EFFECT OF COWPEA FLOUR SUPPLEMENTATION ON THE NUTRITIVE VALUE OF WHOLE WHEAT FLOUR LEAVENED BREAD

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ABSTRACT

The influence of cowpea flour supplementation on the nutritive value of whole wheat flour bread was investigated in this study. Whole wheat flour (WWF) and Cowpea flour (CPF) were evaluated for their proximate composition. The bread samples were also evaluated for their proximate composition, mineral content i.e. P and Fe and phytic acid content. Phytic acid content was also determined in the raw WWF and CPF in order to ascertain the reduction of phytic acid on baking and natural fermentation. The moisture content, crude protein, crude fat, crude fiber, ash content and N.F.E were significantly (P<0.05) influenced by the level of supplementation. The effect of supplementation on mineral content was also significant (P<0.05).

Phosphorus content of supplemented bread was higher than control (286.20 mg/100g) but decreased from 412.40 to 321.30 mg/100g by increasing supplementation level of CPF. Iron content increased from 3.73 to 4.92 mg/100g as the percentage of CPF was increased. Phytic acid content of breads increased significantly (P<0.05) from 0.79 to 1.52 g/100 g with higher levels of CPF. There was significant difference in the scores for sensory evaluation of the bread (P<0.05). It was observed that quality scores for all sensory parameters declined with an increase in CPF. Hedonic rating for supplemented breads ranged from 7.1 (like moderately) to 5.4 (neither like nor dislike) for all sensory attributes. Sensory evaluation revealed that up to 10% cowpea supplemented breads were preferred over control and other supplemented breads.
Key Words: Cowpea, Flour supplementation, Nutritive value, Wheat flour and leavened bread.

INTRODUCTION
Wheat (*Triticum aestivum*-L) constitutes a major source of most of the diet in the developing countries including Pakistan. Wheat is consumed primarily as a source of carbohydrate and protein. Two-third of the cultivated land is occupied under the wheat in the world. Whole wheat flour contained moisture; 12.0, protein; 10.0, lipids, (fat); 1.6, carbohydrates; 72.6, fiber; 1.3, and ash; 1.4 g/100g respectively. Whole wheat flour contained 43 mg Ca, 284 mg P and 45 mg iron. Wheat is the major contributor of protein content of daily diet (2). In developing countries where a growing population and lack of agricultural development and productivity results in a limited supply of high quality protein for the average person. This problem can be solving by supplementation of leguminous seeds with wheat flour. This situation has created a great demand for vegetable proteins obtained from legumes. In Pakistan 80% wheat is consumed in the form of chapattis. A slice (11.4g) of bread gives us energy of 29 kcal. From 100g of bread we can obtain 254Kcal energy. Wheat proteins have relatively low amounts of essential amino acids such as lysine.

Cowpea (*Vigna unguiculata*) locally known as Lobia is a very important crop among the grain legumes. Major producing countries are Nigeria, Brazil, USA and India. In Pakistan cowpea are extensively grown in Hazara, Swat and Dir district. Cowpea seed is high in protein and having starchy endosperm that can easily be processed into flour. Cowpea is also a good source of B complex vitamins, cowpea contains substantial quantities of lysine and when blended with cereals, produces mixtures with complementary amino acid profiles and improves nutritional quality.

Therefore this study was initiated to investigate the supplementation of cowpea flour with whole wheat flour to an acceptable level to improve the nutritional status of large population dependent on plant protein.

RESEARCH METHODOLOGY
The present research work was carried out in the Department of Food Science and Technology The University of Agriculture Peshawar. Samples of wheat grains and cowpea were purchased from the local market of Peshawar. The samples were thoroughly cleaned manually and then washed and oven dried.
Milling Of Flour: The flour was made from wheat and cowpea according to the standard method of (1).

Proximate Analysis of Flour: The samples were analyzed for moisture, ash, fat, fiber, protein and nitrogen free extract by the standard methods of (1).

Determination of Minerals (Phosphorus and Iron): Phosphorus and Iron of whole wheat flour and cowpea flour were determined by wet digestion U.S.D.A. (15).

Determination of Phytic acid: Phytic acid content of whole wheat flour and cowpea flour was determined by the method of (7).

Preparation of Composite Flour: Wheat and cowpea flour was taken in the following proportions for the preparation of bread:

<table>
<thead>
<tr>
<th>Treatments</th>
<th>Wheat Flour (%)</th>
<th>Cowpea Flour (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>T₀</td>
<td>100</td>
<td>-</td>
</tr>
<tr>
<td>T₁</td>
<td>95</td>
<td>5</td>
</tr>
<tr>
<td>T₂</td>
<td>90</td>
<td>10</td>
</tr>
<tr>
<td>T₃</td>
<td>85</td>
<td>15</td>
</tr>
<tr>
<td>T₄</td>
<td>80</td>
<td>20</td>
</tr>
</tbody>
</table>

Baking of Bread

Breads were prepared according to the standard method of (1). Leavened breads were prepared from the entire five samples (whole wheat flour with different proportions of cowpea) by using the following formula.

<table>
<thead>
<tr>
<th>Flour</th>
<th>100g</th>
</tr>
</thead>
<tbody>
<tr>
<td>Salt</td>
<td>1 g</td>
</tr>
<tr>
<td>Water</td>
<td>According to the absorption capacity</td>
</tr>
<tr>
<td>Starter  (from previous dough)</td>
<td>1g</td>
</tr>
</tbody>
</table>

All the ingredients were thoroughly mixed to form dough. Dough was kneaded by working with hands for 5-10 minutes, and then the dough was left over for 180 minutes’ fermentation. Dough weighing 80gm was rounded, flattened and was baked for 2-4 minutes at a temperature of about 210°C by indigenous method (tandoor) in replication. After baking breads were subjected to chemical and sensory analysis according to the standard methods of (1, 9).

Statistical Analysis

All the data regarding different treatments were statistically analyzed by CRD and means were separated by applying LSD test as recommended by (14).
RESULTS AND DISCUSSIONS
The present research work was carried out to investigate the influence of cowpea flour supplementation on the nutritive value of whole wheat flour bread. Cowpea was soaked in water and oven dried then milled into flours. The wheat was thoroughly cleaned washed and oven dried. Both the flours were milled by using Udycyclone mill. The flours were stored in polyethylene bags for further studies. Composite flour was prepared by replacing wheat flour at 5, 10, 15 and 20 % by cowpea flour.

The raw flours of wheat and cow pea was analyzed for their chemical composition. The breads prepared from various blends were analyzed for their proximate composition, iron, phosphorous, phytic acid. The breads were also subjected for sensory evaluation by a panel of trained judges. Results pertaining to chemical composition of whole wheat flour, cowpea flour and leavened bread are reported as under.

Proximate composition of cowpea and whole wheat flour
The data regarding the proximate composition of cowpea flour and whole wheat flour are presented in Table. 1 and II. The results showed that wheat flour contained 11.9 % moisture, 10.76 % crude protein, 1.60 % crude fat, 2.13% crude fiber, ash 1.40 % and Nitrogen free extract 72.21%. Cowpea flour contained 9.58 % moisture, 22.50 % crude protein, 1.90 % crude fat, 5.99 % crude fiber, ash 3.20 % and Nitrogen free extract 56.82%. These results are in close agreement with the findings of (17). Phosphorus 315 and 339 Iron 4.83 and 4.94 Phytic acid 1140, 1400 (mg/100g) were recorded for wheat and cowpea flours respectively. These findings are in close conformity with the research work carried out by (9) who found that the amount of phytic acid varied from 0.04 to 2.0% in legumes, from 0.5 to 1.89% in cereals and from 2 to 5.20% in oil seeds.

Table. 1  Shows proximate composition of Whole Wheat Flour and Cowpea Flour.

<table>
<thead>
<tr>
<th>Flour Type</th>
<th>Moisture %</th>
<th>Proteins %</th>
<th>Crude Fat %</th>
<th>Crude Fiber %</th>
<th>Ash %</th>
<th>N.F.E. %</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wheat</td>
<td>11.89 ± 0.14</td>
<td>10.76 ± 0.06</td>
<td>1.60 ± 0.30</td>
<td>2.13 ± 0.03</td>
<td>1.40 ± 0.04</td>
<td>72.21 ± 0.47</td>
</tr>
<tr>
<td>Cowpea</td>
<td>9.58 ± 0.08</td>
<td>22.50 ± 0.98</td>
<td>1.90 ± 0.26</td>
<td>5.99 ± 0.16</td>
<td>3.20 ± 0.07</td>
<td>56.82 ± 1.43</td>
</tr>
</tbody>
</table>

Values are mean of three replications ± standard deviation
Table II. Shows Phosphorus, Iron and Phytic Acid Content of Whole Wheat Flour and Cowpea Flour.

<table>
<thead>
<tr>
<th>Flour Type</th>
<th>Phosphorus (mg/100g)</th>
<th>Iron (mg/100g)</th>
<th>Phytic acid (mg/100g)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wheat</td>
<td>315 ± 5.29</td>
<td>4.83 ± 0.34</td>
<td>1140 ± 0.04</td>
</tr>
<tr>
<td>Cowpea</td>
<td>339 ± 9.17</td>
<td>4.94 ± 0.03</td>
<td>1400 ± 0.03</td>
</tr>
</tbody>
</table>

Values are mean of three replications ± standard deviation

Proximate Composition of Control and Supplemented Bread

The breads prepared from whole wheat flour supplemented with cowpea flour were analyzed for proximate composition. The data is shown in (Table.3.).

Moisture Content

The result pertaining to the moisture content of control and supplemented breads is shown in (Table.3.). These results show a decreasing trend from T1 (20.20) to T4 (18.19), which indicates that moisture content decreases with increasing supplementation level of cowpea flour. These findings are in partial agreement with the finding of (12) who reported that supplemented breads (with pigeon pea and chick pea) had lower moisture content.

Table: 3 Shows Proximate Composition of Control and Supplemented Bread.

<table>
<thead>
<tr>
<th>Treatments</th>
<th>Moisture %</th>
<th>Proteins %</th>
<th>Crude Fat %</th>
<th>Crude Fiber %</th>
<th>Ash %</th>
<th>N.E.F. %</th>
</tr>
</thead>
<tbody>
<tr>
<td>100 % WWF</td>
<td>20.64 d</td>
<td>12.39 a</td>
<td>1.79</td>
<td>2.98 c</td>
<td>4.12 c</td>
<td>58.08 a</td>
</tr>
<tr>
<td>95% WWF + 5% CPF</td>
<td>20.20 ab</td>
<td>15.29 c</td>
<td>1.80</td>
<td>3.00 c</td>
<td>4.20 c</td>
<td>55.51 b</td>
</tr>
<tr>
<td>90% WWF + 10% CPF</td>
<td>19.93 ab</td>
<td>18.20 b</td>
<td>1.83</td>
<td>3.33 b</td>
<td>4.41 b</td>
<td>52.30 c</td>
</tr>
<tr>
<td>85% WWF + 15% CPF</td>
<td>18.94 bc</td>
<td>19.79 a</td>
<td>1.93</td>
<td>3.49 b</td>
<td>4.90 a</td>
<td>50.95 cd</td>
</tr>
<tr>
<td>80% WWF + 20% CPF</td>
<td>18.19 c</td>
<td>21.02 a</td>
<td>1.95</td>
<td>3.99 a</td>
<td>5.02 a</td>
<td>49.83 d</td>
</tr>
<tr>
<td>C.V (%)</td>
<td>4.39</td>
<td>4.21</td>
<td>4.79</td>
<td>3.81</td>
<td>1.68</td>
<td>2.39</td>
</tr>
</tbody>
</table>

Values are mean of three replications ± standard deviation

Values followed by different small letters are significantly (p<0.05) different from each other.

WWF = Whole wheat flour

CPF = Cowpea flour
Protein Content
The mean values regarding the protein content of control and supplemented bread have been given in (Table.3.). The maximum value was recorded for T₄ (21.02) while the minimum value was recorded for To (12.39). The data revealed that protein content increased from 12.39% (control) to 21.02% (T₄) as the percentage of cowpea flour supplementation was increased respectively. Hussain (8) reported that cowpea flour contained protein (23.4%) higher than wheat flour (10.00%). So with the increasing of supplementation level protein content also increases in the bread. In a similar study, (10) substituted 20% cowpea (raw and germinated) in bread and reported increased protein and ash contents in the bread.

Crude Fat
Data regarding crude fat are given in (Table.3.). The data showed that crude fat content increased from 1.79% (Control) to 1.95% (T₅) as the percentage of cowpea supplementation was increased. The results are in conformity with the findings of (4), who reported that supplementation of wheat flour with cowpea flour to levels of 15% increased the fat content.

Crude Fiber
The data in the table.3 indicated that crude fiber of bread supplementation with cowpea increased significantly from 2.98% (Control) to 3.99% (T₅) by increasing the supplementation level. Our results are in conformation with the finding of (13) who reported that supplementation of wheat flour with debittered fenugreek flour, increased fiber content.

Ash Content
The results pertaining to the effect of supplementation on ash content of bread are shown in (Table.3.). Ash content increases from 4.12% (To) to 5.02 (T₅) with an increasing supplementation level of cowpea respectively. The results are in conformity with the findings of (4) who reported that supplementation of wheat flour with cowpea flour to levels of 15% increased the ash content.

Nitrogen Free Extract (N.F.E)
The results regarding N.F.E. of the supplemented bread are shown in (table.3.) The data revealed that maximum value was recorded for T₀ (58.08) while the minimum value was recorded for T₄ (49.83). N.F.E. decreased from 58.08 (Control) to 49.83 (T₃) with the addition of high proportion of cowpea respectively. The decrease content may be due to the lower N.F.E. of cowpea flour.
Phosphorus Content

The data pertaining to the phosphorous content of control and supplemented bread is shown in (Table.4.). The results revealed that maximum phosphorous content was recorded for T₁ (412.40) while minimum for T₀ (286.20). These results are in conformity with the findings of (6), who stated that increasing levels of pigeon peaflour in the blends for bread and cookie making significant increase in the mineral content of the baked goods.

Iron Content

The mean values for iron content given in (Table.4). The maximum value was recorded for T₄ (4.92) while minimum value for T₀ (3.73). These findings are in agreement with those of (6), who reported that an increasing level of pigeon pea in bread, chapattis and cookies significantly increased the protein and mineral content of the baked products.

Table.4 Shows Phosphorus, Iron and Phytic Acid Content of Control and Supplemented Bread.

<table>
<thead>
<tr>
<th>Treatments</th>
<th>Phosphorus (mg/100g)</th>
<th>Iron (mg/100g)</th>
<th>Phytic acid (g/100g)</th>
</tr>
</thead>
<tbody>
<tr>
<td>100% WWF</td>
<td>286.20 c ± 45.05</td>
<td>3.73 c ± 0.12</td>
<td>0.79 c ± 0.09</td>
</tr>
<tr>
<td>95% WWF + 5% CPF</td>
<td>412.40 a ± 8.45</td>
<td>3.79 c ± 0.15</td>
<td>0.91 c ± 0.06</td>
</tr>
<tr>
<td>90% WWF + 10% CPF</td>
<td>391.50 a ± 4.91</td>
<td>4.50 b ± 0.12</td>
<td>1.09 b ± 0.08</td>
</tr>
<tr>
<td>85% WWF + 15% CPF</td>
<td>349.80 b ± 10.21</td>
<td>4.67 b ± 0.07</td>
<td>1.43 a ± 0.02</td>
</tr>
<tr>
<td>80 % WWF + 20% CPF</td>
<td>321.30 bc ± 10.69</td>
<td>4.92 a ± 0.05</td>
<td>1.52 a ± 0.12</td>
</tr>
<tr>
<td>C.V (%)</td>
<td>6.15</td>
<td>2.51</td>
<td>6.58</td>
</tr>
</tbody>
</table>

Values are mean of three replications ± standard deviation

Values followed by different small letters are significantly (p<.0.05) different from each other.

WWF = Whole wheat flour
CPF = Cowpea flour

Phytic Acid Content of Supplemented Bread

The data pertaining to the Phytic acid content of control and supplemented bread is given in (Table.4). The maximum value was recorded for T₄ (1.52) where as minimum value for T₀...
(0.79). According to Reddy et al. (1982), cowpea contain more phytic acid (0.86%) as compared to whole wheat flour (0.29%) so with increasing level of Cowpea supplementation the phytic acid content also increases.

**Table.5 Organoleptic evaluation of WWF bread and CPF Supplemented Bread.**

<table>
<thead>
<tr>
<th>Treatments</th>
<th>Colour</th>
<th>Taste</th>
<th>Texture</th>
<th>Overall Acceptability</th>
</tr>
</thead>
<tbody>
<tr>
<td>100% WWF</td>
<td>6.8 b ±0.10</td>
<td>6.3 c ±0.19</td>
<td>6.7 ab ±0.08</td>
<td>6.9 b ± 0.10</td>
</tr>
<tr>
<td>95% WWF +5% CPF</td>
<td>7.2 a ±0.05</td>
<td>7.4 a ±0.10</td>
<td>6.9 a ±0.26</td>
<td>7.1 a ± 0.11</td>
</tr>
<tr>
<td>90% WWF +10% CPF</td>
<td>7.1 a ±0.11</td>
<td>6.9 b ±0.26</td>
<td>6.5 bc ±0.10</td>
<td>7.0 ab ± 0.07</td>
</tr>
<tr>
<td>85% WWF +15%CPF</td>
<td>5.8 c ±0.10</td>
<td>6.5 c ±0.10</td>
<td>6.4 c ±0.08</td>
<td>6.3 c ± 0.10</td>
</tr>
<tr>
<td>80% WWF +20% CPF</td>
<td>5.7 c ±0.10</td>
<td>5.5 d ±0.08</td>
<td>4.9 d ± 0.10</td>
<td>5.4 d ± 0.10</td>
</tr>
<tr>
<td>C.V (%)</td>
<td>1.38</td>
<td>2.49</td>
<td>2.25</td>
<td>1.44</td>
</tr>
</tbody>
</table>

Values are mean of three replications ± standard deviation.

Values are followed by different small letters are significantly (P<0.05) different from each other.

WWF = Whole Wheat Flour
CPF = Cowpea Flour

**Organoeleptic Evaluation**

Whole wheat flour bread alone and supplemented bread with different levels of cowpea presented to a panel of ten judges for evaluation of colour, taste, texture and overall acceptability. The results are presented in (Table.5.).

**Colour**

Data regarding color score of breads reveals that there was a gradual change in the color score of bread (Table.5.). Bread with 5% cowpea flour supplementation level got the highest score T₁ (7.20 'Like Moderately') followed by T₂ (7.1) where as 20% level of cowpea bread got the lowest score T₄ (5.7 'Neither Like Nor Dislike'). (3) reported that as amino acids reacts with reducing sugars and a result Millard reaction takes place which results in the reducing quality score for the color of breads.
Taste
Data regarding taste score of breads revealed a gradual decrease in quality scores (Table 5.). Breads with 5% cowpea flour supplementation got the highest score $T_1$ (7.4 `Like Moderately`) followed by $T_2$ (6.9) whereas 20% level got the lowest score $T_4$ (5.5 `Neither Like Nor Dislike`). The decreasing trend of taste may be due to the beany taste of cowpea flour which dominated when used in high amount. Our results are in conformity with (3) observed that wheat breads with 15 to 20% soy flour had lower taste rating due to much higher beany flavour.

Texture
Data regarding texture score of breads showed a decreasing trend with an increase in cowpea flour level (Table 5). Breads with 5% cowpea flour got the highest score $T_1$ (6.9 `Like Slightly`) followed by $T_2$ (6.05) whereas 20% level got the lowest score $T_4$ (4.9 `Dislike Slightly`). The decreasing trend in the quality score for texture of breads was due to high proteins present in cowpea flour. (16) mixed different levels (10 to 40%) of soybean hulls (SH) with wheat flour in the preparation of high fiber cookies with pleasant sensory characteristics.

Overall Acceptability
Data regarding overall acceptability score of breads shows decreasing trend with an increase in cowpea flour level (Table 5). Bread with 5% cowpea flour got the highest score $T_1$ (7.1 `Like Moderately`) followed by $T_3$ (7.0%) whereas 20% level got the lowest score $T_4$ (5.4 `Neither Like Nor Dislike`). These findings are in line with acceptability of supplemented bread reported by (5).

CONCLUSION
Supplemented bread contained more protein, fat, ash and minerals content as compared to control bread. It may be concluded from the present research work that cowpea flour at 10% level is acceptable for all sensory attributes and can be successfully used for supplementation with out adverse affect on baking performance or eating quality. It is obvious from the findings of this research work that certainly it can improve the nutritional status of the population dependent on plant protein to combat malnutrition problems. Phytic acid content was reduced on baking but drastic reduction was noticed on natural fermentation followed by baking.
REFERENCES

