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Effect of incorporation of soya flour to wheat flour on nutritional and sensory quality of biscuits

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Abstract
The research study was conducted to evaluate the quality characteristics of soya flour -wheat flour enriched biscuits which could be used as a protein incorporation snack food. In this study, wheat flour was replaced with soy flour at different levels that is 10% (S1), 15% (S2), and 15% (S2) biscuits is nutrition evaluation. Biscuits were analyzed for hedonic and sensory parameters. Protein content of soy flour and wheat flour incorporation biscuits increased from13 to 37.5% as compared to control along with a significant increased in fat (3 to 20.1), fibre (1 to 3.5%), Results from nutrition analyses and hedonic evaluation indicate that good quality biscuits can be prepared by substituting wheat flour with 15% soy flour and addition of may affect the backing quality. Soy protein directly lowers serum cholesterol levels. Soybeans also contain biologically active or metabolic proteins such as enzymes, trypsin inhibitors, hem agglutinins, and cysteine proteases very similar to papain. Wheat also contributes essential amino acids, minerals, and vitamins, and beneficial photochemical and dietary fibre components to the human diet, and these are particularly enriched in whole-grain products. Protein Energy Malnutrition (PEM) of the Tamil Nadu population can be reduced through the development of biscuits in this way.

Keywords: Biscuits, food fortifications, protein, soy flour, wheat flour.

Introduction
Protein Malnutrition is widely recognized as a major health problem in worldwide due to cereal-based dietary pattern. The protein quality of the cereal-based diet can be improved by fortifications. suggestion, to meet the recommended dietary allowances of infants, preschool children, adolescent girls, pregnant and lactating women, low-cost supplementary foods. The use of protein-calorie sources of vegetables or other origins as a supplementation on regular diet has been proposed a possible solution to this problem.

Nowadays, bakery food products, especially biscuits are becoming very popular in Tamil Nadu in rural as well as urban areas among all the age groups due to its several attractive features, including wider consumption, low cost among other processed foods, varied taste, easy availability and good eating quality, and relatively long shelf life (Gandhi et al. (2001); Biscuits are high in carbohydrates, fat, and calorie but low in fibre, vitamin, and mineral which make it unhealthy for daily use. This may be achieved through incorporation of protein-rich ingredients from soybean and wheat flour as a fortification of biscuits.

Soy protein directly lowers serum cholesterol levels (Mirrahimi *et al* (2010) [17]. Soybeans also contain biologically active or metabolic proteins such as enzymes, trypsin inhibitors, hemagglutinins, and cysteine proteases very similar to papain (American Soybean Association (2004) [4]. The soy cotyledon storage proteins are important for human nutrition. Soybean contains isoflavones, which are said to have potential anticancer effects. It contains two primary isoflavones called 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. Soy foods are quite important to us as they reduce the risk of heart disease. Regular consumption of soy food delays the process of aging and also improves mental and physical abilities, memory power, and haemoglobin levels of children (American Soybean Association (2004) [4]. Owing to these qualities, soybean has long been used in incorporation foods.

In view of this consideration, the present work was designed to economically complement and fortify wheat flour and soy flour for biscuit production and to study the effect of different combination of soy flour on the nutritional and sensory quality of the developed biscuits.

Material and Methods

Selection of Soya Bean

The soya bean is the seeds of the leguminous soya bean plants. Soya food have been a staple part of the Chinese diet for over 4000 years but have only been widely consumed in western countries. It contains protein 16g, Dietary fibre 12g. Other soybean nutrients include vitamin B6, and B1, phytosterols, and minerals nutrient such as calcium, phosphorous, Iron, and potassium.

Soya bean were obtained from the local Market in Madurai, Tamil Nadu, India. The seeds were cleaned by hand to remove foreign materials. The cleaned seeds were processed using for sun drying method.

Raw Materials

Soybean and wheat was collected from the local market in Madurai, Tamil Nadu. Other ingredients were collected from the local market.

Preparation of raw materials

Soybean seeds were sorted and soaked in water for 6 h. Thereafter, the seed coat was removed and drained. The seeds were then cleaned and sun dried at 65 °C for 10 h. The dried seeds were milled into flour. The flours were screened through a 0.25 mm sieve and stored at 4 °C in a refrigerator to prevent spoilage particularly rancidity until usage. The process ensures effective removal of most anti nutritional factors.

Process of soy beans into flour

Method

Step 1. Get the quantity of soy beans you desire, clean it by remove foreign materials from it.

Step 2. Wash beans in clean water.

Step 3. Drop one cup of soy beans in six cups of boiling water and continue to boil for about 25 minute. Do not cover it.

Step 4. Drain, wash, remove the coat and separate beans from the hull in cold water.

Step 5. Dry the beans.

Step 6. Grind beans into flour.

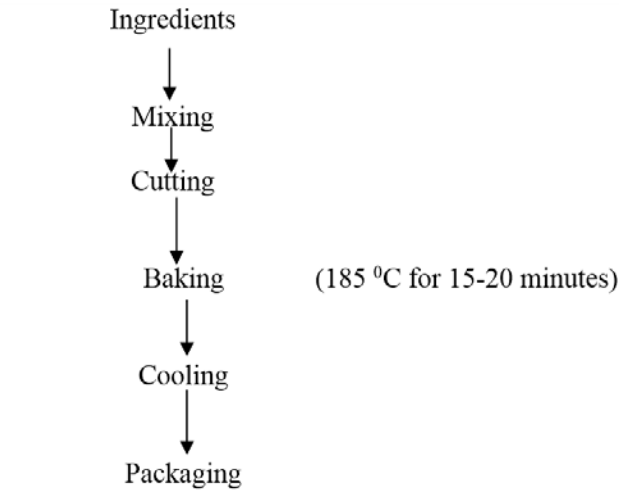
Step 7. Store the flour in a dry, air tight container for not more than one month.

After the flour has been obtained, it can then be incorporated in our daily meals for a healthy live, see the following recipes

Blend formulation and biscuit production

Sugar and fat (margarine) were mixed together, and then wheat flour, soybean flour, common salt, sodium-bicarbonate and water were added to prepare dough. The dough was mixed for 15 min until a uniform smooth paste was obtained using hand. The paste was rolled on a flat rolling board sprinkled with the some flour to a uniform thickness using a wooden hand roller. Circular biscuits were cut (using a circular biscuit-cuter of diameter 4 cm), placed on a greased baking tray and kept at a normal room temperature for 2 h to allow proper dough leaving. Then these trays of the eight blends were baked at once in an oven at a temperature of 184oC for between 15-20 min when a very light brown colour was formed, biscuits were removed, allowed to cool, packed in HDPE film and stored.

Production of Biscuits



Flow chart for biscuit production, (Ihekoronye, 1999)

Physical properties of processed soya bean powder

The physical properties of the all processed soya bean powder were analyzed. The physical characteristics such as rehydration ratio, water absorption capacity and bulk density of the processed soya bean flour were analyzed.

Bulk Density

The bulk density of the soya bean seeds powder was determined by the method of a specified quality of the sample was put into an already weighed 5 ml measuring cylinder (wI); it was gently taped to eliminate air spaces between the powder in the measuring cylinder and the volume was noted. The new mass of the sample and sample was determined. The bulk density was computed as

$$BD - \frac{W1\ W2}{\text{VOL. of sample use}}$$

Water and oil absorption

These were determined as described by Beuchat (1977) [10]. The powder (1g) was mixed with 10ml distilled water for water absorption and 10ml of oil for oil absorption in a Kenwood blender for 30 seconds. The samples were then allowed to stand at 25 ^{o}C for 30 min and centrifuged at 3500ppm for 30 min. The supernatant was decanted and discarded. The weight of water or oil absorbed by 1g of flour was calculated and expressed as water or oil absorption capacity (Beuchat 1977; Eke and Akobundu1993) [11, 12].

Chemical analysis of processed soy bean powder

Chemical characteristics like proximate composition of the all processed soya bean flour powder were done.

Moisture

A know amount of sample was weighed into a previously weighed moisture cup and dried in an oven at 60 ^{0}C to a constant weight and moisture content.

Calculated as follow.

$$\text{Moistures (x)} = \frac{\text{Weight sample before drying- weight of sample after drying}}{\text{Sample weight}} \times 100$$

Determination of Protein

The Protein Content was determined using a Foss Tescator protein digester and KJECTEC 2200 distillation apparatus (Kjeldahl method) according to the procedure of AOAC. Concentrated H2SO4 (12ml) and 2 tablets of catalyst were put into a Kjeldahl digestion flask containing 1g of the sample. The flask was placed in the digester in a fume cupboard and switched on and digestion was done for 45 minutes to obtain a clear colourless solution. The digest was distilled with 4% boric acid, 20% Sodium hydroxide solutions were automatically metered into it in the KJECTEC 2200 distillation equipment until distillation was completed. The distillate was then titrated with 0.1M HCl until a violet colour formation indicating the end point. A blank was run under the same condition as with the sample. Total nitrogen content was then calculated according to the formula

$$\text{Crude Protein} = (\text{Titre value (of sample)} - \text{blank})$$

$$\frac{\text{X } 0.01\text{x } 14.007 \text{ x } 6.25 \text{ x}100}{1000 \text{ x Weight of sample } 2.4.3}$$

Determination of Crude Fat

The Content fat was extracted in a Soxhlet extractor with hexane and quantified gravimetrically. 1g of sample was weighed into an extraction thimble and then stopped with grease-free cotton. Before extraction commenced the round bottom cans was dried, cooled and weighed. The thimble was placed in extraction chamber and 80ml hexane was added to extract the fat. The extraction was carried out at 135 ℃ lasted for 1hour 40 minutes after which the fat collected in the bottom cans was cooled in a desiccators.

$$\text{Crude Fat} = \frac{\text{Weight of fat x } 100}{\text{Weight of sample}}$$

Determination of Fibre

The contents were then boiled for 30 minutes and ensuring that the level of the acid was maintained by addition of distilled water. After 30 minutes, the contents were then filtered through a muslin cloth held in a funnel. The residue was rinsed thoroughly until its washing was no longer alkali. The residue was then introduced into an already dried crucible and ashed at 600 ℃ ±200 ℃.

Fibre = Final Weight of Crucible – Initial

$$\frac{\text{Weight of crucible}}{\text{Weight of Sample}} \text{ X } 100$$

Statistical analysis

Data analysis was performed using Statistical Package for the Social Sciences (SPSS version 15.0 SPSS Inc. Chicago, Illinois, U.S.A). Values were expressed as percentage and mean ± SD. 't' test was used for determining the significance/non-significance of results. Means were separated using *t*-test.

Nutritional analysis of soya bean flour enriched high protein biscuits

The carbohydrate, protein, fat, fibre, content were analysed 15g of soy flour incorporated biscuits.

Result and Discussion

Physical Characteristics of Selected Soya Bean Powder

The physical characteristics of selected soya bean powder such as drying ratio, rehydration ratio, bulk density; water absorption capacity is show in table-1.

Table 1: Physical Characteristic of Selected Soya Bean Powder

Sl. No	Physical Parameter	Raw
1.	Drying ratio	25
2.	Rehydration ratio	16.60
3.	Bulk density	4.6
4.	Water absorption capacity	7.3
5.	Oil absorption capacity	4.4

Result of dehydration ratio of the processed soya bean seeds were 25 in raw and rehydration ratio 16.60, were bulk density 4.5 respectively. The water absorption capacity of the processed soy bean was 7.3 and oil absorption capacity of soy bean seeds were 4.4 respectively.

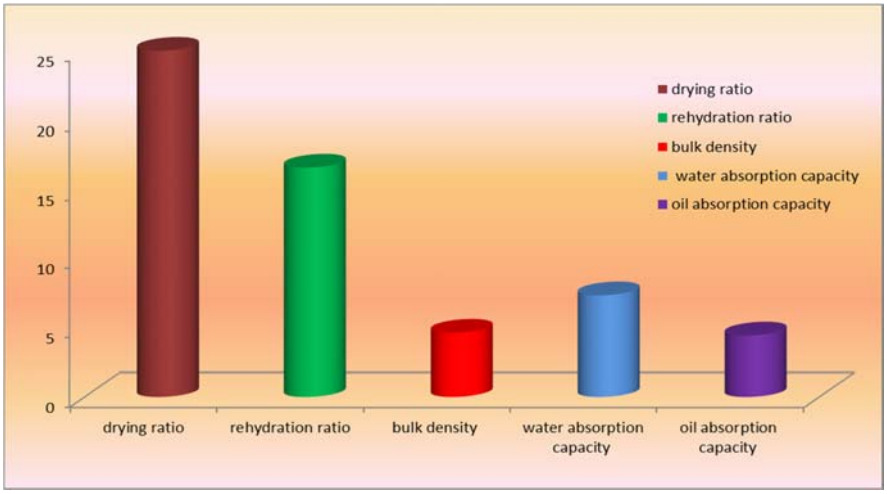


Fig 1: Physical Characteristic of Soya Bean Powder

Chemical Composition of Raw Soya Flour and Wheat Flour:
The chemical composition of raw soya flour and wheat flours is shown in the table – 2.

Table 2: Chemical Composition of Wheat Flour and Soya Bean Flour Blends.

Sl. No	Chemical Composition	Wheat Flour	Soya Flour
1.	Moisture (%)	14	4.37
2.	Carbohydrate (g)	76	23.05
3.	Protein (g)	13	37.5
4.	Fat (g)	3	20.5
5.	Fiber (g)	1	1

The chemical composition of wheat flour indicated that the moisture 14 percent carbohydrate 76(g); protein 13(g); fat 3(g); fibre 1(g); is respectively. The chemical composition of soy bean flour indicated that the moisture 4.37precent carbohydrate 23.05(g), protein 37.5(g); fat 20.5(g); fibre 1(g) respectively.

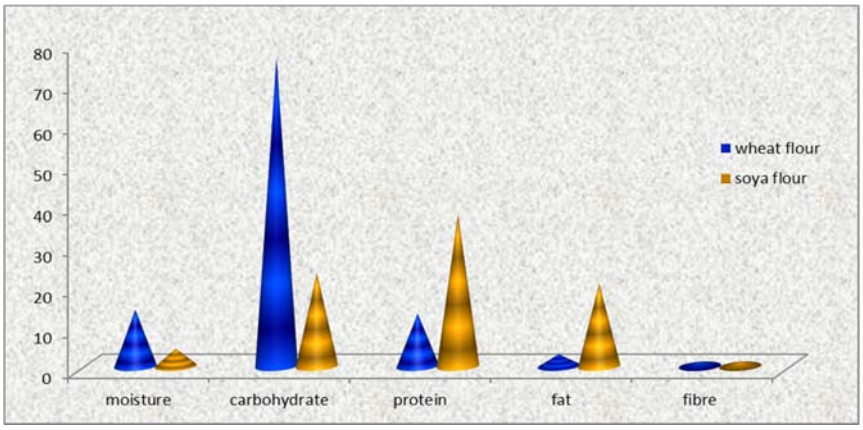


Fig 2: Chemical Composition of Wheat Flour and Soya Bean Flour Blends

3. Sensory Evaluation of Soya Bean Flour Enriched Biscuits

Table 3

Sl. No	Scoring	Mean	Standard
1	Appearance	4.8	1.145
2	Texture	4.66	0.260
3	Taste	4.833	0.372
4	Flavour	4.7	0.458
5	Over all acceptability	4.66	0.327

The mean and standard deviation value of appearance was 4.8±1.145. The mean and standard deviation value of texture was 4.66±0.260. The mean and standard deviation value of taste was 4.833±0.372. The mean and standard deviation value of flavour was 4.7±0.458. The mean and standard deviation value over all acceptability was 4.66±0.327 respectively.

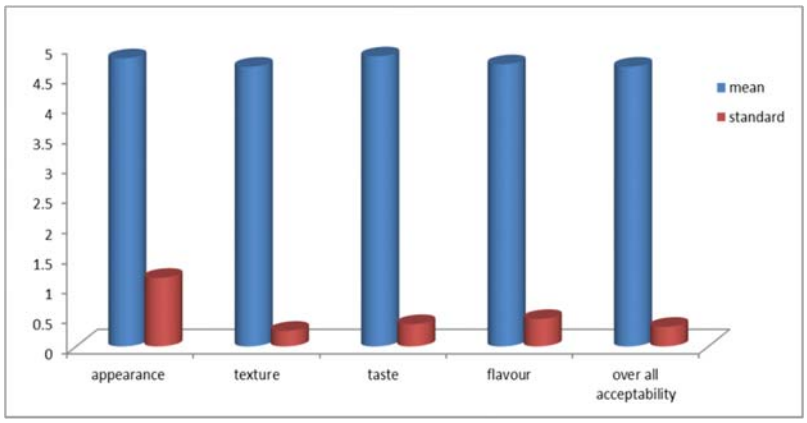


Fig 3: Sensory Evaluation of Soya Bean Flour Enriched Biscuits

Sensory evaluation soya flour and wheat flour biscuits

In the present study, sensory scores of biscuit enriched with 10% (sample 1), and 15% (sample 2), soy flour keeping the wheat flour content fixed (10%), showed that with regard to flavour, taste, body texture, colour and appearance, and overall acceptability, the sensory characteristics of sample 2 (15%) were found to be the best and sample 1(10%) were also found acceptable.

Sensory attributes of soya flour and wheat flour biscuits incorporated with different levels of soy flour.

Taste

The 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. The score for taste had been decreased from 12 to 18 with the increase in the level of substitution of soy flour. Biscuit containing 10% soy flour (sample 1) was rated poorest in taste (12). The scores for colour of the biscuits change from 15 to 10.The highest score (20) were obtained for treatment sample 2.

Texture

The texture of the crust was related to the external appearance of the biscuit top which implies smoothness or roughness of the crust. With the increase in substitution of soy flour to the biscuits, the texture of crust was decreased from sample 1 12 and increase from sample 2 18. The highest score of sample 2 biscuits.

Flavour

In the case of flavour of the biscuit, it was decreased from 10 to 15 with an increase in the substitution of soy flour. This could be due to the beany flavour of soy flour (Akubor and Ukwuru (2005).

Overall acceptability

Overall acceptability includes many implications, which is an important parameter in organo-leptic estimation. Treatment sample 1 that is 10% soy flour-added biscuit and Treatment sample 2 that is 15% soy flour-added biscuits for the overall acceptability. The overall acceptability for sample2 (15%). At the 15% (sample2) level of soy flour incorporation, the biscuits had higher scores for all the sensory attributes evaluated. Above this level, biscuits received a lower sensory score.

Conclusion

This study has demonstrated that Biscuits with soy flour substitution, up to 20% were nutritionally superior to that of the whole wheat flour biscuits. Although 10% and 15% soy flour incorporation biscuit is nutritionally different, organoleptically they are close to each other. The findings of the present study may help in developing commercial processing technology for effective utilization of soy flour and wheat flour especially in the manufacturing of biscuits. The Protein Energy Malnutrition (PEM) of the Tamil Nadu population can therefore be reduced through the development of these biscuits. The amino acids profile of the whole wheat flour was also improved by biscuits of soya flour, especially the lysine content which is the most deficient amino acid in wheat flour also increased significantly. Postmenopausal women consuming a fibre-rich diet, with whole wheat flour, have shown to reduce the risk of breast cancer by 34% compared to those who consume fibre in the lesser amounts. Soya bean flour would provide a convenience protein source to use as an ingredient to prepare protein rich healthy food formulations

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