Qualitative study of wheat cultivar Faisalabad-08 with soya bean blends

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Abstract

This study aimed to quantify gluten, α-amylase activity and proximate composition in Faisalabad- 08 wheat, soya bean, and wheat and soya bean blends. The wheat flour was blended with 5 and 10% soya bean and gluten, α-amylase activity and proximate composition were determined with standard methods. The gluten contents decreased slightly, while falling number increased after blending (5%) with soya bean of wheat flour. Regarding extensograph, the energy and resistance to extension decreased and extensibility increased of blended samples. The fat, fiber, protein and ash contents were found higher in soya bean followed by soya bean and wheat blends and wheat. From results, it is concluded that the blended wheat flour with soya bean can be used successfully for baking purposes.

1. Introduction

Wheat (*Triticum aestivum* L.) is extensively used for production of flat breads such as the steam-leavened chapatti, a major source of nutrients and staple diet common to Pakistan, India, and some parts of Africa [1]. Wheat contributes 13.1% to the agricultural value and 2.8% to total GDP of Pakistan with average production of 23.4 million tons per year. Besides being a rich source of carbohydrates, wheat contains protein, essential amino acids except lysine, minerals such as phosphorus, magnesium, iron, copper and zinc and vitamins like thiamin, riboflavin, niacin and vitamin E [2]. Wheat is a good source of calories and other nutrients but its protein is of lower nutritional quality when compared to milk, soya bean, pea and lupin proteins as its protein is deficient in essential amino acids such as lysine and [3]. Legume protein is the major component of the diet of food-producing animals and is increasingly important in human nutrition. Soya is the most important legume because of their desirable functionality, high nutritional value and healthy properties. However, the incorporation of high levels of soya products had negative effects in gluten network formation, extensibility properties and gas retention of dough and final bread quality [4]. The soybeans are rich in lysine and are, therefore, a good complement to wheat protein that is deficient in lysine contents. The availability

of nutrient varies with the form of soy food proportion and soybean is used in a variety of foods, and can be easily incorporated in the diet to promote desirable health effects [5]. A 55% protein (moisture-free basis) has been reported in soy bean. Generally, the oil content in most legumes are 20–25% of protein, but soya beans typically contain 30–45% protein at 13% moisture ranges from 15 to 24% and averages 19.16% on a 13% moisture basis [6]. Soybean is the only source that contains all the amino acids. It is use in the production of bread as composite flour [7]. Soy flour addition improves the nutritional quality of the diet as it improves the nutritional quality of the protein [8]. It is reported that the functional food combine many nutritional benefits of whole-wheat supplemented with soya beans whose health has been compromised such as those suffering from protein-energy-malnutrition, diabetes and obesity [9]. Gluten can be defined as the rubbery mass that remains after wheat dough is washed to remove starch granules and water-soluble constituents. In practice, the term 'gluten' refers to the proteins, because they play a key role in determining the unique baking quality of wheat by conferring water absorption capacity, cohesivity, viscosity and elasticity on dough [10]. Gluten is the composite of two proteins called gliadin and glutenin. These exists in combination with starch in the endosperm of some grass-related grains such as wheat, rye, and barley. Gliadin and glutenin comprise about

80% of the protein contained in wheat seed [11]. It is well known that the falling number method is a viscometric assay that involves the rapid gelatinization of a flour or meal suspension in water, by immersion in a boiling water bath, with subsequent measurement of the liquifaction of the starch by alpha-amylase. Increasing levels of a-amylase result in a decrease in falling number down to 60 s, beyond which further increases in activity cannot be measured. Because alpha-amylase is an endo-acting enzyme, that inserts breaks in the interior of the very large starch molecules, small amounts of enzyme cause dramatic reductions in viscosity. This is reflected in an inverse curvilinear relationship between alpha -amylase activity and FN [12]. New wheat variety Faisalabad-08 developed at Wheat Research Institute, AARI, Faisalabad which showed higher yield in a series of trials [13]. It is reported that the variety Faisalabad-08 furnished 22.75 percent more yield than Inqalab-91 in preliminary and regular yield trials during 2003-04. It gave 6.14 percent higher yield in B-trial than Inqalab-91 during 2004-05 in normal planting. Faisalabad-08 is a higher yielding variety than Inqalab-91 and is comparable with Seher-06 [14]. It showed durable tolerance to both stripe and leaf rusts due to diverse genetic background and its quality is comparable to Inqalab- 91. It is a full season variety with wider adaptability and due to disease resistant capability was selected for making the blends with soya bean.

2. Materials and methods

2.1. Collection of Samples

Samples of wheat cultivar Faisalabad-08 and soya beans were collected from Ayub Agriculture Research Institute, Faisalabad.

2.2. Gluten Content

Gluten content was measured according to the procedure [15] method number 38-12A. A 10 g of wheat flour Faisalabad-08 blended with 5% and 10% soya bean flour samples and the gluten index was calculated using following relation;

Gluten index (GI) = Wet gluten remaining on sieve (g) / Total wet gluten (g) × 100

2.3. Alpha amylase activity

Alpha amylase activity was measured by the Falling number apparatus according to the procedure, method 56-81 B [15].

2.4. Extensograph

The consistency of dough was determined according to the prescribed method, number 54-10 [15].

2.5. Proximate composition

Wheat cultivar Faisalabad-08, soya beans as well as 5% and 10% blends with wheat were analyzed for moisture, crude fat, crude fiber, crude protein and ash [15].

3. Results and Discussion

3.1. Gluten analysis

Wheat variety Faisalabad-08, soya beans and their blends were analyzed for gluten content and results are shown in Table 1. Statistical analysis showed that the gluten index values were significantly different among samples. Addition of soya beans to wheat samples decreased the gluten index value. However, the gluten content in wheat was found to be higher as compared to reported literature. Torbica et al. [16] reported the gluten index value ranging from 80%. Bainy et al. [17] revealed the presence of 75% of gluten in wheat flour sample. This difference may be due the variety and agro-climatic difference. According to Randhawa et al. [18], the gluten content may vary among varieties. Author reported significant variation in gluten content due to the variation in genetic makeup of wheat varieties, climatic conditions and differences in cultural practices and locations. Results with the addition of soya bean decrease the value of gluten as compared to the sample of wheat. It has been previously reported that the presence of soy protein weakens the formation of gluten gels, but that a ratio of 80% gluten and 20% soy protein caused the elastic modulus to be larger than that of heat-set gels prepared with either protein in isolation [19]. Senthil et al. [20] similar trend in gluten index that soya bean can suppress the values of gluten index. The gluten content of the wheat flour was relatively lower as compared to other cereals like the barley or oats which are more extensively studied for their high gluten content [21]. The mean flour gluten content was 94%, while in blends showed the gluten content of 83 and 77% and no gluten contents were observed in soya sample. These differences in the gluten content between the flour and soya is comparable to the study carried out by Izydorczyk et al. [22] on barley which states that the dry heat treatments which includes roasting, do not have any effect on the solubility of the gluten. Addition of soya flour to wheat flour in the proportion of 5% and 10% brought about a slight decrease in the gluten content. The main purpose of adding soya flour to wheat flour was to improve the protein quality, because it is reported that barley flour could be incorporated into wheat flour along with the defatted soybean flour to compensate the gluten loss that occurs with addition of soya bean flour [21].

3.2. Alpha amylase activity

Table 1 shows the values of falling number which indicates the alpha amylase activity in wheat cultivar, soya beans and mixture of wheat with 5% and 10% soya beans. Statistical analysis showed that the values for alpha amylase activity were significant different among sample. According to Gyiri and Sipos [23], the highest falling number indicate lower the alpha amylase activity, while lowest falling number indicated highest the alpha amylase activity. Soya beans addition to the wheat sample showed lowest values of falling number which indicates that the higher alpha amylase activity. Our findings are in accordance with Sanful and Darko [24].

Table 1: Gluten and alpha amylase activity wheat and soya blends

Parameters	FSD-08 ± SE	Soya ± S.E	5% ± S.E	10% ± S.E
Gluten content (%)	94 ± 1.63[a]	0.00 ± 0.00[c]	83.0 ± 5.33[b]	77.99 ± 2.80[b]
Falling number (Sec)	361 ± 3.79[a]	61 ± 0.00[c]	324 ± 5.69[b]	322 ± 3.71[b]

Table 2: Extensograph values of wheat, soya beans and their blends

Samples	Energy (cm^2)	Resistance to extension Rx (BU)	Extensibility (mm)	Ratio = Rx / Rm
Wheat	24 [d]	150[d]	85[d]	1.8[b]
5%	16[b]	73[b]	62[c]	1.2[a]
10%	18[c]	100[c]	55[b]	1.8[b]
Soya bean	6[a]	24[a]	21[a]	1.2[a]

Table 3: Proximate composition of wheat, soya and their blends

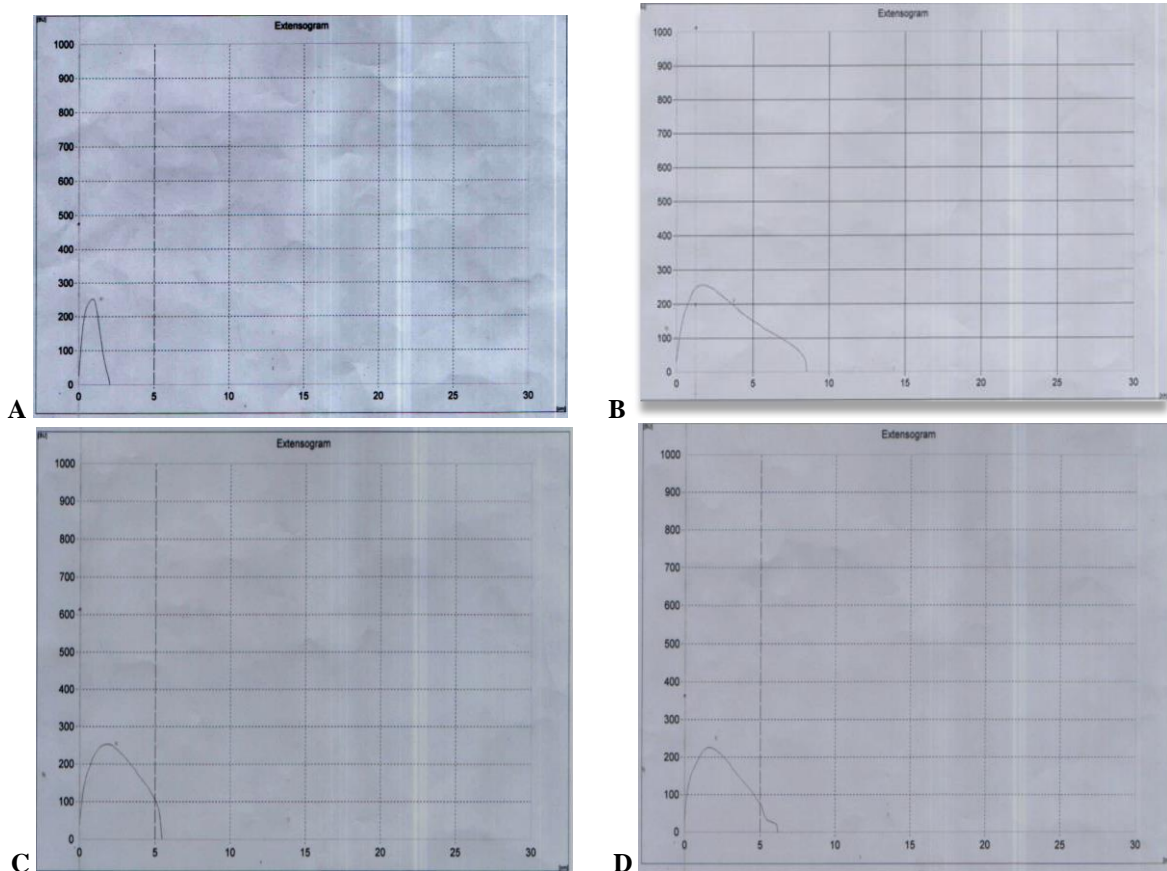| Parameters	FSD-08±SE	Soya±SE	5%±SE	10%±SE
Fat (%)	1.36±0.09[c]	20.5±0.76[a]	2.4±0.21[c]	4.0±0.29[b]
Fiber (%)	0.42±0.037[b]	3.53±0.291[a]	0.433±0.018[b]	0.567± 0.035[b]
Protein (%)	12.3±1.14[d]	32.98±0.98[a]	21.2±1.40[c]	26±0.87[b]
Ash (%)	1.46±2.40[c]	4.49±0.135[a]	1.6±0.176[c]	2.46±0.291[b]

Fig. 1. Extensogram: A- Soya bean, B- wheat cultivar FSD-08, C-10% soya-wheat blend and D-5% soya-wheat blend

This trend in high alpha-amylase activity may be due to grain degradation, because alpha-amylase resolves the starch in flour and lowers flour viscosity [25].

3.3. Extensograph

Table 2 shows the results of energy (cm^2), resistance to extension Rx (BU), extensibility (mm) and ratio = Rx/ Rm of wheat cultivar Faisalabad-08, soya beans and their 5% and 10% blends, while Extnesogram can be seen in Fig. 1. Extnesogram data indicates the dough extensibility of wheat when soya beans were added in the wheat. Extensogram shows the inverse relation between the resistance and extensibility. Statistical analysis showed that the wheat revealed more resistance and soya beans least and the mean values were found to be significantly different. However, blends did not affect the Extnesogram values. It has been reported that the flours of low *R/E* ratio become slack and flow excessively in rolling while very high values indicate great resistance to stretching compared to extensibility with dough tightening in resting periods and becoming difficult to sheet. Soy protein produced more resistant, less extensible and weaker mixtures. The substitution of wheat protein by soy protein decreased mixture elasticity and increased mixture viscosity due to the network weakening [1]. Singh *et al.* [26] also observed that effect of soya flour on extensograph characteristics and showed that incorporation of soya flour increased the water absorption capacity. At 20% level of soya flour the water absorption was 77% and at 40% level, it was 80%. The stability of the dough was found to decrease from 4.5 to 3.0 min when the soya flour content increased from 20 to 40%. Similarly, Santhil *et al.* [20] showed that incorporation of soya flour increased the water absorption capacity. At 20% level of soya flour the water absorption was 77% and at 40% level, it was 80%. Similar increase in water absorption and decrease in stability were also observed as the percentage level of legume flour in the blend was increased. This increase in water absorption might be partly due to a higher protein content of the blends which contributes to greater hydration capacity of dough containing soya flour which may be due to higher soluble protein content in the soya flour and concomitant water binding by soya flour.

3.4. Proximate Composition

Wheat, soy bean and soya bean blends with wheat were analyzed for moisture, crude fat, crude fiber, crude protein and ash and results are shown in Table 3. Results indicate the values of proximate composition of wheat and soya beans blend were significantly different among sample. Dhingra and Jood [27] reported that bread incorporated with defatted soy flour at 2-10% level had higher content of protein, total ash, calcium and phosphorous. The acceptability study revealed that full fat soy flour substitution was preferred with better organoleptic quality due to fat application. The seed of soya bean contains about 17·5% by weight of oil, 37·8% protein, 32% carbohydrate, 9·57% fiber and 5·6% ash and its flour, with or without oil removal, provides a basic material for a wide range of protein foods. The efficient processing and storage of soya

bean requires that the moisture content may be reduced to appropriate levels by drying [28]. According to Senthil [20], the defatting of soya flour increased the contents of protein, ash, crude fiber and carbohydrates but fat content may decrease. Sanful and Darko [24] also reported similar results that wheat, soya beans, 5% and 10% wheat soya blend for crude protein, crude fat, crude fiber, moisture and ash content were (11.0%, 35%, 19%, 22%), (2.0%, 19.5%, 14.2%, 17%), (o.5%, 4.0%, 0.45, 0.65), (9.9%, 6.6%, 9.4%, 9.5%) and (1.41%, 5.4%, 2.1%, 2.7%), respectively. In present study, the high level of protein, fat, fiber and ash with the addition of soya was also observed.

4. Conclusions

Qualitative study of gluten and α-amylase activity of wheat cultivar Faisalabad-08 showed that the gluten index decreases gradually with the addition of soya bean. The high gluten index in wheat variety Faisalabad-08 indicated that it is good for baking industry. Alpha amylase activity increases with the addition of soya bean. The proximate composition showed high values of protein, fat, fiber and ash content with the addition of soya beans, while effect on moisture content was non-significant.

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