Comparative evaluation of certain functional properties of four different varieties of Lima Bean (*Phaseolus Lunatus*) flour

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**ABSTRACT**

Four different varieties (white, purplish red, speckled and brown) of lima bean (*Phaseolus lunatus*) flour were studied for the functionality of the proteins in their flour. The coloured varieties, that is the brown, speckled and purplish red had higher values of water binding capacities 1.92 ± 0.08, 1.73 ± 0.12 and 1.80 ± 0.10 respectively when compared with the white variety 1.20 ± 0.10. There was significant difference \( P<0.05 \) in the values of oil absorption of the different varieties with the brown variety having the highest oil absorption capacity of 2.38 ± 0.14. Other functional properties of the four varieties shows significant difference \( P<0.05 \) indicating the ease or not with which flour of the four varieties of the bean could be used in food formulas.

**INTRODUCTION**

Lima bean (*Phaseolus lunatus*) also known as ‘Butter bean’, ‘Rangoon bean’, ‘Burma bean’, ‘Madagascar bean’ or ‘Sieva bean’ is a legume, of the leguminosae family [1]. Legumes have been referred to as “poor man’s meat” [2], because they serve as useful but cheap source of good quality protein, especially during the hungry periods [3].

Lima bean (*Phaseolus lunatus*) is one of the most widely cultivated pulse crops, both in temperate and subtropical regions. Unlike many other legumes, there is a dearth of information on this legume. The utilization and exploitation of a seed or legume generally depends on the available information and data on such legumes.

Functional properties of foods are intrinsic physicochemical characteristics, which affect the behaviour of protein in food systems during processing, manufacturing, storage and preparation [4].
This study was conducted to compare the functional properties of four different species of lima beans in a bid to evaluate the ease with which flour from the various bean species could be used in food formulas.

**MATERIALS AND METHODS**

**Collection and preparation of samples**
Four varieties of lima beans (*Phaseolus lunatus*) were purchased at Uromi market, Esan East Local Government Area, Edo State, Nigeria. They were the white, speckled, purplish red and brown varieties of the bean.
The bean samples were sun dried and thereafter milled in preparation for the analysis.

**Physico-Chemical Analysis**
Water absorption capacity, emulsion activity and stability were evaluated using the method of Beuchat, 1977. [5], which expresses water absorption capacity as gram of water absorbed, emulsion activity and stability were expressed as the ratio of the height of the emulsified layer to that of the height of whole layer expressed in percentage. Oil absorption capacity was evaluated by the method of Sosulski *et al.*, 1976. [6], while foam stability and capacity were evaluated using the method of Coffmann and Garcia, 1977. [7].

**Statistical analysis**: Statistical analysis was performed using Students t-test and P< 0.05 being considered statistically significant.

**RESULTS**

<table>
<thead>
<tr>
<th>Parameters</th>
<th>White</th>
<th>Purplish Red</th>
<th>Speckled</th>
<th>Brown</th>
</tr>
</thead>
<tbody>
<tr>
<td>Water absorption capacity (WAC) (g/g)</td>
<td>1.20 ± 0.10a</td>
<td>1.80 ± 0.10b</td>
<td>1.73 ± 0.12c,b</td>
<td>1.92 ± 0.08d</td>
</tr>
<tr>
<td>Oil absorption capacity (OAC) (g/g)</td>
<td>2.200 ± 0.14a</td>
<td>1.938 ± 0.10b</td>
<td>1.892 ± 0.07c,b</td>
<td>2.376 ± 0.14d</td>
</tr>
<tr>
<td>Emulsion activity (EA) (%)</td>
<td>33.33 ± 7.07a</td>
<td>53.33 ± 7.07b</td>
<td>73.33 ± 4.24c</td>
<td>60.00 ± 7.07d</td>
</tr>
<tr>
<td>Emulsion stability (ES) (%)</td>
<td>40.66 ± 1.41a</td>
<td>46.66 ± 2.83b</td>
<td>43.33 ± 1.00c</td>
<td>48.66 ± 1.41d</td>
</tr>
<tr>
<td>Foam capacity (FC) (%)</td>
<td>14.36 ± 0.71a</td>
<td>18.81 ± 1.41b</td>
<td>19.80 ± 1.00c</td>
<td>20.30 ± 0.71d</td>
</tr>
<tr>
<td>Foam stability (FS) (%)</td>
<td>5.94 ± 1.41a</td>
<td>9.90 ± 1.00b</td>
<td>17.82 ± 1.41c</td>
<td>14.85 ± 1.00d</td>
</tr>
<tr>
<td>Bulk density (g/cm³)</td>
<td>0.685 ± 1.41a</td>
<td>0.746 ± 1.41b</td>
<td>0.758 ± 1.00c,b</td>
<td>0.714 ± 2.83d</td>
</tr>
</tbody>
</table>

Values of Mean ± SEM of three estimations. Different alphabets on the same row indicates significance difference (P<0.05). The same alphabets on the same row indicates no significance difference (P<0.05).

**DISCUSSION**

Functional properties reflect the intrinsic physical attributes of protein (composition, amino-acid sequence, conformation and structure) as effected by interactions with food components (water, ions, protein, lipid, carbohydrate) and the immediate environment.

The water absorption capacity observed for the various varieties of lima bean (*Phaseolus lunatus*) show that the brown variety had the highest value of 1.92 ± 0.08, followed by the purplish red variety (1.80 ± 0.10) and speckled variety (1.73 ± 0.12). The white variety showed the least value for water absorption, with a value of (1.20 ± 0.10). There was statistical significance (p < 0.05) for all the samples, but on comparing the varieties with each other, there
was no significant difference between the speckled and purplish red varieties of lima beans in water absorption capacity, oil absorption capacity and bulk density. All the varieties had low water absorption capacity compared to cowpea and soybean flour, which have been reported to have water absorption capacities of 9.2 – 10.2 g/2g (Cowpea) and 3.8 – 6.0 g/2g (Soybean) [8].

The results observed for oil absorption capacity in the different varieties of lima beans flour were comparable to the reported values observed in cowpeas (1.3 – 2.0g/2g) and soybean (1.7 – 3.9/2g [8].

Foam capacity value of 14.5 – 20.5% was observed for the lima bean varieties, which were comparable to that reported for cowpea 9.0 – 29.0% but higher than those observed in soybean 0.0% [8]. The low values of foam stability and capacity recorded for the four different varieties of lima bean (*Phaseolus lunatus*) studied show that lima bean flour might not be suitable for food products that required a high percentage of porosity.

Lima bean flour was observed to have high emulsifying activities (33.3 – 60.0%) though lower than those reported for African yam bean (66.0 – 84.0%) [9]. There was significance difference (p<0.05) for emulsifying activity and stability for the four varieties of lima beans. Values for emulsifying activity and stability of lima bean flour could be useful in ground meat formulations such as in sausages, baked foods and soups. This implies that the brown variety will be more suitable for such food formulations.

Bulk density values of lima bean flour in this study were higher than those reported for cowpea (0.62g/ml) [10] and lower than those noted in beniseed (1.3g/ml) [11].

In conclusion, all four varieties of lima bean have great potential as source of plant proteins due to their high content of crude protein as reported in most literature. They could be incorporated into various human foods, where they can serve as protein supplement. The functional properties such as emulsifying activity, bulk density and oil absorption capacity indicate the ease with which flour from these varieties could be used in food formulas. Also when considering it as a potential food, a good knowledge of these functional properties is required so that the purpose for which it is to be utilised can be achieved.

REFERENCES


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