# PROFILE ANALYSIS (TPA) OF CAKES SUPPLEMENTED WITH SOY FLOUR

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**ABSTRACT:** Wheat flour was replaced with soy flour at four different levels i.e. 5, 10, 15 and 20%. Effect of soy flour on chemical, sensory and textural characteristics of cakes was evaluated. Chemical characteristics of cakes were as follows: moisture (20.40 to 20.75%), ash (0.68 to 1.14%), fat (27.04 to 32.94%), protein (6.45 to 12.35%) fiber (0.09 to 0.24%) carbohydrate (32.82% to 45.43%) and energy values (450.52 to 476.18 kcal/100g). A gradual increase in ash, fat, protein, fiber and energy value with the increase in concentration of soy flour was observed in wheat-soy flour and cakes. Cakes containing 10% and 15% soy flour got the highest scores for taste. There was a gradual decrease in hardness of cakes supplemented with r-soy flour indicating softness in the texture of cakes. Thus the quantity and quality of protein contents and texture of cakes was improved with the addition of soy flour.

**Key words:** Soy flour, Protein, Texture Profile Analysis, Cake

## INTRODUCTION

Wheat is a staple food in Pakistan. It is the cheapest source of calories and protein for the local people in Pakistan (Anjum *et al*., 2002). Wheat is mainly consumed in the form of chapattis in Pakistan. Some of wheat is used in bakery products like bread, cookies, cakes and pastries (Ahmad *et al*, 2002). Baking industry has its importance among food industry all over the world. Cakes and biscuits occupy primary position, both for production and consumption, as compared to other bakery products. Cakes are used as snacks between meals, as supplementary foods for toddlers and school going children and as refreshment item in vanous occasions and other social gatherings (Akhtar *et al*., 2006). Cakes are also eaten in breakfast and are liked by all age groups. Cakes are generally low in protein and fiber but very high in carbohydrates and fats.

Protein deficiency is a serious problem faced by people whose diet consists mainly of cereals or other starchy foods (Carlson *et al*., 1981). The shortage of energy, protein and essential amino acids are the main problems of human nutrition in developing and under developed countries including Pakistan. The nutritional quality can be improved by increasing protein content and limiting amino acids especially lysine (Anjum *et al*., 2005).

Soybean seeds contain 35-45% protein at maturity (Nagano *et al*., 1996). This protein is well known for its functional and nutritional properties (Chen *et al*., 2002, 2004) and due to these properties, soybean proteins are nowadays incorporated in many food products. Thus, there is a big potential of high commercial value to use soy protein fractions in the development of novel products (Zhu *et al*., 2008).

The present study was conducted to evaluate the nutritional and sensory quality of cakes supplemented with soy flour. Texture profile analysis (TP A) of cakes was also conducted to evaluate the effect of soy flour on the textural properties of cakes. Soy supplementation of cakes will be helpful to overcome deficiency of protein and calories.

## MATERIALS AND METHODS

**Raw materials:** Commercial wheat flour was obtained from Rehmat Flour Mills, Lahore. The flour exhibited water absorption 57.5, development time 1.8 min, stability 1.7 min, dry gluten 8.2% and falling number value 405. Soybeans were soaked in distilled water for overnight and boiled for twenty minutes. The foam on the top of water was removed continuously during boiling. Soybeans were dried in twin tunnel dehydration unit and ground to prepare soy flour. The soy flour contained moisture 7.25%, ash 3.72%, fat 22.8%, protein 43.1%, fiber 2.30%, carbohydrate 23.13% and energy value 460.9 kcal/100g.

**Preparation of cakes:** Cake from commercial wheat flour (T1) was used as control. Wheat flour was replaced by soy flour in proportions 5, 10, 15 and 20%, corresponding to T2, T3, T4 and T5, respectively. Cakes were prepared according to the procedure described in AACC (2000). Wheat soy flour and cakes were analyzed for chemical tests by following the standard methods described m AACC (2000). Sensory evaluation was done by a panel of judges according to standard method by using hedonic scale (Larmond, 1977). The parameters studied were crumb color, symmetry, taste and crust. Overall acceptability was expressed as the average of all sensory characteristics.

**Texture profile analysis (TPA):** The textural characteristics of cakes were analyzed with a TA.XT2 Texture Analyzer (Stable Micro Systems Ltd., England) by TP A measurements (Bourne, 1978). The thickness of slices was kept 1.5 cm. The samples were compressed twice by a cylinder probe (P/40C) to 40% of their original height at a constant crosshead speed of 1mm/s. Three replications of each measurement were made. The data thus obtained were subjected to statistical analysis through ANOVA technique and means were compared by Duncan's Multiple Range Test (Steel *et al*., 1997).

## RESUL TS AND DISCUSSION

**Chemical characteristics of wheat-soy flour:** Chemical characteristics of wheat-soy flours differed significantly among different treatments (P S 0.05). Significantly higher moisture and carbohydrate contents were observed in T1 (Table 1). T5 (containing 20% soy flour) exhibited significantly higher ash, fat, protein, fiber and energy value. However, non significant differences were observed in T2 (containing 5% soy flour) and T3 (containing 10% soy flour) for moisture, ash and fiber contents. Crude fiber contents of wheat-soy flour fell in the following descending order: T5, T4, T3, T2 and T 1. The differences between the former three and the later three were non- significant.

The chemical characteristics of wheat-soy flour were as follows: moisture (9.65 to8.30%), ash (0.58 to 1.47%), fat (1.63 to 7.38%), protein (10.56 to 17.14%), fiber (0.12 to 0.27%) and carbohydrate (65.71 to 77.58 %). However, energy values ranged from 366.75 to 396.74 kcaU1 DOg. There was a gradual increase in ash,

fat, protein, fiber and energy value with the increase in concentration of soy flour. Thus the supplementation of wheat flour with soy flour has improved the quantity and quality of protein.

**Chemical characteristics of cakes:** Chemical characteristics of cakes prepared from wheat-soy flour showed significant differences (P S 0.05) among ash, fat, protein, fiber, carbohydrate and energy value. However, non-significant differences were observed in moisture contents of cakes (Table 2). Significantly higher ash, fat, protein, fiber and energy was observed in T5 (containing 20% soy flour). Ash contents exhibited the descending order; T5, T4, T3 and T2. However, the differences among these treatments were non-significant with respect to ash contents.

The ranges of chemical characteristics and energy values of different cakes were as follows: moisture (20.40 to 20.75%), ash (0.68 to 1.14%), fat (27.04 to 32.94%), protein (6.45 to 12.35%) fiber (0.09 to 0.24%) carbohydrate (32.82% to 45.43%) and energy values (450.52 to 476.18 kcal/l DOg). Moisture content is important factor controlling the shelf life of cakes. Akhtar *et al*. (2006) observed high moisture contents (41.32%) in commercial cakes. They also reported that cakes of bakeries in Faisalabad were low in ash, fiber and protein but high in fat and carbohydrate contents. In the present study, a gradual increase in ash, fat, protein, fiber and energy value with the increase in concentration of soy flour was observed. Thus the supplementation of wheat flour with soy flour has improved the quantity and quality of protein contents in cakes. However, carbohydrate contents decreased gradually with the addition of soy flour. It was found that fat contents were a little higher than observed by Akhtar *et al*. (2006). However, fat contents can be decreased by using less fat in the formula or by the addition of defatted soy flour.

**Sensory evaluation of cakes:** Statistical analysis showed that there was a significant change in color of cakes supplemented with soy flour. Cakes containing 5% soy flour got the highest score (8.0), where as cakes containing 20% soy flour got the lowest score (6.8). The data indicated that there was a reduction in score of color with the increase in amount of soy flour in cakes. However, all the cakes were accepted with respect to the quality of color. Siddiqui *et al*. (2003) observed that decreasing trend of quality score for color of biscuits may be due to high level of proteins present in soy flour. Amino acids react with reducing sugars during baking and as a result Maillard reaction takes place. The color gets darker with the increase in protein. Thus more darkness results in the reduction of quality scores for color.

Symmetry and taste of cakes showed non-significant differences among the treatments (Table 3). Although cakes containing 10% and 15% soy flour got the highest scores for taste while cakes with 20% soy flour got the lowest score (6.7). However, all the treatments were in the acceptable range. The decrease in score may be due to beany flavor of soy flour. Kinsella (1979) has pointed out that the most difficult problem limiting the increased use of soy proteins is the strong beany, grassy and bitter flavors. However, Gandhi *et al*., (2001) replaced wheat flour with soy flour up to 40% and found that all the biscuits of various blends were acceptable with no significant differences among them.

The differences among overall acceptability were more pronounced. On overall acceptability basis the cakes prepared with 10% soy flour supplementation got maximum score. However, the differences among T3, T2 and T1 were non-significant. It was observed that T2 (containing 5% soy flour) and T3 (containing 10% soy flour) exhibited non-significant differences with respect to crust and overall acceptability of cakes. The comparison of taste and overall acceptability of cakes supplemented with soy flour is presented in Fig. 1. It is evident that overall acceptability decreased with the increase m soy flour concentration above 10%. However, remarkable decrease in scores of overall acceptability was observed at 15% soy flour level. It was also observed that there was a slight improvement in the taste of cakes supplemented with soy flour. However, at 15% supplementation of soy flour, a slight decrease in taste was observed.

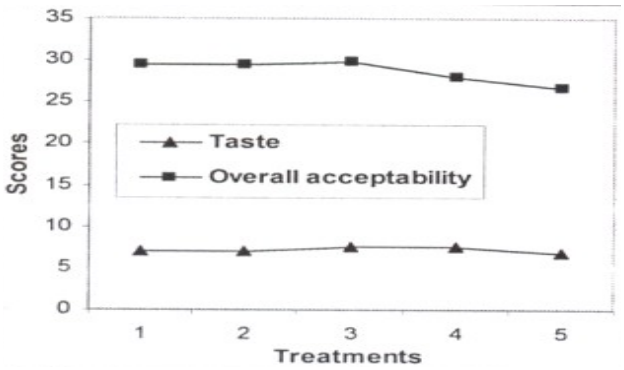


Fig. 1. Comparison of taste and overall acceptability of cakes supplemented with soy flour

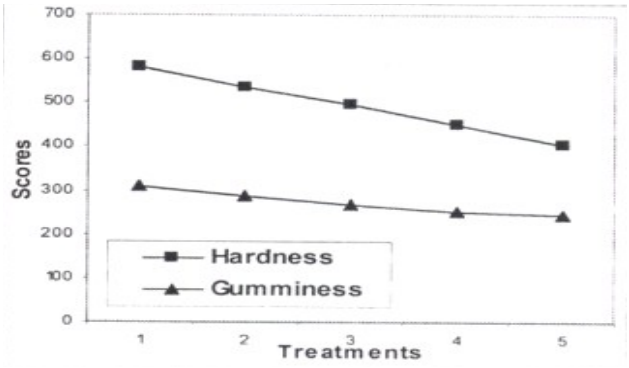


Fig 2. However, the rate of decrease in gumminess is smaller than hardness.

**Texture profile analysis of cakes:** TPA results of cakes supplemented with soy flour are shown in Table 4. It was observed that hardness, fracturability, spnngmess, cohesiveness and gumminess decreased with the increase in concentration of soy flour. However, spnngmess and cohesiveness exhibited non-significant differences with the increase in concentration of soy flour. The presence of soy flour effectively decreased hardness, fracturability and gumminess of cakes. Hardness is related with the Fig. 2. Comparison of hardness and gumminess of cakes supplemented with soy flour.strength of gel structure under compression. Springiness, noted as elasticity, reflects how much the structure of tested gel is broken down by the initial compression. High springiness gel results in few large pieces during the first TP A compression whereas low springiness gel results in more small pieces (Lau et aI., 2000). Cohesiveness measures the difficulty of breaking down in the gel's internal structure. Gumminess, as the product of hardness and cohesiveness, usually is a complementary parameter of hardness (Zhu *et al*., 2008).

All TPA characteristics (hardness, fracturability, springiness, cohesiveness and gumminess) of T1 (cakes without soy flour) are statistically higher than the cakes containing soy flour. There was a gradual decrease in hardness of cakes supplemented with soy flour indicating softness in the texture of cakes. Thus the texture of cakes was improved with the addition of soy flour. Similarly fracturability decreased indicating that less force was required to break the piece. The results indicated non-significant differences among T2 (containing 5% soy

flour) and T3 (containing 10% soy flour) with respect to fracturability and gummmess. However, non-significant differences were observed among T4 (containing 15% soy flour) and T5 (containing 20% soy flour) for the same parameters. The present work suggests that better quality of cakes can be prepared with supplementation of 10% soy flour. The comparison of hardness and gumminess of cakes supplemented with soy flour is given in Fig 2. A gradual decrease in hardness and gumminess of cakes is evident from

**Table 1: Chemical characteristics of wheat-soy flour.**

| | Moisture** | Ash** | Fat** | Protein** | Fiber* | Carbohydrate* * | Energy** |
|---|---|---|---|---|---|---|---|
| T1 | 9.65[a] | 0.58[d] | 1.63[d] | 10.56[e] | 0.12[b] | 77.58[a] | 366.75[d] |
| T2 | 9.32[ab] | 0.75[cd] | 4.90[c] | 11.02[d] | 0.14[b] | 74.01[b] | 383.66[c] |
| T3 | 8.98[bc] | 0.92[c] | 5.87[b] | 13.10[c] | 0.18[ab] | 71.13[c] | 389.03[b] |
| T4 | 8.74[c] | 1.20[b] | 6.62[ab] | 15.11[b] | 0.24[a] | 68.33[d] | 392.38[b] |
| T5 | 8.30[d] | 1.47[a] | 7.38[a] | 17.14[a] | 0.27[a] | 65.71[e] | 396.74[a] |
| F value | 16.41 | 19.11 | 65.03 | 386.09 | 4.66 | 265.99 | 73.75 |

Means with same letters in a column are not significantly different (P :s0.05).

**Table 2: Chemical characteristics of cakes prepared from wheat-soy flour.**

| | Moisture[N]> | Ash* | Fat** | Protein** | Fiber* | Carbohydrate** | Energy** |
|---|---|---|---|---|---|---|---|
| T1 | 20.40[a] | 0.68[b] | 27.04[e] | 6.45[d] | 0.09[c] | 45.43[a] | 450.52[d] |
| T2 | 20.46[a] | 0.86[ab] | 29.05[d] | 6.91[d] | 0.13[bc] | 42.72[b] | 459.45[c] |
| T3 | 20.54[a] | 0.90[ab] | 30.78[c] | 8.78[c] | 0.16[abc] | 39.00[c] | 467.50[b] |
| T4 | 20.68[a] | 0.93[ab] | 31.86[b] | 10.76[b] | 0.20[ab] | 35.77[d] | 472.06[a] |
| T5 | 20.75[a] | 1.14[a] | 32.94[a] | 12.35[a] | 0.24[a] | 32.82[e] | 476.18[a] |
| F value | 0.37 | 3.67[a] | 77.56 | 106.96 | 3.70 | 95.75 | 54.83 |

Means with same letters in a column are not significantly different (P :s0.05).

**Table 3: Sensory evaluation of cakes prepared from wheat-soy flour.**

| | Crumb color* | Symmetry N::> | Taste [N]:> | Crust* | Overall acceptability* * |
|---|---|---|---|---|---|
| T1 | 7.5 ab | 7.0 a | 7.0 a | 8.0 a | 29.5 ab |
| T2 | 8.0 a | 7.0 a | 7.0 a | 7.5 ab | 29.5 ab |
| T3 | 7.8 a | 7.0 a | 7.5 a | 7.5 ab | 29.8 a |
| T4 | 7.0 b | 6.5 a | 7.5 a | 7.0 b | 28.0 bc |
| T5 | 6.8 b | 6.5 a | 6.7 a | 6.7 b | 26.7 c |
| F value | 4.23 | 1.13 | 1.81 | 3.65 | 8.51 |

Means with same letters in a column are not significantly different (P :s0.05).

**Table 4: Texture profile analysis of cakes prepared from wheat-soy flour.**

| | Hardness** | Fracturability* * | Springiness[Ns] | Cohesiveness[Ns] | Gumminess* * |
|---|---|---|---|---|---|
| T1 | 581.40 a | 0.77 a | 0.90 a | 0.54 a | 310.40 a |
| T2 | 535.30 b | 0.63 b | 0.88 a | 0.53 a | 285.00 ab |
| T3 | 495.50 c | 0.57 b | 0.86 a | 0.50 a | 265.90 bc |
| T4 | 450.20 d | 0.45c | 0.85 a | 0.46 a | 252.50 c |
| T5 | 406.1 0 e | 0.36 c | 0.82 a | 0.38 a | 243.60c |
| F value | 178.62 | 23.55 | 0.43 | 1.36 | 10.13 |

Means with same letters in a column are not significantly different (P :s0.05).

**Conclusion:** The differences among overall acceptability of cakes were more pronounced. On overall acceptability basis, cakes containing 10% soy flour got maximum scores. However, all the treatments were in the acceptable range. The presence of soy flour effectively decreased hardness, fracturability and gumminess of cakes. The texture of cakes was improved with the addition of soy flour. The present work suggests that better quality of cakes can be prepared with supplementation of 10-15% soy flour. However, fat contents in cakes can be decreased by using less shortening in the formula or by the addition of defatted soy flour.

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