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Normalization and improvement of flax seed assimilated baked foodstuffs with their value assessment

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Abstract

The demand of consumers has bigger for the new food products with taste, safety, convenience and nutrition. Nutrition has appeared an added dimension in the chain of food product development. Due to presence of various bioactive composites flaxseeds have been considered as wide-ranging medicinal food and found to be protective against various metabolic disorders. Flaxseed contains abundant useful constituents which have positive effects in disease inhibition. Several Recent studies have shown that the flaxseed in its whole or in its flour form can be incorporated in various recipes and can be developed in form of bakery and other products. Although scientific evidence supports flaxseed consumption but many people are still unaware of the benefits provided by flaxseed and its beneficial role in hindrance of disorders. Flaxseed or linseed (*Linum usi tatissimum* L.), comes from the flax plant, which is an annual herb. The objective of the study was the development of flaxseed powder value added products and their quality evaluation. Flaxseed powder in different ratio i.e. T1 (10%), T2 (20%), T3 (30%), T4 (40%), T5 (50%) and T6 (60%) with wheat flour. Several preliminary trials were conducted to standardize flaxseed powder and finally therefore T3 was found more acceptable. Flaxseed powder products (Biscuit and muffin) were compared with control product and found that overall acceptability of flaxseed was more when compared to control. Nutrient content was significantly higher in flaxseed products compared to control.

Keywords: flaxseed, nutrient, foodstuff, standardize, preliminary trials

1. Introduction

From the earlier few years, people are becoming more health mindful and demanding the food having high nutritional value. By the way, the demand for flaxseed in food and beverages, functional foods and functional qualities of many traditional foods are being explored. Flax seeds continues to surge forward in its gratitude as a functional food and has recently added attention in the area of disease inhibition primarily because it is the amusing known source of various functional food gears such as alpha-linolenic acid, lignans, as well as being a good source of fiber. Traditionally, flaxseed was grown for its oil bearing seed and for its fiber. But with quickly changing global health state and awareness concerning the ill effects overmedication, plant based products have increased the attention.

In the modern era one of the important challenges today faced by the current living is good health as in this era the people are suffering from numerous degenerative lifestyle diseases. Growing consciousness about the role of diet and search for wellness has generated interest in foods that can work like medicine. With rapid deviances in lifestyle scenario and fast apprehension of the ill effects of overmedication and wrong food practices; the scientists and health professionals are exploring the plant products. 'Functional foods' are foods or dietary components that may provide a health benefit outside basic nutrition. Functional foods distribute a health boost elsewhere what is expected from their traditional nutrient content (Institute of Food Technology expert Report, 2005) [8]. Flaxseed has to be deliberated as a functional food, due to its impending health beneficial compounds. Flaxseed (*Linum usitatissimum* L.) is a plant that produces both fibre and a hard, brown-shelled, oilbearing seed known for its nutritional benefits. The plant grows in every part of the world except the tropics and the arctic, and blooms a pleasing blue, five-petalled flower The spherical fruit capsules contain two seeds in each of five compartments. The seed is flat and oval with a pointed tip. It have smooth glossy surface. The color of flaxseed fluctuates from color dark brown to yellow. The texture of flaxseed is crisp and chewy possessing a pleasant nutty taste (Basch *et al.* 2007) [2].

In present era, consumer's trend towards functional food has increased significantly as health awareness rose. Flaxseed can be one stop for novel high quality source of nutrition.



Plate 1: The flowers of Flaxseed Plant



Plate 2: The Brown colored Flaxseeds

Flax plant (*Linum usitatissimum*) has long been used as industrial oil and fibre crop. Flaxseed is a star of various nutritious compounds which plays a significant role in the prevention of various disorders. It has been grown in some parts of the world, particularly Canada (35%), Argentina (21.8%), China (18.9%), India (13.8%) and the U.S. (11.3%). The main constituents of flax seed include its mucilage (6%), insoluble fibers (18%), proteins (25%), and oils (30-40%) with α -linolenic acid (50-60% of oils) being the primary fatty acid (Trease and Evans, 1980) [17]. Its mucilage can be easily extracted from the seed and has been recycled as a stabilizer and thickener in the food industry (Mazza and Biliaderis, 1989) [14].

1.1 Functional food components of flaxseed

Flaxseed is a very good source of various functional food components. These are:

1.1.1 Lignans: Lignan is one of the important constituent of flaxseed. The lignans are a bunch of chemical compounds originate in plants. Lignans are one of the chief classes of phytoestrogens, which are estrogen-like chemicals and also act antioxidants. Secoisolariciresinol diglucoside (SDG) is a major lignin. Lignan consumption reduces cardiovascular risk and inhibits the development of some types of diabetes. Lignan is also initiate to be defensive against cancer.

1.1.2 Alpha- Linoleic Acid: Flaxseed is a very noble source of α -linolenic acid. ALA from flaxseed exerts positive effect on blood lipids. 12 g of ALA was taken three times a day by group of healthy young women in the flaxseed oil capsules

and compared with group given in flaxseed flour supplemented products. Impressive reductions in blood lipids were observed in both cases (Cunnane *et al.* 1993) [5].

1.1.3 Fiber: Fiber occurs as structural material in the cell walls of plants and has important health paybacks for humans. Flaxseed is an amusing source of dietary fiber. Diets rich in dietary fiber may help reduce the risk of heart disease, diabetes, colorectal cancer, obesity and inflammation (Morris, 2003) [11]. High quantity of dietary fiber adds loose to waste products in the gut and increases bile movement in the gastrointestinal movement. The fiber content of flaxseed could potentially affect insulin secretion and its mechanism of action in maintaining plasma glucose homeostasis. Flaxseed was shown to reduce the post prandial blood glucose response in humans.

1.1.4 Gum: Flaxseed gum has nourishing value as dietary fiber as such it appears to play a role in sinking diabetes and coronary heart risk. It also appears to play an important role in prevention of cancer and obesity (Oomah and Mazza, 2003) [14]. Flaxseed gum performs like typical viscous fiber with the ability to reduce blood glucose response.

Flaxseed has been used in the diet of humans for thousands of years. While drawing the long and attractive history of flaxseed's use, the systematic story of the plant and its modern prospective is revealed (Oomah and Mazza, 2003) [14]. In ancient times, flaxseed was grown for its oil bearing seed and for its fiber. In ancient Egyptian tombs Linen cloth woven from flaxseed has been found, while Jewish high priests of the Old Testament wore garments made from flax. Before World War II flaxseed had been commonly used as food and it was forgotten until its comeback in the 1990s. Studies reveal that it is not only a nutritious food, but it also has therapeutic benefits, both preventative and curative (Hall, 2006) [7]. Early records show that it has been grown since the beginning of civilization, and people all over the world have celebrated its usefulness throughout the ages. In southern Mesopotamia (5200 -4000 B.C.) irrigation was used to grow flax. History also reveals that Babylonians cultivated flaxseed as early as 3000 B.C. and their burial chambers depict flax cultivation and clothing from flax fibers. Hippocrates wrote, about using flaxseed for the relief of intestinal discomfort (650 B.C.) and Theophrastus recommended the use of flaxseed mucilage as a cough remedy (in the same era) Axelson *et al.* 1982) [1].

From the earlier few years, people are becoming more health aware demanding the food having high nutritional value and the same time deliberating health benefits. In this regard, the demand for flax in food and beverages, functional foods and dietary supplements has risen dramatically (Chen *et al.* 2002) [4]. The use of flaxseed as a functional food is gaining more popularity in the recent years. In ancient times it is grown for food and other uses. Flaxseed is a tremendous source of various bioactive complexes such as alpha linoleic acid, proteins, soluble and insoluble dietary fiber as well as omega-3 fatty acids. The flaxseed can be cast-off as a whole or in the form of flour can be combined in dissimilar other foods with bakery foodstuffs. A lot of work has been carried out on the composite flour technology with distinct reference to improve the wheat flour quality concluded blending it with other flours. Flaxseed is well-thought-out to be a complete functional food due to the existence of α -linolenic acid (Newkirk, 2008) [13] and other bioactive compounds. Flax is

deliberated a functional food or source of functional elements, because it contains various functional mechanisms all of which have positive effects in disease prevention. Although scientific confirmation provisions flaxseed consumption, many people are still uninformed of the benefits delivered by this product and its possible uses in the production of foodstuffs (Bozan, and Temelli 2008) [3]. There are numbers of studies indicating the role of raw flaxseed and its baked products in health upgrade and disease prevention (Udeniqwe *et al.*, 2009) [18]. The flaxseed comprises both soluble and insoluble fibers. About one-third of the fiber in flaxseed is soluble and it may help to lower cholesterol and to normalize levels of blood sugar. The remaining two-thirds of the fiber in the flaxseed is insoluble which aids digestion by aggregate bulk and preventing constipation. Flaxseed has gained much prominence in recent times as ethno medicine due to its wide pharmacological actions. Although its therapeutic prospective, as antioxidant, primarily as anticancer, antidiabetic, inhibition in insomnia, prevention in bone disorders and an anti-atherosclerotic agent is known (Institute of Medicine, 2002) [9].

Flaxseed (*Linum usitatissimum*) belonging to family Lineaceae, is a blue flowering annual herb that produces small flat seeds varying from golden yellow to reddish brown colour. Flaxseed possesses crispy texture and nutty taste (Morris 2007; Rubilar *et al.* 2010) [11, 15]. Flaxseed is also known as linseed and these term are used interchangeably.

Flaxseed or linseed (*Linum usitatissimum*) is a minor oil seed. It is grown in about 4-5 lakh ha of land with a normal yield of 395 kg/ha in India (Dubey *et al.* 2009) [6]. The significant flaxseed growing states of the country are Madhya Pradesh, Uttar Pradesh, Chhattisgarh, Bihar, Rajasthan, Orissa and Karnataka (Singh *et al.* 2009) [16].

Flaxseed has been used as a precious nutritional food grain and traditional medicine in human diets for thousands of years and more freshly it has been cast-off as a source of nutraceuticals and recognized as a functional food, whose benefits on health are commonly accredited to high concentration of linolenic acids (Omega 3) and lignans as well as noteworthy amounts of dietary fiber containing soluble and insoluble fibers. About one third of fiber is soluble and it may aid to lower cholesterol and to control levels of blood sugar. The remaining two third part of the fibre in flaxseed is insoluble which aids digestion by increasing bulk and inhibiting constipation

Flaxseed is cast-off as a nutritional additive in food preparation particularly in bakery products and in preparation of dietary products. It has shown its capacities for

incorporations into dissimilar food products. Although it is a rich source of many nutrients, it also has got anti-nutritional factors such as, trypsin inhibitors, cyanogenic compound of about 264 to 540 mg/100g. These compounds either inhibit the Flaxseed (*Linum usitatissimum* L.) accessibility of protein or toxic to humans. Hence dispensation by adopting thermal and mechanical applications including roasting, cooking in microwave, autoclaving and boiling are suggested to avail the nutritional profits from these seeds.

2. Materials and Methods

2.1 Standardization of flaxseed powder mix recipes

In the present study recipes were standardized and developed by the use of flaxseed powder. Recipes were standardized to achieve the desirable colour, flavour, texture, taste, appearance and overall acceptability.

2.1.1 Biscuit: The butter (50gm) and sugar (50gm) were creamed together in a large bowl and creamed well until fluffy. Flaxseed Mix with wheat flour in different ratios, baking soda (1.5gm), baking powder (1.5gm) and chocolate powder (20gm) were sieved together and mix properly. Then slowly mixed dry ingredients into shortening cream and with the help of milk make soft dough. Rolled the dough and cut into desired shape with the help of cookie cutter. Preheat the oven at 180 °C for 10 minutes. Bake the biscuits in oven at 180 °C for 20-25 minutes.

2.1.2 Muffin: Preheat oven at 180 °C for 10 minutes. Flaxseed Mix with wheat flour in different ratios, baking soda (1.5gm), baking powder (1.5gm) and chocolate powder (20gm) were sieved together and mix properly. The butter (50gm) and sugar (50gm) was creamed together in a large bowl and creamed well until fluffy. Then add dry ingredients and blend properly. Finally the carbonated beverages were added to the mixture and blended for 2 minutes to improve the quality of batter and final product. The batter was filled into the muffins moulds and baked at 180 °C for 25-30 minutes.

2.2 Sensory evaluation

The prepared flaxseed Mix recipes were organoleptically evaluated by ten panels of judges. For the selection of panel members threshold test is used. The flaxseed Mix was evaluated for various sensory quality characteristics such as color, flavor, taste, texture, appearance, and overall acceptability.

Table 1: Score card for Organoleptic Evaluation

Name of Panel member:				Date:		
Characteristics	Colour	Flavour	Texture	Appearance	Taste	Overall acceptability

Note: Fill score in columns according to your evaluation of given sample. Scoring is done on 9 point hedonic scale; scores are viz. Like extremely (9), Like very much (8), Like moderately (7), Like slightly (6), Neither like or dislike (5), Dislike slightly (4), Dislike moderately (3), Dislike very much (2), Dislike extremely (1) Evaluation of the product was done on the basis of 9 point hedonic scale. The test sample was given in triplicates with control. Control sample was prepared from the usual recipes. All samples were coded to avoid any type of biasness.

2.3 Nutrient calculation: Nutrients of developed products was calculated by using Nutritive value of Indian foods (NIN, 2007) [12].

2.4 Statistical Analysis

Statistically, all the collected data on organoleptic evaluation were analysed. Data were presented as mean \pm S.D. Analysis of Variance (ANOVA) was used to assess the sensory characteristics of flaxseed Mix recipes. Statistical analysis was performed using O.P. STAT Software.

3. Results and Discussion

The present study was based on the standardization and development of flaxseed mix recipes viz. Biscuit, Muffin. The developed products were tested for their organoleptic

evaluation for the most acceptable level. The standardized and developed flaxseed Mix Products are given in Plate 3.1 under sub heading.



Biscuit prepared by Wheat Flour



Biscuit prepared by flaxseed powder



Muffin prepared by Wheat Flour



Muffin prepared by flaxseed powder

Plate 3: Standardization and development of wheat Flour (WF) and flaxseed mix products.

3.1 Organoleptic evaluation of flaxseed mix products.

Sensory attributes are the major criteria for the acceptability of the products. Sensory characteristics have been recognized to be the deciding factor in food acceptability. Sensory of products prepared by adding flaxseed powder have been presented below:

Perusal for the sensory scores as evident for the Table 2 revealed that T3 (30%) obtained highest score *i.e.* 8.26±0.23

for colour, 8.33±0.08 for flavour, 8.23±0.12 for taste, 8.16±0.12 for texture, 8.36±0.08 for appearance, and for 8.26±0.10 overall acceptability when compared to other counterparts. It also clear that from overall acceptability point of view T3 (30%) score the highest 8.26±0.10, 7.63±0.12 for T1(10%), 7.63±0.12 for T2(20%), 7.98±0.15 for T4(40%), 8.25±0.16 for T5(50%), 7.77±0.12 for T6(60%) respectively when compared to all other treatments.

Table 2: Mean acceptability scores of flaxseed powder added biscuits

Treatment	Colour Mean±SD	Flavour Mean±SD	Taste Mean±SD	Texture Mean±SD	Appearance Mean±SD	Overall Acceptability Mean±SD
Control(T0)	7.36±0.13	7.43±0.17	7.43±0.26	7.30±0.20	7.66±0.03	7.44±0.14
T1(10%)	7.63±0.26	7.60±0.10	7.56±0.12	7.63±0.06	7.73±0.08	7.63±0.12
T2(20%)	7.933±0.12	7.90±0.11	7.76±0.03	7.63±0.06	7.73±0.08	7.63±0.12
T3(30%)	8.26±0.23	8.33±0.08	8.23±0.12	8.16±0.12	8.36±0.08	8.26±0.10
T4(40%)	8.06±0.13	7.86±0.20	7.83±0.14	7.80±0.17	8.33±0.17	7.98±0.15
T5(50%)	8.26±0.23	8.33±0.08	8.23±0.12	8.16±0.12	8.30±0.10	8.25±0.09
T6(60%)	7.56±0.24	7.66±0.14	7.76±0.18	7.56±0.12	8.30±0.00	7.77±0.12
C.D.	0.630	0.540	0.522	0.452	0.364	0.443
C.V.	4.503	3.888	3.764	3.283	2.542	3.182

For all the other sensory attributes a decreased was noted in the score with increases in the level of ratio of flaxseed powder, the sensory scores ranged between “like moderately

to like very much”. The sensory scores obtained in case of flaxseed powder biscuit depicted that on overall basis control was “Liked very much”.

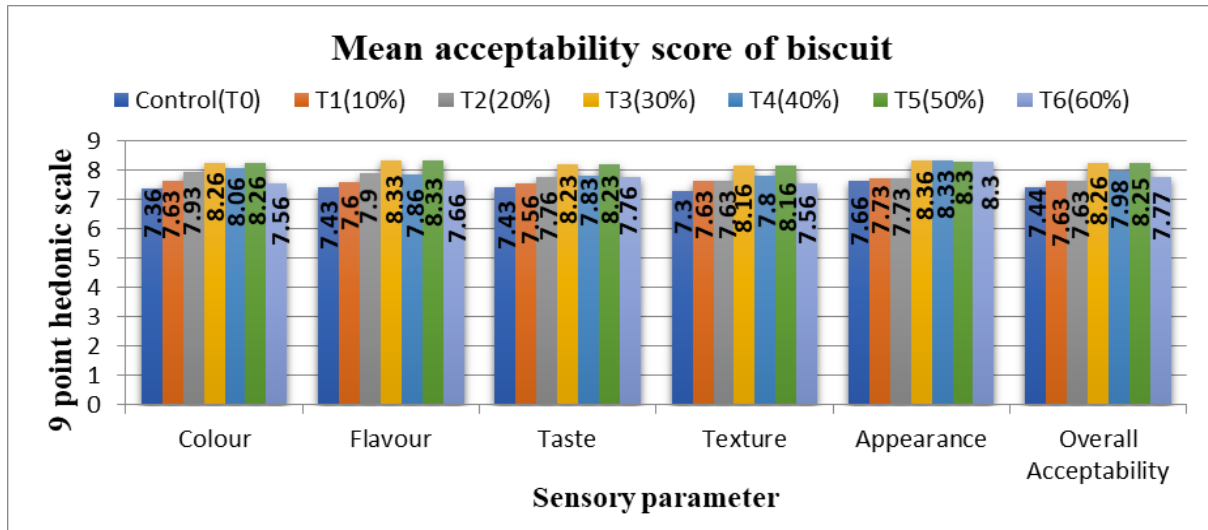


Fig1: Mean acceptability score of flaxseed powder added biscuits

By T3, T1, T2, T4, T5, than T6. Revealed that ratio of flaxseed powder increase in the sensory up to 30% ratio level, but then the sensory scores continuously decreased with T1, T2, T4, T5, and T6 therefore T3 biscuit of flaxseed powder selected for further study.

3.2 Sensory evaluation of flaxseed powder added muffin

Sensory evaluation of flaxseed added muffin in different proportion a long with control has been presented in Table 3 and figure 2. The overall mean score of flaxseed powder added ranged from 7.51±0.05 to 8.72±0.06.

Table 3: Mean acceptability score of flaxseed powder added muffin

Treatment	Colour Mean±SD	Flaovur Mean±SD	Taste Mean±SD	Texture Mean±SD	Appearance Mean±SD	Overall Acceptability Mean±SD
Control(T0)	7.33±0.08	7.40±0.05	7.53±0.03	7.40±0.20	7.90±0.11	7.51±0.05
T1(10%)	7.53±0.03	7.60±0.00	7.50±0.05	7.73±0.06	8.13±0.29	7.64±0.02
T2(20%)	7.80±0.10	7.73±0.20	7.86±0.03	7.73±0.06	7.96±0.08	8.48±0.63
T3(30%)	8.80±0.05	8.73±0.03	8.53±0.16	8.73±0.16	8.83±0.03	8.72±0.06
T4(40%)	8.16±0.12	8.16±0.14	8.06±0.08	8.03±0.16	8.26±0.14	8.14±0.12
T5(50%)	8.30±0.20	8.36±0.23	8.16±0.08	8.26±0.20	8.40±0.05	8.30±0.15
T6(60%)	8.20±0.17	8.20±0.10	8.10±0.00	8.13±0.03	8.50±0.11	8.22±0.00
C.D.	0.384	0.419	0.256	0.443	0.445	0.782
C.V.	2.708	2.952	1.817	3.132	3.037	5.428

This indicated that the flaxseed powder added muffins were found to full under the category of “Liked very much” to “Liked moderately”. Among the all treatments sensory score of muffins prepared with 30 per cent level of flaxseed powder ranked highest for all sensory attributes i.e 8.80±0.17 for

colour, 8.73±0.03 for flavour, 8.53±0.16 for texture, 8.83±0.03 for appearance and 8.72±0.06 for overall acceptability than muffin prepared with 10, 20, 30, 40, 50, and 60 per cent level of flaxseed powder.

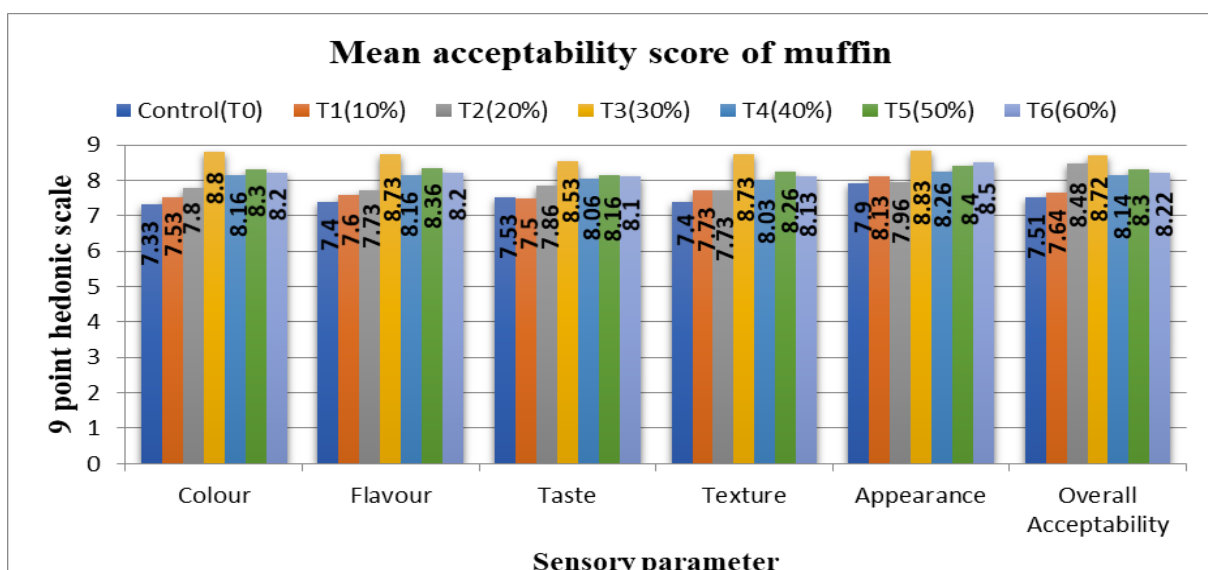


Fig 2: Mean acceptability score of flaxseed powder added muffin

Further it can be discerned that there was general decrease in all sensory attribute with increase in incorporation level 60 per cent of flaxseed powder. The nutritional composition provides basic information about the component and quality of the products. Result of proximate and mineral contents of products have been presented below:

3.3 Nutrient composition of most acceptable flaxseed biscuit

Data regarding the nutrient composition of flaxseed biscuit (per 100 dry weight basis) have been presented in table 4.

Table 4: Nutrient composition of *biscuit* (100g)

Nutrient constituents	Control	T3 (30%)
Moisture (g)	29.1	27.33
Protein(g)	10.77	13.22
Fat(g)	41.91	52.38
Ash (g)	1.18	1.35
Fiber (g)	2.76	9.78
CHO	57.12	105.85
Energy (kcal)	477	540
Calcium (mg)	38.54	109.5
Iron (mg)	1.86	2.95
Phosphorus (mg)	118.87	219.37

Perusal of data clearly shows that the biscuit (control) contained moisture (29.1%), protein (10.77%), fat (41.91%), ash (1.18%), fibre (2.76%), carbohydrate (57.12%), energy

(477.39 kcal), calcium (38.54mg), iron (1.86mg), phosphorus (118.87mg) in per 100 g.

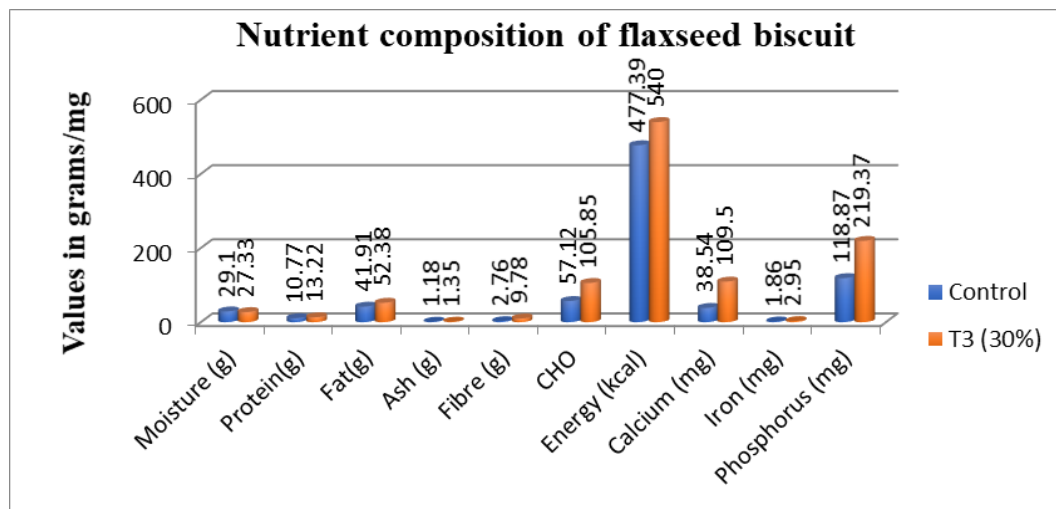


Fig 3: Nutrient composition of *biscuit*

Flaxseed flour added biscuit found to contain moisture 27.3 per cent, protein 10.18 per cent, fat 52.3 per cent, 1.35 ash per cent, 9.78 fibre per cent, carbohydrate 105.85 per cent, energy 540 per cent, calcium 109.5 mg, iron 2.95 mg, phosphorus 219.37 mg. An increase in the nutrient content of biscuit prepared by beetroot powder was noted when compared to control (except protein, fat, calcium, phosphorus, carbohydrate and energy content) was clearly due to the incorporation of flaxseed powder in the product.

3.4 Nutrient composition of most acceptable flaxseed muffin

Flaxseed powder incorporated muffin was found to be containing moisture 21.04 per cent (Table5). A significant increase was observed in moisture, ash, calcium, and iron content when compared to control protein content was found to be 12.86 per cent in beetroot incorporated muffin.

Table 5: Nutrient composition of *muffin* (100g)

Nutrient constituents	Control	T3 (30%)
Moisture (g)	21.04	19.27
Protein(g)	10.41	12.86
Fat(g)	41.26	51.73
Ash (g)	0.51	1.29
Fibre (g)	2.76	9.78
CHO(g)	96.08	20.28
Energy (kcal)	509	537
Calcium (mg)	26.4	97.4
Iron (mg)	18.45	2.93
Phosphorus (mg)	110.5	211

While carbohydrate and energy content increased slightly when compared to control, respectively. Calcium and phosphorus content also observed to be increased when

compared to control but iron content found to be slightly higher in flaxseed powder incorporated muffin (2.93 mg) respectively.

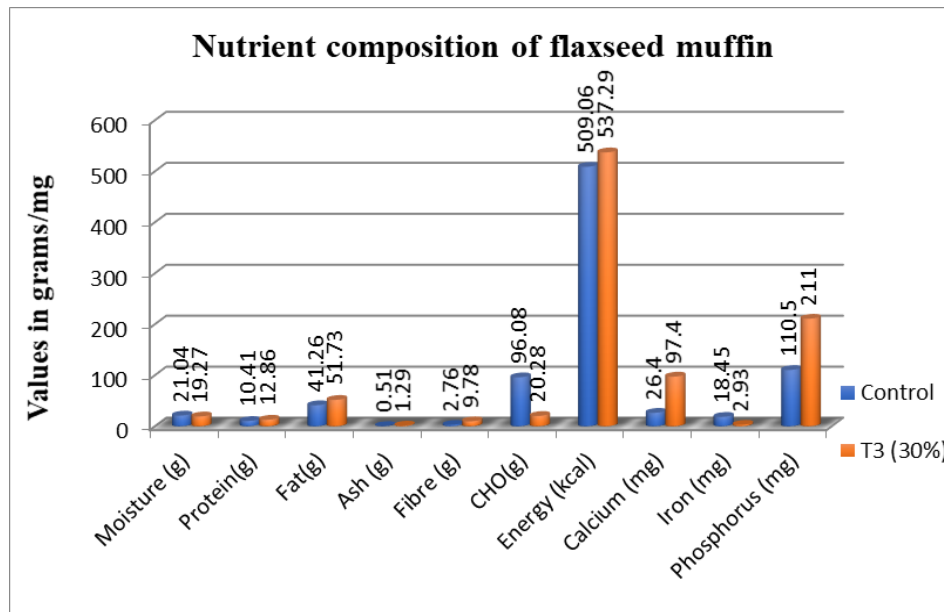


Fig 4: Nutrient composition of muffin

4. Conclusions

The products made from flaxseed Mix were found to be highly acceptable and obtained higher scores as compared to control. Flaxseed products prepared with 30 per cent flax seed powder incorporation had better nutrient and sensory properties (colour, taste, texture etc.) and it also improved the nutritional profile over control products.

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