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Nutritional, organoleptic evaluation and storage study of peanut *chikki* supplemented with flaxseeds

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Abstract

Introduction: Flaxseeds are known to have very high potential to prevent many chronic diseases, due to its good quality fat and fiber content. Peanut *Chikki*, an Indian sweet was supplemented with the flaxseed to enhance the nutritional value of the standard product.

Materials and methods: Flaxseeds were utilized to replace peanuts in the traditional peanut *Chikki* at 50% and 100%. The developed product was then evaluated for its nutritional and sensory parameters using standard procedures.

Results and discussions: Results showed that incorporation of Flaxseed increased the nutritional quality of *Chikki* significantly especially in fat, fiber and protein content, 6%, 1% and 2.9% respectively. Storage studies (30 days) revealed that the addition of Flaxseed increased the peroxide value of samples during storage (~12 meq/kg), thereby making the samples more prone to rancidity.

Conclusion: Considering the fiber, protein content and organoleptic evaluation it can be concluded that Flaxseed incorporated *Chikki* acceptable by panellists and inclusion of such fortified common daily use snacks will help community to maintain a healthy life.

Keywords: Flaxseeds, flaxseed *Chikki*, physicochemical characteristics, Sensory evaluation, Storage study

1. Introduction

Flaxseed is a smooth, flat and reddish-brown in color is native to the region extending from the eastern Mediterranean to India also called as linseed. The texture of flaxseed is crisp and chewy possessing a pleasant nutty taste [1]. Beyond its oilseed crop ability, proximate composition of flaxseed makes it more promising for its utilization in different food products.

Flaxseed is one of the richest vegetarian sources of α -linolenic acid (omega 3 fatty acid) and soluble mucilage [2]. Whole flaxseeds contain 28% dietary fiber (7-10%soluble fiber, 11-18% insoluble fiber); 40% fats (57% of omega 3 fatty acids) and 21% proteins. As a percentage of total fat, flaxseeds contain 54% omega-3 fatty acids (mostly ALA), 18% omega-9 fatty acids (oleic acid) and 6%omega-6 fatty acids (linoleic acid); the seeds contain 9% saturated fat, including 5% as palmitic acid [3, 4]. Flaxseed oil contains 53% 18:3 omega-3 fatty acids (mostly ALA) and 13% 18:2 omega-6 fatty acids. It is also the richest source of phytoestrogens - lignans. Consumption of flaxseeds has shown to reduce total and LDL cholesterol as well as platelet aggregation. The major bioactive components responsible for hypolipidemic action of flax seeds are dietary fiber. The increased use of omega (ω)-3 fatty acids was a powerful example of nutritional strategy that may produce significant cardiovascular benefits [5-7]. Flaxseeds have been used in the traditional Austrian medicine internally (directly soaked or as tea) and externally (as compresses or oil extracts) for treatment of disorders of the respiratory tract, eyes, infections, cold, flu, fever, rheumatism and gout [8]. In present era, consumer's trend towards functional food has increased significantly as health awareness rose. *Chikki* is a sweet product prepared by mixing various types of nuts and other ingredients either with jaggery or sugar. *Chikki* is popular all over the country amongst all age groups but school going children and rural areas are the main targets. Thus this study was developed with the intention of incorporating these nutrition dense flaxseeds to the traditional Indian sweet *Chikki*, which is popular throughout the country and consumed by all the sections of the population.

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2. Materials and methods

Peanuts, flaxseeds and jaggery were purchased from the local market of Ludhiana because of its easy proximity. Both peanut seeds and flaxseeds were roasted (110-120 °C) until sufficiently dried and became crisp and brittle to touch. Peanuts were then peeled and crushed coarsely.

2.1. Preparation of standard *Chikki*

Peanut *Chikki* (A-control) was made by using the traditional standard recipe. Jaggery and peanuts were taken in equal amounts; jaggery was crushed and heated till the hard crack stage was developed (150 °C). Pre weighed crushed peanuts were added to this jaggery syrup and were mixed thoroughly to cover the peanuts properly. Hot mass was then transferred on to a wooden board which was already greased. The mass was then spread uniformly with help of a roller. Vertical and horizontal lines were marked with a knife or cutter to make uniform pieces and then cooled to room temperature (~27 °C). The *Chikki* was then packed in polypropylene pouches.

2.2. Preparation of *Chikki* with flaxseeds

Roasted flaxseeds were added to the standard peanut *Chikki* (sample A) at 50% (Sample B) and 100% (Sample C) replacement of peanuts. This 50% and 100% replacement was based on sensory evaluation and thus was chosen for further studies. Remaining procedure, was used same as mentioned for the standard recipe. Both the samples were stored at room temperature (~27 °C) in polypropylene pouches

2.3. Physico-chemical characteristics of *Chikki*

2.3.1. Moisture estimation

Moisture content was determined by following the oven drying method [8].

2.3.2. Texture measurement

Universal Texture Measuring system (Model LR-5K, Lloyds, UK) was used to measure the snap (breaking strength of the *Chikki*). The uniform size *Chikki* was taken and 3-point bending/breaking test was performed using a load cell of 100 N with 3 replicates with a cross head speed of 50 mm/min. The force required to break the *Chikki* into 2 pieces was recorded as the breaking strength (snap) and expressed in Newton (N).

2.3.3. Fiber estimation

Moisture and fat free sample (2g) were digested with 200ml of 1.25 per cent H₂SO₄ by gentle boiling for half an hour. The contents were filtered and the residue was washed several times with hot distilled water till it became free from acid. Acid free residue was then transferred to the same flask to which 200ml of 1.25 per cent NaOH was added. The contents were digested again for half an hour, filtered it and residue was again washed with hot distilled till it became alkali free. The residue was dried in an oven overnight at 100°C and weighed and then placed in muffle furnace at 600°C (±50°C) for 4 hours. The loss in weight after ignition the sample represented the fiber in the sample [9].

2.3.4. Protein estimation

Protein was determined by using the Folin-Ciocalteu reagents, which reacts with aromatic residues of proteins and yields blue color which in turn is read in colorimeter [10].

2.3.5. Fat estimation

Fat content was determined by Soxhlet extraction method [9].

2.3.6. Peroxide value

Peroxide value is a measure of the peroxides contained in the oil. The peroxides present were determined by titration against thiosulphate in the presence of potassium iodide. Starch was used as an indicator [10].

2.3.7. Carbohydrates

Carbohydrate estimation was done by using the formula given below:

$$\% \text{Carbohydrate} = 100 - [\text{moisture} + \text{ash} + \text{protein} + \text{fat}]$$

2.3.8. Calorific value

Energy value was calculated by using the undermentioned formula:

$$\text{Energy} = [(9 \times \text{g. fat}) + (4 \times \text{g. protein}) + (4 \times \text{g. carbohydrate})]$$

2.3.9. Sensory evaluation

To assess the quality, acceptability, the products were presented to a panel of ten judges and the evaluation for sensory parameters such as color, taste, flavour, texture and overall acceptability characteristics were carried out using a 9 point hedonic scale. *Chikki* samples with code number were served one at a time for evaluation. Sensory evaluation was carried out for freshly prepared *Chikki* products and those stored for 30 days at 27 ± 2 °C.

2.3.10. Storage study

Chikki were packed in polypropylene pouches and kept at ambient temperatures (~27 °C) for 30 days. The storage stability was determined by estimating moisture content, peroxide value and sensory evaluation by 10 panel members.

2.3.11. Statistical analysis

All analyses were carried out in triplicate. Critical difference (CD) was studied in between the values to differentiate among the means of different samples ($p \leq 0.05$)

3. Results and Discussion

3.1. Moisture content

Moisture of *Chikki* is very critical as it determines the quality and stability of the product. All the products had a moisture content of 3.4 - 3.8%. The moisture content in the sample C (flaxseeds) was highest i.e 3.8%. This was followed by the other two samples. No significant difference was seen amongst the 3 samples. However, the moisture content increased during storage. It was estimated in the range of 5.2 to 5.8% in the samples B (peanut and flaxseed), C (only flaxseed) and A (control) respectively. (Fig 1)

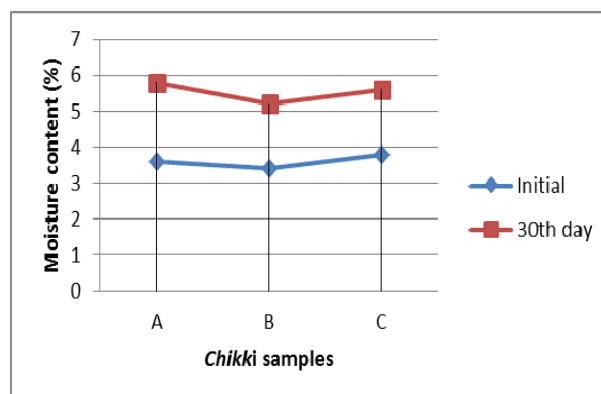


Fig 1: Moisture content of *Chikkis* at initial and 30th day of storage
*Mean (n=3)

3.2. Texture analysis

Chikki was found to have a good crunchy and brittle texture at first. The Breaking strength (snap) was measured as 64.3 -67.9 N initially which then gradually reduced to 41.5 - 43.7 N at the 30th day of storage. This could be due to the absorption of moisture by the *Chikki*. (Fig 2)

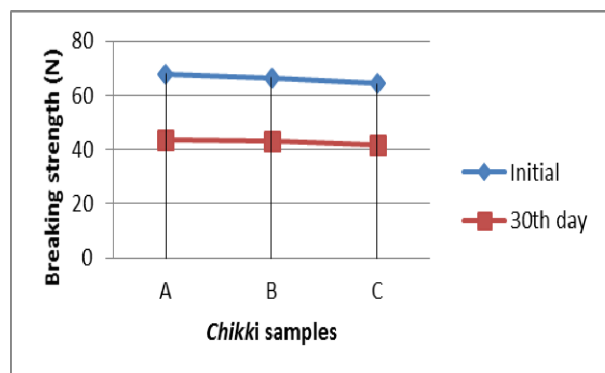


Fig 2: Texture analysis of *Chikkis* at initial and 30th day of storage
*Mean (n=3)

3.3. Fiber content

Fiber content is the crucial aspect of this research study. Fiber content was found to be increased on addition of flaxseeds to the standard *Chikki*. Total fiber content of three samples was in between 1.6-2.6%, least present in the control sample. Fiber content gradually increased with increase in the composition of flaxseeds.

3.4. Fat content

The fat content in the samples was in the range 18.1 – 24.5%. The sample contributing to the highest fat content was sample C containing only flaxseed. The increased concentration of fat was due to the increased concentration of flaxseed thereby improving the product quality in terms of good fatty acids.

3.5. Protein content

The protein content in the samples was in the range 10.1%-12.9%.

3.6. Calorific value

In terms of energy all the samples (Table 2) came out to be in range 467.3 kcal- 493.9 kcal. The sample possessing the highest energy content was C (flaxseed) and least total energy content was found in sample A (control).

Table 2: Quality parameters of peanut and flaxseed *Chikki*

Quality Parameters	A (Standard peanut <i>Chikki</i>)	B (Peanut + flaxseed <i>Chikki</i>)	C (Flaxseed <i>Chikki</i>)
Moisture (%)	3.6± 0.40 ^a	3.4± 0.30 ^a	3.8± 0.20 ^a
Ash (%)	1.4± 0.36 ^a	1.3± 0.26 ^a	1.2± 0.03 ^a
Fat (%)	18.1± 1.80 ^a	24.5± 1.52 ^b	19.5± 1.32 ^a
Fiber (%)	1.6± 0.57 ^a	2.3± 0.28 ^a	2.6± 0.28 ^a
Protein (%)	10.1± 0.10 ^a	12.92±0.005 ^b	12.06± 0.015 ^c
Carbohydrate (%)	67.3±0.08 ^a	58.78±0.10 ^b	64.04±0.25 ^c
Calorific value (kcal)	467.3±3.55 ^a	479.8 ±1.04 ^b	493.9 ±2.57 ^c

Values are mean ± standard deviation (n=3). Different superscript letters indicate significant difference from the control (p<0.05).

3.7. Peroxide value

Peroxide value is relatively a measure of the peroxides content in the oil. Peroxide value thus gives an indication about the rancidity of a sample. In this particular study peroxide value was determined between 1-2 days after preparation of samples. Therefore in this experiment conducted resulting peroxide value of the samples which were tested ranged between 2.1-4.2 meq/kg. The highest peroxide value was found to be in sample C (4.2meq/kg) containing only flaxseed and least was found in the control sample. Thus concluding that, addition of flaxseed to increase the good fatty acids, but made the *Chikki* more prone to rancidity. Also PV was found to be increased during the entire storage period of 30 days, with highest of 16.4 meq/kg in sample C, only flaxseed *Chikki*. (Fig 3)

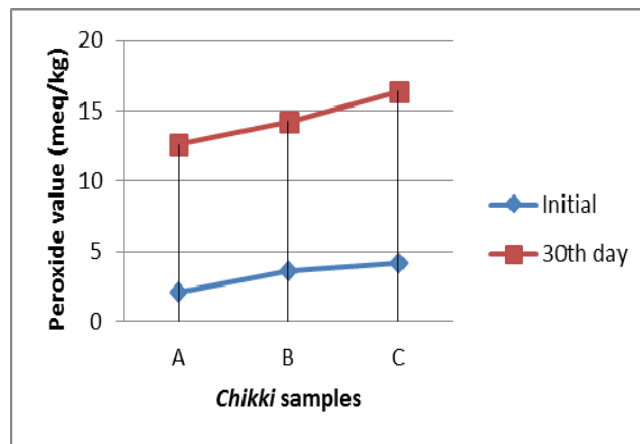


Fig 3: Peroxide value of *Chikkis* at initial and 30th day of storage
*Mean (n=3)

3.8. Sensory analysis

Sensory analysis of *Chikki* showed that the products were similar in all desirable quality attributes. (Table 3) Addition of flaxseed, increased the acceptability of the product. Significant differences were observed in the taste, appearance and overall acceptability of the flaxseed *Chikkis* (B and C).

Table 3: Sensory evaluation of the *Chikkis*

Sensory Parameters	A (control peanut <i>Chikki</i>)	B (Peanut + flaxseed <i>Chikki</i>)	C (Flaxseed <i>Chikki</i>)
Appearance	7.6± 0.69 ^a	7.75± 0.63 ^a	7.3± 0.67 ^a
Colour	7.5± 0.70 ^a	7.55± 0.68 ^a	7.4± 0.69 ^a
Taste	7.5± 0.91 ^a	7.7±0.94 ^a	7± 1.41 ^a
Texture	7.8± 0.78 ^a	7.8± 0.91 ^a	7.6± 1.07 ^a
Flavor	7.7±0.67 ^a	7.5±0.84 ^a	7.2±1.54 ^a
Overall acceptability	7.57±0.64 ^a	7.6±0.72 ^a	7.26±0.86 ^a

* Values are mean ± standard deviation (n=10); Different superscript letters indicate significant difference from the control (p<0.05).

Sensory scores of all desirable attributes decreased slightly at the ambient conditions at the end of 30 days when compared to the initial values but were still acceptable. Slight off taste and rancidity was evident in *Chikki*.

Table 4: Sensory evaluation of the *Chikkis* (30 days)

Sensory Parameters	A (control peanut <i>Chikki</i>)	B (Peanut + flaxseed <i>Chikki</i>)	C (Flaxseed <i>Chikki</i>)
Appearance	8± 0.66 ^a	7.3± 1.33 ^a	6.9± 1.44 ^a
Colour	8± 0.66 ^a	7.1± 1.28 ^a	7.2± 0.78 ^a
Taste	7.6± 0.84 ^a	6.8±1.03 ^a	6.2± 2.04 ^a
Texture	7.75± 0.63 ^a	7.1± 1.66 ^a	6± 1.94 ^a
Flavor	7.7±0.67 ^a	6.6±0.96 ^a	6.05±2.31 ^a
Overall acceptability	7.68±0.87 ^a	7.03±1.30 ^a	6.23±1.85 ^a

* Values are mean ± standard deviation (n=10);
Different superscript letters indicate
significant difference from the control (p<0.05).

4. Conclusion

Flaxseed *Chikki* was acceptable and thus could be incorporated in convectional food items to improve the nutritional quality of the product as well as add variety in the diet. Roasting of seeds enhanced its flavor and taste. The nutritional parameters of the Flaxseed *Chikki* with 100% incorporation were superior as compared to the peanut *Chikki*. Fiber and fat significantly increased in the 100% Flaxseed *Chikki*, while protein content was found in the 50% incorporated sample. Study suggest that flaxseed incorporated food products can have good consumer acceptability along with its nutritional benefits. Work in pursuit of this strategy includes continuing efforts to ensure that dietary diversification, food fortification, supplementation, and public health measures are taken comprehensively to combat many chronic disease complications.

Conflict of interest

No conflict of interested reported

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