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Preparation and characterization of function oat cookies fortified with different concentration of fish powder

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Abstract
Recently, the demand for foods and beverages, which improves health or proves beneficial, has been intensified. Baked cookies can act as an important vehicle carrying bioactive compounds in the field of functional foods. The study was undertaken to investigate the effect of addition of fish powder (2, 4, 6, 8, 10%) on the Physio-chemical, nutritional and sensory quality of oats cookies. Control oats cookies prepared without fish powder had protein content 10.9% which gradually increased with increased fish powder. Analysis of color of fish cookies revealed a decrease in the lightness value (L^*) of fish cookies (54.2) with addition of fish powder and cookies added with 10% fish powder had a lower L^* value of 52.6. Fish powder was a significant increase in the spread ratio of cookies. Oats cookies prepared with 2% fish powder had the highest sensory score for overall acceptability. The result of the current study indicate that fish powder can be added up to 4% to improve the nutritional property of oats cookies without significant effect on Physio-chemical, nutritional and sensory quality of oats cookies.

Keywords: Oats cookies, fish powder

Introduction
Now a day, world's most devastating problems are hunger and malnutrition, which are invariably linked to poverty. Fish is important for livelihoods, income and as food for the rural poor, who suffer disproportionately from under nutrition [7]. Functional foods are foods that have a potentially positive effect on health, beyond basic nutrition. Fish protein can be applied for food fortification and production of value added/functional foods.
Fish powder is a dried and stable fish product, intended for human consumption, in which the protein is more concentrated than in the original fish meat. Fish powder has produced by converting a fish mince into protein concentrate, which has no resemblance to the original raw material, for human nutrition. FPC is used in the food industry for developing restructured and ready-to-eat food products.
Other side, many bakery products share high in calories and fat but low in protein, vitamins and other nutrients [11]. Bakery products, which normally contain fat and carbohydrate, can be made with increased protein content and nutritional value by adding fish protein concentrate. Demands for different types of healthy snacks are increasing rapidly around the world and dietary fiber enriched oats cookies are certainly popular among these products [3, 5]. Oats, which is an important source of dietary fiber β-glucan, is known to lower cholesterol [6].
Therefore, fish cookies are flour based products thoroughly mixed with fish powder. It could have a long shelf life without any adverse changes. However, the application of fish powder as food material is less developed. The keeping quality of baked foods such as crackers, cookies and biscuits is of great economic importance, since these products are widely used and are often stored for extended periods before consumption.

Materials and Methods
Preparation of fish powder
Fish powder is stable protein concentrate prepared from low value fish Croaker. The fish was washed with potable chilled water, followed by weighing and dressing in which removal of head, gut, fin, scale. The process of washing and weighing were repeated in order to remove microbial load and taking measurement of yield respectively. Subsequently, the ratio of

processed fish to water at 1:1 was adjusted and subjected to boil in hot water at temperature of 120-130°C for 30 minute. After completion of boiling process, it was allowed to cool down at ambient temperature by spreading on the dressing table and the weight was recorded precisely by using digital weighing balance. Then meat was collected by handpicking method and washed again by 4-5 time. The periodic washing cycle of meat is the essential steps in order to prepare microbial free FPC. The picked meat was first wrapped by piece of cloth and subsequently pressed it to remove the excessive water. Then prepared raw fish powder was poured on aluminum tray and kept in oven at temperature of 60- 70 ºC for drying and then pulverized it.

Preparation of oats cookies

For preparation of oat based oats cookies involved fortification of FPC along with other ingredients such as oatmeal powder, cardamom powder, sooji, sugar and vegetable oil was also used. Further, fish powder mixed as per calculated combination and dough was prepared manually. Afterward, the shape was given to oats cookies by using mold and then coconut powder was coated all over oats cookies. Later, the oats cookies were baked/cooked in microwave oven at temperature of 110 ºC for 10 min. the temperature of backed oats cookies was kept down to room temperature.

Table 1: Various ingredients (gm) used for preparation of oats cookies fortified with different percentage of Fish powder.

Treatment	Oatmeal powder	Vegetable oil	Sugar	Sooji/ rawa	Cardamom powder	Fish powder
T0	500	250	180	60	10	0
T1	500	250	180	60	10	20
T2	500	250	180	60	10	40
T3	500	250	180	60	10	60
T4	500	250	180	60	10	80
T5	500	250	180	60	10	100

Where, T0 = Control
T1= 2% Fish powder
T2= 4% Fish powder
T3= 6% Fish powder
T4= 8% Fish powder
T5= 10% Fish powder

Analysis of oat cookies fortified with fish powder

Sensory quality

Sensory evaluation of the samples was conducted by five expert panel members. Evaluate the products for acceptability based on its color, taste, appearance, texture and overall acceptability using nine- point hedonic scale (Peryam and Pilgrim, 1957) [10].

Physical parameters

Spread ration

Spread ratio = Biscuit width (mm)/ Biscuit thickness (mm) × 100

Color analysis

The color property of fish crackers samples was measured by using Color Reader CR-10 (Konica Minolta Sensing Inc. Japan). For determination of color, the sample was ground to powder with the help of grinder. The powder was completely filled in Petridis provided that no light is allowed to pass during the measuring process. The lightness (L^*), redness (a^*) and yellowness (b^*) values were recorded. The equipment was standardized with a white color standard.

Proximate compassion analysis

Proximate composition analyses were performed according to AOAC (2006) [1] procedures. Water content was determined by drying samples at 105±2 ºC until a constant weight was obtained. Dry samples were used for determination of crude fat, protein and mineral contents. Crude fat was measured by solvent extraction method in a soxhlet system where n-hexane was used as solvent. Crude protein content was calculated by using nitrogen content obtained by Kjeldahl method. A conversion factor of 6.25 was used for calculation of protein content. Total mineral content was determined by incinerating samples at 550±10 ºC for 5 hours. The weight of the residual ash, expressed as a percentage of the dry sample weight, was taken as the total inorganic residue.

Statistical analysis

Data obtained from all the tests were analyzed by using one-way analysis of variance (ANOVA) and followed by Duncan multiple range test of the Statistical Package for Social Science version 22.0 (SPSS inc., Chicago, Illinois, U.S.A). Statistical significance was indicated at the 95% confidence level. Values expressed are means of three determinations ± standard deviation.

Results and Discussion

Sensory evaluation

The judge panel gave scores of sensory quality characteristics for the effect of fortification of FPC at different levels (0%, 2%, 4%, 6%, 8% and 10%); flavour, color, taste, appearance, texture and overall acceptability of biscuit was studied and obtained results are shown in Table 2. From the obtained judging results, it could be observed that the fortification of 2% FPC used in oat cookies didn't cause any significant effect on overall acceptability of produced biscuits which exhibited the hedonic scale of very good or excellent judging scores and better acceptability.

Table 2: Sensory evaluation of oats cookies fortified with different concentration of Fish powder

Sensory	T0	T1	T2	T3	T4	T5
Texture	6.0 ± 0.10^{abc}	9.0 ± 0.06^{a}	8.0 ± 0.15^{a}	7.0 ± 0.10^{ab}	5.5 ± 0.15^{bc}	5.0 ± 0.10^{c}
Color	6.0 ± 0.06^{abc}	8.0 ± 0.10^{a}	8.0 ± 0.06^{a}	7.0 ± 0.15^{ab}	6.1 ± 0.10^{abc}	5.0 ± 0.10^{c}
Appearances	7.0 ± 0.20^{ab}	8.0 ± 0.10^{a}	7.5 ± 0.25^{ab}	7.4 ± 0.15^{ab}	6.0 ± 0.06^{abc}	5.4 ± 0.15^{c}
Odour	6.5 ± 0.10^{abc}	8.5 ± 0.15^{a}	7.5 ± 0.20^{ab}	7.0 ± 0.10^{ab}	5.0 ± 0.06^{c}	5.0 ± 0.10^{c}
Taste	7.0 ± 0.20^{ab}	9.0 ± 0.10^{a}	8.0 ± 0.20^{a}	7.0 ± 0.06^{ab}	5.0 ± 0.15^{c}	4.0 ± 0.10^{c}
Overall acceptability	6.0 ± 0.10^{abc}	9.0 ± 0.06^{a}	8.0 ± 0.10^{a}	7.0 ± 0.10^{ab}	5.5 ± 0.15^{bc}	5.0 ± 0.10^{c}

^{a,b,c} Value with different superscripts in a row for each parameter differ significantly ($p< 0.05$). Each value is represented dry weight based as the mean ± SD of n=5.

Spread ratio

Spread ratio of cookies was significantly increased due to fish powder incorporation. The increase in diameter and spread ration could be attributed due to difference in their fat, protein

and moisture contents which affect the water absorption capacity. Moreover, the aggregation of FPC induced formation of protein network, which helped increase the elasticity and extensibility of the dough, thus leading to increased spread ratio. Similar result was reported by Bereket *et al.* (2018) [3].

Table 3: Spread ratio of oats cookies fortified with different concentration of Fish powder

R.S	T0	T1	T2	T3	T4	T5
	2.42±0.01^{ab}	2.78±0.04^{ab}	2.93±0.05^{ab}	3.28±0.04^{a}	3.48±0.02^{a}	3.57±0.04^{a}

^{a,b} Value with different superscripts in a row for each parameter differ significantly (p<0.05). Each value is represented dry weight based as the mean ± SD of n=4.

Color

'L'-value was significantly decreased from 54.2 ± 0.35, 54.1 ± 0.45, 53.7 ± 0.15, 53.4 ± 0.15, 53.2 ± 0.15 and 52.6±0.25 in T0, T1, T2, T3, T4 and T5 respectively. Mohamed *et al.* (2014) [9] noted similar result where *L** value of control cookies was 60.52±0.05 and add 3% of carp fish protein concentrate (CFPC) in cookies that value was 56.73±0.07.

Table 4: Color of oats cookies fortified with different concentration of Fish powder

Color	T0	T1	T2	T3	T4	T5
L	54.2±0.35^{a}	54.1±0.45^{a}	53.7±0.15^{a}	53.4±0.15^{a}	53.2±0.15^{a}	52.6±0.25^{ab}
a	-4.5±0.15^{a}	-4.3±0.2^{a}	-5.7±0.15^{ab}	-5.9±0.15^{ab}	-6.3±0.15^{bc}	-6.5±0.15^{bc}
b	26.1±0.25^{a}	25.7±0.15^{a}	24.4 ± 0.2^{ab}	23.1±0.15^{abc}	22.8±0.25^{bc}	22.4±0.20^{bc}

^{a,b,c} Value with different superscripts in a row for each parameter differ significantly (p< 0.05). Each value is represented dry weight based as the mean ± SD of n=4.

Proximate composition

The proximate composition of oats cookies sample T0 (0% FPC), T1 (2% FPC), T2 (4% FPC) T3 (6% FPC), T4 (8% FPC), T5 (10% FPC), is given in Table 5. Protein content of cookies increased with increased FPC percentage. Highest protein content in T5 treatment (28.4 ± 0.48) and lowest was reported in T0 treatment (10.9± 0.14). Similar result observed by Mohamed *et al*. (2014) [9] that protein percentage increased due to add fish protein concentrate.

Moisture content was increased with increased FPC percentage. Moisture content was lowest in T0. Similar moisture value was recorded by Bereket *et al.* (2018) [3] for biscuit incorporated with fish fillet protein concentrateslightly higher than moisture content (3.56-4.26%) reported by Mohamed *et al.* (2014) [9]. This might be attributed due to difference in raw materials, fish species and processing techniques used in the study.

Fat content was decreased with increased FPC percentage. Ash content increased with increased FPC (Chudasama *et al.*, 2018). The increased ash content of the supplemented biscuits (from 0.64 to1.1% for 0 to 10% addition of FPC, respectively) can be considered beneficial, because aquatic animal food products are a richer source of most essential minerals and trace elements than cereal products. Similar study recorded by Mohamed *et al*. (2014) [9] and Ibrahim (2009).

Table 5: Proximate composition of oats cookies fortified with different concentration of Fish powder

	T0	T1	T2	T3	T4	T5
Moisture	1.29±0.03^{a}	1.4±0.04^{a}	1.8±0.04^{a}	2.3±0.06^{b}	2.8±0.07^{b}	3.4±0.08^{bc}
Protein	10.9±0.14^{c}	12.9±0.14^{bc}	14.9±0.21^{b}	19.3±0.27^{ab}	24.1±0.37^{a}	28.4±0.48^{a}
Fat	31.9±0.04^{b}	30.4±0.08^{b}	29.2±0.1^{ab}	28.5±0.09^{a}	26.8±0.07^{a}	26.5±0.04^{a}
Ash	0.64±0.03^{ab}	0.66±0.01^{ab}	0.7±0.02^{a}	0.80±0.01^{a}	0.88±0.03^{a}	1.1±0.05^{a}

^{a,b,c} Value with different superscripts in a row for each parameter differ significantly (p<0.05). Each value is represented dry weight based as the mean ± SD of n=4.

Conclusion

Development of bakery products using oatmeal powder mixed with croaker fish flour, without compromising on the quality of final product, would help to improve the nutritional quality fish incorporated of bakery product. The small sized underutilized fish croaker will not only be utilized for value addition, but also for development of diversified fishery products with enhanced nutritional value of ready to eat snack foods. Adding fish flour made from the low cost fish in cereal based bakery processing is not so common. With its rich protein, minerals, and other nutrient contents in fish flour may give a new option for development of healthy snack food for health-conscious consumers while offering new opportunities to the snack food industry.

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