

DEVELOPMENT OF READY-TO-EAT COOKIES FROM GEO SPECIFIC ANCHOVY (*STELOPHORUS HETEROLOBUS*) FORTIFIED WITH PUMPKIN SEED FLOUR

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ABSTRACT

The purpose of this study carried out in 2022-2023 was to develop and assess the sensory and nutrient characteristics of pumpkin seed flour fortified anchovy-based (*Stelophorus heterolobus*) cookies. The results showed that addition of pumpkin seed flour at a ratio of 30 percent and anchovy powder 10 percent did not change the consistency or flavour of cookies and enhanced the nutritive value. Fortified anchovy cookies were found to provide calorie (1256.8kcal), carbohydrate (74.63g), protein (19.13g) and fat (42.2g) per 100 grams. The fibre content of cookies was found to be 10.49g as pumpkin seed flour and wheat flour are rich in fibre. The calcium, iron, and vitamin C content of the sample were 116.63mg, 4.72mg, and 15.64mg respectively. Microbial analysis of cookies revealed that it was safe for human consumption in terms of E. coli with Total Plate Count of <10cfu/g and 6400cfu/g respectively. Fortification of cookies with vegetable seeds into products serves as a good alternative in promoting dietary diversification and sustainability.

Keywords: Anchovy, Fortified Cookies, Microbial analysis, Nutrient Analysis, Organoleptic, Pumpkin Seed Flour.

INTRODUCTION

In the present modern lifestyle, exists a rise in the need for a variety of instant food products to fulfil consumer preferences, dietary diversity and prevention of malnutrition which made the development of geospecific products critical. Food consumption trends have changed dramatically in recent years and because of changing lifestyle the number of meals eaten away from home have steadily increased. Lack of time for cooking and the affordability of such foods are two factors contributing to the growth of the ready-to-eat meal industry (Mohammadi-Nasrabadi *et al.*,

2021). Cookies are convenient for consumers since they offer a diverse selection of snack options with a lengthy shelf life and lower price. Fisheries and aquaculture serve a critical role in providing nutritious, low-carbon foods to a growing global population (FAO, 2021). The average annual increase in global consumption of fish (3.2%) outpaced the average growth in population (1.6%) between 1961 and 2016 (Bhandary *et al.*, 2021). The nutritional value of cookies is determined by their ingredients, which is improved by altering their composition (Abdel Moemin, 2015). Malnutrition occurs when people consume baked foods without any

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Fig. 1. Processing of anchovy cookies

vitamin supplements. As a result, cookies and ready to eat foods must be enhanced or fortified by addition of one or more necessary ingredients like pumpkin seeds that are not usually found in food in order to boost their nutritional content.

MATERIAL AND METHODS

The present study was carried out during 2022-2023 and funded by Directorate of Collegiate Education, Government of Kerala under ASPIRE Research Award. Anchovy (*Stelophorus heterolobus*) were collected from Fathima Matha fish market at Thiruvananthapuram, Kerala. The preliminary preparation of the anchovy viz washing, cutting, sundrying, grinding was adopted to enhance the palatability and acceptability of the products. The other major ingredients like pumpkin seed (*Cucurbita maxima*), were purchased from a

local market, in Alappuzha, Kerala. The seeds were taken from the fluffy portion of a ripe pumpkin after it was split into half (fibrous strains). The seeds were washed, dried in the oven (93°C, 3-4hours) and grounded into fine flour. The flour can be used for fortification as it is inexpensive, abundant in nutrients, and has excellent sensory qualities (Goranova *et al.*, 2019).

Production of cookies and assessment of quality

For the preparation of cookies initially all ingredients were weighed according to the percentage used as listed in Table 1. The cookies were made using the procedure outline (Goswami *et al.*, 2015). Cookies with anchovies were made using incorporation of anchovy powder, pumpkin seed flour and wheat flour at various levels and other ingredients were kept constant.

Table 1. Composition of variation of anchovy cookies

Sl. No	Ingredients(g)	Control group(C1)	Sample1 (S1)	Sample2 (S2)	Sample3 (S3)
1	Wheat flour	100	60	65	70
2	Anchovy powder	0	30	20	10
3	Pumpkin seed flour	0	10	15	20
4	Butter(unsalted)	30	30	30	30
5	Sugar	30	30	30	30
6	Ginger	5	5	5	5
7	Green chilly	12	12	12	12
8	Chilli powder	5	5	5	5
9	Garam masala	5	5	5	5
10	Salt	2	2	2	2
11	Gingelly seeds	4	4	4	4
12	Baking powder	2	2	2	2



S1 S2 S3

Fig. 2. Standardization of anchovy cookies

S1* S2* S3*

Fig. 3. Variations of anchovy cookies**Table 2. Mean value of organoleptic properties of anchovy cookies**

Sl.No	Product Characteristics	C1	S1	S2	S3
1	Appearance	7.2 ± 0.2	6.0 ± 0.836	6.2±0.447	8.0±0.707
2	Color	7.1 ± 0.21	6.0±0.707	6.2±0.447	8.2±0.836
3	Texture	8.05 ± 0.2	7.0±0.894	6.6±0.547	8.0±0.894
4	Taste and Odour	8.05 ±0.2	7.0±0.547	6.6±0.707	8.0±0.707
5	Flavor	7.5 ±0.15	7.0±0.894	7.2±0.547	8.6±0.836
6	Acceptability	7.25 ± 0.24	6.4±0.547	6.4±0.894	8.2±0.836

C1-Control (Wheat 100)

S1-(Wheat: Anchovy: Pumpkin 60:30:10)

S2-(Wheat: Anchovy: Pumpkin 65:20:15)

S3-(Wheat: Anchovy: Pumpkin 70:10:20)

Nutrient, microbial and organoleptic analysis of cookies was done. Control cookies were prepared using all ingredients except anchovy powder and pumpkin seed powder following above procedure.

Sensory evaluation

Sensory evaluation has been used to accept or reject food products from the beginning of humanity (Ruiz-Capillas *et al.*, 2021). The sensory evaluation for the developed anchovy cookies was done in three palatability trials with a trained panel of twenty-five members and the products were evaluated using Hedonic 9 point rating scale to assess the acceptability of the product (Hajela, 2017).

Statistical analysis and interpretation of data

After gathering score given by the panelists, mean and standard deviation were derived for comparing the different sensory characteristics of the developed products and data was interpreted.

RESULTS AND DISCUSSION

Standardization of cookies

After undergoing verification, product evaluation, market study the quantity of the ingredients were standardized to get one serving portion of anchovy. The standard quantity of the ingredients for the development of the anchovy products are given below in Table 1. The cookie yield was 13g while taking

100g of raw material, and each cookie weighed 15.2 ± 0.057 for S1, S2 and S3 samples respectively.

Sensory evaluation of the products

The variations of anchovy products were served separately for organoleptic evaluation of appearance, color, texture, flavour, taste, odour and overall acceptability. The evaluation of scores for anchovy cookies along with control are presented in Table 2.

For sample S1, the mean value of scores obtained each for texture and flavor was 7.0 ± 0.894 , for appearance, colour, taste and odour the mean score was 6.0 ± 0.836 , 6.0 ± 0.707 and 7.0 ± 0.547 respectively compared to control group. Mean score for sample S3 was 8.0 ± 0.707 for appearance, 8.2 ± 0.836 for colour, 8.0 ± 0.894 for texture and 8.0 ± 0.707 for taste and 8.6 ± 0.836 for flavor. Sample S3 has the highest overall acceptability (8.2 ± 0.836) which makes it better among the three samples. Sample S1 and S2 were the second acceptable cookies with mean score of (6.4 ± 0.547 and 6.4 ± 0.894).

The scores of cookies formulated with anchovy powder are slightly higher for attributes of appearance and texture, but lower for attributes of taste and odor. Panelist assessed that the cookies formulated with 10% anchovy powder showed a better appearance compared to control, because of homogenous shape and smooth surface. The color in

Table 3. Nutritive value calculation of anchovy cookies

Sample	Energy (kcal)	CHO (g)	Protein (g)	Fat (g)	Fibre (g)	Calcium (mg)	Iron (mg)	Vitamin C(mg)
Control C1/100g	349.89	70.98	11.52	2.21	2.98	42.34	4.13	0.01
Anchovy cookies per 100 g	1256.8	74.63	19.13	42.2	10.49	116.63	4.72	15.64

*CHO Carbohydrate

Table 4. Nutritive analysis of anchovy cookies

Sl.No	Nutritional composition per 100g	Procedure	Mean score
1	Energy(kcal)	Bomb calorimeter method	469.66±10.0
2	Carbohydrate(g)	Phenol sulphuric acid method	41.64±5.0
3	Protein(g)	Biuret method	26.41±0.5
4	Fat(g)	Chloroform/methanol extraction method	21.94±0.1
5	Fibre(g)	Colorimetric method	4.60±0.1
6	Vitamin C(mg)	2,6-Dichloroindophenol (DCIP)	79.06±2.0

cookies is strongly influenced by the basic ingredients used, namely anchovy powder which has a slightly brownish color. In terms of texture, addition of small quantity of anchovy powder into formulation produced cookies with more crispy but soft texture inside the mouth. Addition of 10% of anchovy powder into cookies formulation lowered the hardness of the cookies. However, study reported that addition of higher concentration of anchovy powder (up to 20%) into cookies formulation produced higher hardness. For attributes of taste and odour, cookies formulated with anchovy powder were still lower compared to control. Addition of anchovy powder into cookies was identified to produce fish odour and a slightly bitter aftertaste according to panelists. Similar results were also reported by other study, which stated that addition of fish-derived ingredient into food products affects negatively the sensory characteristics of the product, especially for attribute of flavor and odour, if it used at inappropriate concentration (Ikasari *et al.*, 2020). From the mean score it was observed that, sample S3 has good flavor and taste than other two samples and higher overall acceptability.

Nutritive Value Calculation and Nutrient Analysis of Developed Anchovy Cookies

A fundamental strategy for raising the nutritional quality of supplemental feeds is to ensure dietary diversity. A diet's quality can be improved and micronutrient requirements can be met by diversifying it more (Yankah *et al.*, 2020). Nutritional quality is one of the criteria that determines the consumer acceptance of the developed product. In this study nutritional composition of the developed anchovy products were calculated with help of Indian Food Composition Tables (Longvah *et al.*, 2017). In order to assure nutritional quality of the developed products, nutrients like energy content, carbohydrate, protein, fat, fibre, iron, calcium and vitamin C of the cookies was determined.

The nutritive value calculation of anchovy cookies were done using Nutrical software 3.0 version compared to control cookies as shown in Table 3. From the 3 variations, the variation with highest acceptability S3 (10:20:70) was selected and nutritive value was calculated.

Table 5. Microbial analysis of anchovy cookies

Microbial analysis	Anchovy cookies per gram	Mean Score
E.coli	<10cfu/g	3.6±0.22
Total Plate Count(TPC)	6400cfu/g	4.4±0.21

Anchovy cookies incorporated with pumpkin seed were highly nutritious and high in vitamin C and calcium (Thalib *et al.*, 2021). Fortified anchovy cookies were found to provide calorie (1256.8kcal), carbohydrate (74.63g), protein (19.13g) and fat (42.2g) per 100 grams. The fibre content of cookies was found to be 10.49g as pumpkin seed flour and wheat flour are rich in fibre. The calcium, iron, and vitamin C content of the sample were 116.63mg, 4.72mg, and 15.64mg respectively. The developed cookies is nutritious and balanced and provide protein, fat and carbohydrate intake of 1/3rd portion of RDA.

Nutrient analysis of cookies

The laboratory analysis has estimated the exact value of composition present in the anchovy cookies using various techniques for the respective chemical composition.

Table 4 shows the result of nutritional composition of anchovy cookies. 100g of cookies provide 41.64 g of carbohydrates and 469.66 Kcal of energy. The results of protein analysis of cookies showed an average of 26.41 g per 100 g. Fish has a high-quality protein content since they contain complete amino acids and possess excellent digestive qualities. According to a recent study (Jeyanth *et al.*, 2018), the cookies produced from 50% dried anchovy powder substitution had the highest protein content of 18%. The result shows that cookies on an average contains 21.94 g of fat. Pumpkin seed flour is also rich in phytosterol, a variety of polyunsaturated fatty acids of 37 to 45% (Kaur and Sharma, 2018). Fat from cookies provide 469.66 kcal of energy per 100 g of the final product. In order to prevent obesity and protein deficiency in youngsters as they get older, food should have a low fat level and a high protein content. Analysis of fibre content of cookies displayed an average of 4.60g fibre per 100 g of cookies. Nutrient analysis Table-4 shows that anchovy cookies contained high amount of vitamin C

(79.06mg) which occurs possibly as a result of fortification with pumpkin seed flour.

Table 5 shows the E. coli content in anchovy cookies. An indication of the safety of food is the absence of E. coli bacteria utilized as a sign of the absence of pollution from human and animal waste as well as of adequate food and water sanitation. The E. coli levels in developed cookies was <10cfu/g compared to normal range of the E.coli <20cfu/g. From the findings, the Total Plate Count (TPC) microbes of anchovy cookies were 6400 cfu/g compared to normal range of TPC 10^3 to $< 10^4$ that revealed the microbial safety of cookies.

CONCLUSION

Current research study has tried to improve the nutritional value of cookies with the addition of anchovy powder fortified with pumpkin seeds. The developed product was acceptable in terms of organoleptic qualities and balanced in terms of nutrition and found to be a good option in combating micronutrient deficiencies promoting sustainability. It was substantiate from the result that the fortified cookies can be recommended as a substitute for snacks to meet the recommended dietary allowances enhancing the nutritional well-being of malnourished population and for the management of specific disease conditions.

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