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Standardization of process technology and quality assessment of flaxseed incorporated nutra cookies

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Abstract
The present investigation was aimed to development of nutra cookies with incorporation of different proportions flaxseed. To standardize the processing technology and analyze the characteristics of nutra cookies *viz.,* chemical, sensory, fatty acid profile textural and microbial characteristics of nutra cookies. The formulation was carried out using flaxseed flour, refined wheat flour, sugar, milk in Preparation of nutra cookies. Different formulation were made with variation in Flaxseed flour level from 0 to 25% for C_0, C_1, C_2, C_3, C_4 and C_5 respectively. Prepared nutra cookies then evaluated for organoleptic properties with respects to colour and appearance, flavour, texture, taste and overall acceptability using 9 point hedonic scale. The results revealed that nutra cookies prepared with supplementation of 30% Whole Flaxseed (C2) secured highest score (i.e. 8.5) was superior as compared to rest of samples. It was found that nutra laddu prepared with flaxseed was rich source of proteins and fiber. Thus, flaxseed can be well utilized as a functional ingredient for preparation of nutra cookies with good nutritional and medicinal value.

Keywords: Flaxseed, refined wheat flour, nutra cookies, functional food, fatty acid profile textural and microbial, sensory evaluation

Introduction
Flax (*Linum usitatissimum* L.) is a native plant of the Mediterranean and Western Asia areas and has been cultivated since ancient times. It is known that the flaxseed is rich in nutrients and phytochemicals. Flaxseed is emerging as one of the key sources of phytochemicals in the functional food arena. In addition to being one of the richest sources of a-linolenic acid oil and lignans, flaxseed is an essential source of high-quality protein and soluble fibre and has considerable potential as a source of phenolic compounds. Flax lignan is also a source of useful biologically active components found in plant foods, such as phytochemicals, and it is considered a functional food.

Flaxseeds have nutritional characteristics and are rich source of ω-3 fatty acid: α-linolenicacid (ALA), short chain polyunsaturated fatty acids (PUFA), soluble and insoluble fibers, phytoestrogen lignans (secoisolariciresinol diglycoside-SDG), proteins and an array of antioxidants. According to its physicochemical composition, flaxseed is a multicomponent systemwith bio-active plant substances such as oil, protein, dietary fibre, soluble polysaccharides, lignans, phenolic compounds, vitamins (A, C, F and E) and minerals (P, Mg, K, Na, Fe, Cu,Mn and Zn) (Ivanova *et al*., 2012) [7]

The protein content of flaxseed varies from 20 to 30 per cent, constituting approximately 80 per cent globulins (linin and conlinin) and 20 per cent glutelin. Flaxseed has an amino acid profile comparable to that of soybean and contains nogluten. Although flax protein is not considered to be a complete protein due to the presence of limiting amino acid- lysine (Hall *et al.*, 2006) [5].

Flax fibers include both soluble and insoluble dietary fibers. The proportion of soluble to insoluble fibre varies between 20:80 and 40:60 (Morris, 2003) [9]. The major insoluble fibre fraction consists of cellulose and lignin, and the soluble fibre fractions are the mucilage gums (Genser V.M and Morris, 2003) [9]. Mucilage gums are polysaccharides that become viscous when mixed with water or other fluids and have an important role in laxatives (Singh *et al.*, 2012) [12].

Flaxseed has potential health benefits besides the nutrition, due to mainly 3 reasons: first, due to its high content of ω-3 α-isease, hypertension, atherosclerosis, diabetes, cancer, arthritis, and osteoporosis, autoimmune and neurological disorders. Flaxseed oil is believed to bring mental and physical endurance by fighting fatigue and controlling aging process. Flaxseed has also been reported to act as anti-arrhythmic, anti-atherogenic and anti-inflammatory agent in addition to improving vascular function (Gogus and Smith, 2010) [4].

The whole flaxseed can be added to bread dough and other baked goods such as muffins, bagels, crackers and waffles. It can also be applied to a variety of multi-grain cereals as well as snack foods to add nutty taste, extra texture and nutritive value. When this seed is sprinkled on top of the baked goods before baking, they also add crunch, taste and eye appeal. Similarly, ground flaxseed can be added in several food products from breads to energy bars (Morris, 2003) [9]. Oil is the main product obtained from flaxseed. It is also a valuable ingredient for specialty salad oil as well as for dietary spreads and butter blends (Kozlowska *et al.*, 2008) [8].

The effect of linseed on the baking properties of cakes and cookies. Wheat flour was replaced with linseed flour from 0 to 25 percent, at five different levels. Physical properties of cookies such as average thickness, width increased as the amount of linseed increased, but the spread factor decreased. The overall loaf volume of the cakes decreased with the increase in linseed. The results indicated that up to 20 per cent linseed can be incorporated, to get acceptable bakery products (Bashir *et al*., 2006) [2].

The present study was conducted to incorporate flaxseed in different food products and study the effect of addition on proximate composition, fatty acid profile, sensory and microbial quality of flaxseed incorporated food products such as nutra laddu and nutra cookies. The present research is helps to explore the public knowledge and perceptions of the efficacy, safety and reason to consume flaxseed.

Materials and Methods

Materials

The Raw material like Flaxseed, refined wheat flour, sugar, milk, etc. will be procured from the local market of Parbhani. Chemical and reagent will be obtained from laboratory, Department of Food Chemistry and Nutrition, College of Food Technology, VNMKV, Parbhani.

Proximate composition of nutra cookies

Raw materials such as flaxseed flour and nutra cookies were analysed for proximate composition including moisture, fat, protein, total carbohydrate, crude fiber, ash and mineral composition was carried out as per the methods given by AOAC, 2005 [1].

Determination of minerals composition of nutra cookies

Two grams of defatted sample was weighed and heated at 550 ºC. Then, the obtained ash were digested with concentrated Hydrochloric acid (HCL) on hot plate. The digested material was then filtered using whatman No. 42 filter paper and the final volume made to 100ml with distilled water that was further used for analysis with respects to iron, calcium, potassium, contents by using methods Ranganna (1986) [10].

Fatty acid composition of flaxseed

Fatty acid composition of the flaxseed was determined using Gas chromatography of FAMES (Fatty Acid Methyl Esters) with Flame Ionization Detector by AOCS Official Method Cd 14c-94 (2003). The oil (10–20 mg) was saponified for 1 hr with 1 ml of methanolic KOH (0.7 N) at 60 ^{0}C, followed by neutralization with 1 ml of methanolic HCl (0.7 N). The resulting free fatty acids were extracted in hexane and evaporated to dryness. The fatty acids were methylated using boron trifluoride (14% in methanol) and 0.2 ml benzene. The FAME was extracted in hexane, washed with water and evaporated to dryness. Fatty acid analysis was performed using a gas–liquid chromatograph (Shimadzu, GC-14B, Shimadzu Corporation, Japan) (Plate 6) fitted with a fused silica capillary column (BP 21: 30 m length, 0.30mm i.e., 0.50 µm film thickness). The GC was equipped with a flame ionization detector, Clarity Lite 420 integrator and at isothermal conditions. The column temperature was set at 220 ^{0}C, the injector temperature at 230 ^{0}C and the detector temperature at 240 ^{0}C. Nitrogen gas was used as the carrier gas with a flow rate of 1 ml/min. Individual fatty acids in the oil were identified by comparison with the retention times of standard fatty acid methyl esters.

Texture profile analysis (TPA)

Stable Micro System *TAXT2plus* Texture Analyzer was used for texture profile analysis (TPA) of energy bar. The test was configured so that the hardness calculated at the time of the test by determining the load and displacement at predetermined points on the TPA curve. Hardness (H) was the maximum load expressed in kg applied to the samples during the first compression. Textural determinations were made by using three point bendrig probes for bend test. The bars were bended to determine structural characteristics present inside or on the surface. Samples for bend test were placed centrally on heavy duty platform under three point bendrig probes. Both the load cell and probe were calibrated before test. Hardness measurement of bars by bending involved plotting force (g) versus time (sec). The maximum force (g) was used as an index of hardness for the bend test (Rehman *et al*., 2012) [11].

Microbial examination of product

The microbial examination of samples was carried out as per the method cited in Indian Standard Institute (ISI) (1969). The results obtained for each count was recorded as colony forming unit per ml of sample i.e. cfu/ml.

Formulation of flaxseed flour incorporated cookies

Refined wheat flour (maida) was replaced with flaxseed flour as per formulations given in Table 1.

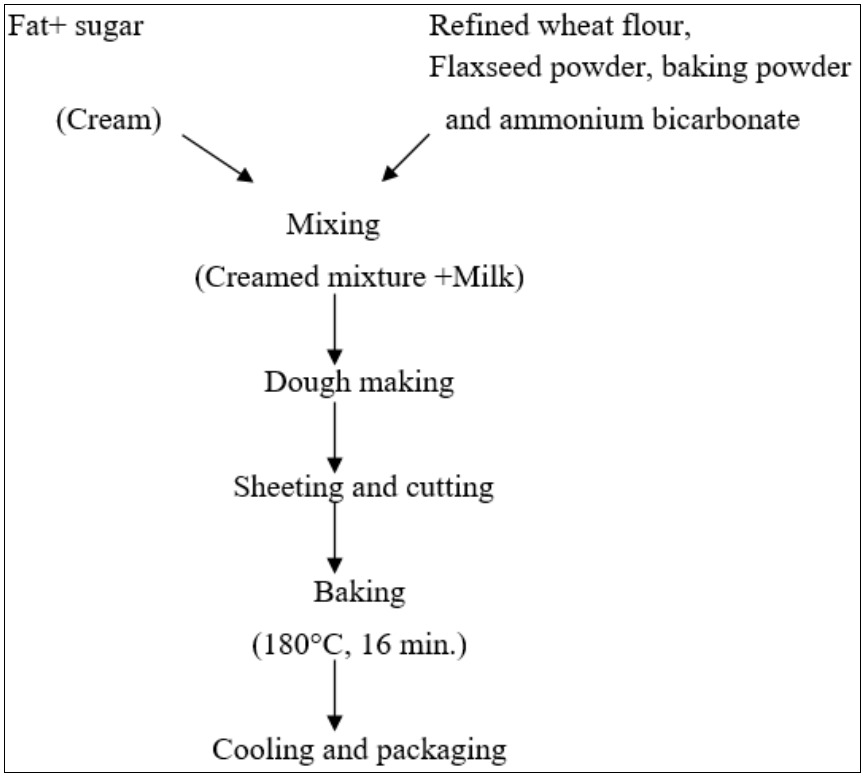
Table 1: Formulation of flaxseed incorporated nutra cookies

Sr. No.	Ingredients	C_0	C_1	C_2	C_3	C_4	C_5
1	Refined wheat flour (maida) (g)	100	95	90	85	80	75
2	Flaxseed flour(g)	00	05	10	15	20	25
3	Sugar (g)	52	52	52	52	52	52
4	Shortening (g)	48	48	48	48	48	48
5	Baking powder (g)	2	2	2	2	2	2
6	Ammonium bicarbonate (g)	1	1	1	1	1	1
7	Milk (ml)	20	20	20	20	20	20

Control = 100% Refined wheat flour
C_1 =95% Refined wheat flour + 05% Flaxseed flour
C_2 = 90% Refined wheat flour + 10% Flaxseed flour
C_3 = 85% Refined wheat flour + 15% Flaxseed flour
C_4 = 80% Refined wheat flour + 20% Flaxseed flour
C_5 = 75% Refined wheat flour + 25% Flaxseed flour

Preparation of nutra cookies

Flaxseed fortified nutra cookies were prepared as per the formulations given in Table 1. Roasted flaxseed flour was fortified by substituting refined wheat flour at 0%, 5%, 10%, 15%, 20%, and 25%. Table 4 represents the details of treatment and their respective coding. Dry ingredients i.e. refined wheat flour, custard powder; baking powder and RFF were thoroughly mixed and sieved twice for uniform blend. Hydrogenated fat and shortening were creamed together manually for 10 min. to get bright and fluffy mass. Milk and essence was added in the mass and mixed for another 5 min. Finally, dry ingredient blend flour was slowly added to the above creamed mass and mixed for 2 min. The cookie dough was sheeted to 8 mm thickness and cut into circular shape using 42 mm diameter cutter. The cookies were then baked at 180C for 15 min. The cookies were cooled for 10 minutes, then packed in LDPE bags or in PET boxes.



Flow sheet for preparation of Nutra cookies

Results and Discussion

Proximate composition of flaxseed incorporated nutra cookies

Data pertaining to various proximate compositions of flaxseed nutra cookies were determined for moisture, fat, protein, carbohydrates, ash and crude fiber and results obtained are depicted in Table 2.

Table 2: Proximate composition of flaxseed incorporated nutra cookies

Sr. No.	Treatments	Proximate composition (g/100 g)					
		Moisture	Crude Protein	Fat	Ash	Crude fiber	Carbohydrate
1.	Control	4.21	6.01	29.96	0.35	0.18	58.23
2.	C_1	4.20	6.70	30.40	0.56	0.88	56.56
3.	C_2	4.24	6.37	31.00	0.65	1.25	54.32
4.	C_3	4.30	6.09	32.10	0.74	1.65	52.58
5.	C_4	5.10	6.66	32.50	0.81	1.98	51.26
6.	C_5	5.18	6.25	32.80	0.89	2.01	49.30

* Each value is average of three determinations

Physical properties of prepared flaxseed incorporated cookies were analyzed and obtained values are statistically analyzed and presented in Table 2.

It is found from Table 18 that the highest moisture content was found to be in C_2 sample up to 4.24 per cent. Control sample was found to have the highest amount of crude protein and fat content. Ash and crude fiber content was found highest in sample C_2 as .65 per cent and 1.25 per cent respectively. Carbohydrate content was found to be highest in C_2 sample than other samples.

Mineral content of flaxseed incorporated nutra cookies

The mineral element constitutes an important group of nutrients required by the human body for optimal functioning. Micronutrients such as calcium (Ca), phosphorous (P), iron (Fe), magnesium (Mg) and potassium (K) were analyzed from flaxseed incorporated nutra cookieswas presented in the Table 3.

Table 3 describes the mineral composition of flaxseed nutra cookies. The potassium content of formulated flaxseed nutra cookies found to be highest than other minerals. The amount of potassium reported 0.22 and 0.18 in control sample of flaxseed nutra cookies.

Table 3: Mineral content of flaxseed incorporated nutra cookies

Minerals	Control sample	Sample C_2
Potassium (mg/100g)	0.18	0.22
Calcium (mg/100g)	22.86	144.52
Phosphorous (mg/100g)	0.09	0.12
Magnesium (mg/100g)	0.04	0.02
Iron (mg/100g)	1.09	2.10

*Each value is average of three determinations

The phosphorus content sample C_2 was highest than control sample. The phosphorus content of sample C_2 and control sample was found as 0.12 and 0.09. However calcium content of sample C_2 and control sample gave reading of 144.52 and 22.46. The magnesium content of sample C_2 was seen as 0.02 and in control sample 0.04 was observed .The iron content in control sample and sample C_2 was found to be 2.10 and 1.09 respectively.

Fatty acid profile of flaxseed incorporated nutra cookies

Fatty acid profile with respects to saturated fat, polyunsaturated fat and monounsaturated fats of essential oil extracted from spices such as flaxseed nutra laddu were determined by using gas chromatography mass spectroscopy. Results obtained for fatty acid profile are illustrated in table 4.

Table 4: Fatty acid profile of flaxseed incorporated nutra cookies

Fatty acid	Sample Control	Sample C_2
Poly unsaturated fatty acid (PUFA)	2.49	8.72
Alpha Linolenic acid	0.18	3.54
Linoleic acid	2.21	3.81
Oleic acid	39.80	36.89
Stearic acid	5.41	5.52
Palmitic acid	38.56	31.37

*Each value is average of three determinations

Data presented in table 4 revealed that the alpha Linolenic acid in control and flaxseed formulated sample C_2 was found to be 0.18mg/100g and 3.54 g/100g respectively. Moreover, the polyunsaturated fats were analyzed which indicated that flaxseed formulated sample C_2 contained high amount of unsaturated fats (8.72 g/100g) as compared to control sample (2.49 g/100g). Results shown for oleic acid reported that control sample found to have high monounsaturated fats (36.68 g/100g), in addition to that flaxseed formulated sample C_2 had very low amount of saturated fats (39.80 g/100g) respectively.

Sensory analysis of flaxseed incorporated nutra cookies

Flaxseed incorporated nutra cookies were subjected to the sensory evaluation and recorded values are depicted in Table 5

Table 5: Sensory characteristics of flaxseed incorporated nutra Cookies

Sr. No.	Sample	Sensory attributes					
		Appearance	Colour	Taste	Flavor	Texture	Overall acceptability
1.	Control	8.0	8.0	8.1	8.1	8.1	8.1
2.	C_1	8.1	8.1	7.9	7.8	8.1	8.1
3.	C_2	8.1	7.5	7.9	7.5	8.2	8.0
4.	C_3	7.6	7.3	7.6	7.2	7.8	7.6
5.	C_4	7.4	7.0	7.1	6.9	7.2	7.2
6.	C_5	6.9	6.6	6.4	6.2	6.8	6.6

* Each value is average of three determinations

It is revealed from table 5 that among all treated samples, control, C_1 and C_2 samples were found to be good with score of 8.0 for overall acceptability than other cookies samples. The samples C_1 and C_2 were found to be good in appearance, colour, taste, flavour and texture compared to C_4 and C_5 samples.

Microbial analysis of flaxseed incorporated nutra cookies

Prepared Flaxseed nutra cookies was selected on the basis of sensory quality and analyzed for microbial load at interval of 30 days up to 90 days stored at room temperature. The microbial study of sample was done for total plate count and yeast and mold count. The results obtained on microbial examination from present investigation are presented in the table 6

It is evident from table 6 that TPC observed in Flaxseed nutra cookies sample was nil and yeast and mold count was found to be zero on the day of production and similar results were obtained up to 45 days of storage (at room temperature).

Table 6: Microbial parameters of flaxseed incorporated nutra cookies

Treatments	Total Plate Count (cfu/g) x 10^1	Yeast and Mold Count (cfu/g) x 10^1
Control	1.05	0.85
C_1	1.10	1.25
C_2	1.25	1.42
C_3	1.63	1.58
C_4	1.85	1.69
C_5	1.98	1.78

* Each value is average of three determinations

The data pertaining to the microbial analysis in terms of Total plate count (TPC) as well as Yeast and Mold count (YMC) of cookies incorporated with flaxseed at ambient temperature for the storage period of 48 hours is presented in Table 6.
It is evident from Table that Total Plate Count (TPC) and Yeast and Mold Count (YMC) of cookies incorporated with flaxseed was found to be increased with the incorporation flaxseed, while it was observed that TPC and YMC were less in control cookies samples.

Texture profile analysis of flaxseed incorporated nutra cookies

A texture analysis is primarily concerned with measurement of the mechanical properties of a product. Texture analyzer performs this test by applying controlled force to the product and recording its response in the form of force, deformation and time. Hardness is the force necessary to attain a given deformation of the material or it is the force required to bite through the sample (Itagi *et al.*,2013) [6]. Texture of flaxseed nutra laddu was measured using *TA XT2* texture analyser (stable micro system) within 24 hours after preparation. The results shows the hardness of energy bar are presented in table 7.

Table 7: Textural quality parameters of flaxseed incorporated nutra cookies

Cookies Sample	Hardness (kg)
C_0	3.89
C_1	4.31
C_2	4.62
C_3	5.05
C_4	5.96
C_5	6.18

* Each value is a mean of three determinations.

The result obtained in table 7 confirmed that the incorporation of flaxseed significantly ($P<0.05$) increased the hardness of cookies (3.89 to 6.18 kg) as compared to control cookies without addition of flaxseed. As the flaxseed is rich in fiber, the hardness of cookies significantly influenced by addition of flaxseed since the refined wheat flour contained less fiber as compared to flaxseed.

Conclusion

It can be observed from the analysis that in the case of all the sensory attributes, nutra cookies prepared with 10:90 proportions of Flaxseed to refined wheat flour were found to be highly appropriate and reported to maximum ranking. It may be inferred that flaxseed can be used to make good quality nutra cookies, as it is a rich source of omega-3 fatty acids and a good source of high quality proteins and fibers has beneficial effects on human health. As a result, flaxseed can be used as a functional ingredient in the preparation of nutra cookies with good nutritional and medicinal value that serve as a functional food.

References

1. AOAC. Official Methods of Analysis of the AOAC International, 18thed. Association of Official Analytical Chemists, Gaithersburg, MD, 2005.
2. Bashir S, Masud T, Latif A. Effect of flaxseed (*Linum usitatissimum*) on the baking properties of cakes and cookies. International Journal of Agricultural Research, 2006; 1(5):496 -502.
3. Genser VM, Morris DH. Introduction, history of the cultivationand uses of flaxseed. In: Muir AD, Westcott ND (eds) Flax, the Genus *Linum*. Taylor and Francis, London, 2003, 1-21.
4. Gogus U, Smith C. n-3 Omega fatty acids: a review of current knowledge. Int J Food Sci Technology, 2010; 45:417-436.
5. Hall IC, Tulbek MC, Xu Y. Flaxseed. Advances in food and nutrition research, 2006; 51:97.
6. Itagi HN, Singh V, Indiramma AR, Prakash M. Shelf stable multigrain halwa mixes: preparation of halwa, their textural and sensory studies. Journal of Food Science and Technology. 2013; 50(5):879-889.
7. Ivanov D, Kokic B, Brlek T, Colovic R, Vukmirovic D, Levic J *et al*. Effect of microwave heating on content of cyanogenicglycosides in linseed. Ratar. Povrt., 2012; 49:63-68.
8. Kozlowska J, Munoz GA, Kolodziejczyk PP. Food and feedapplications for flaxseed components. In: International conference on flax and other bast plants. Saskatoon, Canada, 2008, 299-307.
9. Morris DH. Flax: A health and nutrition primer. Winnipeg: Flax Council of Canad, 3 ed, 2003; 1(1):11.
10. Ranganna S. Handbook of Analysis and Quality Control for Fruit and vegetables Products. Second Edition. Tata McGraw Hill Publishing Limited, New Delhi, 1986.
11. Rehman S, Nadeem M, Haseeb M, Awan JA. Development and physico-chemical characterization of apricot-date bars. Journal Agricultural Research. 2012; 50(3).
12. Singh KK, Jhamb SA, Kumar R. Effect of pre-treatments on performance of screw pressing for flaxseed, Journal of Food Process Engineering. 2012; 35:543-556.