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Preparation of fish chakli by using edible fish powder (*Scomberomorus guttatus*) incorporated with different flours

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Abstract
Investigations was carried out on the development of value added snack product (fish chakli) from spotted seer fish powder (*Scomberomorus guttatus*). The fish chakli was produced by using spotted seer fish because of its abundance and popularity at veraval fishing harbor and fish market. Here, three different flours such as rice flour, wheat flour and Bengal Gram flours were used with same ratio of edible fish powder (EFP). According to proximate analysis, physical analysis and sensory evaluation the best combination was choose. The entire fried samples were evaluated by 9 members for sensory evaluation of fish chakli. Sensory evaluation includes appearance, color, texture, odor, taste, crispiness and overall acceptability. Highest sensory score appeared in combination 2 (Wheat flour: EFP). Breaking effect was appeared in combination-1 (Rice flour: EFP) and poor texture and taste was noted in combination -3 (Bengal Gram flour: EFP).

Keywords: Different flours, edible fish powder, fish chakli, spotted seer fish

1. Introduction
India has a great legacy of traditional foods, where the peoples employ the foods in a different manner like eating purpose, economic input, and many other tasks. Snacking can be explained as problem-free consumption of easy to handle, small-scale portioned, warm or cold products in solid or liquid form which need limited or no preparation and are deliberate to satisfy the hunger (Kumar *et al.,* 2012; Chudasama *et al*., 2019) [5, 3]. Snack products helps to control weight management by reducing the appetite in between meals, at the time meals, and thus preventing overeating (Kirk, 2000) [4]. Value addition is key component in food processing industry, especially in the export oriented fish processing industry through the improved awareness of highly valued foreign exchange. One such important traditional fish-based snack food is '*Chakli*' known by different names in many states of India. In Gujarat they are called "*Chakri*", "*Chakli*" in Maharashtra; in southern states of India they are called "*Murukku*". "*Chakkuli*" in Karnataka; "*Chakralu*" in Andhra Pradesh; "*Jantikalu*" in Telangana and "*Chakkuli*" or "*Chakri*" in Goa. "*Chakli*" is a deep-fried product, which is a common snack item in south India. It is available commercially in different forms and is prepared in households. Thus, fish based chakli can justify being important items to the consumer as a source of essential amino acids and other nutrients. The use of fish meat in the development of chakli will open novel chances for lucrative utilization of fish and enrich the nutritional aspect of people as well as the success of the fish industry.

Scomberomorus guttatus (Family: Scombridae) called spotted seer fish. The production of *S. guttatus* is 39,027 tonnes during 2013. In Indian waters, the Seer fish landing was highest during 2011 but on an average of 204671 tonnes has been landed during 2008-2012. Seer fishes forming 1.7% of the total marine fish catch of the country are considered as one of the high-value resources Andhra Pradesh (14.3%) and Tamil Nadu (11.5%) on the east coast and Gujarat (22.8%). Maharashtra (16.9%) and Kerala (16.1%) on the west coast are the principal contributors of seer fish. Seer Fish resource is being mainly exploited all along the Indian coast by both mechanized and non-mechanized fishing units by employing different types of gears mainly drift gill net, hooks and line, trawl net, shore-seine, etc. Hooks of different sizes are used in hand line, long line and troll lines (Sinha and Premchand, 2015) [9]. India, Indonesia, Iran, Myanmar, Pakistan, and Malaysia all have important fisheries for *S. guttatus* and the catches are largely dominated by gillnet (Secretariat, 2015) [8].

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The edible fish powder is a dried and stable form of fish which is intended for human consumption. It is a magnificent source of highly digestible amino acids and also has high gelation ability. Fish powder, which is less likely to produce unpleasant fishy odour while incorporated in various food items, would be a potential source of protein and serve as a new approach adding innovative dimension in nutritional intake, which eventually could turn out to be promising source with respect to mitigating nutritional deficiency. Thus the aim of the study is to find out the suitable combination of fish powder to flour ratio for successful development of fish chakli.

2. Materials and Methods
Fresh Spotted seer fish *(Scomberomorus guttatus)* caught from Veraval fish landing center and transported in iced condition with temperature range of 0 to 2 ^{0}C to fish processing laboratory of College of Fisheries Science, Veraval. The whole spotted seer fish was washed in chilled water before dressing. Head, gut, tail, and scales were removed manually and washed with chilled water. After washing, boiling into water (l: 2) for 30 minutes. Then meat was separated by hand picking and washed thoroughly in potable water. Then meat put in oven for drying and Fish edible powder was prepared. Other ingredients such as Rice flour, Wheat flour, Bengal gram flour, Vegetable oil, Spices, Sesame seeds and Buttermilk were procured from local market for preparation of fish chakli.

Table 1: Formulation of fish chakli mixture

Sr. No.	Ingredients	Quantity
1	Edible fish powder	500 g
2	Different flours (Rice flour, Wheat flour & Bengal gram flour)	500 g
3	Red chilli powder	25 g
4	Turmeric powder	6 g
5	Salt	3 g
6	Sesame seeds	20 g
7	Fish masala	10 g
8	Buttermilk	As per requirement

Flow chart of preparation of fish chakli
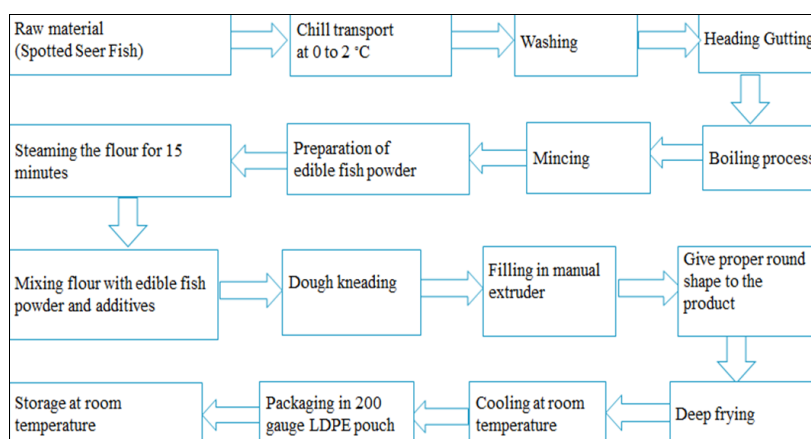
3. Analytical procedures
3.1 Instrumental color profile
Color of analysis was determined by using a color reader (CR-10, Konica Minolta Sensing, Inc., made in Japan). Values corresponding to L^*, a* and b* were measured. Measurement was carried out in single for each treatment replication. Color value L^* (100 = white; 0 = black) is an indication of lightness; a* measures chromaticity, with positive values indicating redness and negative values indicating greenness; while b* also measures chromaticity, with positive values indicating yellowness and negative values indicating blueness. (Baumgartner *et al.,* 2018) [2].

3.2 Determination of oil absorption
The percentage of oil absorption was calculated according to the standard method Mohamed *et al.,* (1988) [6] which is given below:

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

Weight of chakli before frying
The fish chakli samples were weighed before and after frying in groundnut oil, using a digital balance. This was done in four replicates and the average weight was taken.

3.3 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].

3.4 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 modified procedure of Peryam and Pilgrim (1957) [7].

Preparation of EFP (Edible Fish Powder)

| **Raw material** | **Mincing after boiling** | **Removing moisture** |

| **Prepared boiled meat** | **Drying** | **Prepared dry meat** |

| **Grinding into mixture** | **Prepared EFP** | **Packed into air tight pouch** |

Preparation of fish chakli

| **Different flours** | **Preparation of dough** | **Prepared dough** |

| **Filling dough into chakli maker** | **Preparation of chakli** | **Deep frying** |

Rice flour + EFP (50:50)   **Wheat flour + EFP (50:50)**   **Bengal gram flour + EFP (50:50)**

4. Results

Table 2: Proximate composition of different flours and EFP (Fig. 2 to 5)

Proximate composition	Rice flour	Wheat flour	Bengal gram flour	EFP
Moisture	5.58 ± 0.10	12.37 ± 0.02	10.30 ± 0.15	7.97 ± 0.51
Protein	6.75 ± 0.52	10.23 ± 0.03	19.87 ± 1.02	79.35 ± 0.60
Fat	0.37 ± 0.03	0.96 ± 0.03	4.76 ± 0.33	0.83 ± 0.13
Ash	1.93 ± 0.10	0.93 ± 0.01	0.57 ± 0.18	11.85 ± 0.05
Carbohydrate	85.37 ± 0.21	75.51 ± 0.47	64.50 ± 0.20	-

Each values are in mean ± SD (Standard Deviation), n=4(%, dry basis).

Table 3: Proximate composition of fish chakli fortified with different flours and EFP (Fig. 4 to 8)

Proximate composition	Combination-1 (RF+EFP)	Combination-2 (WF+EFP)	Combination-3 (BF+EFP)
Moisture	3.19 ± 0.01	3.31 ± 0.02	4.13 ± 0.02
Protein	23.23 ± 0.06	25.16 ± 0.02	29.30 ± 0.06
Fat	25.44 ± 0.02	25.14 ± 0.01	29.78 ± 0.03
Ash	1.43 ± 0.10	1.63 ± 0.12	1.78 ± 0.03

Each value is represent as the Mean ± S.D of n = 4 on dry weight basis

Table 4: Sensory evaluation of fish chakli fortified with different flours and EFP (Fig. 9)

Sensory Evaluation	Combination-1 (RF+EFP)	Combination-2 (WF+EFP)	Combination-3(BF+EFP)
Appearance	7.20 ± 0.29	8.22 ± 0.26	6.36 ± 0.12
Colour	7.62 ± 0.26	7.92 ± 0.23	6.14 ± 0.25
Texture	5.66 ± 0.29	7.58 ± 0.29	5.70 ± 0.00
Odour	6.84 ± 0.23	8.0 ± 0.00	5.50 ± 0.50
Taste	6.86 ± 0.25	8.34 ± 0.20	5.06 ± 0.17
Crispiness	6.27 ± 0.01	7.76 ± 0.02	5.51 ± 0.01
Overall acceptability	6.72 ± 0.40	7.88 ± 0.29	5.58 ± 0.50

Each value is represent as the Mean ± S.D of n = 4 on dry weight basis

Table 5: Color of fish chakli fortified with different flours and EFP (Fig. 10 & 11)

Color	Combination-1 (RF+EFP)	Combination-2 (WF+EFP)	Combination-3 (BF+EFP)
L (Before frying)	39.33 ± 0.25	37.83 ± 0.21	33.53 ± 0.10
a (Before frying)	5.50 ± 0.05	7.38 ± 0.25	11.70 ± 0.15
b (Before frying)	24.10 ± 0.10	27.69 ± 0.02	30.37 ± 0.01
L (After frying)	26.45 ± 0.20	23.35 ± 0.10	19.08 ± 0.10
a (After frying)	7.50 ± 0.06	9.38 ± 0.25	15.83 ± 0.12
b (After frying)	29.75 ± 0.26	32.57 ± 0.37	38.23 ± 0.76

Each value is represent as the Mean ± S.D of n = 4 on dry weight basis

Table 6: Oil absorption of fish chakli fortified with different flours and EFP (Fig. 12)

Combinations	Oil absorption (%) (%)
Combination-1 (RF+EFP)	27.05 ± 0.04
Combination-2 (WF+EFP)	29.01 ± 0.03
Combination-3 (BF+EFP)	33.55 ± 0.20

Each value is represent as the Mean ± S.D of n = 4 on dry weight basis (RF - Rice flour, WF - Wheat flour, BF - Bengal gram flour)

5. Discussions
5.1 Proximate composition of fish chakli fortified with different flours with EFP
The proximate composition of fish chakli samples for Combination-1 (Rice flour [RF] + EFP), Combination-2 (Wheat flour [WF] + EFP) and Combination-3 (Bengal gram flour [BF] + EFP) is given in Table 3 and fig. 4 to 8 respectively. The data showed that the moisture content of 3.19 ± 0.01%, 3.31 ± 0.02% and 4.13 ± 0.02% was combination-1, combination-2 and combination-3 respectively. The protein content of combination-1 to combination-3 was 23.23 ± 0.06%, 25.16 ± 0.02%, 29.30 ± 0.06%, respectively, were as fat content was 25.44 ± 0.02%, 25.14 ± 0.01% and 29.78 ± 0.03% for combination-1 to combination-3. Ash content of combination-1 to combination-3 was found to be 1.43 ± 0.10%, 1.63 ± 0.12% and 1.78 ± 0.03 respectively. Thus, Combination-3 (Bengal gram flour

[BF] + EFP) has higher protein, moisture, fat and ash content but very poor in sensory characteristics compare to another two combinations.

5.2 Sensory evaluation of fish chakli fortified with different flours and EFP

The samples were analyzed for general appearance, color, odour, texture, taste, crispiness and overall acceptability. The panels mean score of sample combination-1, combination-2 and combination-3 was presented in the Table 4 and Fig. 9. Highest sensory score appeared in Combination-2 (Wheat flour [WF] + EFP) followed by Combination-1 (Rice flour [RF] + EFP) and Combination-3 (Bengal gram flour [BF] + EFP). Breaking effect was observed in combination-2. Chakli prepared with Bengal gram flour is highly unacceptable due to its poor sensory score. Thus, chakli prepared with wheat flour has higher acceptability because of its very good texture and other sensory characteristics.

5.3 Color of fish chakli fortified with different flours and EFP:

'L'-value (Lightness) of fish chakli (before frying) for combination-1 to combination-3 were 39.33 ± 0.25, 37.83 ± 0.21 and 31.53 ± 0.10 respectively, were presented in Table 5 and Fig. 11. *'L'*-value of fish chakli (after frying) for combination-1 to combination-3 were 26.45 ± 0.20, 23.35 ± 0.10 and 19.08 ± 0.10 respectively, were presented in Table 5 and Fig. 12. The *a*-value (Redness) of fish chakli (before frying) for combination-1 to combination-3 were 5.5 ± 0.06,

7.38 ± 0.25 and 11.70 ± 0.15 respectively, were presented in Table 5 and Fig. 11. The *a*-value of fish chakli (after frying) for combination-1 to combination-3 were 7.50 ± 0.06, 9.37 ± 0.25 and 15.83 ± 0.11 respectively, were presented in Table 5 and Fig. 12. The *b*-value (Yellowness) of fish chakli (before frying) for combination-1 to combination-3 were 24.1 ± 0.10, 27.69 ± 0.02 and 33.37 ± 0.01 respectively, were presented in Table 5 and Fig. 11. The *b*-value of fish chakli (after frying) for combination-1 to combination-3 were 29.75 ± 0.26, 32.57 ± 0.37 and 38.23 ± 0.76 respectively, were presented in Table 5 and Fig. 12.

Here, *'L'* value of all three combinations was decreased after frying. Whereas, *'a'* and *'b'* value are increased after frying in all the samples. Highest *'L'* value observed in Combination-1 (26.45 ± 0.20) followed by combination 2 and 3. Higher *'a'* and *'b'* value recorded in Combination-3, which was (15.83 ± 0.12) and (38.23 ± 0.76) respectively. The variation in the colour is due to type of ingredients used.

5.4 Oil absorption of fish chakli fortified with different flours and EFP

Oil absorption percentage of fish chakli fortified with different flours and EFP were 27.05 ± 0.04, 29.01 ± 0.04 and 33.55 ± 0.20 for combination-1 to combination-3, respectively, was presented in Table 6 and Fig. 10
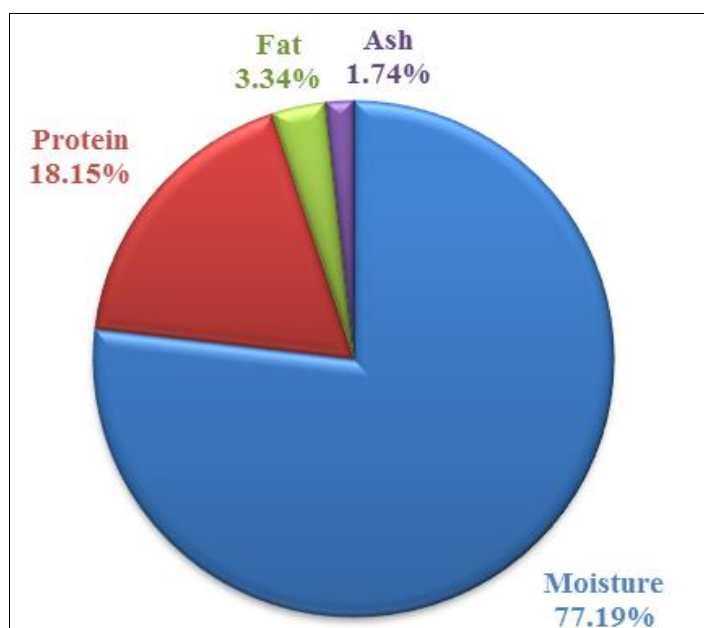
Graphical presentation of result

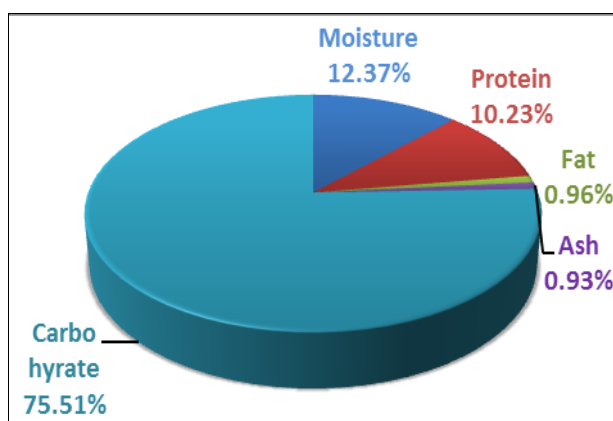**Fig 1:** Proximate composition of fresh Spotted seer fish

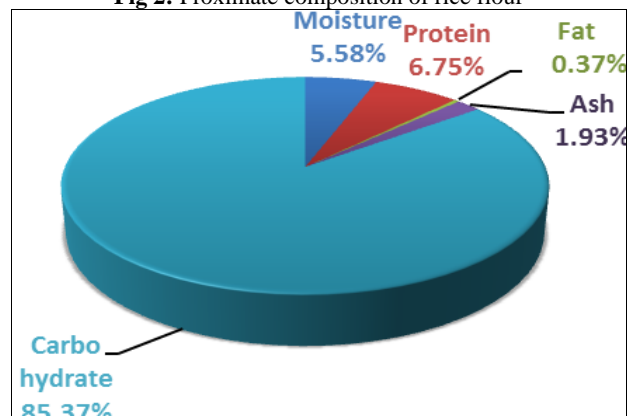**Fig 2:** Proximate composition of rice flour

Fig 3: Proximate composition of wheat flour
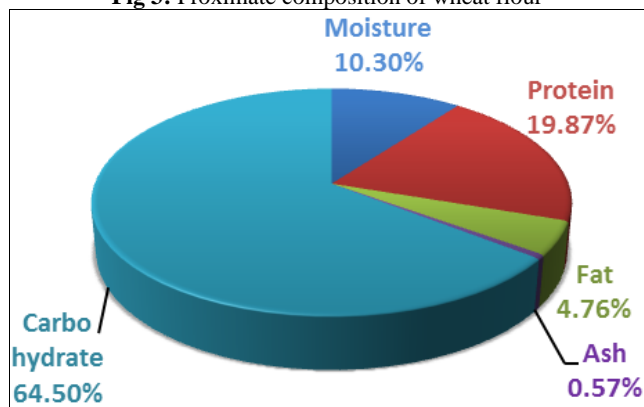

Fig 4: Proximate composition of Bengal gram flour
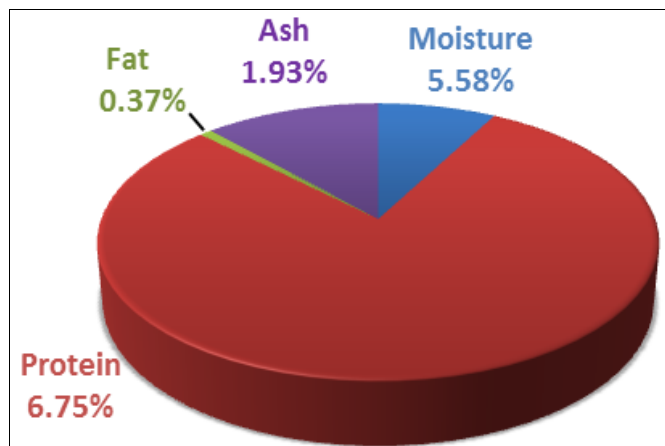

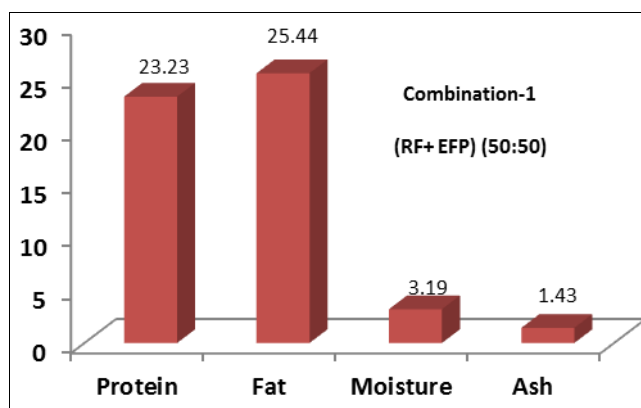**Fig 5:** Proximate composition of EFP

Fig 6: Proximate composition of Combinatin-1
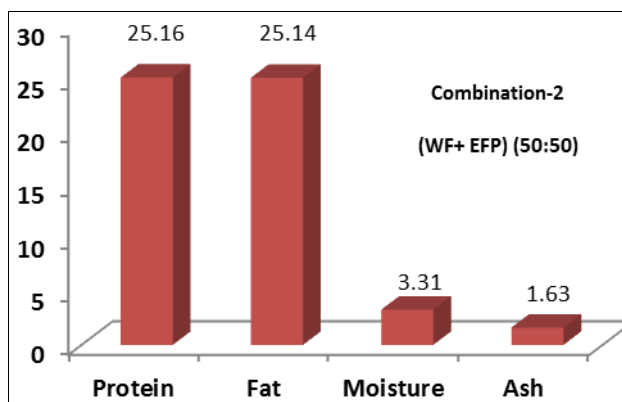

Fig 7: Proximate composition of Combinatin-2
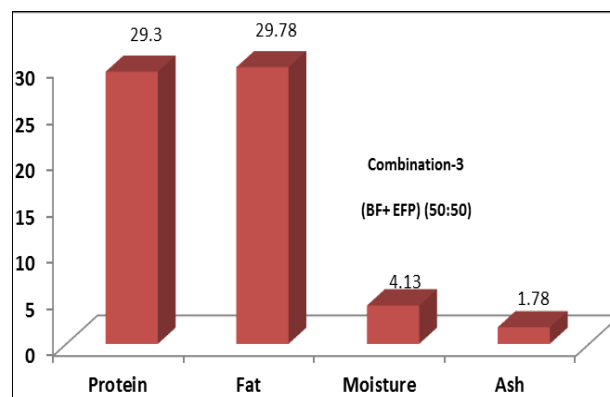

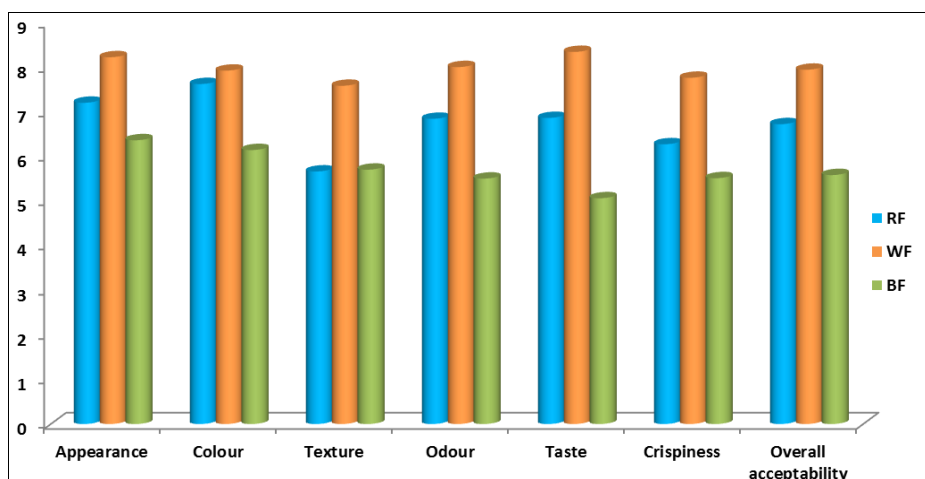**Fig 8:** Proximate composition of Combinatin-3

Fig 9: Sensory evaluation of fish chakli fortified with different flours and EFP (50:50)
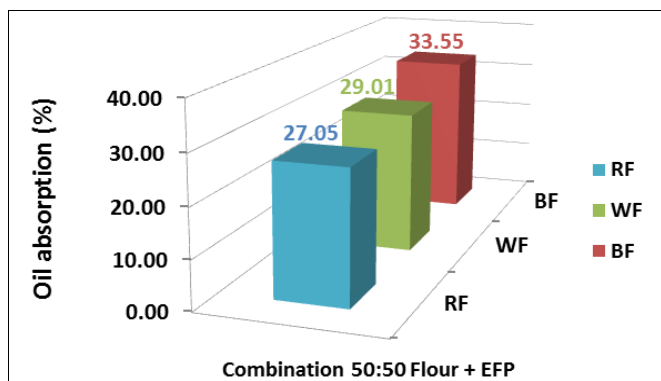
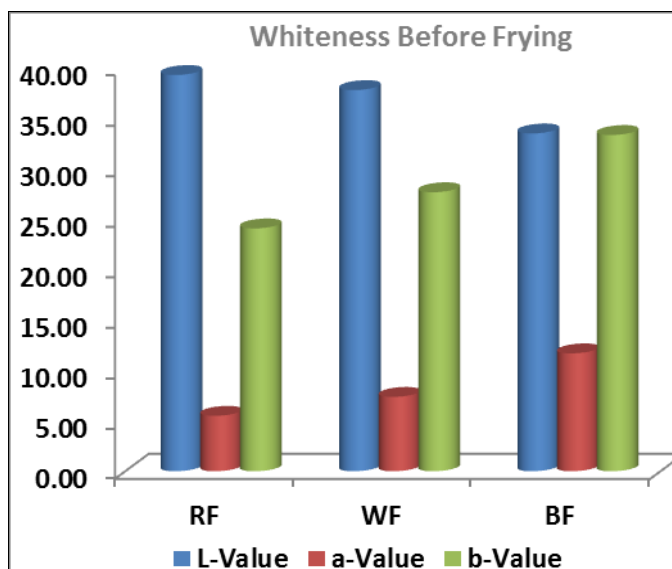**Fig 10:** Oil absorption of fish chakli

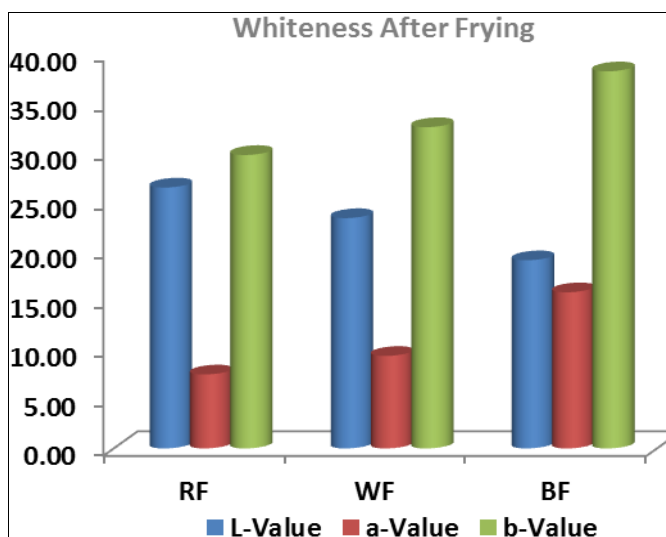**Fig 11:** Color profile of fish chakli (Before frying)

Fig 12: Color profile of fish chakli (After frying)

6. Conclusion

Fish chakli could be prepared by incorporating 50:50 percent flours and edible fish powder. Although, chakli prepared with wheat flour (combination-2) has good sensory attributes compare to other two combinations. Thus, the present study showed successful utilization of different flours and fish edible powder in the preparation of chakli. This product was having high nutritive values with high protein and mineral contents. This product provides a great source of income and

doesn't require any sophisticated equipment for preparation. Also, they have a shelf life up to 30 days at ambient temperature.

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