



ANALYTICAL ASSESSMENT ON PHYSICO-CHEMICAL AND SENSORIAL ATTRIBUTES OF SPC (Soya Protein Concentrate) FORTIFIED BISCUITS

Kelapure Nilesh N.¹, Dr. Jaju Rameshwar H.² and Salve Rabul V.³

¹Assistant Professor, Dept. of Food Chemistry and Nutrition, MGM College of Food Technology, Gandheli, Aurangabad

²Assistant Professor, Dept. of Food Trade and Business Management, MGM College of Food Technology, Gandheli, Aurangabad

³Assistant Professor, Dept. of Food Chemistry and Nutrition, MGM College of Food Technology, Gandheli, Aurangabad

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Abstract: Soybean products have been designated as one of world's healthiest foods due to being an excellent source of high quality protein as well as providing various health benefits. SPC contain 84.5% protein which justifies it was suitable as nutritional ingredient and further to study formulation of biscuits with different wheat and SPC blend ratio. SPC flour was supplemented with refined wheat flour at the rate of 5, 10, 15, and 20. Biscuits were prepared from composite flours. Biscuits prepared without SPC flour were kept as control. Biscuits containing 20% and lower level of the full fat SPC flour were acceptable in relation to their overall acceptability in that biscuits prepared with 15% SPC were found to be superior to others.

Keywords: SPC, Fortification, Composite flour, Biscuits.

Introduction:

Soybeans (*Glycine max*) are a species of legume that yields a valuable amount of oil that has a healthy fatty acid profile and high-quality protein that is replete in all the essential amino acids required for sustaining human nourishment (Young, 1991). Soybeans have antihypertensive, anticholesterol, and antioxidant activities, and appear to prevent several types of cancer (Wu *et al.*, 1998; Messina, 1995).

According to the top Indore-based industry body the Soybean Processors Association (SOPA) in its latest estimates released on Friday showed India's total Soybean output at 11.49 million tonnes. It is highest in four years, for the harvesting season 2016-17 as compared to 7.2 million tonnes reported in the previous year. In November 2016, the United States Department of Agriculture (USDA) has forecast India's soybean output at 9.7 million tonnes, which was revised later to 11.5 million tonnes in December 2016.

Soybean contains 36 - 40% protein, 18-20% oil, 13-17% soluble carbohydrates like sucrose,

stachyose, 13-17% insoluble carbohydrates Dietary fibres, 8 to 10% moisture, /ash/and others. Soybeans are also good sources of calcium, iron, zinc, phosphate, magnesium and vitamin B. Soybean has great potential as an exceptionally nutritive and very rich protein food. It can supply much needed protein to human diet, because it contains above 40 percent protein of superior quality and all the essential amino acids particularly glycine, tryptophan and lysine, similar to cow's milk and animal proteins. Soybean oil is rich in polyunsaturated fatty acids and contains no cholesterol (Garcia *et al.*, 1997).

Soya protein concentrate is soy protein with highest content of protein, it is made from de oiled soy meal by removing most of the fats and carbohydrates, yielding a product with 65 to 90 % protein. Soy concentrates are characterized by certain functional properties: solubility, gelation, emulsification, dispersibility, viscosity, and retort stability (Tsen *et al.*, 1973; Hooda and Jood 2005).

Baking industry in India is considered as one of the major industries in food processing. Wheat

based baked products like bread, biscuits, and cakes are popular among the baked products. Among the bakery products, biscuits are most significant. Biscuits are important food snacks for childrens and adults. However these are most commonly relished by school going children and adults. Biscuits hold an important position in snack foods due to variety in taste, crispiness and digestibility. Commercially available biscuits are prepared from white flour that is nutritionally inferior to whole wheat flour (Hussain., 2006).

At present biscuits are prepared from white flour which is inferior in quality and low in fiber content. Low levels of dietary fiber causes certain non infectious diseases such as diverticulosis, atherosclerosis and colonic cancer. For this reason interest in research has arisen in increasing fiber content in the diet. Baked products have proved to be acceptable carriers of fiber from various sources. The specific objectives of the studies are as follows.

- 1) To formulate biscuits with fortification of soya protein concentrate (SPC) for value addition and protein enrichment.
- 2) To estimate the chemical composition of SPC fortified biscuits.
- 3) To perform sensory evaluation of SPC fortified biscuits.

Materials and Methods

The present investigation entitled '**Analytical Assessment on Physico-chemical and sensorial attributes of SPC (Soya Protein Concentrate) Fortified Biscuits**' was carried out in Department of Food Science and Technology, MGM College of Food Technology, Gandheli, Aurangabad.

1. Collection of Materials: All the materials like refined wheat flour, SPC, sugar, salt, preservatives, packaging materials and other ingredients procured from local market Aurangabad. All the required chemicals were analytically graded one and obtained from Department of Food Science and Technology. The equipments and machineries required in the present investigation were utilized from the various Departments Viz., Department of Food Science and

Technology (FST), Department of Food Chemistry and Nutrition (FCN), High Tech Laboratory. MGM College of Food Technology, Aurangabad.

2. Formulation and Preparation of Biscuits:

2.1 Product Formulation

Biscuits were predominantly based on refined wheat flour (RWF) and Soy Protein Concentrate blended composite flour so as to upgrade the nutritional quality. In present investigation, the primary work was done to enhance the nutritional quality of biscuits by incorporating Soy Protein Concentrate (SPC).

Preliminary experimental work was done with different high levels of Soy Protein Concentrate (SPC) incorporation so as to select the range of per cent incorporation which could be used in formulating composite flour for biscuits. Through trial and error, coupled with continued informal sensory evaluation by a panel of food scientists, as a result of preliminary trials, it was found that not more than 20% of SPC could be used in preparation of composite flour as further increase in SPC concentration resulted in drastic reduction of overall acceptability of product. Further systematic studies have been carried out by considering following composite flour formulation for biscuit preparations. The rest of the recipe was kept constant so that only the effect of variation in composite flour on sensorial, physical and chemical characteristics of prepared biscuits can be investigated.

T_{1(c)} - Refined wheat flour (RWF) without incorporation of SPC

T₂ - 5% replacement of RWF with SPC

T₃ - 10% replacement of RWF with SPC

T₄ - 15% replacement of RWF with SPC

T₅ - 20% replacement of RWF with SPC

2.2 Preparation of composite flour

Composite flour utilized in the preparation of soy protein concentrate and wheat flour biscuits were prepared by the blending of an appropriate proportion of soy protein concentrate with wheat flour.

Table 1: Preparation of Composite Flour

Samples with % incorporation	Refined Wheat flour (RWF) /maida (gms/ %)	SPC
T ₁ ©	100(100%)	-
T ₂	95 gms(95%)	5 gms(5%)
T ₃	90 gms (90%)	10 gms(10%)
T ₄	85 gms (85%)	15 gms(15%)
T ₅	80 gms (80%)	20 gms(20%)

2.3 Recipe for soy protein Concentrate and refined wheat flour biscuits

The soy protein Concentrate and refined wheat flour biscuits were prepared using the basic formula of Gaines and Tsen (1980) as under.

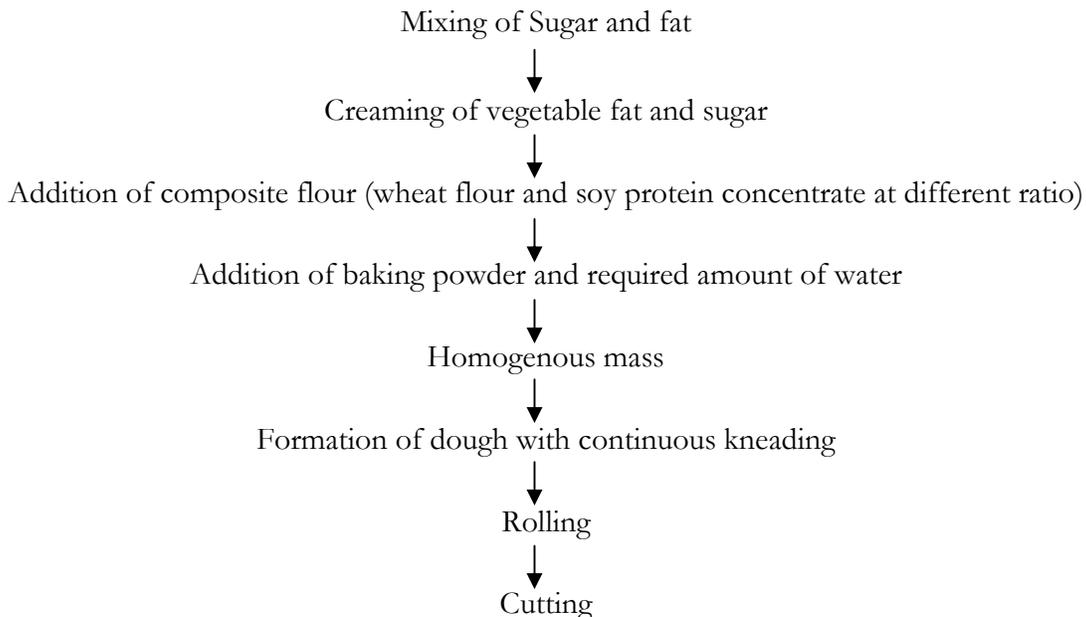
Table 2: Recipe for soy protein Concentrate and refined wheat flour biscuits

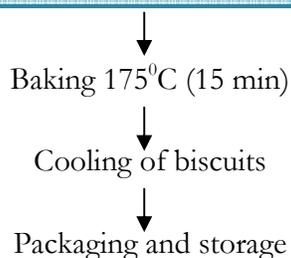
Ingredients	Quantity
Flour	100
Sugar	33
Shortening	34
Salt	1
Glucose	1
Sodium bi carbonate	0.27
Ammonium bi carbonate	0.20
Distilled water	As per requirement

2.4 Preparation of SPC and RWF Fortified biscuits:

Hydrogenated oil, powdered sugar and salt were creamed. The composite flour was slowly added to cream. It was thoroughly kneaded manually by adding required amount of water in which the sodium bi carbonate, ammonium bi carbonate and glucose dissolved. It was kneaded for five minutes.

Immediately after being kneaded, the dough was rolled between to glass sheets to a uniform thickness. The sheet was then cut out in circular shape with the help of cutter. Finally biscuits were baked at 175^o C. for 15 min in oven. The method of preparation of biscuits was similar as summarized in the flowsheet as follows.





2.5 Physical Analysis of Biscuits:

The biscuits containing different level of soy protein concentrate were analyzed for weight (g), diameter (cm), thickness (cm), and spread factor according to the method described in A.A.C.C (2000).

2.6 Determination of the chemical composition of the biscuits

The chemical composition of the biscuits was determined as per AOAC, 1984 specifications. The parameters evaluated were protein, carbohydrates, fat, moisture, ash, crude fibers

2.7 Sensory analysis

The sensory evaluation of different treatments of biscuits for various attributes including color, flavor, taste, texture and overall acceptability

was carried out using semi trained panel members using hedonic rating. On the day of evaluation, biscuits from all the treatments were placed in transparent plates, labeled with random codes. Panelists were given water and crackers to neutralize their mouth between the samples. The biscuits sample were presented in randomly coded order and judges were asked to rate their acceptance by giving a score for all the parameters. Judgments were made through rating products on a 9 point Hedonic scale with corresponding descriptive terms ranging from 9 ‘like extremely’ to 1 ‘dislike extremely’.

Sensory Evaluation (Score Card)

Project Title: Analytical Assessment on Physico-Chemical and Sensorial Attributes of SPC (Soya Protein Concentrate) Fortified Biscuits.

Samples	Color	Flavour	Taste	Texture	Appearance	Overall acceptability
Control						
T ₁						
T ₂						
T ₃						
T ₄						
T ₅						

The score rating was done as per

- 9 - Liked extremely
- 8- Liked very much
- 7- Liked moderately
- 6 - Liked slightly
- 5 - Neither liked nor disliked
- 4 - Disliked slightly
- 3 - Disliked moderately
- 2 - Dislike very much
- 1 - Dislike extremely

Signature of Evaluator
Name & Designation of the Evaluator

Results and Discussion

The study was comprises of two parts: First part include preparation of Soy Protein Concentrate of defatted soy oil meal and its compositional

analysis and Second part include its utilization in preparation of composite flour for biscuits and to observe its effect of physical, sensorial and nutritional value.

The whole data obtained on various aspects of soy protein concentrate fortified biscuits was under suitable captions as follows:

1. Composition of Soy Protein Concentrate and refined wheat flour:

Wheat flour was a principal ingredient in preparation of biscuits due to its much appreciated

rheological characteristics. The data related to composition of refined wheat flour was determined and presented in Table 3. Results showed that refined wheat flour contains 72.25% carbohydrates, 8.15% protein, and 1.98% fat the other factors estimated were found to be 11.38%, 1.84%, 2.17% of moisture, ash and crude fibers respectively.

Table 3: Chemical composition of Soy protein concentrate and Refined wheat flour

Particulars	Refined wheat flour	Soy protein concentrate
Moisture	11.38	2.98
Ash	1.84	0.73
Crude fiber	2.17	1.76
Carbohydrates	72.25	9.71
Protein	8.15	84.5
Fat	1.98	0.43

* Each value was average of three determinations.

The carbohydrate, fat, crude fibre and ash content of Soy Protein Concentrate were found to be 9.71, 0.43, 1.76 and 0.73 per cent respectively. The proximate composition of SPC describes the suitability of adopted method. On the basis of obtained data pertaining to SPC, it could be stated that defatted soy meal was found to be suitable for the extraction of Soy Protein Concentrate.

2. Physical parameters of SPC fortified biscuits

Physical analysis of soy protein concentrate biscuits was important from both consumers as well as manufactures point of view and it was desirable that biscuits should retain their shape during baking. Soy protein concentrate and wheat flour biscuits along with control were analyzed for physical characteristics including weight, diameter, thickness, and spread factor and results were presented in table 4.

Table 4: Physical parameters of SPC fortified biscuits

Biscuits Samples	Weight (g)	Diameter (cm)	Thickness (cm)	Spread factor	Top grain
T ₁	10.43	4.14	0.90	50.17	Rare
T ₂	10.40	4.16	0.88	51.20	Acceptable
T ₃	10.39	4.19	0.87	52.00	Acceptable
T ₄	10.38	4.21	0.86	53.71	Good
T ₅	10.36	4.25	0.85	54.23	Not acceptable

* Each value was average of three determinations.

3. Chemical composition of SPC fortified biscuits

The results of the proximate composition of the biscuits containing different levels of wheat and soy protein concentrate flour are presented in table 5.

Table 5: Composition of biscuits prepared with different ratio of Soy Protein Concentrate

Biscuits Samples	Moisture (%)	Ash (%)	Crude Fibers (%)	Carbohydrates (%)	Protein (%)	Fat (%)
T ₁ ©	2.98	0.70	1.42	67.40	5.36	21.14
T ₂	3.21	0.90	1.20	63.80	9.34	20.96
T ₃	3.76	1.14	1.23	61.05	11.75	20.71
T ₄	4.01	1.37	1.17	59.18	13.61	20.63
T ₅	4.58	1.74	1.16	56.38	15.68	20.44

*Each value was the average of three determinations

4. Sensorial quality characteristics of SPC fortified Biscuits

The biscuits were prepared using soy protein concentrate flour at different levels ranging from 0 to 20 percent. The prepared biscuits were evaluated for their quality and sensory acceptability using 9 point hedonic scale. The biscuits were evaluated with respect to color, flavor, taste, texture, appearance, overall acceptability of the final product.

The sensory score was presented in table-6. It can be revealed from Table-6 that there was increase in sensory score with addition of soy protein concentrate in the product but only up to certain level. The over utilization (20% and more) of soy protein concentrate flour may produces undesirable top grain, undesirable flavor and also decrease in overall acceptability.

Table 6: Sensory quality of SPC fortified biscuits

Treatments	Blend ratio (SPC: wheat flour)	Color	Flavor	Taste	Texture	Appearance	Overall acceptability
T _{1(c)}	00:100	7.8	7.7	8	8.3	8.2	8.1
T ₂	05:95	7.3	7.8	7.5	7.6	7.6	7.5
T ₃	10:90	7.6	7.8	7.8	8.0	8	7.9
T ₄	15:85	7.5	7.9	7.9	8.1	8.1	8.2
T ₅	20:80	6.9	7.0	7.2	6.8	7.2	7.0

The panel of the semi trained judges from MGM College of Food Technology, Aurangabad were given the wheat and soy protein concentrate flour biscuits, sample of different treatments represented by following denominations for Organoleptic evaluation.

Sample	Soy protein Concentrate	Wheat flour
T ₁	= 0%	100%
T ₂	= 5%	95%
T ₃	= 10%	90%
T ₄	= 15%	85%
T ₅	= 20%	80%

Conclusion

Preliminary experimental work was done with different high levels of Soy Protein Concentrate (SPC) incorporation so as to select the range of per cent incorporation which could be used in formulating composite flour for biscuits. Through trial and error, coupled with continued informal sensory evaluation by a panel of food scientists, as a result of preliminary trials, it was found that not more than 20% of SPC could be used in preparation of composite flour as further increase in SPC concentration resulted in drastic reduction of overall acceptability of product.

Therefore biscuits were prepared with incorporation of soy protein concentrate from 0% [control i.e. T_{1(c)}], 5% [T₂], 10% [T₃], 15% [T₄], 20% [T₅] and analyzed for their physical, chemical and

Organoleptic evaluation, In that sample T₄ with 15% incorporation found to be superior with respect to all the aspects further increase in the soy protein concentrate level will reduce overall acceptability of the product.

Experiments were conducted as per desired experimentations to study preparation of soy protein concentrate from de oiled soy meal and also to judge the compatibility in formulation of biscuits. Then the efforts were made to form the biscuits with high level of soy protein concentrate but it was found that only up to 20% incorporation was suitable above this level there was drastic reduction in overall acceptability so among the different blend ratios for biscuits only 15% of soy protein concentrate was found to be superior.

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