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Preparation and quality analysis of fortified biscuits based on defatted soy flour and flax seed flour

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Abstract
In this research, the quality of biscuits was determined on the basis of physico-chemical characteristics namely: Moisture content, Ash content, Fat content, Protein content, and Crude Fiber content and sensory analysis including sensory attributes namely colour, flavour, texture, taste and overall acceptability. Prepared with wheat flour and defatted soy flour (DSF) were 85:15, 70:30, 60:40 and the level of flaxseed powder was 0%. Then flaxseed powder was added at a level of 10, 20, 25% and DSF was maintained at level of 30% respectively. A novel fortified biscuit was successfully produced and it was observed as the concentration of DSF and flaxseed powder increased the moisture, ash, and protein showed gradual increase whereas dietary fibre and fat showed a rapid increase as the concentration of Flax seed powder was increased. Also the dark color intensity was increased with the increase in fortification. The sensory score of colour, flavor, taste, and texture was decreased slightly during storage. On the basis of nutritional and sensory quality, biscuit when fortified with blends of 20% flax seed powder and 30% DSF resulted in better quality and nutritious biscuits.

Keywords: Biscuits, Flaxseed Powder, Defatted soy flour

1. Introduction
Multi-Grain biscuit packed full of dietary fiber and lean protein, multi-grain biscuit is good for present time's fast life style. These great tasting biscuits are made of all natural ingredients and formulated to give a nutrient packed meal replacement to help control your calorie intake. Each biscuit contain only 100 calories, while supplying 8 g of dietary fiber and 5 g of protein. Multi-Grain biscuits will help through the three major challenges of weight loss, overcoming desire to eat, controlling hunger and nutrition balance. It is mainly through the use of healthy and nutritious low calorie food to help develop healthy eating habits.

Fortification of foods is of current interest because of nutritional awareness of consumers. Supplementation with legumes is one way to meet the needs for protein foods, particularly baked foods. Biscuits are widely consumed that have relatively long shelf life and good eating qualities. Such qualities of food products make large scale production and distribution possible, in the shorted period. Biscuits can be easily fortified (Mishra *et al.,* 1991) [7] with protein rich flours to provide convenient food in order to supplement protein in the diet. Biscuits have been man's food since a long time.

Flaxseed *(Linum usitatissimum)* has been part of the human diet for thousands of years, and more recently it has been used as a source of nutraceuticals. It has been identified as a functional food, whose benefits to health are generally attributed to high concentrations of linolenic acids (omega-3) and lignins, as well as significant quantities of dietary fiber. Flaxseed contains approximately 28 percent fiber, of which one third is soluble and has proved to reduce cholesterol. The remaining two thirds of insoluble dietary fiber can increase fecal mass, reducing transit time in the lumen, preventing constipation (Hussain *et. al.* 2006) [5]. Linolenic acid is the predominant fatty acid in the lipids of the flaxseed, and studies have showed its beneficial effect on the growth and development of children as well as on reducing the risk of cardiovascular disease, stroke, and inflammatory and immunological disorders (Lucas *et. al*. 2002) [6].

Soy protein is a protein that is isolated from soybean. It is made from soybean meal that has been dehulled and defatted. Dehulled and defatted soybeans are processed into three kinds of high protein commercial products : soy flour, concentrates, and isolates. Soy protein isolate has been used since 1959 in foods for its functional properties.

Recently, soy protein popularity has increased due to its use in health food products, and many countries allow health claims for foods rich in soy protein. Soy protein is generally regarded as being concentrated in protein bodies, which are estimated to contain at least 60–70% of the total soybean protein. Upon germination of the soybean, the protein will be digested, and the released amino acids will be transported to locations of seedling growth. Soybeans contain a small but newly very significant 2S Albumin storage protein. Legume proteins, such as soy and pulses, belong to the globulin family of seed storage proteins called legumin and vicilins, or in the case of soybeans, glycinin and beta-conglycinin. Soybeans also contain biologically active or metabolic proteins, such as enzymes, trypsin inhibitors, hemagglutinins, and cysteine proteases very similar to papain.

The use of soyabean for the production of protein enriched biscuit were studies by several authors like (Akubor and Ukwuru, 2004) [3]; (Banureka and Mahendran, 2009) [4] and (Oluwamukomi *et al.*, 2011) [8]. The main objectives of the present studies were to analyse the effect of different heat treatments, such as roasting and steaming on quality of soy flour and their effect on the quality of biscuits and to analyse the changes in the rheological characteristics of the wheat flour and soya flour blends. The water activity level in food is of practical importance as it controls the onset and severity of mould spoilage. It is commonly observed that foods most likely to show rapid deterioration due to biological and chemical changes are usually those with high water content (Abdullaha *et al.*, 2000) [1]. Water activity is used in many cases as a Critical Control Point for Hazard Analysis and Critical Control Points (HACCP) programs. For many years researchers tried to equate bacterial growth potential with moisture content, they found that the values were not universal but specific to each food product (Abbas *et al.*, 2009) [2].

Materials and Methods

Sample Preparation

Biscuits were prepared using creamery method for making biscuit dough. The ingredients used in biscuits were flour blends (100%), sugar (40%), shortening (35%), skim milk powder (2.0%), sodium chloride (1%), sodium bicarbonate (1%), vanilla essence (0.4ml), and water (20ml). We are six samples prepared and these samples show in table 1.1. The dough was sheeted to a thickness of 3mm with the help of an aluminium platform and frame. The sheeted dough was cut in to a round shape using a molder. The cut dough was transferred to aluminium tray. The biscuits were baked in an electric oven maintained at 150℃ for 35 minutes. The baked biscuits were cooled for about 35 minutes, packed into LDPE bags for further analysis.

Sensory characteristics

Sensory attributes of biscuit samples packed in LDPE were evaluated in fresh condition. Samples were subjected to Organoleptic testing before and after the storage. Hedonic scale rating was used for evaluation of biscuit samples. Sensory characteristics of biscuit samples from wheat flour, defatted soy flour, flaxseed powder and other ingredients were carried out in order to determine the various attributes namely: colour, flavour, taste, texture and overall acceptability.

Table 1: Details of treatment combination

Treatments	Wheat Flour	Defatted Soya Flour	Flax Seed Flour
T_0	100%	0%	0%
T_1	85%	15%	0%
T_2	70%	30%	0%
T_3	60%	40%	0%
T_4	60%	30%	10%
T_5	50%	30%	20%
T_6	45%	30%	25%

Results and Discussions

The physio-chemical characteristics of fortified biscuits based on the Defatted Soy Flour and Flax Seed Powder. Six samples prepared for analysis and storage at room temperature for further investigation. We are found that the moisture content in fortified biscuits increase with increasing due to reason of the storage condition and the sugar ratio and the low moisture content ensures that biscuits are generally free from microbial spoilage and confers a long shelf life on the products. The highest moisture content value was found 2.98 of T_6 samples after 45 days during storage condition and T_6 sample were ratio, 45% wheat flour, 30% defatted soya flour and 25% flax seed flour. It also gives biscuit, a relatively high energy density compared with other baked goods. Incorporation of soya flour to wheat flour has the added advantage of improving the nutrient value of biscuits especially when cereals are blended with legumes. The ash content values are decreasing and found the lowest value 0.30 of T_0 samples at the 45 days and the highest value is 1.80 of T_2 sample. This may be explained as soy flour contained a greater amount of total dry solid with high emulsifying properties compared to wheat flour. Due to low moisture content of the beans, moisture content of the biscuit decreased with the increasing amount of soy flour in the blend. The fat content decrease with decreasing, we are found the lowest value of fat content is 06.55 of T_0 and the highest value is 26.05 of T_6 at fresh samples according on ingredients blended. The crude fiber decrees with decreasing, we are found the lowest value 0.07 of sample T_0 and the highest value of the crude fiber content is 0.65 of the sample T_3 at fresh level. The crude fat content level decrease reason is the level of the flex seed powder in biscuits and storage level condition.

Table 2: Effect the Physico- chemical characteristics (Moisture, Ash, Fat, Protein and Crude Fiber Contents) of fortified Biscuits samples during storage conditions

Moisture Content				
Treatments	**0 Days**	**15 Days**	**30 Days**	**45 Days**
T_0	2.10	2.15	2.21	2.29
T_1	2.25	2.28	2.33	2.37
T_2	2.30	2.35	2.40	2.45
T_3	2.38	2.42	2.47	2.52
T_4	2.53	2.57	2.61	2.67
T_5	2.70	2.72	2.75	2.81
T_6	2.78	2.81	2.86	2.98

Ash Content				
Treatments	0 Days	15 Days	30 Days	45 Days
T_0	0.50	0.46	0.38	0.30
T_1	0.90	0.85	0.80	0.75
T_2	1.80	1.74	1.69	1.52
T_3	1.50	1.30	1.22	1.00
T_4	1.11	1.00	0.90	0.82
T_5	0.98	0.88	0.71	0.66
T_6	1.00	0.92	0.81	0.65
Fat Content				
Treatments	0 Days	15 Days	30 Days	45 Days
T_0	22.10	22.05	20.97	19.33
T_1	21.00	19.12	18.00	17.01
T_2	21.14	19.00	18.12	18.00
T_3	19.00	18.77	17.88	16.22
T_4	18.52	17.11	17.09	16.00
T_5	18.00	16.72	16.00	15.15
T_6	19.12	18.18	17.77	16.22
Protein Content				
Treatments	0 Days	15 Days	30 Days	45 Days
T_0	07.05	07.03	6.90	06.55
T_1	08.22	07.88	07.12	06.77
T_2	15.03	15.00	14.95	14.85
T_3	20.2	20.00	19.93	19.75
T_4	17.04	17.01	16.90	16.65
T_5	21.05	21.10	20.90	20.55
T_6	26.05	26.00	25.94	25.40
Crude Fat Content				
Treatments	0 Days	15 Days	30 Days	45 Days
T_0	0.12	0.11	0.10	0.07
T_1	0.66	0.63	0.60	0.58
T_2	1.25	1.21	1.19	1.15
T_3	1.65	1.62	1.60	1.57
T_4	1.32	1.27	1.15	1.00
T_5	1.55	1.21	1.00	0.92
T_6	0.90	0.81	0.76	0.60

Conclusion

It was concluded from this study that the physico-chemical analysis showed that there was an increase in moisture content in the biscuit sample with increasing the level of DSF and Flax seed powder. But during storage moisture content of biscuits packed in LDPE increased considerably with increase in storage period as there is some amount of moisture ingress in biscuit samples. Ash, Protein, Crude fiber and fat decreased with decreasing the level of DSF and flaxseed powder but decreased during storage period. The percent score of fat content of (control) and experimental biscuit samples fortified with DSF was decreased as WF and DSF were having low fat content. The fat content then increased in experimental treatments fortified with FSP due to high percentage of fat in flax seed powder. The Sensory score of colour, flavor, taste, texture and overall acceptability was decreased slightly during storage. On the basis of nutritional and sensory quality, biscuit when fortified with blends of 20% flax seed powder and 30% DSF resulted in better quality and nutritious biscuits.

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