

Physical and Sensoric Attributes of Flaxseed Flour Supplemented Cookies

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Abstract: Full fat flaxseed flour was supplemented with wheat flour @ 5, 10, 15, 20,25 and 30%. Cookies were prepared from composite flours. Cookies prepared without flaxseed flour were kept as control. The mean quality score of the cookies decreased with the increase in the level of the flaxseed flour supplementation. Colour and crispiness of the cookies showed a declining trend as compared to flavour and texture of cookies. Cookies containing 20% and lower level of the full fat flaxseed flour were acceptable in relation to their overall acceptability. Significant reduction in the spread factor of the cookies was observed. Addition of the flaxseed flour restricted the spread of the cookies.

Key Words: Full fat flaxseed flour, Wheat flour, Sensory characteristics, physical evaluation

Introduction

Among the bakery products, cookies are most significant. These are an important food product used as snacks by children and adults in Pakistan. However these are most commonly relished by school going children, who need more protein per unit body weight than adults. Cookies hold an important position in snack foods due to variety in taste, crispiness and digestibility. These are popular among all age groups especially in children. Commercially available cookies are prepared from white flour that is nutritionally inferior to whole wheat flour (1).

The term biscuit is derived from the Latin *bis coctus* or the old French biscuit, meaning twice cooked. This refers to the practice generally abandoned on the 18th century, of first baking the product in a hot oven and then transferring to a cooler oven to complete the drying process (2).

Flax is a blue flowering crop. The seeds of the flax are tiny, smooth, flat and pointed at one end. Because of its link to good health flaxseed is rapidly becoming a new food in many diets. Flaxseed has used in the diets of the humans for thousands of years. The Babylonians cultivated flaxseed as early as 3,000 B.C. Nutrition researchers have identified several substances in flaxseed appear to have health benefits: Lignans, fiber, and omega-3 fatty acids.

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 alpha-linolenic acid oil and lignans, flaxseed is an essential source of high quality protein and soluble fiber and has considerable potential as a source of phenolic compounds (3).

Flaxseed contains both soluble and insoluble fiber (about 28 gram total per 100 grams of the flax seed). About one-third of the fiber is soluble. Studies have found that the soluble fiber in the flaxseed like that found in oat bran and fruit pectin can help to lower cholesterol. Soluble fiber also has been found to regulate blood sugar levels. The remaining two-thirds of the fiber in the flaxseed is insoluble. Insoluble fiber aids digestion by increasing bulk, reducing the time that waste remains in the body and preventing constipation. These characteristics seem to have a role in protecting against cancer.

Flaxseed oil is rich in alpha-linolenic acid that is both an essential fatty acid and omega-3 fatty acid. Researchers are interested in omega-3 fatty acids for their roles in proper infant growth and development, reducing risk factors for heart diseases and stroke (regulation of cholesterol, triglyceride. Blood pressure, blood clotting), immune and inflammatory disorders.

Incorporating flaxseed into a diet is simple and can add a tasty twist to routine dishes. The small, radish brown whole seeds have a nutty taste and can be sprinkled over salads, soups, Yoghurt or cereals. Whole or ground flaxseed can replace some of flour in bread, muffin, pancake and cookie recipes.

Flaxseed can be added to baked products as a whole seed, imparting a healthy appearance and increased texture quality. However, flaxseed can be ground (milled) prior to consumption to obtain the potential health benefits from the Omega-3 fatty acids and lignans. Flaxseed is high in mucilage (gums) that can increase the water absorption properties of the dough, which can impact mixing time and dough handling characteristics. The American Institute of Baking recommends additional formula water at a rate of 75% of the added ground flaxseed by weight (4).

Keeping in view the medicinal and nutritional benefits of the flaxseed, cookies were prepared from the composite flour containing varying levels of the full fat flaxseed flour. The objectives of the study were:

- I. To prepare composite flours by supplementing different proportions of full fat flaxseed flour with the straight grade flour.
- II. To prepare cookies from composite flours and their sensory evaluation to assess the suitable level of flaxseed supplementation.
- III. To determine the physical properties of the cookies, so as to check the effect of supplementation.

Materials and Methods

Procurement of Raw Material

Wheat

Wheat variety Iqbal 2000 was purchased from the Department of Agronomy and research was conducted in the Postgraduate Research Laboratory, Institute of Food Science and Technology, University of Agriculture, Faisalabad.

Flaxseed

Flaxseed was purchased from Oil Seed Research Institute, Ayub Agriculture Research Institute, Faisalabad.

Cleaning of wheat and flaxseed

Wheat and flaxseed were cleaned manually to remove dust particles, damaged seeds, seeds of other crops and other impurities such as weeds and metals.

Preparation of wheat and flaxseed flours

Straight grade flour

Wheat grains were tempered at 14% moisture by following the procedure of AACC (5). Tempered wheat was milled in Quadrumat Senior mill to get the straight grade flour.

Flaxseed flour

Flaxseed grains were milled in Udy cyclone mill to get full fat flaxseed flour.

Proximate analysis of wheat and flaxseed flour

Wheat and flaxseed flours were analyzed for crude fat, crude fiber, crude protein, total ash, moisture content and NFE according to their methods described in AACC (5).

Composite flour (straight grade flour+ full fat flaxseed flour)

Treatments	Straight grade flour %	Full fat Flaxseed flour%
T ₀	100	0
T ₁	95	5
T ₂	90	10
T ₃	85	15
T ₄	80	20
T ₅	75	25
T ₆	70	30

Preparation of cookies

Cookies were prepared from composite flours with some modifications in method described in AACC (5). Following recipe was used for the preparation of cookies.

Flour/composite flours	500g
Sugar	250g
Hydrogenated vegetable ghee	250g
Eggs	3(numbers) Avg. wt 60g each
Baking powder	10g

Method

The ingredients were weighed accurately. Vegetable ghee and sugar was mixed and eggs were added one by one. The composite flours and baking powder were sifted and added to sugar-ghee- egg mass and mixed to get a homogeneous mass. The batter was then rolled out with the help of the rolling pin. Cookies were cut out with the help of cookie cutter having 36mm diameter and placed in trays. Baking was done at 218-233° C for 10-12 minutes. Cookies were allowed to cool at room temperature for 8-10 minutes.

Physical analysis of cookies

For the determination of diameter (width), thickness and spread factor, following methods of AACC (5) were followed.

Diameter

To determine the diameter (D), six cookies were placed edge to edge. The total diameter of the six cookies was measured in mm by using a ruler. The cookies were rotated at an angle of 90° for duplicate reading. This was repeated once more and average diameter was reported in millimeters.

Thickness

To determine the thickness (T), six cookies were placed on top of one another. The total height was measured in millimeters with the help of ruler. This process was repeated thrice to get an average value and results were reported in mm.

Spread factor

Spread factor (SF) was determined from the diameter and thickness, with the help of following formula:

$$SF = \frac{D}{T} \times CF \times 10$$

where CF is a correction factor at constant atmospheric pressure. Its value was 1.0 in this case.

Sensory evaluation of cookies

To assess the quality and acceptability, the cookies were presented to a panel of judges and the sensory evaluation was carried out for colour, flavour, texture, crispiness and overall acceptability according to methods described by Larmond (6).

Statistical Analysis

The data was statistically analyzed by performing analysis of variance technique (7) and interpreted

according to Duncan's Multiple Range Test at 5% level of probability.

Results and Discussion

Proximate composition of different type of flours

Proximate composition of, straight grade flour and full fat flaxseed flour have been given in Table 1. The results showed that flaxseed flour contains highest amount of fat as compared to other types of flour. Moisture content and NFE were higher in straight grade flour.

Table 1. Proximate composition of different type of flours (%).

	Straight grade flour (SGF)	Full fat flaxseed flour (FF)
Moisture	12.20	4.50
Ash	0.59	3.46
Crude fat	1.80	37
Crude fiber	0.28	8.2
Protein	11.30	22.4
NFE	73.83	24.22

Physical evaluation of cookies prepared from composite flours

Thickness

Results disclosed that the thickness of the cookies prepared from the composite flour containing flaxseed flour varied significantly between the treatments. Thickness of the cookies showed gradual increase as the level of flaxseed flour replacement. Data regarding the mean values of the thickness of the cookies (Figure 1) showed that highest value (61mm) was found in T₆ while lowest value (43.33 mm) was found in T₀ that was control.

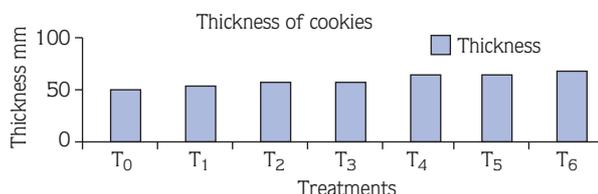


Figure 1. Thickness of the cookies with different flaxseed flour content.

Diameter

Mean Diameter of the cookies (Figure 2) prepared from the different treatments of the composite flour revealed that highest significant value (291 mm) was observed for the cookies prepared from T₆ while lowest values were found for the cookies prepared from T₀ and T₁ i.e 260.33 mm and 262 mm respectively. The mean values of the diameter of cookies prepared from other treatments were found between 266mm and 280.33 mm.

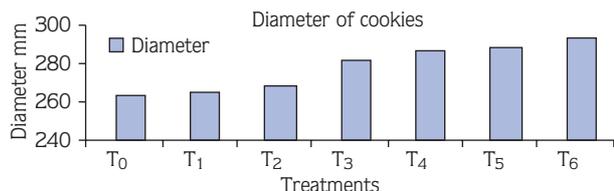


Figure 2. Diameter of the cookies with different flaxseed flour content.

Spread factor

Spread factor is the ratio that depends on the values of the thickness and diameter of the cookies. Highest spread factor (Figure 3) (58.33) was observed in the cookies prepared from T₀ and lowest (48.49, 47.71) have been found in T₅ and T₆ respectively. Results regarding the physical evaluation of the cookies are in line with Tsen et al. (8) who reported that fortified wheat flour with soy flour isolate upto the level of 50% drastically reduced spread factor and increased cookie thickness. Hoojat an Zebik(9) also showed that 20 and 30% replacement of navy bean, sesame seed flour reduced the spread factor of the whole wheat flour cookies.

Sensory evaluation of cookies prepared from composite flours

Colour

Colour is very important parameter in judging the properly baked cookies that not only reflects the suitable

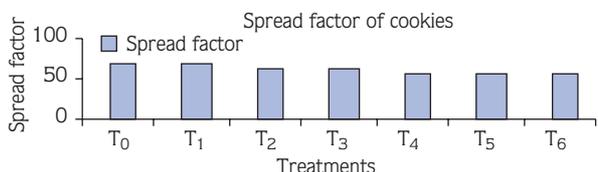


Figure 3. Spread factor of the cookies with different flaxseed flour content.

raw material used for the preparation but also provides information about the formulation and quality of the product (Figure 4). Mean quality score of the colour of the cookies have been given in the Table 3. It is evident from the results that highest score was scored by cookies prepared from T₀ while lowest by cookies prepared from T₆. Judges have disliked the cookies prepared from T₅ and T₆ with respect to colour when subjected under sensory evaluation. More darkness in the colour of the cookies was observed as the level of the supplementation of the flaxseed flour was increased in the wheat flour that may be subjected to the dark brown colour of the flaxseed.

Flavour

Flavour is the main criterion that makes the product to be liked or disliked. Quality score for the flavour of the cookies revealed that the flavour of the cookies varied significantly among different treatments. The results indicated that the cookies prepared from T₀ significantly got highest score (8.20) for flavour. With respect to the flavour, the judges accepted cookies prepared from all the treatments of the composite flours containing flaxseed flour.

Crispiness

Table 3 shows the quality scores for the crispiness of the cookies. It is obvious from results that quality score for the crispiness of the cookies ranged from 4.41 to 8.00. The highest (8.00) significant value for the quality score of the cookies was found for T₀ and lowest (4.41) for the cookies prepared from T₆. Judges have disliked the cookies prepared from T₆ when subjected under sensory evaluation for their crispiness.

Texture

Texture of the cookies containing flaxseed flour in their formulation was significantly affected with the increase in the level of the flaxseed flour. Cookies prepared from T₀ got highest (8.50) score while lowest score was obtained in the cookies prepared from T₆. With respect to the texture, judges have accepted cookies prepared from all the treatments of the composite flours.

Overall acceptability

The statistical analysis regarding the overall acceptability of cookies prepared from composite flours have been depicted in Table 3. It is obvious from the results that supplementation significantly effected the

Table 2. Physical characteristics of the cookies containing full fat flaxseed flour.

Treatment	Thickness	Diameter	Spread factor
T ₀ (whole wheat flour)	44.33e	260.33f	58.73a
T ₁ (5% flaxseed flour)	45.33e	262.00f	57.80ab
T ₂ (10% flaxseed flour)	48.33d	265.00e	54.83c
T ₃ (15% flaxseed flour)	49.33d	279.00d	56.56b
T ₄ (20% flaxseed flour)	56.00c	283.66c	50.66d
T ₅ (25% flaxseed flour)	59.00b	286.00b	48.49e
T ₆ (30% flaxseed flour)	61.00a	291.00a	47.71e

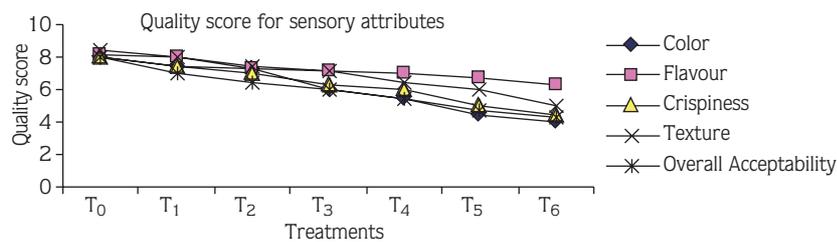


Figure 4. Quality score of the cookies with different flaxseed flour content.

Table 3. Sensory attributes of the cookies containing full fat flaxseed flour.

Treatment	Colour	Flavour	Crispiness	Texture	Overall Acceptability
T ₀ straight grade flour)	8.00a	8.20a	8.00a	8.50a	8.00a
T ₁ (5% flaxseed flour)	7.50b	8.00a	7.50b	8.00b	7.00b
T ₂ (10% flaxseed flour)	7.25b	7.25b	7.00c	7.50c	6.50c
T ₃ (15% flaxseed flour)	6.00c	7.12b	6.25d	7.20c	6.00d
T ₄ (20% flaxseed flour)	5.50d	7.00bc	6.00d	6.50d	5.50e
T ₅ (25% flaxseed flour)	4.50e	6.75c	5.00e	6.00e	4.75f
T ₆ (30% flaxseed flour)	4.00f	6.33d	4.41f	5.00f	4.25g

overall acceptability of the cookies. Maximum score (8.00) was obtained by cookies prepared from T₀ while minimum scores (5.00) and (4.75) were scored by the cookies prepared from T₅ and T₆. Cookies prepared from T₅ and T₆ have been rejected by judges with respect to overall acceptability. The results of the sensory evaluation of the biscuits prepared from the different treatments of the composite flour are according to the findings of Gambus *et al.* (10), Iqbal (11), Shearer (12), Alpers and Sawyer-Morse (13), Sharma *et al.* (14) and Ullah (15) who reported increasing the level of flaxseed flour, matri

flour, cow pea flour in the biscuits resulted in the significant decrease in the sensory attributes of the cookies.

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