RESEARCH PAPER — FOOD SCIENCE RESEARCH JOURNAL
e ISSN-2230-9403 ■ Visit us : *www.researchjournal.co.in*
Volume 6 | Issue 2 | October, 2015 | 299-303
DOI : 10.15740/HAS/FSRJ/6.2/299-303

Effects of germination on nutritional and organoleptic quality of soybean biscuits incorporated with refined wheat flour

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Soybean (*Glycine max* L.) is one of the nature's wonderful nutritional gifts. It is considered as "Gold" obtained from soil and is thus rightly called today the "*Gold Nugget of Nutrition*" owing to its nutritional composition. Soybean is rich in protein, calcium, iron, phosphorus, lecithin and most of the vitamins. Protein content of soybean is about 2 times of other pulses, 4 times of wheat, 6 times of rice grain and 4 times of milk. In this study, efforts have been made to supplement refined wheat flour with germinated soybean flour to develop nutritionally protein- enriched biscuits which can be easily consumed by all people and its sensory evaluation. A systematic approach was followed to develop and standardize the process for the preparation of soya biscuits. Soybean was germinated for two and three days. Six samples were prepared by mixing soybean flour in percentage 0 per cent, 10 per cent, 20 per cent, 30 per cent, 40 per cent and 50 per cent with refined wheat flour 100 per cent, 90 per cent, 80 per cent, 70 per cent, 60 per cent and 50 per cent. The samples were evaluated for sensory characteristics using nine point hedonic scale and numerical scoring method. Organoleptic evaluation indicated that there were significant differences between the control treatment and soy flour supplemented biscuits of two day and three day germination in the organoleptic attributes of colour, flavour, texture, crunchiness, mouthfeel and overall acceptability. From the overall acceptance rating, 40 per cent and 50 per cent soy flour incorporated biscuits of two day germination and 50 per cent of three day germination obtained the highest preference compared to other combinations. The protein content of both 50 per cent soy incorporated biscuits was high which indicates improvement of protein quality with increase in protein concentration.

Key Words : Soy flour, Germination, Sensory evaluation, Protein enrichment

How to cite this article : Gupta, Vandana and Singh, Mukta (2015). Effects of germination on nutritional and organoleptic quality of soybean biscuits incorporated with refined wheat flour. *Food Sci. Res. J.*, **6**(2): 299-303.

INTRODUCTION

Soybean is an excellent source of protein (40 – 45 %); hence the seeds are richest in food value of all plant foods consumed in the world (Kure *et al.,* 1998) like Japan and China and has been increasingly grown in the United States (Srilakshmi, 2009). It is also rich in calcium, iron, phosphorus and most of the vitamins. It is the only source that contains all essential amino acids. The usefulness of the grain legumes in developing high protein foods in meeting the needs of the vulnerable groups of the population is now well recognized and several high protein energy foods have been developed industrially in different parts of the world. Sanful and Darko (2010) prepared bread and found that the

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supplementation of wheat flour with soybean flour would greatly improve the protein nutritional quantity of bread and the general acceptability of whole wheat bread and soy supplemented bread with soybean flour below 30 per cent was preferred to bread with soybean flour beyond 30 per cent. Banureka and Mahendran (2009) developed biscuits of soy flour to substitute it with wheat flour from 0 to 25 per cent and found that 10 per cent soybean flour incorporated biscuit obtained the highest preference compared to other combinations. Dhingra and Jood (2000) used supplementations of soy (full fat and defatted) and barley flours to wheat flours at 5, 10, 15 and 20 per cent levels and carried out an increase in protein combination, with full fat and defatted soy flour up to 15 per cent, this significantly increase the contents of protein, total lysine, dietary fibre.

Soybean plays a vital role in decreasing the protein deficiency of the diet. Protein content of soybean is about 2 times of other pulses, 4 times of wheat, 6 times of rice grain and 4 times of milk. Soybean has 3 per cent lecithin, which is helpful for brain development (Akubar and Ukwuru, 2005). The most important attributes of soybean is their health benefits linked to the prevention and treatment of many chronic diseases owing to their protein and isoflavone activities. Arliss and Biermann (2002) studied that the consumption of soy protein in place of animal protein reduced serum concentrations of total cholesterol, low density lipoproteins (LDLs), and triglycerides. A large number of soybean components have diverse biological activities. These include hormonal, immunological, bacteriological and digestive effects (Csaky and Fekete, 2003). Sometimes raw soybean can be harmful to human, swine, chickens, in fact, all monogastric animals because of antinutritional factors. By the process of germination, the toxic substances can be destroyed and the activity of toxic substances can also be minimized. Most of the nutrients like B- complex vitamins, vitamin C, beta- amylase increase and the unacceptable beany flavour can also minimized at a significant level. Heat treatment of soybean can also reduce the activity of trypsin inhibitors and thereby improve protein digestibility.

The consumption of cereal snack foods such as biscuits, cookies, wafer's and short bread has become very popular in India. Among these biscuits possess several attractive features including wider consumption base, relatively long shelf- life and good eating quality. Good eating quality makes biscuits attractive for protein fortification and nutritional improvements, particularly in children feeding programmes, for the elderly and low income groups. Enrichment of cereal based foods with other protein sources such as oil seeds and legumes have received considerable attention (Ayo and Olawale, 2003). This is because of oil seeds and legumes are high in lysine, an essential limiting amino acid in most cereals. Incorporation of germinated soy flour with refined wheat flour in different quantities will improve the nutrient quality of cereal based biscuits. It was observed at nine point hedonic scale (Srilakshmi, 2009) with different attributes and protein evaluation was also done (AOAC, 2006). The present study was conducted with the following objectives.

– Development of protein enriched biscuits incorporated with refined wheat flour.
– Sensory evaluation of the developed products.
– Assessment of nutritional quality of the products.

METHODOLOGY

Soybean, wheat flour, sugar, fat, egg and sodium bicarbonate (baking powder) were purchased from the Lanka market in Varanasi.

Processing of soybean flour:

The soybean seeds were processed into flour using the method of IITA (1990) (Fig. A). The process ensures effective removal of most anti-nutritional factors (Sanful

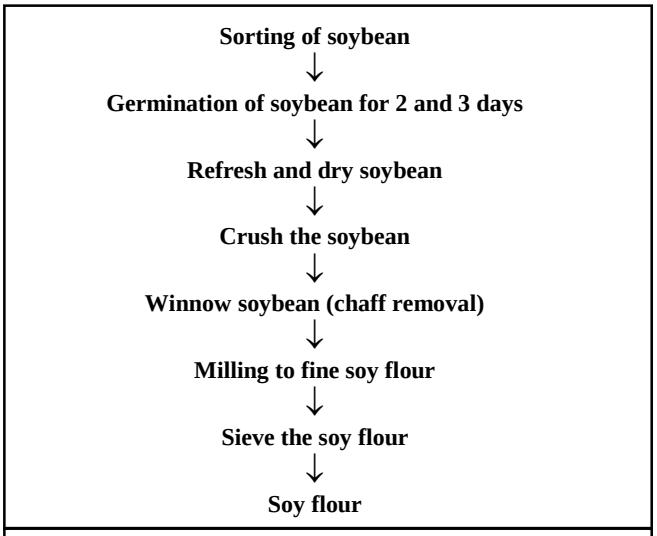

Fig. A : Flow chart for the production of soy flour

and Darko, 2010).

Development of protein enriched biscuits:

Six samples were prepared by mixing soybean flour with refined wheat flour in the proportion indicated in Table A. The mixing was done to ensure a homogenous mixture of the samples (Sanful and Darko, 2010).

Table A : Composition of the samples used in this work

Sample	Soy flour (%)	Refined wheat flour (%)
A	0	100
B	10	90
C	20	80
D	30	70
E	40	60
F	50	50

Biscuits were produced from the six formulations using the method of Ihekoronyea (1999). Sugar (80 g) and fat (100 g) were mixed together. All purpose refined wheat flour, soy flour and baking powder (2-3 g) were sieved thrice together. The sieved flour and egg were added to the creamed paste. As per the treatment, firm dough was prepared from all mixture by hand. The dough was rolled on a flat rolling slab sprinkled with the some flour to a uniform thickness. Circular biscuits were cut, placed on a greased baking tray and kept at once in an oven at a temperature of 190^0C for between 20 – 25 minutes. When a very light brown colour was formed, biscuits were removed, allowed to cool, packed into airtight container and stored.

Weight of all the ingredients
↓
Mixing of all the ingredients into dough
↓
Kneading of the dough firmly until smooth
↓
Cutting into the desired shape
↓
Placing in greased baking tray
↓
Baking in pre – heated oven (190^0c for 20 – 25 minutes)
↓
Removed and placed on cooling rack
↓
Making of packages

Fig. B : Flow chart for biscuit production (Ihekoronyea, 1999)

Analysis of sensory characteristics:

The sensory attributes including colour, flavour, body and texture, crunchiness, mouth feel and overall acceptability were evaluated by a group of 5- 10 panellists. The evaluation was held either 11 am for the morning session and at 3 pm for the afternoon session. The nine – point hedonic scale was used to evaluate the degree of liking and disliking for preference of the biscuits in following sequence: like extremely-9, like very much-8, like moderately-7, like slightly-6, neither like nor dislike-5, dislike slightly-4, dislike moderately-3, dislike very much-2 and dislike extremely-1 (Indian Standard, 1971).

Statistical analysis:

The mean scores were analysed using Fisher's t – test method which is also known as student t - test. The organoleptic evaluation of different attributes of samples was done by this method.

$$\text{t - test} = \frac{\bar{x} - \bar{y}}{S\frac{1}{n_1} + \frac{1}{n_2}}$$

where, $\bar{x} = \frac{\sum xi}{n}$ =Mean of first sample

$\bar{y} = \frac{\sum yi}{n}$ = Mean of second sample

$$S = \frac{1}{n_1 + n_2 - 2}\sqrt{\sum(xi - \bar{x})^2 + \sum(yi - \bar{y})^2}$$

Nutritional analysis:

The biscuits were analysed for protein by Kjeldahl method (AOAC 18th Ed., 2005) to know the amount of protein because soybean has a high amount of protein. By this method, the difference of protein into biscuits was analysed.

$$N_2(\%) = \frac{\text{(Sample titre - blank titre) x Normality of NaOH used for titration x 14}}{\text{Weight of sample x 1000}}$$

Crude protein (%) = % N × 6.25

OBSERVATIONS AND ASSESSMENT

The results obtained from the present investigation as well as relevant discussion have been summarized under following heads :

Mean organoleptic scores on nine point hedonic scale of incorporated soy biscuits:

Table 1 shows that the mean of organoleptic scores for all attributes of incorporated soy biscuits (two day germination) in different proportion in which the overall acceptability of both sample E1 (40:60) and sample F1 (50:50) was greater than other samples. All attributes of sample F1 (50:50) were high in comparison to sample A (control).

Table 2 shows that the mean of organoleptic scores for all attributes of incorporated soy biscuits (three day germination) in different proportion in which over all acceptability of sample F2 (50:50) was greater than other samples. All attributes of sample F2 (50:50) were high except texture and mouthfeel rather than sample A (control).

Table 3 shows that the t – calculated value of sample F1 and E1 are greater than t – tabulated value in

Table 1 : Mean organoleptic scores on nine point hedonic scale of incorporated soy biscuits (two day germinatation)

Product	Mean of organoleptic attributes given by ten judges						
Biscuits (two day germination)	Sample	Colour	Flavour	Texture	Crunchiness	Mouthfeel	Over all acceptability
	Sample-A	7.5	7.5	7.6	7.5	7.8	7.8
	Sample-B1	7.8	7.8	8.2	7.6	7.6	8.2
	Sample-C1	7.6	7.2	7.2	7.3	6.6	7.4
	Sample-D1	8	7.7	7.7	7.7	7.6	8
	Sample-E1	8.3	8	8.3	8	7.8	8.4
	Sample-F1	8.5	7.8	8.4	8.4	8	8.4

Table 2 : Mean organoleptic scores on nine point hedonic scale of incorporated soy biscuits (three day germinatation)

Product	Mean of organoleptic attributes given by ten judges						
Biscuits (three day germination)	Sample	Colour	Flavour	Texture	Crunchiness	Mouthfeel	Over all acceptability
	Sample-A	7.5	7.5	7.6	7.5	7.8	7.8
	Sample-B2	7.1	7.1	6	6.2	6.5	7.3
	Sample-C2	7.1	6.3	6.5	6.3	6	6.6
	Sample-D2	7.2	7	7.1	6.8	6.8	7.1
	Sample-E2	7.5	7.7	7.4	7.4	7.2	7.7
	Sample-F2	7.7	8	7.5	7.6	7.2	8.5

Table 3 : t–tabulated and t-calculated value for overall acceptability of soy biscuits (two-day germination)

Product	Samples	Mean	t-calculated	t-tabulated
Soy biscuits	SA(control)	7.8	-	2.1 at 5% level of
	SB1	8.3	1.38	significance and 18 d.f.
	SC1	7.5	0.71	
	SD1	7.9	0.32	
	SE1	8.4	2.12	
	SF1	8.5	2.34	

S = Sample

Table 4 : t–tabulated and t-calculated value for overall acceptability of soy biscuits (three-day germination)

Product	Samples	Mean	t-calculated	t-tabulated
Soy biscuits	SA	7.8	-	2.1 at 5% level of
	SB2	7.2	1.43	significance and 18 d.f.
	SC2	6.8	1.93	
	SD2	7.2	1.69	
	SE2	7.9	1.42	
	SF2	8.5	2.69	

comparison to other samples. Therefore, null hypothesis is rejected. It is dependent. It proves that there is significant difference between samples and SF1 and SE1 are acceptable than other samples whether as SF1 is better than SE1.

Table 5 : Protein value of soy biscuits

S. No.	Sample particulars	Protein (g/100g)
1.	SA (Control)	9.24
2.	SF1	14.45
3.	SF2	14.30

Table 4 shows that the t – calculated value of sample SF2 is greater than t – tabulated value in comparison to other sample. Therefore, null hypothesis is rejected. It is dependent. It proves that there is significant difference between samples and SF2 is more acceptable than other samples.

Here only selected samples F1, F2 and control sample A were analysed. Result shows that the incorporated soya flour biscuits sample F1 (2 day germination) and sample F2 (3 day germination) concluded higher amount of protein in comparison to control sample (refined wheat flour) and also included addition of soy flour increases protein content of biscuits.

Conclusion :

The present treatise was an outcome of efforts to prepare soybean biscuits, assessment of the acceptability of soybean biscuits through sensory evaluation, nutritional analysis and statistical analysis. It was observed that the sensory evaluation of prepared soybean biscuits showed rising scores with increasing amount of soybean flour. This signifies that germinated soy biscuits can be used as normal biscuits because it has a high amount of protein and other nutrients.

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Received : *17.07.2015*; **Revised:** *01.09.2015*; **Accepted :** *10.09.2015*