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Evaluation of quality and sensory parameters of soy flour prepared from boiled soybean

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Abstract
The evaluation of quality and sensory parameters of soy flour prepared from boiled soybean was carried out at the department of Agricultural Process Engineering, CAE & T, VNMKV, Parbhani (Maharashtra). Soybean variety JS -335 was selected for the study on the basis of popularity and yield. Soybean was procured from Soybean Processing Center, VNMKV, Parbhani. Whole unbroken soybean free from infestations was selected for study purpose. The boiled and subsequently dried soybeans were milled to obtain soy flour. Evaluation of quality parameters viz., moisture content, protein content, bulk density, dispersibility, water absorption capacity and color of soy flour samples was performed as per the standard procedures. Moisture content of soy flour prepared from boiled soybean was increased with increase in boiling time. The protein content and dispensability were found to decrease with boiling time. However, the bulk density and water absorption capacity were found to increase with increase in boiling time. There was non-significant difference in colour values of soy flour samples prepared from boiled soybeans. Also there was non-significant difference in sensory parameters such as colour and appearance, texture, flavour and overall acceptability of soy flour samples prepared from 15 min to 60 min boiled soybean.

Keywords: Soy flour, dispersability, boiled soybean

Introduction
Soybean (*Glycine max*) is often called as "Miracle Crop". It is an important oilseed belonging to the family *Leguminosae*. It is one of the most important oil and protein crops of the world. Soy is one of the natures wonderful nutritional gifts. It is considered as "GOLD" obtained from soil and is thus rightly called today "Gold Nugget of Nutrition" owing to its nutritional composition (Singh *et al*., 2001). Soy flour is most widely used in baked goods 2-15 % is added to breads, crackers, muffins, donuts, cakes, rolls, cookies, tortillas, or chapattis. In baked goods, soy flour increases the storage life and nutritional value, while adding moisture as needed with little or no increase in cost. Also it is also used in pasta products, processed meats, gravies, sauces, soups, cereals, prepared mixes, dairy substitutes, candies, special diet foods and spice bases. In other products, it generally lowers the cost and improves the functional properties by serving as a conditioner, emulsifier, moisture retainer, antioxidant etc. (William *et al*, 2004). Hence the quality parameters viz., moisture content, protein content, bulk density, dispersibility, water absorption capacity and colour were evaluated for soy flour prepared from boiled soybean. Sensory parameters were also determined.

Materials and Methods
Procurement of Soybean
Soybean variety JS-335 was selected for the study on the basis of popularity and yield. Soybean was procured from Soybean processing center, VNMKV, Parbhani. Whole unbroken soybean free from infestations was selected for study purpose.

Preparation of soy flour from boiled soybean
1 kg clean soybeans which were free from dirt and other foreign material were taken and boiled in water (seeds to water ratio 1:5) in a water bath at 100ºC temperatures for 15 minutes and dried in tray dryer at 60ºC temperature till constant weight was obtained. Soybeans were stirred at an interval of 30 minutes to ensure uniform drying. The dried soybeans were milled to obtain soy flour. Soy flour obtained was finally packaged in packaging material due to hygroscopic nature of soy flour, then used for analysis. Similarly soybeans were boiled for 30,

45 and 60 min and dried in tray dryer at 60ºC temperature till constant weight was obtained. The soy flour was then prepared by milling dried soybeans.

Moisture content

A 5gm sample was taken in a tare moisture box and was weighed accurately using a single pan digital balance of 0.0001g sensitivity to get the exact weight of the sample. It was kept in hot air electric oven maintained at temperature of 105 ± 1ºC for 4 hours. The sample was taken out of oven, cooled in desiccators and weighed to determine the moisture content.

$$\text{Moisture content (\%)} = \frac{\text{Wt. of original sample} - \text{Wt. of dried sample}}{\text{Wt. of original sample}} \times 100$$

Protein content

The protein content was determined by Micro-Kjeldahl's apparatus.

Bulk density

The bulk density of soy flour was determined by the method of (Wang *et al.*, 1976). 5 g of the sample was weighed into 50 ml graduated measuring cylinder. The samples were packed by gently tapping the cylinder on the bench top 10 times from height of 5cm. The volume of the sample was recorded.

$$\text{Bulk density (g/ml)} = \frac{\text{Weight of the sample}}{\text{Volume of the sample after tapping}}$$

Dispersibility

Dispersibility was determined using the method described by (Kulkarni *et al.*, 1991) [7]. Ten grams of the flour sample was weighed into 100 ml measuring cylinder, water was added to each volume of 100 ml. The set up stirred vigorously and allowed to stand for three hours. The volume of settled particles was recorded and subtracted from 100. The differences reported as percentage dispersibility.

% Dispersibility = 100 - volume of settled particle

Water absorption capacity

In a weighed centrifuge tube 5gm of sample and 30 ml of distilled water was added and material was suspended in water by mixing with a thin glass rod taking care to see that no sample adhered to the side of centrifuge tube. After holding for a period of 30 min, 10 ml of distill water was used to wash the sample adhering to the stirring rod and centrifuge tube if any. The suspension was then centrifuged at 3000 rpm for 15 min. The superman liquid was discarded and the tube kept mouth down at an angle of 15-20 in forced draught air oven at 50ºC. It was placed in desiccators at the room temperature and subsequently weighed. Water absorption capacity was calculated as the amount of water retained by 100 g of sample and expressed in percent. (Bodhankar, 1992) [4].

$$\text{WAC} = \frac{\text{V1-V2)} \square \text{þ}}{\text{Weight of sample}} \times 100$$

V1 = Initial volume of water used
V2 = Volume of water remaining (not absorbed)
þ = Density of water (1 g/cm3)

Colour

Colour (L, a, b values) of the samples were determined by using colour flex EZ colorimeter, which gave values of: a) Luminosity (L) or sample whiteness which was the total reflection of light in a scale (0 to 100), where 0 represents perfect black and 100 perfect white; b) Shade or "a" parameter, known as the predominant wave length, where negative values shows a tendency to red colour, and c) the colour intensity or "b" parameter where negative values show a tendency to blue colour and positive values a tendency to yellow colour. The A*, B* were converted into hue angle (tan-1 b*/a*) and Chroma ((a*2+b*2)1/2) (Agrahar and Jha, 2010) [3].

Sensory evaluation

Organoleptic evaluation is the way of knowing acceptability of product using the senses, viz., sight, smell, touch, test and hearing. It is also a way of simulating the consumer response by a few experienced judges, a panel of ten judges comprising of faculty and students of the institutes was formed. Sensory evaluation was carried out by the standard method. (ISI, 1971a, 1971b). All indexes were measured using a scale from 0 to 9, where a score of 9 presents excellent quality and a score of 0 represents the lowest quality level. Soy flour samples were evaluated in different sensory attributes by a panel of minimum 10 judges of College of Agricultural Engineering and Technology, VNMKV, Parbhani. Sensory attributes like color and appearance, texture, flavour, and overall acceptability were assessed using nine point hedonic scales for all samples.

Results and Discussion

The results of quality parameters viz., moisture content, protein content, bulk density, dispersibility, water absorption capacity and color of soy flour prepared from roasted soybean are presented in table 1.

Moisture content

The results of analysis of moisture content of soy flour prepared from boiled soybean are shown in table 1. The moisture content of the raw soy flour (unprocessed) was found as 5.04 %. The moisture content of soy flour samples ranged from 5.26 % for soy flour prepared from 15 min boiled soybean to 5.58 % for soy flour prepared from 60 min boiled

soybeans. From the data, it was observed that there was increase in moisture content of flour with increase in boiling time. Increase in boiling time did not result in any significant effect in the moisture content of soy flour. But generally, boiling was found to slightly increase in the flour moisture content. These observations were in agreement with those reported by Onuegbu *et al.,* (2013) for boiled *ukpo* seed flour.

Protein content

The data regarding protein content of soy flour prepared from boiled soybean is given in table 1. It indicates that increased boiling time 15 to 60 min showed a significant effect on the protein content of soy flour prepared from boiled soybean. The protein content ranged 38.63 % to 37.87 % for soy flour prepared from 15 min boiled to 60 min boiled soybean. From the data it was observed that protein content decreased significantly in case of soy flour prepared from 15 min boiled soybean to 60 min boiled soybean. These decreases might be attributed to leaching of nutrients during boiling. A similar observation for decreasing protein content was reported by Onuegbu *et al*., (2013) for boiled ukpo seed flour

Table 1: Quality parameters of soy flour prepared from boiled soybean

Treatment/ Parameter	Moisture content (%)	Protein content (%)	Bulk density (g/cm3)	Dispersibility (%)	Water absorption capacity (%)	Color				
						L*	a*	b*	Hue angle	Chroma
T(control)	5.04	38.82	0.50	63.54	234.28	85.06	0.58	27.92	88.80	27.92
B1	5.26	38.63	0.55	61.32	237.17	83.79	0.63	25.64	88.59	25.64
B2	5.37	38.46	0.61	59.14	240.28	83.46	0.88	25.36	88.01	25.37
B3	5.49	38.15	0.65	57.06	243.47	83.24	1.18	24.73	87.26	24.75
B_4	5.58	37.87	0.68	56.35	247.64	82.94	1.24	24.37	87.08	24.40
SE ±	0.141	0.201	0.030	0.894	1.945	0.504	0.19	0.496	0.719	0.883
CD	NS	0.656	0.098	2.962	6.441	NS	NS	NS	NS	NS

Where, T = Control (Unprocessed)
B1 = Soy flour prepared from 15 min boiled soybean
B2 = Soy flour prepared from 30 min boiled soybean
B3 = Soy flour prepared from 45 min boiled soybean
B4 = Soy flour prepared from 60 min boiled soybean

Bulk density

The results pertaining to analysis of variance of soy flour samples for bulk density are given in table 1. It was observed that the bulk density of the raw soy flour (unprocessed) was 0.50 g/cm3. The bulk density of soy flour sample was found minimum i.e. 0.55g/cm3 for soy flour prepared from 15 min boiled soybean and maximum i.e. 0.67g/cm3 soy flour prepared from 60 min boiled soybean.

Dispersibility

The results of dispersibility of soy flour samples prepared from boiled soybeans are presented in Table 1. The dispersibility of the raw soy flour was found as 63.54 %. The dispersibility of soy flour samples ranged from 61.32 % for soy flour prepared from 15 min boiled soybean to 56.35 % soy flour prepared from 60 min boiled soybean. From data it was observed that the dispersibility of soy flour samples decreased significantly.

Water absorption capacity

The results of analysis of water absorption capacity of soy flour are shown in table 1. Water absorption capacity of raw soy flour was found as 234.28 %. The water absorption capacity was highest for soy flour prepared from 60 min boiled soybeans i.e. 247.64%, and lowest for soy flour prepared from 15 min boiled soybeans i.e. 237.17%. A significant increase in water absorption capacity of soy flour samples was observed among the values. This suggests that there is an increase in cellular water uptake with increased boiling time. Above trend of WAC is comparable with those reported by Onuegbu *et al* (2013) for boiled *ukpo* seed flour.

Colour

The quality of soy flour is assessed by yellowness index. The results of analysis of color parameters viz., lightness, redness, yellowness, hue and Chroma of soy flour prepared from raw and boiled soybeans are shown in table 1. From table 1, it was observed that there was non-significant difference in colour values of soy flour samples prepared from boiled soybeans.

The L* value depicts the lightness of sample. Raw soy flour has higher L* value 49 i.e. 85.06 which was decreased further with increasing boiling time. The lightness of soy flour varied from 83.79 to 82.94 for soy flour prepared from15 min boiled soybeans to soy flour prepared from 60 min boiled soybeans. Raw soy flour has lower a* value i.e. 0.58 which was increased further in soy flour prepared from 15 to 60 min boiled soybean. The redness of soy flour varied from 0.63 to 1.24 for soy flour prepared from15 min boiled soybeans to soy flour prepared from 60 min boiled soybeans. Raw soy flour has higher b* value i.e. 27.92. The yellowness of soy flour ranged 25.64 to 24.37 for soy flour prepared from 15 to 60 min boiled soybean. From the data it was observed that yellowness of soy flour samples decreased as boiling time increased. Hue angle was highest for soy flour prepared from raw soybean i.e. 88.80. Hue angle was observed to be decreased in soy flour samples prepared from 15 to 60 min boiled soybean i.e. 88.59 to 87.08. Similarly Chroma values were found to be decreased from 25.64 to 24.40 in soy flour samples prepared from 15 to 60 min boiled soybean.

Sensory evaluation of soy flour prepared from boiled soybean

Quality assessment of soy flour prepared from raw, 15 min, 30 min, 45 min and 60 min boiled soybean was performed for various quality attributes viz., colour and appearance, texture, flavour and overall acceptability. Analysis of variance for scores of quality attributes and overall acceptability is presented in Table 2.

Table 2 shows that there was non-significant difference in sensory parameters such as colour and appearance, texture,

flavour and overall acceptability of soy flour samples prepared from 15 min to 60 min boiled soybean.

Table 2: Sensory evaluation of soy flour prepared from roasted soybean

Treatment	Colour and appearance	Texture	Flavour	Overall acceptability
T (Control)	8.0	8.0	7.8	7.6
B1	8.5	8.3	8.2	8.3
B2	8.4	8.4	8.3	8.4
B3	8.4	8.4	8.3	8.4
B4	8.3	8.5	8.4	8.5
SE±	0.172	0.156	0.197	0.263
CD	NS	NS	NS	NS

NS-Non significant

Conclusion

There was increase in moisture content of flour with increase in boiling time it was observed that protein content decreased significantly in case of soy flour prepared from 15 min boiled soybean to 60 min boiled soybean. The dispersibility of soy flour samples decreased significantly. A significant increase in water absorption capacity of soy flour samples was observed. There was non-significant difference in sensory parameters such as colour and appearance, texture, flavour and overall acceptability of soy flour samples prepared from 15 min to 60 min boiled soybean.

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