International Journal of Chemical Studies

P-ISSN: 2349–8528
E-ISSN: 2321–4902
IJCS 2020; 8(1): 2350-2353

Received: 04-11-2019
Accepted: 06-12-2019

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Effect of time & temperature on fry fish cutlet of Indian mackerel (*Rastrelliger kanagurta)* & evaluation of quality changes

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DOI: https://doi.org/10.22271/chemi.2020.v8.i1aj.8620

Abstract
Investigations were carried out on the development of ready to cook fish paste products from Indian mackerel (*Rastrelliger kanagurta*). The fish cutlet was produced by using Indian mackerel because of its abundance and comparatively low price. The sample selected was of the average weight of 1.6 kg from which the yield of picked meat was 400 grams. Here potato was used for the binding purpose, and egg and bread crumb were used for coating in fish cutlet. Different time and temperature were used in which the T3 sample was fried at 180 °C for 2, 3 and 4 minutes, T2 sample was fried at 170 °C for 2, 3 and 4 minutes and T1 sample was fried at 160° C for 2, 3 and 4 minutes. Then all 27 fried samples were judged by 9 members for Sensory evaluation of fish cutlet product. In sensory evaluation include appearance, Color, texture, odor, and overall acceptability, etc. During the sensory evaluation, the T3 sample (at 180° C for 3 minutes) was best in sensory characteristics. So, at increasing temperature with decreasing time duration for frying of fish cutlets was increasing demand for consumption.

Keywords: Indian mackerel, value-added product (Fish cutlet), battered, breaded, time, temperature, frying, sensory evaluation

Introduction
The demand for fish is expected to exceed all the available supplies in near future, owing to revolutionary changes taking place in the dietary habit of people all over the world and the consumers look at fishery products as healthy foods. Fishery products have also become a major commodity in international trade and are a source of foreign exchange for several countries, particularly those from Asia. Owing to the stagnation of landing of high-value sea products, as a result of unplanned un-exploitation and underutilization of a significant amount of total landing, consisting of low-cost bycatch fish, there is need for the total utilization of catch to meet the increased global requirement of a commodity.

During the last few years, there has been a considerable structural change in the seafood and export industry. There is a growing demand for "Ready to Fry or Cook" Or "Ready to Eat or Serve" type seafood, which prepared from low-value fishes like mackerel, Crocker, ribbonfish, threadfin bream, lizard fish, etc. These are converted into value-added products in various forms like a fish cutlet, fish wafers, fish pickle, fish finger, fish papad, fish crackers fish noodles, etc. in which fish cutlet is one such example for diversification. According to joseph *et al.* (1984) [4], fish mince from low priced fish can be utilized for the preparation of cutlet which has a satisfactory frozen shelf life. The production of the cutlet is a viable technology to utilize low price fish and is adopted by many entrepreneurs. Joseph and Perigreen used a 50:100 ratio in cutlet prepared from mackerel. Species differentiation and a higher ratio of potato to meat increased more starch in cutlet and bind all ingredients properly. Gopakumar (1989) and Yaliger *et al*. (1993) found that the fish cutlet can be stored at -20°c for five and six months respectively.

Kamat *et al*. (2003) prepared fish cutlets from bleached and unbleached mincemeat. Fish cutlets prepared from belched mincemeat were acceptable for two months and those from unbleached mincemeat were acceptable for up to one month from organoleptic and biochemical quality. Kamat used a 50:100 ratio of potato in cutlet prepared from mackerel.

Material and Method

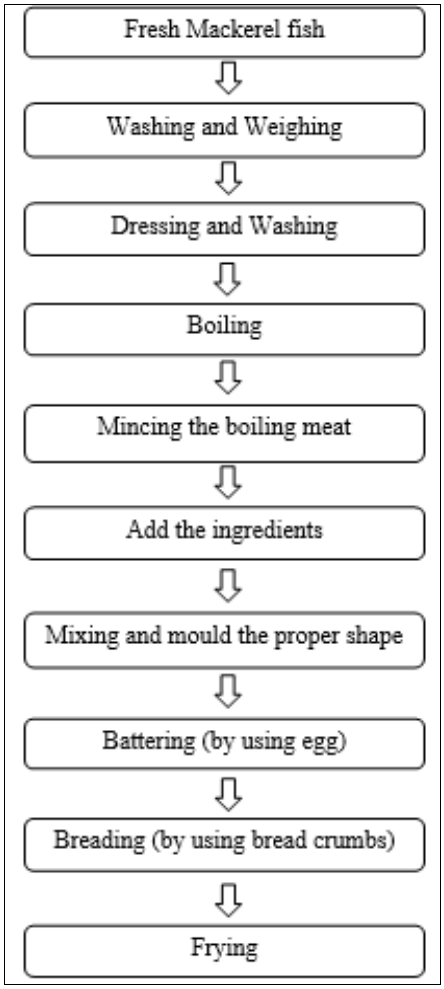
Sample preparation

Fresh Indian mackerel were collected from the fish market of Veraval, which used for the study. The fish was brought in a plastic bag to the laboratory and washed in clean potable water to make it free from sand and any other extraneous material. Washed fishes dressed hygienically and further washed it. After dressing weighing was done. Then boiled the fish for 20 minutes with the paste of green chili, ginger, and oil. Then cool for 4-5 minutes. After cooling picked meat by removing bones and skin. Picked meat mixed with mashed potatoes and other ingredients (chili powder, Garam masala, Turmeric powder, the paste of green chili and ginger, salt, baking powder, etc.). Mold it according to the required shape to the fish cutlet in deep frying machine at different times and temperatures. Battering was done by dipping in egg white and then rolled in the bread crumbs powder until the uniform coating of the breading material was on the surface.

Deep frying of the prepared cutlet.

Table 1: Formulation of fish cutlets mixture

S. No.	Name of the ingredients	Quantity
1	Boiled fish meat paste	400g
2	Boiled potatoes paste	400g
3	Ginger paste	25g
4	Garlic paste	25g
5	Red chili powder	30g
6	Turmeric powder	3g
7	Salt	7g
8	Backing powder	2g
9	Garam masala	10g
10	Egg	3 to5 piece
11	Bread Crumbs	200g



Flow chart fry fish cutlet

Analytical procedures

Instrumental color profile

The color of foods has been measured using L*a*b* or CIELab color space, which is an international standard accepted by the Commission Internationale de l'Eclairage (CIE) in 1976 (Dhimmar *et al*., 2019). Color profile was measured by whiteness meter (Konica Minolta Colorimeter CR-14) which has *L**, a* and b* values. *L** denotes lightness, a* (redness) and b* (yellowness) values were recorded on crushed kachoris kept in a group in the Petri plate. The equipment was standardized with a white color standard.

Determination of oil absorption

The percentage of oil absorption was calculated according to the standard method which is given below:

$$\text{Oil absorption (\%):} \frac{\text{Weight of kachori after frying - Weight of kachori before frying}}{\text{Weight of kachori before frying}} \text{ x } 100$$

The fish kachoris were weighed before and after frying in groundnut oil, using a digital balance. This was done in five replicates and the average weight was taken.

Proximate composition

The moisture, fat, protein and ash content of the fish kachori was estimated using an automatic moisture meter, Socs plus, Kel plus and Muffle furnace, respectively following the method of AOAC (2000) [1].

Sensory Evaluation

Nine-member experienced panel of judges including teachers and postgraduate students of the Department of Fish Processing Technology evaluated the samples for the sensory attributes viz. appearance, color, odor and overall acceptability using a 9-point hedonic scale according to standard procedure (Peryam and Pilgrim, 1957) [12]. Where, 9 = like extremely and 1 = dislike extremely.

Results and Discussions

Proximate composition

	Raw fish	Raw cutlet	Fried cutlet
Moisture	81.233±2.804	68.6±1.646	60.513±2.509
Ash	1.7±0.2	2.703±0.364	3.7933±0.237
Protein	16.866±1.1930	17.463±0.7050	21.213±1.4196
Lipid	1.666±0.3785	2.84±0.511	7.3433±1.1508

(n=3, mean±SD)

Physical analysis

whiteness before frying			
	*L**	a*	b*
T1t1	49.1±0.5	9.3±0.15	19.8±0.30
T1t2	49.0±0.61	9.3±0.2	19.8±1.3
T1t3	48.7±0.85	9.1±0.20	19.8±0.3
T2t1	49.1±0.50	9.2±0.15	19.7±0.58
T2t2	49.0±0.51	9.3±0.1	19.8±1.50
T2t3	48.9±0.58	9.3±0.1	19.6±0.47
T3t1	49.2±0.45	9.3±0.23	20.5±1.4
T3t2	49.2±0.52	9.3±0.1	20.5±1.10
T3t3	49.0±0.45	9.2±0.15	19.7±0.45

whiteness after frying			
	*L**	a*	b*
T1t1	31.9±2.95	8.5±0.781	22.9±4.30
T1t2	36.9±3.39	6.6±1.56	27.9±3.75
T1t3	46.2±0.83	1.4±1.30	32.8±1.49
T2t1	35.3±0.76	3.6±3.75	26±1.60
T2t2	41.1±1.91	2.5±1.06	32.2±1.26
T2t3	43.0±1.15	0.4±0.25	33.7±2.45
T3t1	49.2±7.63	2.2±1.32	39.8±7.53
T3t2	46.7±2.70	1.3±0.11	38.1±1.09
T3t3	35.2±1	3.6±3.75	26±1.57

Oil absorption			
	t1 (2min.)	t2(3min)	t3(4min)
T1 (160ºC)	21±2	21.6±1.55	21±3
T2 (170ºC)	15.3±1.57	16.3±1.53	17±2
T3 (180ºC)	12.6±1.52	10±1	12±1

(n=3, mean±SD)

Sensory analysis

Parameters	T1 (160ºC)			T2 (170ºC)			T3(180ºC)		
	t1(2min)	t2(3min)	t3(4min)	t1(2min)	t2(3min)	t3(4min)	t1(2min)	t2(3min)	t3(4min)
Appearance	5.8±0.2	6.3±0.1	6.7±0.15	7.3±0.15	7.6±0.1	7.6±0.15	8.1±0.1	8.6±0.1	8.1±0.15
Color	4.9±0.05	5.1±0.1	5.4±0.05	7.6±0.15	7.8±0.15	8.0±0.20	8.0±0.11	8.7±0.11	8.2±0.20
Texture	6.0±0.05	6.2±0.11	7.0±0.11	7.1±0.11	7.4±0.05	7.7±0.17	7.9±0.05	8.4±0.05	8.0±0.05
Oder	4.4±0.1	4.5±0.1	5.1±0.17	6.1±0.1	6.1±0.05	6.7±0.1	7.9±0.15	8.4±0.05	8.1±0.1
Overall acceptability	5.2±0.23	5.5±0.11	6.0±0.11	7.1±0.1	7.2±0.05	7.5±0.1	8.0±0.05	8.4±0.05	8.1±0.05

Discussion

Based on all analysis cutlet prepared at 180 ºC for 3 minutes shown good results in physical and sensory attributes. Compare to T1 and T2 treatments T3 (180 ºC for 3 minutes) has greater whiteness, low oil absorption and having good appearance, texture, color, odor and overall acceptability.

Conclusion

Small size mackerel is underutilized low priced fish. Since small mackerel is not in demand as table fish, it is diverted for drying and curing and sometimes even for manure production. This results in the loss of valuable protein-rich resources. As this species is sold at a low price, fishermen also do not get good returns for their catch. The present study outlines the scope and utilization of small-sized mackerel of low value for the development of minced meat and minced based products like a fish cutlet. Since the fish are abundantly available and low priced, developing a minced based product will bring good returns to fishermen as well as nutritious and convenience food to present-day consumers with less time to spare on preparation. In this study fried temperature is 180 °C for 3 minutes was best in terms of odor, and texture and appearance.

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