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# Physical and Sensory Quality of Little Millet Composite Flour Bread with Addition of Soy Flour

**Priyadarshani P. Deshmukh and Nirmala B. Yenagi**
Dept. of Food Science and Nutrition, College of Rural Home Science, University of Agricultural Sciences, Dharwad, Karnataka, India
Email: deshmukhpriyadarshini19@gmail.com

**ABSTRACT**
*In the study the soy flour was incorporated to enhance the physical and nutritional quality of little millet composite bread. The physicochemical properties of refined wheat, little millet and germinated soy flour showed significant differences. The highest values of water absorption, solubility, pH, protein, crude fibre and ash content were seen in germinated soy flour. Little millet flour had significantly higher fat, crude fibre and ash content than the refined wheat flour. Incorporation of germinated soy flour at 2.5 and 5.0 per cent increased the loaf weight and decreased the specific volume of bread. However, there was no significant difference for sensory quality parameters, among the breads. Thus little millet composite flour bread can be enriched nutritionally with addition of soy flour up to 5.0 per cent as a source of protein and dietary fibre without affecting the sensory quality.*
***Key words:*** *Little millet, physicochemical properties, soy, composite bread*

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## INTRODUCTION

The consumption of convenient ready to eat (RTE) cereal foods is increasing throughout the world. Bread has become a staple food of the modern diet. Traditionally bread is made from refined wheat flour, as gluten present in the wheat has unique properties which impart excellent physical properties to wheat bread. However refined wheat flour is lacking in dietary fibre and micronutrients. The use of composite flours for product development and / or for value addition is also recent development across the globe owing to some health, economic and social reasons as well as increased demand for nutritious products. Utilization of locally grown cereals in baking industry is an additional advantage for the farmers to have more economic value to crop, better remuneration, value addition and diversified health products.

By any nutritional parameter, millets are miles ahead of rice and wheat. Millets are rich in vitamins, minerals, sulphur containing amino acids and phytochemicals, and hence are termed as "nutri-cereals" [1]. Addition of non gluten flours to refined wheat flour improves the nutritional quality, especially the soluble fibre content of refined wheat flour. Millet composite flour bread can be prepared by incorporation of millet at 30 to 50 per cent [2, 3]. Soybean is an excellent source of protein (35-40%), hence the seed is the richest in food value of all plant foods consumed in the world. It is also rich in calcium, iron, phosphorus and vitamins. It is the only source that contains all the essential amino acids [4]. Several researchers have investigated the effect of supplementation of wheat flour with soy and other legume flours for making products such as bread [4, 5]. The benefits of these composite flours are largely centered on nutritional considerations. Hence, the purpose of this investigation was to characterize the effect of soy flour addition on the quality of little millet composite bread.

## MATERIAL AND METHODS

Refined wheat flour (RWF) (*Supermoti*), little millet flour (LMF) (*Panicum miliare*), germinated soy flour (*Manna*), sugar, salt, sunflower oil and dry yeast (*Gloripan*) were used in this study for preparation of breads. These ingredients were procured from the local market of Dharwad.

**Physicochemical properties and particle size distribution of flours:** Physicochemical properties viz; bulk density, water absorption capacity (WAC), oil absorption capacity, swelling power, solubility and pH as well as particle size distribution of flour samples determined as per the standard procedures [6].

**Proximate composition of the flours:** Proximate composition viz, moisture, protein, fat, crude fibre and ash content of the flours was studied by using standard AOAC procedures [7]. Carbohydrate content of bread samples was calculated by difference method.

**Preparation of composite flours:** Little millet composite flour was prepared by blending at 30 per cent level with refined wheat flour (RWF:LMF-70:30). Further this composite flour was enriched with germinated soy flour at two levels (2.5 and 5 %) by replacing refined wheat flour.

**Method of preparation of bread:** Ingredients used for bread preparation were 150 g composite flour, 2.25g dry yeast, 9g sugar, 7.5g oil, 2.4 g salt and an adequate amount of water to obtain dough of optimum consistency. Optimized method of little millet composite flour bread for processing conditions was used to prepare little millet composite flour and soy flour incorporated breads [8].

**Physical quality characteristics of bread:** Bread loaves of little millet composite bread and soy flour incorporated little millet composite breads were weighed after 2 hr baking, using a laboratory scale balance and the readings recorded in grams. Height, length and width of the bread loaves were measured by measuring scale. The loaf volume was determined using seed displacement method. Specific volume was calculated as volume to mass ratio ($cm^3/g$).

**Sensory quality evaluation of breads:** Sensory evaluation of breads was carried out by ten member trained panel of Food Science and Nutrition department. They assessed the appearance, colour of crust and crumb, taste, texture of crust and crumb, flavour, mouth feel and overall acceptability by 9 point hedonic scale. The rating was ranged from 9-like extremely to 1-dislike extremely.

**Statistical analysis:** A minimum of three replications were performed for each analysis. Statistical analysis was conducted to compare treatment means by using one way ANOVA procedure of SPSS software, version 16.0.

## RESULTS AND DISCUSSION

**Physicochemical composition of flours:** Results of flour characterization reveled that refined wheat flour, little millet flour and germinated soy flour was significantly different (Table 1). Bulk density of little millet flour was significantly less than the refined wheat flour and germinated soy flour. The WAC of refined wheat was 58.00 per cent which was observed to be significantly high in little millet and soy flour with a mean per cent values of 79.32 and 130.62 respectively**.** No significant differences were found in the oil absorption capacity of all the three flours. WAC of flour is closely linked to both amount of amino acids in different flours and availability of proteins functional groups in flour [9]. Results obtained for WAC, swelling power and oil absorption capacity of little millet flour were comparable with those reported by others (10) for two little millet genotypes. Swelling power and solubility of refined wheat flour was 7.50g/g and 10.20 per cent respectively. Swelling power was increased slightly for little millet flour (7.70g/g). Whereas germinated soy flour showed significantly less (4.35g/g) swelling power compared to other two flours. A significant increase was seen in the per cent solubility of little millet flour (15.80%) and germinated soy flour (39.48%) when compared with the refined wheat flour. High swelling of millet flour could be due to high content of starch and low protein and fat content [9]. WAC, solubility and pH of germinated soy flour was found to be significantly higher than the refined wheat flour and little millet flour with significantly low swelling power. It may be attributed to differences in the flour particle size and chemical composition of these flours (Fig. 1 and Table 2). The increase in WAC of soy flour may be attributed to the hydrophilic nature of protein present in soy flour. Increased WAC and decrease in the swelling capacity with increase in the full fat soy flour in the tapioca starch was noticed [11]. The results of present study for functional properties of germinated soy flour can be supported by the findings of others (12), who reported that the germination process increased the WAC and solubility with decreased swelling volume of pigeon pea sprout flour. These results were possibly due to the fact that germination increases the soluble dietary fibre content which resulted in increased WAC, hydrolysis of complex starch to simpler compounds that decreased the swelling volume with increase in the solubility [12]. Significant ($p < 0.05$) difference was observed in the pH of flours. The pH of refined wheat, little millet and soy flour was 6.13, 6.07 to 6.55 respectively.

**Particle size distribution of flours**: Refined wheat flour was finest followed by soy flour and little millet flour (Fig. 1). Maximum percentage (40.61) of refined wheat flour was distributed on the sieve size opening of 75µm when compared to little millet flour and soy flour where maximum (46.00 and 35.18 % respectively) flour was distributed on the sieve opening of 180 and 105 µm respectively. The changes in the particle size distribution of flours may be due to differences in the chemical composition (Table 2).

**Proximate composition of the flours:** Results of proximate composition of flours are presented in Table 2. Refined wheat flour had significantly highest (13.83%) moisture content followed by little millet flour (10.78%) and soy flour (9.50%). The protein content of soy flour was seen significantly high (30.83%) compared to other two experimental flours. This may be due to the natural high protein content of soy flour compared to cereal flours [13]. Fat content of refined wheat flour was significantly less (0.23%) followed by soy flour (0.95%) and little millet flour (1.73%). The lower fat content of soy flour may be due to the fact that germination is a series of changes in morphology, physiology and biochemistry (12). Per cent crude fibre was seen significantly high (3.55) in soy flour when compared with refined wheat as well as little millet flour. Ash content of flours was ranged from 0.49 to 7.05 per cent with the highest per cent in soy flour. Little millet flour had significantly high (76.64%) carbohydrate content and it was significantly less in soy flour (48.13%).

**Physical quality characteristics of breads:** Effect of germinated soy flour incorporation on physical quality characteristics of little millet composite flour bread is summarized in Table 3. Loaf weight of breads ranged from 121.07 to 126.76 g with the higher one being for 5 per cent soy flour added bread. Weight of soy flour incorporated breads was found to be increased significantly. This may be due to higher water absorption capacity of germinated soy flour (Table 1). The same behavior was observed for loaf weight on replacement of wheat flour with defatted soy flour and banana flour (14). Loaf height of control little millet composite flour bread was 5.58 cm which was decreased to 5.50 and 5.45 cm with addition of 2.5 and 5 per cent soy flour respectively. No significant difference was found in the width and length of experimental breads. Loaf volume of control little millet composite flour bread, 2.5 per cent and 5 percent soy flour added breads was 381.17, 368.67 and 366.83 $cm^3$ respectively. The specific loaf volume of little millet composite flour bread was found to be 3.09$cm^3$/g. However in case of soy flour incorporated breads it was ranged from 2.89 to 2.92 $cm^3$/g. Significant decline in the specific volume was seen with the addition of soy flour. This may be due to dilution of gluten in the composite flour with replacement of wheat flour by soy flour. Decline in the specific volume of soy flour incorporated wheat breads was observed with 15 per cent soy flour acceptability (5).

**Sensory quality of breads:** Soy flour incorporation did not change the appearance scores of breads (Table 4). Crust colour scores of breads were ranged in between 7.2 to 7.5. Whereas, crumb colour score were found to be in the range of 7.0 to 7.1. Little millet composite flour bread had taste score of 7.2 which was observed to be increased to 7.5 with the addition of soy flour at 2.5 per cent level. Further increased level of soy flour incorporation showed decline in the taste scores. This may be due to beany flavour of soy flour (5). Test scores of texture of little millet composite flour bread for crust and crumb were 6.9 and 7.1, which were noticed to be increased to 7.4 and 7.6 respectively with the addition of germinated soy flour at 5 per cent level. Possibly this may be due to higher content of soluble dietary fibre in the germinated flour (12). Fineness of soy flour compared to the little millet flour may have also contributed to the texture of bread. Little millet composite bread showed lowest (7.1) and breads with the addition of 2.5 per cent germinated soy flour showed highest flavour scores (7.4). Increase in the flavour scores of bread on increasing the level of barley and soy flour up to 10% level and thereafter it was decreased (5). Sensory scores of mouth feel of germinated soy flour breads varied in the range of 7.1 to 7.4. Scores of overall acceptability of breads revealed that the soy bread at 5 per cent incorporation level had equal overall acceptability score (7.3) as that of little millet bread (7.3). Whereas it was highest (7.5) for 2.5 per cent soy flour added breads. However differences found in the sensory scores of all attributes were statistically non-significant.

**Table 1: Physicochemical properties of flours**

| Flour | Bulk density (g/ml) | WAC (%) | Swelling power (g/g) | Solubility (%) | Oil absorption capacity (g oil/g) | pH |
|---|---|---|---|---|---|---|
| RWF | $0.64^{a}$±0.01 | $58.00^{c}$±1.00 | $7.50^{a}$± 0.13 | $10.20^{c}$±0.2 | $0.74^{a}$±0.01 | $6.13^{b}$±0.06 |
| LMF | $0.53^{b}$±0.01 | $79.32^{b}$±1.15 | $7.70^{a}$±0.23 | $15.80^{b}$±0.20 | $0.75^{a}$±0.02 | $6.07^{b}$±0.06 |
| GSF | $0.64^{a}$±0.00 | $130^{a}$.62±0.93 | $4.35^{b}$±0.47 | $39.48^{a}$±0.38 | $0.79^{a}$±0.11 | $6.55^{a}$±0.06 |
| **F value** | 137.37 | 6937 | 155.58 | 14790 | 0.887 | 104.339 |
| **S.Em±** | 0.005 | 0.448 | 0.150 | 0.127 | 0.031 | 0.027 |
| **CD (5%)** | 0.016 | 1.433 | 0.482 | 0.407 | NS | 0.087 |

NS- Non significant, RWF-Refined wheat flour, LMF-Little millet flour, GSF-Germinated soy flour, Mean±SD, Means with the same superscript letters within a column are not significantly different at 5% level

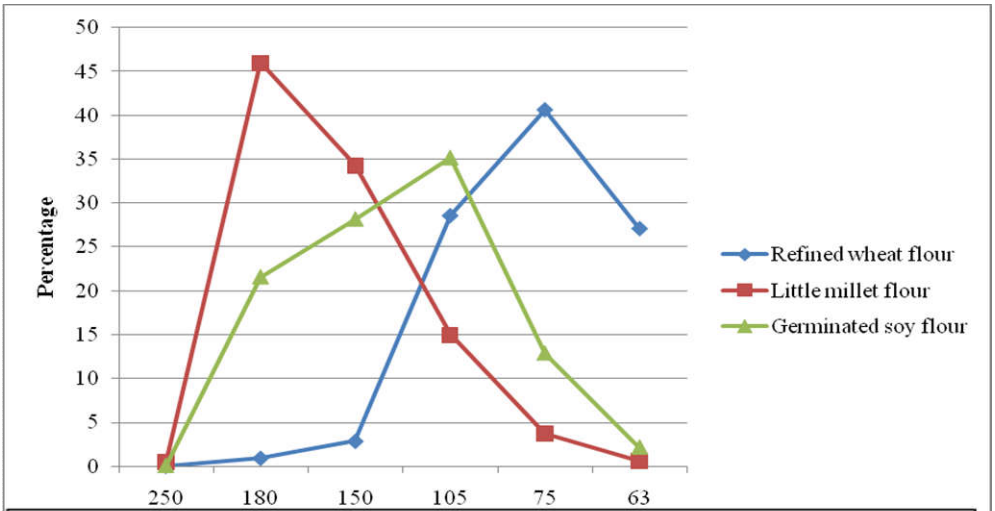


**Fig. 1 Percent particle size distribution of flours**

**Table 2: Proximate composition of flours (g/100g)**

| Flour | Moisture | Protein | Fat | Crude fibre | Ash | Carbohydrate |
|---|---|---|---|---|---|---|
| RWF | 13.83$^{a}$±0.85 | 10.73$^{b}$±0.20 | 0.23$^{c}$±0.02 | 0.29$^{c}$±0.02 | 0.49$^{c}$±0.03 | 74.53$^{b}$±0.95 |
| LMF | 10.78$^{b}$±0.12 | 7.82$^{c}$±0.10 | 1.73$^{a}$±0.17 | 1.75$^{b}$±0.03 | 1.41$^{b}$±0.02 | 76.64$^{a}$±0.28 |
| GSF | 9.50$^{c}$±0.22 | 30.83$^{a}$±0.27 | 0.95$^{b}$±0.19 | 3.55$^{a}$±0.40 | 7.05$^{a}$±0.11 | 48.13$^{c}$±0.86 |
| **F value** | 75.381 | 14980 | 102.93 | 192.58 | 10700 | 1835 |
| **S.Em±** | 0.26 | 0.10 | 0.07 | 0.12 | 0.04 | 0.37 |
| **CD (5%)** | 0.81 | 0.33 | 0.24 | 0.38 | 0.11 | 1.18 |

RWF-Refined wheat flour, LMF-Little millet flour, GSF- Germinated soy flour, Mean±SD
Means with the superscript letters within a column are not significantly different at 5% level

**Table 3: Physical quality characteristics of soy flour incorporated breads**

| Breads | Loaf weight (g) | Loaf height (cm) | Loaf width (cm) | Loaf length (cm) | Loaf volume (cm$^3$) | Specific volume (cm$^3$/g) |
|---|---|---|---|---|---|---|
| LMCO | 121.07$^{b}$±1.75 | 5.58$^{a}$±0.53 | 6.01$^{a}$ ±0.22 | 12.98$^{a}$ ±0.58 | 377.42$^{a}$±4.20 | 3.12$^{a}$±0.11 |
| (R:L:S)(67.5:30:2.5) | 125.77$^{a}$±0.973 | 5.50$^{a}$±0.45 | 5.83$^{a}$ ±0.33 | 12.90$^{a}$ ±0.43 | 368.67$^{b}$±3.20 | 2.92$^{b}$±0.04 |
| (R:L:S)(65:30:5) | 126.76$^{a}$±1.11 | 5.45$^{a}$±0.39 | 5.77$^{a}$ ±0.22 | 12.85$^{a}$ ±0.45 | 366.83$^{b}$±4.75 | 2.89$^{b}$±0.05 |
| **F value** | 31.58 | 0.128 | 1.46 | 0.113 | 21.686 | 13.479 |
| **S.Em±** | 0.54 | 0.18 | 0.10 | 0.20 | 1.67 | 0.03 |
| **CD (5%)** | 1.63 | NS | NS | NS | 5.05 | 0.09 |

NS- Non significant, Mean±SD, LMCO-Little millet control optimized, R- Refined wheat flour, L-little millet flour, S: Soy flour
Means with the same superscript letters within a column are not significantly different at 5% level

**Table 4: Sensory quality of soy flour incorporated breads**

| Breads | Appearance | Crust colour | Crumb colour | Taste | Crust texture | Crumb texture | Flavour | Mouth feel | Overall acceptability |
|---|---|---|---|---|---|---|---|---|---|
| LMCO | 7.4$^{a}$ ±0.70 | 7.2$^{a}$ ±0.92 | 7.1$^{a}$ ±0.74 | 7.2$^{a}$ ±0.63 | 6.9$^{a}$ ±0.32 | 7.1$^{a}$ ±0.74 | 7.1$^{a}$ ±0.88 | 7.2$^{a}$ ±0.79 | 7.3$^{a}$ ±0.67 |
| (R:L:S)(67.5:30:2.5) | 7.4$^{a}$ ±0.97 | 7.4$^{a}$ ±0.70 | 7.0$^{a}$ ±1.05 | 7.5$^{a}$ ±0.85 | 7.0$^{a}$ ±0.47 | 7.4$^{a}$ ±0.52 | 7.4$^{a}$ ±0.70 | 7.4$^{a}$ ±0.70 | 7.5$^{a}$ ±0.85 |
| (R:L:S)(65:30:5) | 7.3$^{a}$ ±0.82 | 7.5$^{a}$ ±0.71 | 7.1$^{a}$ ±0.88 | 7.2$^{a}$ ±0.79 | 7.4$^{a}$ ±0.84 | 7.6$^{a}$ ±0.84 | 7.2$^{a}$ ±0.92 | 7.1$^{a}$ ±0.99 | 7.3$^{a}$ ±0.67 |
| **F value** | 0.44 | 0.38 | 0.04 | 0.52 | 2.03 | 1.24 | 0.33 | 0.33 | 0.24 |
| **S.Em±** | 0.26 | 0.25 | 0.28 | 0.24 | 0.19 | 0.23 | 0.26 | 0.26 | 0.23 |
| **CD (5%)** | NS | NS | NS | NS | NS | NS | NS | NS | NS |

NS- Non significant, Mean±SD, LMCO-Little millet control optimized, R- Refined wheat flour, L-little millet flour, S: Soy flour, Means with the same superscript letters within a column are not significantly different at 5% level

## CONCLUSION

Incorporation of soy flour at 5 per cent level to little millet bread improved the sensory quality of bread with respect to texture. Soy as a source of protein, dietary fibre and micronutrients also improves the nutritional composition and protein quality.

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