Effect of Differently Treated Soyabean Flour on Quality of Biscuits

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Abstract

This present study was carried out to find out the effect of differentially treated soya flour on quality of biscuits. Soya flour in raw, roasted and steamed forms was incorporated (at 10, 20 and 30% levels) to refined wheat flour for the preparation of biscuits. Biscuit made from 100% refined wheat flour was used as control. Rheological properties of control and the blends were measured. Biscuits made from control and the blends were subjected to objective and sensory evaluations. Farinograph characteristics of wheat flour-soya flour blends showed that incorporation of soya flour increased the water absorption of the blends. Roasted soya flour had relatively higher water absorption. Dough development time increased significantly with the incorporation of soya flour especially at 20 and 30% levels. Extensograph characteristics showed a decrease in the extensibility values with the incorporation of soya flour. Amylograms of the wheat flour-soya flour blends showed a gradual increase in pasting temperature of blends with an increase in each level of addition. Different treatments of soya flour blend did not affect the pasting temperature of blends. Peak viscosity values decreased with increase in the level of soya flour incorporated biscuit. Incorporation of soya flour has shown to increase in the moisture content and protein content of the biscuits. Colour measurement showed a higher ΔE value for the biscuits prepared from steamed soya flour blends than the others. Roasting of soya flour removes the raw beany taste but on the other hand, makes the biscuits relatively darker in colour. Steamed soya flour did not have any beneficiary effects on the sensory parameters of biscuits.

Key Words

Soya flour; biscuits; Farinograph; Extensograph; organoleptic quality.

Introduction

Biscuit is most popular bakery product worldwide. It is an unleavened crisp, sweet pastry made from wheat flour, shortening & sugar, and is usually made light by the addition of baking powder. Because of its acceptability in all age group, longer shelf life, better taste and its position as snacks it is consider as a good product of for protein fortification and other nutritional improvement (Bazilla Gayas et al., 2012) Biscuits constitute major component of human snacks in most part of the world.

Wheat flour constitutes the basic ingredient for biscuit production because of its gluten proteins, which are not present in flour of other cereals. Gluten protein forms elastic dough during baking and gives high organoleptic quality to the finished product. (Saghir Ahmad_et al., 2014). The low moisture content ensures that biscuits are generally free from microbial spoilage and confers a long shelf life on the products. 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 soybean, *Glycine max* a grain legume, is one of the richest and cheapest sources of plant protein that can be used to improve the diet of millions of people, especially the poor and low income earners in developing countries because it produces the greatest amount of protein used as food by man (LIU, 2000). Protein energy malnutrition (PEM) is one of the most serious health problems in many part of country especially in developing countries like India (FAO, 2007).

Soyabean plays a unique role in agriculture, commerce and nutrition. For centuries it has been the most important source of dietary protein of millions of people in the orient, constituting a valuable supplement to their diets. The green seeds are consumed as a vegetable, while dry or sprouted seeds are used in a variety of food preparations. It had used for the preparation of milk substitutes and in a variety of fermented products. Soyabean flour has found wide application in a number of food preparations. The use of soyabean for the production of protein enriched biscuit were studies by several authors like (Akubor and Ukwuru, 2004); (Banureka and Mahendran, 2009); (Oluwamukomi et al., 2011). 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.

Materials and methods

Refined wheat flour and sugar was procured from the local market. Defatted soyaflour (M/s Sakti Soya, Pollachi, Tamil Nadu). Shortening (Marvo fat, Hindustan Lever Limited.) Non-Fat Dry Milk (NFDM, Sagar skimmed milk powder, manufactured by Gujarat Co-operative Milk Marketing Federation) was used for the study. Minor Ingredients used were food grade sodium chloride, sodium bicarbonate, ammonium bicarbonate; vanilla essence and liquid glucose were used for the preparation of biscuits.

Preparation of the blends

Roasting of soya flour

Roasting was done by spreading the soy flour (500g) uniformly in trays and kept in roasting oven of 20 minutes at 80-90ºC.

Steaming of soya flour

Steaming was done by placing the soya flour in a pressure cooker and steamed at atmospheric pressure for 20 minutes.

Table 1: Blends Used for the Preparation of Biscuits

Blend No.	Wheat Flour %	Soy Flour%	
1	100	0	Control
2	90	10	Raw Soy Flour
3	80	20	
4	70	30	
5	90	10	Roasted soy flour
6	80	20	
7	70	30	
8	90	10	Steamed soy flour
9	80	20	
10	70	30	

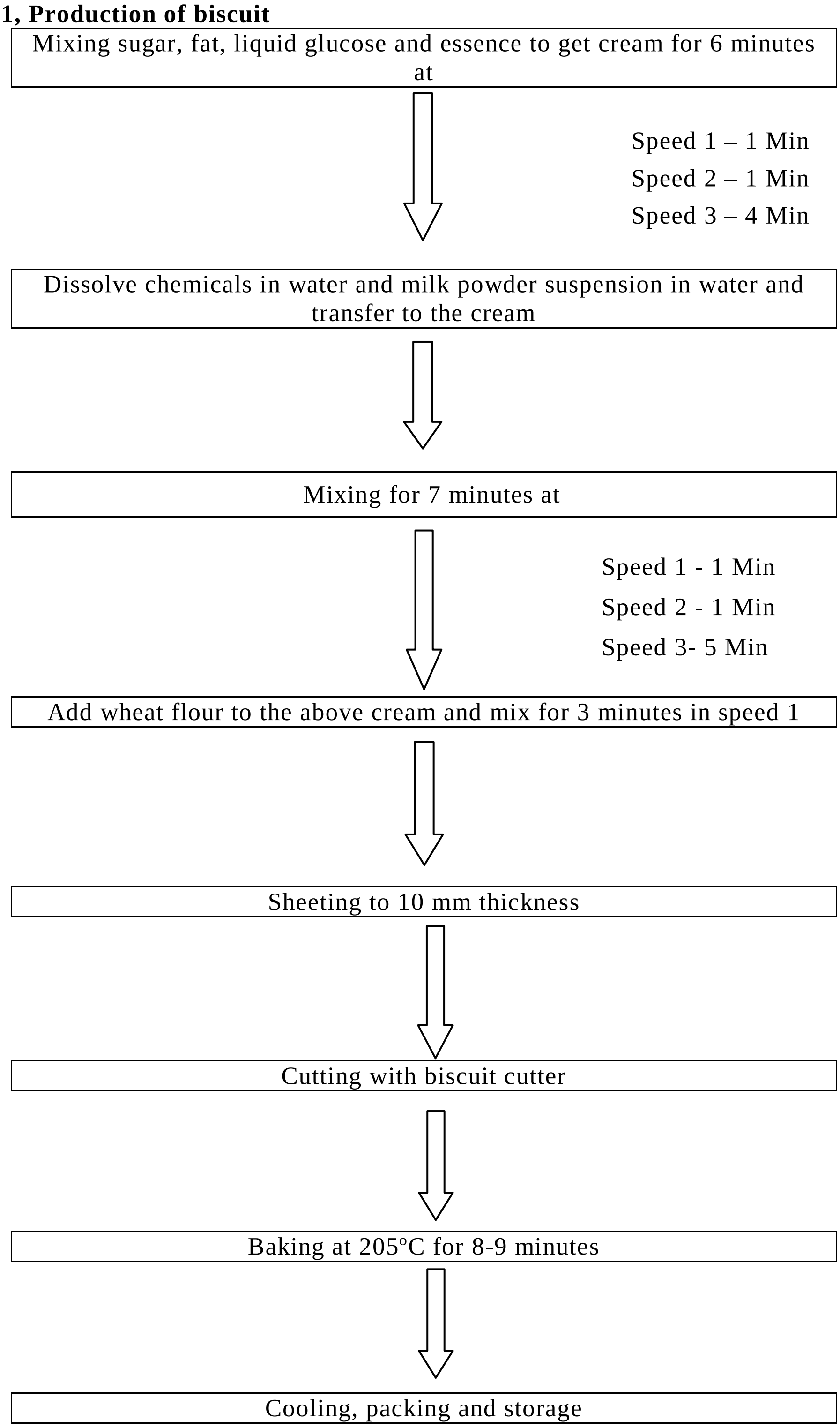
Combinations tried in the study were soyabean flour of 10, 20 and 30% (raw, roasted and steamed) and the remaining were wheat flour (90, 80 and 70%).Manual mixing of flours and followed by passing the mix through a 1mm standard sieve 3 times for uniform blending.

Table 2: Biscuit Formulation

Ingredients	Weight in grams
Flour	100
Sugar	30
Fat(Marvo)	20

Milk Powder	2
Sodium chloride	1
Sodium bicarbonate	0.4
Ammonium bicarbonate	1.5
Liquid glucose	2
Essence (Vanilla)	1 ml
Water	18 ml

Flow Chart-1, Production of biscuit



1) Chemical analysis
Moisture (AACC Method, 44-19), Total ash (AACC Method, 08-01), Total protein (AACC Method, 46-12), Hagberg falling numbers (AACC Method, 56-80), Wet and Dry gluten (AACC Method, 38-10), Diastatic activity (AACC Method, 22-15), Damaged Starch (AACC Method, 76-30A) and Sedimentation value (AACC Method, 56-60) were determined in wheat flour sample according to standard procedures.

2) Rheological Characteristics
Brabender Farinograph (AACC Method, 54-21) Brabender Extensograph (AACC Method, 54-10) was used to study the rheological characteristics of the dough.

A. Farinograph Characteristics
Effect of soya flour on Farinograph Characteristics was determined following AACC Method(AACC Method, 54-21) Samples was taken in 50 g capacity farinograph bowl, instrument was run for 15 minutes. The Farinograms obtained were evaluated for water absorption, dough development time, dough stability and mixing tolerance index.

1) **Water absorption:-**
   It is the amount of water required by a given weight of flour to yield dough of a given consistency (500 BU).
   % water absorption of flour on 14% moisture basis is calculated using the following equations.
   % water absorption = 2 (x+y-50)
   Where x- water added in ml
   y – Weight of flour used in gm.
2) **Dough Development Time(DDT):-**
   It is the time from the first addition of water to the development of dough’s maximum consistency. This value is correlated with commercial mixing time.
3) **Dough Stability:-**
   It is the difference in time between the time when the curve first interrupts the 500 BU line (arrival time) and the time when the curve leaves the 500 line (departure time).
4) **Mixing Tolerance Index:-**
   It is the difference in B.U. from the top of the curve at the peak to the top of the curve measured 5 min after the peak.

B. Extensograph Characteristics
The extensograph characteristics were determined according to AACC Method 54-10. The Extensograms were evaluated for:

1) **Resistance to Extension:-**
   The maximum height of the extensogram in Brabender Units (B.U)
2) **Extensibility:-**
   The total length of the curve measure on horizontal axis in mm.
3) **Energy (cm^2):-**
   The total area under the extensogram curve.
4) **Ratio figure:-**
   The ratio of resistance to extension to extensibility.

3. Amylograph Characteristics
Amylograph characteristics of the flour was determined using Brabender Amylograph, according to AACC Method 22-10. Flour (65g) was made into a smooth suspension in the buffer solution and transferred to the Amylograph bowl. Amylograph starting temperature was 30^0C. The instrument was run until peak viscosity was obtained. The amylograms were evaluated for the following parameters:

a. Pasting Temperature
The temperature at which the curve begins to rise from the base line.
b. Pasting time
The time required for the curve to rice from the base line.

c. Peak viscosity
Highest point in Brabender Units reached by the curve.

4. EVALUATION OF BISCUITS

A. Physical Characteristics

A.1. Texture of biscuits.
Texture measurement of the biscuits was done using Texture Analyser in terms of Kg force required to break the biscuit. The conditions used were as follows:

Texture Measurements
The texture of biscuits in terms of breaking strength was measured using the Texture Analyser. The samples were rested on two supporting beams, 50 mm apart. Another beam connected to the instrument was brought down to break the biscuit at a cross head speed of 50 mm/min and load cell of 50 kg. Care was taken to keep the point of contact equidistant from the supporting beams. The peak force in grams at

breaking represented the breaking strength. Averages of breaking strength of 6 biscuits were reported.

A.2. Colour Characteristics of biscuits

Colour measurements of the biscuit was done using Colour analyser to find the ΔE values of the biscuits. The values of surface colour of biscuits in terms of colour difference and percent whiteness (W) were measured using UV-visible recording spectrophotometer (Model UV-2100, Shimadzu Corporation, Japan). A standard white board made from barium sulphate (100% whiteness) was used as a perfect white object for setting the instrument with illuminated. Biscuits were placed in the sample holder and the reflectance was auto recorded for the wavelength ranging from 360 to 800 nm. The colour difference value for biscuits in comparison to the standard barium sulphate board percent whiteness (W) was recorded.

A.3. Spread ratio

Biscuits were evaluated for thickness (mm), width (mm), and spread ratio. Average of 6 biscuits was reported. Spread ratio is calculated as follows:

$$\text{Spread ratio} = \frac{Width\ (W)}{Thickness\ (T)}$$

B. Sensory Characteristics

The sensory characteristics of the biscuits were evaluated by seven judges. The score card used for evaluation is shown in table 6. The results were analysed statistically using Duncan New Multiple range test (Duncan, 1955).

TABLE: 3 Score sheet for sensory evaluation of biscuits

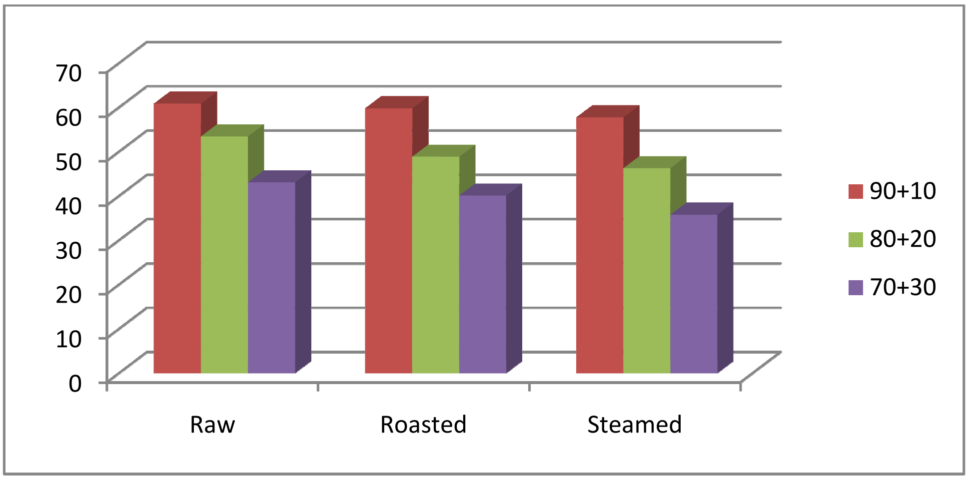
Name:

- ❖ Score the coded biscuit samples for various characteristics given below. Maximum score is given in brackets. You may use quality descriptions given for each parameter.
- ❖ Rinse mouth with water between tests of two samples.

Quality Characteristics:

Sl. No.	Sample No.	Colour (10)	Surface Character (10)	Crumb Colour (10)	Texture (20)	Taste (20)	Mouth feel (10)	Total Score (80)
1.								
2.								
3.								

GAPGH OF QUALITY EVALUATION ANALYSIS – SENSORY



Results and Discussion

Chemical Characteristics of Wheat flour

Table 4 shows that the wheat flour used had a moisture content of 10-57% and ash content of 0.52%. Protein content was found to be 8.99% and dry gluten content was 8.82%. A falling number of 842 sec shows that the flour is from ingeminated wheat with low alpha amylase activity.

Table 4: Chemical Characteristics of Wheat Flour

Sl. No.	Parameter	Composition*
1	Moisture (%)	10.57
2	Ash (%)	0.52
3	Total proteins(%), (Nx5.7)	8.99
4	Wet gluten (%)	25.91
5	Dry gluten (%)	8.82
6	Falling number (sec)	842
7	Diastatic activity (mg of maltose/10g flour)	240.5
8	Damaged starch(%)	12.05
9	Zeleny Sedimentation Value	18.75
10	Reducing Sugar (mg maltose/ 10g flour)	28
11	Non-reducing sugar (mg sucrose/10g flour)	204

** Values entered on 14% moisture basis*

3. Rheological Characteristics of Wheat flour-Soya flour Blends.

a) Farinograph Characteristics.

The results of Farinograph Characteristics of wheat flour-soya flour blends shows that incorporation of soya flour increased the water absorption of the blends. This was the effect of the treatment given to soya flour. However, it was observed that blends containing roasted soyaflour had relatively higher water absorption than those containing either raw or steamed soya flours. Similar results were also reported by Tseu and Hoober (1973). Increase in the water absorption level of blends is due to the high water absorption capacity which in case of the defatted product is equivalent to 110% by weight (Boha and Faoor, 1945). Hence, soya flour can absorb an amount of water equal to its weight when mixed with wheat flour to normal dough consistency (Pyler, 1988).

Analysis of Farinograms showed that the dough development time (DDT) was 2 min for refined wheat flour. The DDT increased significantly with the incorporation of soya flour especially at 20 and 30% levels. The DDT of blends containing raw, roasted and steamed soya flours increased to 10.0, 13.9 and 9.8 minutes respectively when added at 30% level. DDT is related to the change occurring in the gluten proteins (Farrand, 1972). Increase in dough development can be due to dilution of gluten proteins by the presence of soya flour.

Stability of the dough to mixing was 5.4 min for control flour. No significant change was seen in dough stability upto 20% addition of raw and roasted soya flours. At 30% addition a significant increase in the dough stability was observed. On the other hand, addition of steamed soya flour increased the dough stability marginally to 6.8 min at 20% level of addition. No further changes were observed when in amount of steamed soya flour was increased to 30% level. It is thought that Lipoxygenase enzyme present in soya flour has an effect on dough stability (Hoseney, 1994). Mixing Tolerance Index (MTI) increased marginally at 10 and 20% levels of addition of soya flours. However at 30% level of addition a decrease in MTI was observed. This trend was the same for all three varieties of soya flours. Mathews *et al* (1970) reported a decrease in MTI of dough as the level of replacement increases. Some soya flours, however, were reported to increase the MTI (Mathews *et al*, 1970; Hoseney and Faubion, 1981)

Summary and Conclusion

Mixing of wheat flour with soyaflour produced protein enriched biscuit. Farinograph characteristics of wheat flour-soya flour blends showed that incorporation of soya flour increased the water absorption of the blends. Roasted soya flour had relatively higher water absorption. Dough development time increased significantly with the incorporation of soya flour especially at 20 and 30% levels. Extensograph characteristics showed a decrease in the extensibility values with the incorporation of soya flour. It also showed an increase in the resistance to extension with the incorporation of soya flour. A marked decrease in area of the extensogram was seen with increase in incorporation of soya flour. Amylograms of the wheat flour-soya flour blends showed a gradual increase in pasting temperature of blends with an increase in each level of addition. Type of soya flour present in the blend did not seem to affect the pasting temperature of blends. Peak viscosity values decreased with each increase in the level of soya flour incorporated. Estimation of protein content in biscuit showed that with the incorporation of soya flour there was a gradual increase in the protein content of the biscuits. Colour measurement showed a higher ΔE value for the biscuits prepared from steamed soya flour blends than the others. Incorporation of soya flour has shown to increase in the moisture content of biscuits. Results showed a marginal decrease in the spread of biscuit with incorporation of 10% and 20% blends respectively. Texture measurement showed that control biscuit had a minimum value of breaking strength. Incorporation of 10% soya flour of all the three types of soya flours showed a marginal increase in the breaking strength. Sensory evaluation of biscuits revealed that biscuits containing 20% raw, 10% roasted and 10% steamed soya flour were highly acceptable.

In conclusion, defatted soya flour can be used in biscuit formulations to increase the protein content of biscuits. Roasting of soya flour, to some extent, removes the raw beany taste but on the other hand, makes the biscuits relatively darker in colour. Use of steamed soya flour did not have any beneficiary effects as the sensory parameters of biscuits.

Author contribution

All authors contributed equally in this article.

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