated manually from cooked mince which yield 40% of meat based on total weight of flesh. The boiled and peeled potatoes were made into paste. Onion, ginger and chilli were chopped into small size and fried in double refined groundnut oil until brown in colour. Fish mince was mixed thoroughly with potato, ginger, garlic, onion, pepper, coriander leaves, salt and cumin. A small amount of dough was made into balls and flattened to 2 cm thickness. This was dipped in beaten egg- white and rolled in bread crumbs. The breaded cutlet was deep fried in hot oil until brown colouration. Fried cutlets were packed with aluminium foil packed in air-tight containers and stored in refrigerator. Analytical procedure for biochemical, microbiological and sensory quality changes were done on 0 to 25th day of storage.

Fish nuggets

Ingredients and method for preparation: Fish mince 100 g, pepper - 2 g, salt - as per need, turmeric powder - 2 g, vinegar - 1ml, all purpose flour- 2 g, corn flour - 2 g, bread crumbs - 100g, oil - 200 ml.

Batter preparation: All purpose flour (maida) and corn flour powder was mixed with water and make in to thick paste.

The minced fish were boiled for 10 minutes with the addition of turmeric, pepper, salt and vinegar and flesh was separated manually from cooked mince which yield 40% of meat based on total weight of flesh. The cooked mince was mixed thoroughly with all purpose flour, corn flour powder, pepper and salt. A small amount of dough was made into desired shapes. This was dipped in batter and rolled in bread crumbs. The breaded fish nugget was deep fried in hot oil until brown colouration. Both raw and fried fish nugget were packed with aluminium foil packed in air-tight containers and stored in refrigerator. Analytical procedure for biochemical, microbiological and sensory quality changes were done on 0 to 20th day of storage.

Fish fingers

Ingredients and Method for preparation

Fish fillet - 100g, turmeric powder - 1 tsp, chilli powder - 1 tsp, cumin powder - 1 tsp, coriander powder - 1 tsp, ginger and garlic paste - 1 tsp, salt - as per need, pepper - ¼ tsp, lemon juice – 1 tsp, all purpose flour - 1 tsp, egg - 1 number, bread crumbs - 100 g.

The fish fillets were cut in to finger size. Finger sized fish meat were mixed with turmeric powder, cumin powder, coriander powder, chilli powder, pepper powder, ginger and garlic paste, egg, salt and lemon juice and the mix were kept for 30 minutes for marinate. The marinated fillets were rolled in to bread crumbs and deep fried in hot oil. Both raw and fried fish fingers were packed in an aluminium foil then packed in air-tight containers and stored in refrigerator. Analytical procedure for biochemical, microbiological and sensory quality changes were done on 0 to 12th day of storage.

Determination of proximate composition

To estimate the freshness and nutritional quality pH, moisture, protein, lipid and ash contents were analyzed in all the value added fish products prepared from *Scomberomorus guttatus*. The pH value of the products was measured by following method of Ronalad and Ronald (1991). Protein content (Lowry *et al*., 1951), moisture and ash contents (AOAC 2005) were measured in all the value added products.

Microbial analysis

One gram (1g) of fish sample was dissolved in sterile deionized water and serially diluted. 1 ml of appropriate dilutions was seeded on plate count agar using spread plate method, and the medium was then incubated at 37° C for 24 hours. The plate count agar was examined and colonies present were counted and recorded after incubation at 37° C for 24 hours to get the total viable count in cfu/g .

Sensory analysis of fish products produced from Scomberomorus guttatus

During the storage studies, various sensory characteristics such as appearance, colour, flavour, odour, mouth feel, texture and the overall acceptability were evaluated by a group of 7 panellists using a nine (9) point hedonic scale. The average score of 5 was considered to be the borderline of acceptability (9- like extremely; 8- like very much; 7- like moderately; 6- like slightly; < 5 bad) (Peryan and Pilgrim, 1957).

RESULTS

pH, moisture, protein, lipid, ash and TVC count of raw muscle of *S. guttatus* were found to be 6.91, 73.9%, 22.2%, 1.56% and 3×10^2 cfu/g respectively (table 1). The changes in proximate and microbial count of fish cutlets, fish nuggets and fish fingers during storage period were presented in tables 2 and 3. On the initial day of the storage period the values of moisture, protein, lipid and ash contents of fish cutlet were recorded as

63.1 ± 0.1%, 19.6 ± 0.1%, 10.50 ± 0.01% and 2.5 ± 0.07% respectively. On the final day of the storage period (25th day) the values were 51.9 ± 0.02%, 12.9 ± 0.02%, 11.0 ± 0.01% and 3.0 ± 0.07% respectively. On the initial day of storage period the fish nuggets had 51.2 ± 0.1% of moisture, 18.3 ± 0.16% of protein, 11.60 ± 0.01% of lipid and 2.6 ± 0.1% of ash content. The fish nuggets kept in storage for 20 days had 49.4 ± 0.02% of moisture, 11.8 ± 0.1% of protein, 12.05 ± 0.007% of lipid and 2.91 ± 0.015% of ash content. Fish fingers showed 63.3±0.25% of moisture, 13.1 ± 0.1% of protein, 12.52 ± 0.02% of lipid and 2.52 ± 0.22% of ash content on the initial day of storage. On the final day of storage (12th day) fish fingers stored at the refrigerator temperature were found to be 48.6 ± 0.2%, 11.5 ± 0.1%, 13.30 ± 0.01% and 2.73 ± 0.22% respectively.

At the end of the experiment, the fish cutlets, nuggets and fish fingers kept in refrigerator storage showed slight variation in the proximate composition. pH and TVC at the initial and final days of fish cutlets, nuggets and fish fingers were recorded in table (3). The initial pH values of fish cutlets, nuggets and fish fingers were recorded as 5.81 ± 0.07, 5.63 ± 0.12 and 5.72 ± 0.07. At the end of the refrigerated storage period in fish cutlets, nuggets and fish fingers, pH values were increased and recorded as 5.81 ± 0.07 to 5.96 ± 0.0 in fish cutlets; 5.63 ± 0.12 to 5.72 ± 0.01 in fish nuggets and 5.72 ± 0.07 to 5.75 ± 0.0 in fish fingers. TVC in initial and final days of fish cutlets, nugget and fish fingers were recorded as 1.4×10^3 Cfu/g to 2.0×10^3Cfu/g, 1.6×10^3 Cfu/g to 2.2×10^3 Cfu/g and 2×10^3 Cfu/g to 3×10^3 Cfu/g respectively.

The results of organoleptic evaluation of fish cutlets, nuggets and fish fingers during refrigerator storage period were recorded in table (4). On the initial day scores for appearance, colour, flavour, odour, mouthfeel, texture and overall acceptability of fish cutlets were 8.71,9.0, 9.0, 8.71, 9.0, 8.71 and 9.0 and on the final day (25th day) 7.28, 6.57, 6.42, 6.28, 6.0, 6.0 and 6.14 respectively. On the first day scores of fish nuggets were 9.0, 8.71, 9.0, 8.57, 9.0, 8.42 and 9.0. At the end of the 20th day the values were recorded as 6.14, 6.42, 6.71, 6.42, 6.14, 6.28 and 6 respectively. Similarly on the first day scores for appearance (9.0), colour (9.0), flavour (8.71), odour (8.42), mouth feel (8.71), texture (8.57) and overall acceptability (9.0) were recorded in fish fingers. At the end of the 12th day the scores were recorded as 6.0, 6.28, 6.28, 5.85, 6.28, 5.57 and 6.0 respectively.

DISCUSSION

Fish mince based convenient products have become much popular among consumers. Therefore, incorporating fish mince with non-meat protein becomes an important production approach for reducing the cost and improving the nutritional, physical and sensory properties of the product (Jayasinghe *et al*., 2005). The proximate composition values of fish cutlets, nuggets and fish fingers were changed during storage period. Loss of moisture content was observed in all three products, which may be due to the evaporation of moisture from products during storage. This statement was in agreement with the findings of Rani *et al*., (2017), who reported that during frozen storage of fish cutlets and fingers, the moisture content decreased, which may be due to the drip loss thawing of the products. Similar work was reported by Rathod and Pagarkar (2013), who found that moisture, protein and ash content of Pangasius fish cutlet were 53.34%, 18.43% and 2.78%, which at the end of the storage period in refrigeration showed slight variation in moisture (53.34 to 53.03%), protein (18.43 to 17.3%) and ash content (3.28 to 3.85%) in the sample during storage for 18 days. Pandey and Kulkarni (2007) reported a decrease in the moisture content in grass carp cutlets and fish fingers during the frozen storage at -18°C for 6 months. The results were in agreement with the findings of Hassaballa *et al.,* (2009) in fish fingers with pre-frying and Cakli *et al.,* (2005) in fish fingers produced from sardine. Surabhi and Das (2007) found that decrease in moisture content in carp fish cutlet during storage at -18°C for six months.

During the refrigerator storage the decrease in protein and increase in ash content of fish cutlets, nuggets and fish fingers were observed in the present study. The reduction of protein is due to denaturation of fish muscle during chilled and frozen storage (Gopakumar, 2002). The reduction in protein content can be attributed to the leaching out of water soluble nitrogenous compounds, along with moisture during storage. Sehgal *et al*., (2010) suggested that cooking can be a possible reason for reduction in the protein content. Bavitha *et al*., (2016) found that the protein content of fish cake decreased during refrigerated storage period.

During the refrigerator storage the increase in lipid can be attributed to the decrease in moisture content as they are inversely propositional. Similar observation was found by the Ucak *et al*., (2011) during the refrigeration storage of mackerel fish burger for 15 days. During the refrigerator storage the increase in ash content of fish cutlets, nuggets and fish fingers were observed. The ash content of the fish product was higher due to the addition of the ingredients during the preparation of fish products (Praneetha *et al*., 2015). The present result was agreed with the findings of Elyasi *et al*., (2010), who reported that the increased ash content in carp fish fingers from 4.33 ± 0.57 to 6.50 ± 0.0%. Pawar (2011) reported that moisture, protein, fat and ash content in flash fried cutlets as 65.71%, 16.57%, 14.50% and 3.22% respectively, which after chilled storage for 13 days were 65.50%, 15.53% 15.05% and 3.92% respectively. Pilankar *et al*., (2016) also reported that moisture, protein, fat and ash contents in Dhoma fish cutlets (67.40%, 14.86%, 15.43% and 2.31% respectively), which after storage of 180 days were 66.81%, 13.35%, 16.38% and 3.46% respectively.

The change in pH of the fish muscle is usually a good index for quality assessment. It is important determining of fish quality as texture of fish (Vareltzis *et al*., 1997). In the present results the pH value of fish cutlets, nuggets and fish fingers showed slightly increased after cooking process and during frozen storage. The increase in pH value could be associated with the production of basic compounds induced by the growth of bacteria (Simeonidu *et al*., 1998). Turhan *et al*., (2001) reported that pH values of anchovy patties increased from 6.33 to 6.56 after 10 days of storage. Kilinc (2009) determined the pH value of anchovy patties was 6.14 on first day of storage and then increase to 6.36 at the end of the storage period of 5 days.

The results showed that the low level of TVC on the initial day of storage is attributed mainly due to the cooking process at 180 °C for 5 minutes and deep frying. It may be due to the absorption of more oil during frying, which makes the water activity considerably low for grow of spoilage microorganisms, but the microbial load was increasing in all

products during storage may be due to possible fluctuation in storage temperature. Due to that the sample reached the level of rejection on fish cutlets, nuggets and fish fingers on 25, 20 and 12 days of storage. Cakli (2005) found that fish fingers made from different fish species bacterial concentration ranging from 4.50 to 4.61 log/Cfu immediately after frying. Talab *et al*., (2014) also recorded that the increased trend in total viable count of carp cutlets during frozen storage period (2.80 to 5.15 log Cfu/ g).

Sensory evaluation is used as one of the indices for measurement of fish quality during storage. Assessment of organoleptic indices along with chemical and microbial tests is necessary for evaluation of spoilage rate and shelf life of fish and fish products. Battered products have better flavour, texture and appearance and battering is considered a protection against moisture and natural concentrate losses as it contrasts to effect of freezing or reheating. Therefore, battering makes the inside of products juicy while the outside looks crispy (Fiszman and Salvador, 2003). The shelf life of fish and fishery products mainly depend on the sensory characteristic, which are determined by the sensory evaluation of panellists. In the present investigation, the sensory values gradually reduced during storage period; there was slight decline in appearance, colour, flavour, odour, mouth feel, texture and overall acceptability in fish cutlets, nuggets and fish fingers. On the first day the fried cutlets, nuggets and fingers sample had a better appearance. Coatings by battering and breading enhance food product characteristics such as appearance, colour, flavour, odour, mouthfeel and texture. The process protects the natural juicy of foods from the effects of freezing or reheating, thereby ensuring a final product that is tender and juicy on the side and at the same time crisp on the outside (Joseph, 2003).

The results of sensory evaluation of fish cutlets kept in storage showed decrease in overall acceptability of cutlets when storage period increased from 20 to 25 days. In the present study the fish cutlets had shelf life of 25 days in refrigerator storage. Fish nuggets also showed decreased overall acceptability, when storage period increased from 18 to 20 days and the ideal shelf life noted was 20 days. Overall acceptability of fish fingers also decreased during storage period increased from 8 to12 days and the recorded shelf life of fish fingers was 12 days. Pawar (2011) reported that organoleptic score of *Catla catla* fish cutlets kept in chilled storage was slightly decreased in overall acceptability from 0 - 18 days during storage at - 2 to - 4ºC. Vanitha *et al*., (2013) found that *C. catla* fish cutlets remained acceptable upto 180 days of frozen storage at 2°C. Praneetha *et al*., (2015) found that overall mean acceptability of fish fingers declined, while increasing the storage period and also report the ideal shelf life of fish fingers was found as 9 days. Boran and Kose (2007) and Tasakaya *et al*., (2003) also stated that shelf life of various fish product stored in refrigerator condition are 9 to 11 days.

CONCLUSION

The increase in population and increase in urbanization, people are having less time and are looking for ready to eat food products. From the results, it was observed that the quality of fish products (fish cutlets, fish nuggets and fish fingers) during refrigerated storage were within the acceptable limit. Despite a decline in various sensory qualities with the increase in storage period, the fish products were acceptable up to 12 to 25 days. It was established that all quality criteria mentioned above included the microbiological analysis were not reached the maximum limits for the acceptability of fish products. In conclusion, it hoped that the information presented in this study will promote the greater and more effective use of simple homemade fish products.

Table 1 Proximate composition and microbial count of raw fillets of *S. guttatu*s

S. No.	Parameters	Raw fillets
1.	Moisture (%)	73.9± 0.07
2.	Protein (%)	22.2±0.10
3.	Lipid (%)	0.22± 0.10
3.	Ash (%)	1.56±0.02
4.	pH	6.91±0.07
5.	TVC (Cfu/g)	3.0×10^2

Values are shown as mean ± SD

Table 2 Proximate composition of fish cutlets, nuggets and fish fingers during storage period

S.No	Parameters	Fish cutlets		Fish nuggets		Fish fingers	
		Initial	Final	Initial	Final	Initial	Final
1	Moisture (%)	63.1±0.10	51.9±0.02	51.2 ± 0.10	49.4±0.02	63.3±0.25	48.6±0.2
2	Protein (%)	19.6±0.10	12.9±0.02	18.3±0.16	11.8 ± 0.10	13.1±0.10	11.5±0.10
3.	Lipid (%)	10.5±0.01	11± 0.01	11.60±0.01	12.05±0.007	12.52±0.02	13.30±0.01
3	Ash (%)	2.5±0.07	3.0±0.07	2.6±0.10	2.91±0.07	2.52±0.22	2.73±0.22

Table 3 pH and Total Viable Count of fish cutlets, nuggets and fish fingers during storage period

S.No	Parameters	Fish cutlets		Fish nuggets		Fish fingers	
		Initial	Final	Initial	Final	Initial	Final
1.	pH	5.81±0.07	5.96±0.0	5.63±0.12	5.72±0.07	5.72±0.07	5.75±0.0
2.	TVC(Cfu/g)	1.4×10^3	2.0×10^3	1.6×10^3	2.2×10^3	2.0×10^3	3.0×10^3

Values are shown as mean ± SD

Table 4 Sensory analysis of fish cutlets, nuggets and fish fingers during storage period

Parameters	Fish cutlets		Fish nuggets		Fish fingers	
	Initial Day	Final Day	Initial Day	Final Day	Initial Day	Final Day
Appearance	8.71±0.50	7.28±0.50	9.0±0.00	6.14± 0.90	9.0±0.00	6.0±0.81
Colour	9.00±0.00	6.57±0.97	8.71±0.50	6.42±0.98	9.00±0.00	6.28±0.76
Flavour	9.00±0.00	6.42±0.79	9.00±0.00	6.71±0.95	8.71±0.54	6.28±0.76
Odour	8.71±0.50	6.28±0.76	8.57±0.54	6.42±0.98	8.42±0.54	5.85±0.90
Mouth feel	9.00±0.00	6.00± 1.15	9.00±0.00	6.14±0.90	8.71±0.50	6.28±0.76
Texture	8.71±0.70	6.00±1.15	8.42±0.54	6.28±0.76	8.57±0.54	5.57±0.98
Overall acceptability	9.00±0.00	6.14±0.90	9.00±0.00	6.00±1.15	9.00±0.00	6.00±0.79

Values are shown as mean ± SD

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How to cite this article:

Merline, X. and Dr. Chitra, G (2020) 'Nutritional, Microbial and Sensory Qualities of Cutlets, Nuggets and Fingers Prepared from Scomberomorus Guttatus', *International Journal of Current Advanced Research,* 09(05), pp. 22077-22081. DOI: http://dx.doi.org/10.24327/ijcar.2020.22081.4350

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