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DEVELOPMENT OF SOY FORTIFIED HIGH PROTEIN AND HIGH CALORIE SUPPLEMENTARY BISCUITS

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ABSTRACT

A study was conducted to prepare protein enriched biscuits which could be used as a protein supplemented snack food. The study evaluated the effect of substituting soy-flour 20%, 15% and 10% in biscuit production. Biscuits were enriched with soy-flour T_0 (control with no soy flour), T_1 (20 %), T_2 (15 %) and T_3 (10 %). Sensory, nutrient estimation and Microbial qualities of biscuits were evaluated. Organoleptic test of biscuits showed that with regard to flavour and taste, body and texture, colour and appearance and overall acceptability, sensory characteristics of T_3 were found to be the best. The other treatments T_0, T_1 and T_2 were also found acceptable. In nutrient estimation of biscuits, moisture content was found maximum in treatment T_1, protein content was maximum in treatment T_1, fat content was highest in treatment T_1, ash content was highest in treatment T_1, carbohydrate was found maximum in treatment T_3 , calorie content was maximum in T_1, iron content was maximum in T_2 and calcium content was maximum in treatment T_1. Best treatment was T_1 among T_0, T_1, T_2 and T_3. The soy flour added product-biscuit has good shelf life. The product is ready -to-eat so don't require much time for preparation. It is a compact source of energy and nutrients including protein, fat, Iron, calcium etc. It can be concluded that Sensory scores indicated high acceptability for treated biscuit samples. Protein and fat contents of biscuits increased with increasing soy fortifications. Substitution with soy-flour did not adversely affect qualities.

KEY WORDS: Soy flour, fortification, malnutrition, biscuits, organoleptic characteristics

Protein malnutrition is a serious problem in India due to cereal based dietary pattern. Therefore, various preparations based on cereal-pulse combination are of paramount importance to improve the protein quality of Indian diet. FAO (Food and Agricultural Organization) suggested that to meet the recommended dietary allowances of infants, preschool children, adolescent girls, pregnant and lactating women, low cost supplementary foods could be processed domestically by simple, inexpensive processing technology.

Some 49percent of the 10.7 million deaths among under five children each year in the developing world are associated with malnutrition. Nearly 30 percent of humanity is currently suffering from one or more of the multiple form of malnutrition. Currently, an estimated 149.6 million children under five years of age i.e. 26.7percent of the world's children in this age group are still malnourished when measured in terms of weight for age.

The requirement of supplementary foods is increased to reduced malnutrition. Supplementary foods should be such, if taken in small quantity, could provide necessary amount of nutrients. They should be made in form of ready-to-eat snacks, drinks etc. so that they could be taken without any inhibition. But people are still not much aware of their importance. They are just taken as conventional dishes involve either too much time or drudgery. Moreover, the foods bought from hotels and stalls are rarely of high nutritive value. Hence, the need arises for time and labour saving convenience foods for the modern man .

Soybean (*Glycine max*) the miracle bean is the base of healthy life. The nutritive virtues of soybean were intuitively realized in the orient over 4000 years ago. Where it is used in multiple foods. At the turn of last century, the west realized these virtues of soybean but the taste of foods and beverages made from soybeans were unacceptable to western palate that grossly limited their food use.More recently, soybean use is gaining acceptance in the form of textured vegetable protein (TVP), popularly sold as soy vadi and soy nuggets (American Soybean

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Association, 2004). Hundred grams of soybean contains 8.1 g of moisture, 43.2 g of protein, 19.5 g of fat, 20.9g of carbohydrates, 240 mg of calcium, 10.4 mg of iron and 690 mg of phosphorus (Gopalan et al., 1999). Soybean is a versatile plant food that provides high quality protein but only minimal saturated fat. However, recent excitement has focused on soy foods as a rich and essentially unique dietary source of isoflavones and phytoestrogens. Soy protein also directly lowers serum cholesterol levels (Messina, 2004).Soybean is a rich source of almost all the essential nutrients. It is commercially an oil seed but is deficient in vegetable oil. However, most of the oilseed contain 40-50 percent oil but soybean contains about 18 percent of oil (American Soybean Association, 2004). The original impetus for research into soybean is to benefit for its high protein content i.e. about 40 percent in bean. Owing to these qualities, soybean has long been used in supplementary foods. Soybean contains isoflavones, which are said to have potential anticancer effects. It contains two primary isoflavones called as Genistein and Diadzein and a minor one called as Glycitein. They retard bone loss in premenstrual and postmenstrual women, soluble fibre in soy foods control blood sugar. Soyfoods are quite important to us as they reduce the risk of heart disease. It reduces menopausal symptoms and bone deterioration. Regular soyfood consumption delays the process of aging. Soyfood every day is protective against many types of cancers, especially breast and prostate. Also soyfood given to children daily improves mental and physical abilities, memory power and haemoglobin levels.(American Soybean Association, 2004). Soybean was shown to be extremely rich in nearly all the essential amino acids needed by man (Cook and Briggs, 1977).

Biscuits constitute major component of human snacks in most part of the world. It is an unleavened crisp, sweet pastry made from wheat flour, shortening (hydrogenated fat) and sugar, and is usually made light by the addition of baking powder (a mixture of sodium carbonate, sodium bi phosphate and cereal flour) (O'Brien et al., 2003).

Biscuits have been man's food since a long time. It is a processed convenience food ever produced and is most widely acceptable. It is one of the few universal staples, which is complete in it and requires no additional preparation. Thus, for many, biscuit becomes an important source of high molecular carbohydrates, vegetable proteins and some vitamins and minerals. But it is important to know that, as compared to animal proteins refined wheat flour is deficient in certain essential amino acids, thus has a low nutritional value. The nutritional value of biscuit can be enhanced by fortification and supplementation with a wide variety of protein, vitamin and mineral sources.This work was designed to economically complement and fortify wheat flour and cassava with fermented or blanched soy flours for biscuit production.

Table A: Method of preparation of Biscuits: Control and experimental samples

Control	Experimental
20g sugar was powdered and mixed with 20 ml of fat (refined oil) for about 10 minutes. ↓	20g sugar was powdered and mixed with 20 ml of fat (refined oil) for about 10 minutes. ↓
50g refined wheat flour, 15 ml milk, 1/4tsp baking powder, 1/8tsp salt and 5-6 drops of vanilla essence was added and kneaded to stiff dough. ↓	50g refined wheat flour, 15 ml milk, 1/4tsp baking powder, 1/8 tsp salt, 5-6 drops of vanilla essence, 20 percent, 15 percent and 10 percent soybean (*Glycine max*) flour was added to it and kneaded to stiff dough. ↓
Dough was divided in small parts and moulded in desired shapes. ↓	Dough was divided in small parts and moulded in desired shapes. ↓
Tray was greased and biscuits were placed on it. ↓	Tray was greased and biscuits were placed on it. ↓
Biscuits were baked in pre heated oven at 140°C for 10 min.	Biscuits were baked in pre heated oven at 140°C for 10 min.

MATERIALS AND METHODS

The study was carried out in the Foods and Nutrition laboratory of School of Home Science Sam Higginbotom Institute of Agriculture, Technology & Sciences ,Formerly (Allahabad Agricultural Institute Deemed University).

Sensory Analysis

Organoleptic test of the products was done by 9-point hedonic scale scorecard, especially prepared for the purpose. A 10-member trained panelists from staff and students of Halina School of Home Science Sam Higginbotom Institute of Agriculture, Technology & Sciences ,Formerly (Allahabad Agricultural Institute Deemed University). Each attribute was scored based on its intensity scaled on a 9-point hedonic scale (1=disliked extremely, 2=disliked very much, 3=disliked moderately, 4=disliked slightly, 5=neither liked nor disliked, 6=liked slightly, 7 = liked moderately, 8 = liked very much, 9 = liked very extremely) for colour, flavor, mouth feel and texture.

Assays

Biscuits were prepared using different levels of soy flour T_1 (20 %), T_2 (15%), T_3 (10 %) and T_0 was control without addition of soyflour. Analysis of products was done by AOAC methods (AOAC, 2000). Carbohydrate was calculated by difference method; energy was calculated from fat, protein incineration of sample, moisture was determined by heating ether extract method, calcium was determined titrimetrically by titration with potassium permanganate, iron was determined by spectrophotometer method. Soy flour added biscuits were analysed for total bacterial and total yeast and mold count after 15 days.

Statistical Analysis

All biscuit sample data were analyzed statistically. ANOVA was used for determining the significance/ non-significance of results. SPSS 11.5 version was used to analyze the data. Results are expressed as mean & CD.

RESULTS

Sensory Evaluation

In the present study, sensory scores of biscuit enriched with 20 %, 15 % and 10 % soyflour showed that with regard to flavour and taste, body and texture, colour and appearance and overall acceptability, sensory characteristics of T_3 (10%) were found to be the best. Other treatments T_0, T_1 (20%), T_2 (15) and T_3 (10%) were also found acceptable (Fig. 1.1).

Nutrient Estimation

Treatment T_1 with addition of soy-flour had maximum protein content followed by T_2 and T_3 at 20 %, 10 % and 15 % level (Table, Fig.1.2). Treatment T_1 with addition of soy-flour had maximum protein fat content followed by T_2 and T_3 at 20 %, 15 % and 10 % level (Table, Fig.1.3). In the present study, treatment T_3 with addition of soy-flour had maximum protein carbohydrate followed by T_2 and T_1 at 10 %, 15 % and 20 % level (Table, Fig.1.4). In the present study, treatment T_3 with addition of soy-flour had maximum iron content followed by T_2 and T_1 at 10 %, 15% and 20% level (Table, Fig.1.5). In the present study, treatment T_1 with addition of soy-flour had maximum calcium content followed by T_2 and T_1 at 20 %, 15 % and 10 % level (Table, Fig.1.6).

DISCUSSION

Taste is the primary factor which determines the acceptability of any product, which has the highest impact as far as market success of product, is concerned. In the present study, overall acceptance was best for T_3 (Fig. 1.1). In a previous study it was observed that the mean scores for all the assessed organoleptic characteristics decreased with increase in the soybean flour. Organoleptic evaluation indicated that there were no significant ($p<0.05$) differences between the control treatment and 10% soy flour supplemented biscuits in the organoleptic attributes of taste, texture and flavour but differences were significant in colour and overall acceptability. From the overall acceptance rating, 10% soybean flour incorporated biscuit obtained the highest preference compared to other combinations (Banureka and Mahendran, 2009). In another study, the colour, flavour, mouth feel and overall acceptability of biscuits were not significantly affected by the 20% , 5%, 10% or 15% soy flour replacements for wheat flour. However colour scores increased slightly while flavour and mouth-feel decreased slightly as the substitutes

increased (Ugwuona, 2009). In another study it was observed that overall acceptability was maximum for 70% soy fortified biscuit (Kumar et al., 2010).

Soybean is a protein rich oil seed, which is presently number one edible oil source globally. Soybean is rich in polyunsaturated fats, including the two essential fatty acids, linoleic and linolenic, that are not produced in the body. Linoleic and linolenic acids aid the body's absorption of vital nutrients and are required for human health (Hegstad, 2008). In the present study, highest protein and fat content was found in T_1 followed by T_2 and T_3 (Table, Fig.1.2). Protein, fat and energy (calorie) value of soy flour supplemented biscuits increased with progressive increase in proportion of soy flour and 10% soy flour added biscuits obtained values of 9.9%, 20% and 453.58 kcal/g respectively, while lowest values of 5%, 14.5% and 417.36 kcal recorded for the wheat flour biscuits. The moisture and ash were decreased with corresponding increase in the percentage of soy flour (Banureka and Mahendran, 2009). In a previous study, protein and fat contents of biscuits increased with increasing soy fortifications (Ugwuona, 2009). In a study, two types of wheat flour and quality protein maize (QPM) based biscuits with and without processed defatted maize germ cake (PDMGC) supplementation were prepared and compared with wheat flour based biscuits as standard. Both protein quality and quantity improved in wheat flour + QPM based biscuits with supplementation if PDMGC at the cost of slight decrease in IVPD (Gupta and Singh, 2005).

In another study, significant decrease was counteracted by supplementing with 10% soy flour which resulted in a significant increase in the protein content. Therefore biscuit with comparable nutrient content to 100% wheat flour could be produced with wheat composite flour up to substitution level of a minimum of 10% soy flour. This means that biscuit from wheat and soy flour composite will be acceptable in terms of colour, aroma and overall acceptability (Oluwamukomi et al., 2011). In the present study, Iron content is highest in T_2 and calcium content is highest in T_1 (Table, Fig.1.5 and Table, Fig.1.6).

CONCLUSION

The finding of this re-search revealed that, the biscuits produced with soy flour substitution, upto 25%, were nutritionally superior to that of the whole wheat flour biscuits. To obtain biscuits of high nutritional and organolepic qualities, wheat flour could be substituted with 10% of soy flour. Organoleptically, treatment T_3 (10%) was

Fig.1.1:Effectoftreatmentsonsensoryattributesofbiscuits

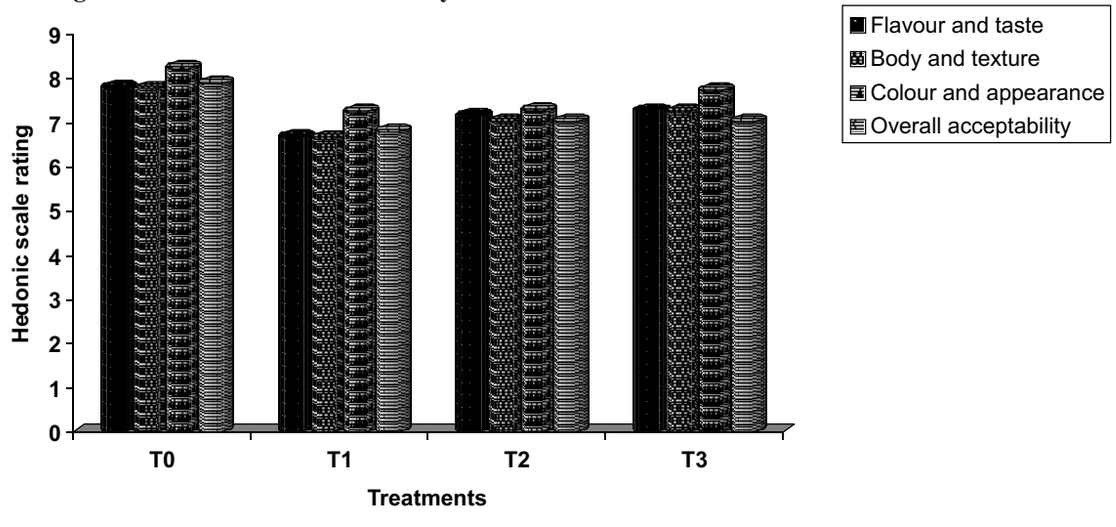


Table , Fig.1.2: Comparison between the Protein (g) content of biscuits with or without addition of soy flour

	R_1	R_2	R_3	Mean
T_0	7.31	7.3	7.15	7.25
T_1	9.38	9.15	9.00	9.17
T_2	8.58	8.5	8.25	8.44
T_3	7.75	7.5	7.55	7.6
S.E.	0.004			
C.D.	0.163			

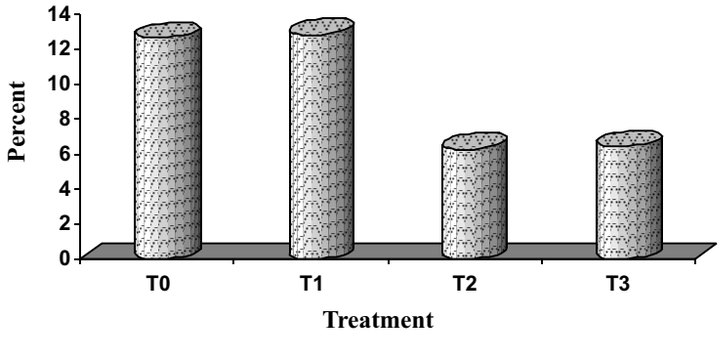


Table , Fig.1.3: Comparison between the Fat (g) content of biscuits with or without addition of soy flour

	R_1	R_2	R_3	Mean
T_0	26.47	26.45	26.38	26.43
T_1	23.28	23.3	23.28	23.28
T_2	22.81	22.59	22.75	22.71
T_3	22.35	22.15	22.25	22.25
S.E.	0.003			
C.D.	0.13			

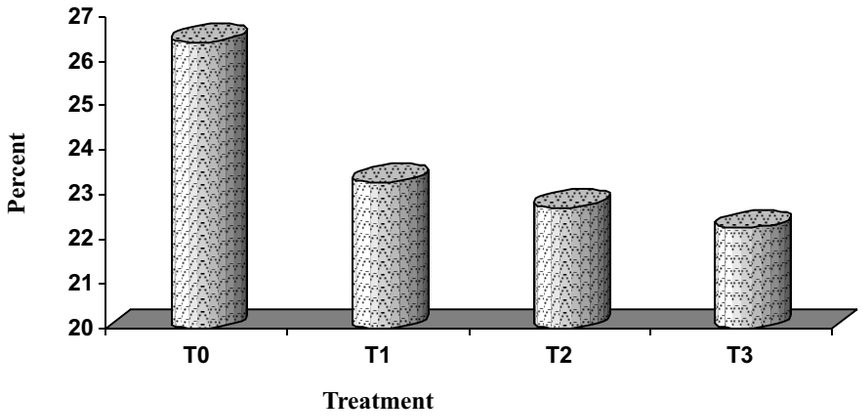


Table , Fig.1.4 :Comparison between the Carbohydrate(g) content of biscuits with or without addition of soy flour

	R_1	R_2	R_3	Mean
T_0	51.93	57.15	54.54	54.54
T_1	50.16	54.30	52.20	52.22
T_2	54.30	65.70	40.04	53.34
T_3	61.80	63.15	62.55	62.55
S.E.	5.01			
C.D.	12.27			

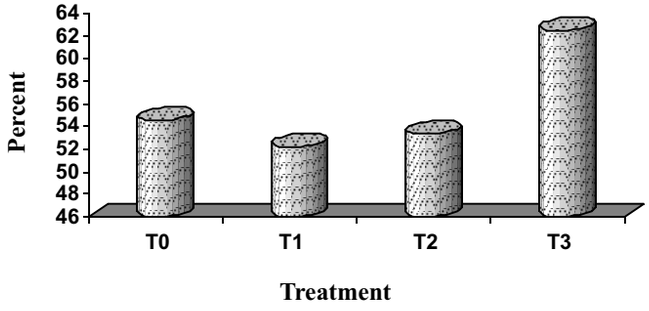


Table , Fig.1.5: Iron content of biscuits with or without addition of soy flour- Iron (mg/100g)

	R_1	R_2	R_3	Mean
T_0	2.59	2.55	2.5	2.54
T_1	0.36	3.35	3.25	2.32
T_2	3.2	3.15	3.25	3.2
T_3	3	3.09	3.12	3.07
S.E.	0.47			
C.D.	1.69			

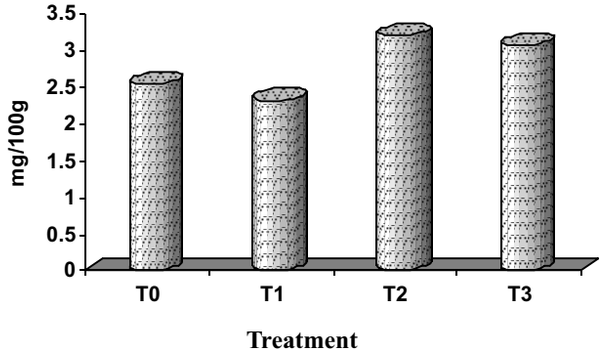
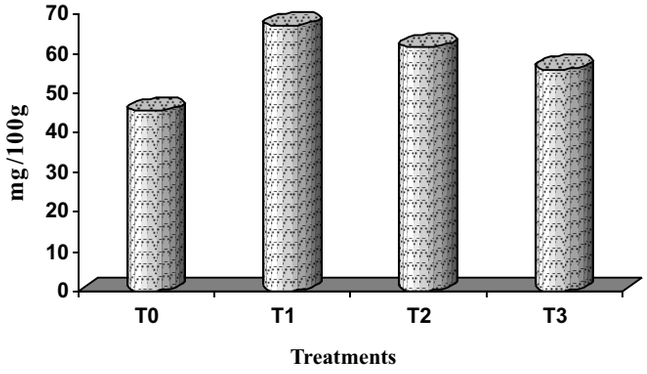


Table , Fig.1.6 :Calcium content of biscuits with or without addition of soy flour Calcium (mg/100)

	R_1	R_2	R_3	Mean
T_0	45.40	45.5	45.55	45.48
T_1	67.10	67.05	66.95	67.03
T_2	61.56	61.5	61.45	61.65
T_3	56.25	55.99	56.20	56.14
S.E.	0.02			
C.D.	0.35			



found to be the best and in biochemical analysis, treatment T_1 (20%) was found to be the best. It might be because highest percent of soybean was added to T_1 (20%) and soybean has high protein, fat, iron, calcium content. As biscuit consumption in whole world is very high, soy fortified biscuits will help in increasing intake of protein, fat and calories.

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