# Optimization of flax seed flour fortified biscuits

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***Abstract:*** Biscuit is a popular snack with long shelf life. It is liked and consumed by all age groups of the population. It mainly consists of maida, bakery shortening and sugar. Therefore fortification of biscuits with flax seed flour provides α-linolenic acid (omega-3-fatty acid) which helps to prevent cardiovascular diseases. This project was taken up to optimize the formulation of flaxseed fortified biscuits on the basis of its organoleptic and textural characteristics. For the development of biscuits, roasted and unroasted flaxseed flour was used. On the basis of preliminary trials, four samples of the biscuit were prepared using unroasted and roasted flax seed flour. The two samples of each unroasted and roasted flax seed flour were in the proportion of 40:60 (Flaxseed flour: Wheat flour) and 50:50 (Flaxseed flour: Wheat flour). Fortified biscuits were developed with standardized method. Effects of fortification of flaxseed flour at different levels were studied on the textural and sensory quality of the biscuits. Hardness and dark colour intensity of the biscuits increased with the increase in the concentration of flaxseed flour. Biscuits prepared with roasted flaxseed flour in 40:60 (Flaxseed flour: wheat flour) was found most acceptable in organoleptic and textural properties.

***Index Terms***- Flax seeds (Linumusitatissimum), α-linolenic acid (omega 3), Composition, Biscuits Preparation.

**Introduction**

The incorporation of substances with functional claims in foods has grown in recent years because of their beneficial properties for the human health. [1] Flaxseed (Linum usitatissimum L) is an oilseed species in oval grain shape that can be found in the brown or gold colors. This grain can be consumed raw, crushed or added to food, and can be found in the form of whole grain, ground and as seed oil. Its aroma is similar to that of walnuts, and it has been added to products such as breads, cookies and cakes. [2, 3] Brown flaxseed, originally from hot and humid climate, also cultivated in Brazil, adapts well to our climate. [4] Over the past few years, the consumption of flaxseed has been noted to increase. This is due to a greater awareness on its benefits to the prevention of chronic non-communicable diseases (NCDs), along with results from studies on the constituents of this grain i.e. α-linolenic acid (omega 3) found in the greatest amount, besides having fiber and protein. This grain is rich in lignans, phenolic acids, flavonoids, vitamins and minerals.[3,5] The three most physiologically important omega-3 fatty acids are alpha-linolenic acid (ALA, 18:3), eicosapentaenoic acid (EPA, 22:5), and docosahexaenoic acid (DHA, 24:6). ALA is the precursor fatty acid of EPA and DHA. ALA is an essential fatty acid that cannot be synthesized by the body [6–9]. Because it is rich in α-linolenic acid, evidence suggests that flaxseed has hypocholesterolemic effects, acting on the reduction of LDL (low density lipoprotein), and thereby it prevents cardiovascular diseases. Studies show that the consumption of flaxseed promotes increased HDL (high density lipoprotein) and its antioxidant properties work in the prevention of cancer and atherosclerosis. [10-11] Soluble fiber in flaxseed may help reduce cholesterol and control blood sugar, and its insoluble fiber may aid in digestion and reduce intestinal transit constipation, and therefore be useful in preventing cancer. [12] Flaxseed bran is an outstanding antioxidant and immunity stimulant, prevents degenerative and cardiovascular diseases, and shows excellent results in the treatment of pre-menstrual tension, menopause, and in reducing the risks of breast, prostate, and lung cancers. [13] Based on available evidence regarding the nutritional benefits of flaxseed. [14] Plant sources for omega-3 fatty acids are flaxseed, walnut, hempseed, soybeans, canola, and rapeseed. Flaxseed (Linum usitatissimum L.) is a rich source of omega-3 fatty acids especially ALA. The US Institute of Medicine's Food and Nutrition Board recommends ALA intakes of 1.1 g/day and 1.6 g/day for women and men, respectively [15] .Flax seeds consumption can be enhanced by incorporating it into food products, such as biscuits. This study aims to develop a formulation of salty biscuits, adding brown flaxseed flour to wheat flour in different proportions, and assess its physical and chemical compositions, along with its sensory and color properties.

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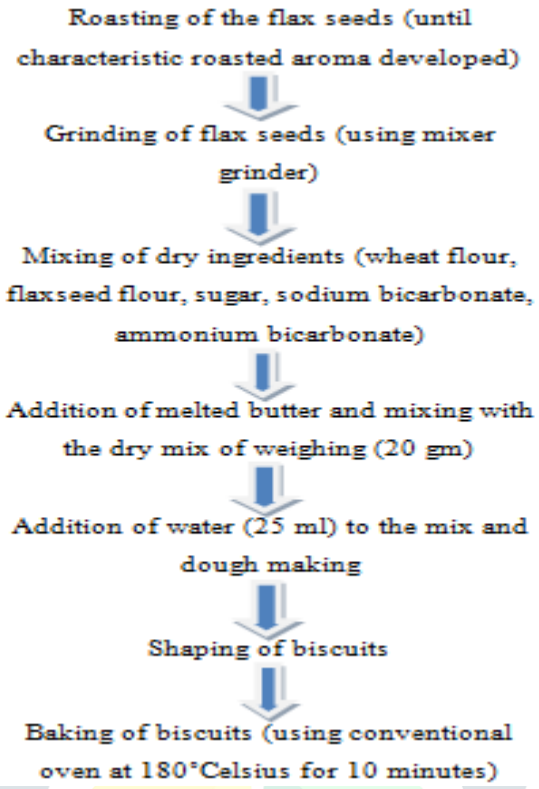
**Materials and Methods:**

The raw materials wheat flour (Triticum Aestivum), flaxseed (Linumusitatissimum) were obtained from the local market. Flaxseed was roasted in an oven at 90˚C for 10 min prior to grinding and then sieved twice using a sieve. Grinding was done in Usha Grinder.

**Sample Preparation:**

Four samples of the biscuit were prepared using sample of unroasted flax seeds of proportion 60:40 (wheat flour: flaxseed flour) and second sample of unroasted flax seeds contains 70:30 (wheat flour: flaxseed flour). And another sample of 50:50 was prepared. The second sample contained wheat flour 70% and flaxseed powder 30%, third sample contained wheat flour 60% and flaxseed flour 40% and the fourth sample contained 50% wheat flour and 50% flaxseed flour. Dough was prepared by adding 40g of sugar, 20g of milk powder, 20gm butter and 1 g of sodium bicarbonate, 0.6gm ammonium hydroxide to the flour and adding water.

**Procedure:**




**Chemical characteristics:**

Moisture, ash and fat content were determined according to AOAC 2000 methods. Protein content was determined as per (IS: 7219:1973): Kjeldhal Method, protein content was obtained by using the conversion factor of 6.25, Crude fibre was determined by (IS: 11062) and carbohydrate content by difference method. Biscuit Preparation: Wheat flour and flaxseed powder blends were prepared in the ratio of roasted flax seeds flour 50:50, 40:60, unroasted flax seeds flour 40:60 and 50:50 respectively. Sensory evaluation: Biscuits were evaluated for overall acceptability (colour, texture, aroma and taste) and was carried out as per 9 point Hedonic scale. The physical analysis of biscuits were determined according to the method of 10-50D, from AOAC, [11] to determine the mass and diameter of the biscuits before and after heating, thickness and expansion factor. The specific volume was calculated by the ratio between baked biscuit apparent volume and weight, being expressed in g cm-1. Biscuit texture profile was assessed in a texturometer (texture analyzer TA. XRplus, Stable Micro Systems).

**Results and Discussion:**

**Proximate composition of raw materials:**

Flaxseed powder had highest fat, protein, dietary fibre and ash content, while wheat flour contained higher carbohydrate content. Table 1

Proximate composition of biscuit samples: Fortification of biscuit resulted in increased protein, fat, ash and dietary fibre content, while carbohydrate content decreased, as compared to control. The fat, protein and dietary fibre increased at higher rate by addition of flaxseed. The fat content also increased. The fibre content decreased as the level of fortification increased because flaxseed contain moderate amount of carbohydrate, Table 2. The results agreed with other research works. Vitali et al. (2008), Okpala et al. (2011), Tyagi et al. (2006) reported that incorporation of plant proteins, soy flour, inulin, pigeon pea, sorghum, mustard flour increased the protein, fibre, moisture and ash content of the final

.

**Table 1: Proximate composition of flaxseed flour**

| Parameters | Composition |
|---|---|
| Moisture | 13% |
| Ash | 0.55% |
| Protein | 10.25% |
| Fat | 1.22% |
| Crude Fibre | 7.80% |
| Alcoholic Acidity | 0.03% |

Sensory Characteristics of biscuits: The Sensory evaluation was carried out as per 9 point Hedonic scale, Table 3. The sensory attributes that were taken into consideration include: color, texture, aroma, taste, overall acceptability & rank. The values represented are the means of ten observations. Among the four fortified samples, the second sample had highest overall acceptability, compared to the other samples. Table 3. (Note: Refer to Annexure 1 for the 9- point hedonic scale).

**Table 3: Sensory evaluation scores of fortified biscuits**

| S. No. | Color | Texture | Aroma | Taste | Overall acceptability | Rank |
|---|---|---|---|---|---|---|
| 01. | 8.20±0.60 | 8.10±0.54 | 7.9±0.54 | 7.8±0.75 | 7.7±0.78 | 7.8±0.75 |
| 02. | 8.00±0.63 | 7.80±0.60 | 7.00±0.89 | 7.9±0.70 | 7.7±0.78 | 7.7±0.78 |
| 03. | 8.10±0.54 | 7.8±0.60 | 8.10±0.54 | 8.10±0.30 | 7.8±0.60 | 8.00±0.45 |
| 04. | 7.40±0.80 | 7.70±0.46 | 7.00±0.89 | 7.00±0.89 | 7.50±0.67 | 7.30±0.64 |

Textural Profile Analysis: The results of textural analysis of different biscuit samples are represented in table 3.

**Table 3: TPA of fortified biscuit samples**

| Composition | Hardness | Flexibility |
|---|---|---|
| 1. Unroasted 40% | 3082±611 | 4.89±0.59 |
| 2. Roasted 40% | 2286±366 | 5.55±0.78 |
| 3. Unroasted 50% | 2715.44±438 | 5.07±0.23 |
| 4. Roasted 50% | 851.63±272 | 4.83±0.10 |

**Conclusion:**

Supplementation of wheat flour with flaxseed powder was done at different levels 10% to 50%. Effect of fortification of flaxseed flour at different levels was assessed on the nutritional, sensory and textural quality of biscuit. A novel fortified biscuit was successfully produced and it was observed as the concentration of flaxseed increased, hardness and dietary fibre increased. The dark color intensity increased with the increase in fortification. On the basis of nutritional and sensory quality, biscuit when fortified with blends of 40% roasted flax seed flour with 60% wheat flour resulted in better quality and nutritious biscuits.

**References**:

1.Wildman REC. Nutraceuticals: a brief review of historical and teleological aspects. In: Wildman REC. Handbook of nutraceuticals and functional foods. Boca Raton: CRC; 2001. p. 1-12.

2. Cui WS. Flaxseed: a functional food for the 21 st century. Canad. Chem. News.1998; 50(5):19-20.

3. Morris DH. Essential nutrients and other functional compounds in flaxseed. Nutr. Today. 2001;36(3):159-162.

4. Marques AC. [Dissertação] Santa Maria: Universidade Federal de Santa Maria; 2008.

5. Figuerola F, Muñoz O, Estévez AM. La linaza como fuente de compuestos bioactivos para la elaboración de alimentos. Agr. Sur. 2008; 36(2):49-58.

6. S. H. Goodnight, "The effects of n-3 fatty acids on atherosclerosis and the vascular response to injury," Archives of Pathology and Laboratory Medicine, vol. 117, no. 1, pp. 102–106, 1993.

7.D. M. Bibus, P. Stitt, andR.Holman, "Ratio of linoleic acid to $\alpha$- linolenic acids in the human diet: Implications in the health of humans and companion animals," in Proceedings of the 57th Flax Institute of the USA, pp. 49–58, North Dakota State University, Fargo, ND, USA, March 1998.

8. D.G.Dorrell, "Distributionof fatty acids within the seed of flax," Canadian Journal of Plant Science, vol. 50, no. 1, pp. 71–75, 1970.

9. J. K. Daun and R. Przybylski, "Environmental effects on the composition of four Canadian flax cultivars," in Proceeding of the 58th Flax Institute of the U.S., pp. 80–91,NorthDakota State

University, Fargo, ND,USA, 2000.

10. Turatti JM. Óleos vegetais como fonte de alimentos funcionais. Óleos & Grãos. 2000; 56:20-7.

11. Prasad K. Dietary flax seed in prevention of hypercholesterolemic atherosclerosis. Atherosclerosis. 1997; 132(1):69-76.

12. Hussain S, Anjum FM, Butt MS, Khan MI, Asghar A. Physical and sensoric attributes of flaxseed flour supplemented cookies. Turk J. Biol. 2006; 30:87-92.

13. Araújo JMA. Química de alimentos: teoria e prática. 3ª ed. Viçosa: UFV; 2004.

10. Maciel LMB, Pontes DF, Rodrigues MCP. Efeito da adição de farinha de linhaça no processamento de biscoito tipo cracker. Alim. Nutr. 2008; 19(4):385-392.

14. Association of Official Analytical Chemists. Official methods of analysis of the Association of Official Analytical Chemists. 16ª ed. Arlington, VA: AOAC; 1995.

15. P. M. Kris-Etherton, D. S. Taylor, S. Yu-Poth et al., "Polyunsaturated fatty acids in the food chain in the United States," The American Journal of Clinical Nutrition, vol. 71, no. 1, pp. 179S–

188S, 2000.