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Determination of the Pasting and Functional Properties of Cowpea (*Vigna unguiculata*) and Soybean (*Glycine max*) Blends

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Authors' contributions

This work was carried out in collaboration among all authors. Author GFO designed the study, and author OPB performed the statistical analysis, wrote the protocol and wrote the first draft of the manuscript. Author BFO managed literature search and proof read the manuscript before submission. All authors read and approved the final manuscript

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Short Communication

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ABSTRACT

Aim: This study was carried out to check the pasting and functional properties of cowpea and soybean blends for culinary uses.
Methods: The two legumes (cowpea and soybean) were combined in different percentage of 90% to 10% which serves as sample A and Sample B and C had 80% to 20% and 70% to 30% respectively. A rapid viscoanalyzer unit (RVA, Model 3D, Newport Scientific-Warriewood, Australia) was used for pasting. The functional properties of samples were determined based on standard methods in the Association of Official Analytical Chemist.
Results: The functional properties results showed a decrease in bulk density with an increase in soybean blend with cowpea (i.e. sample A > B>C). The same pattern of results were recorded for water absorption and swelling capacity. Sample A have the highest value in all the functional properties determined except in oil absorption capacity, total soluble solid, and wettability. The

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pasting properties results showed a reduction in trough value which range from 0.50 RVU in sample C to 8.00 RVU in sample A. Also a reduction in final viscosity results was observed which ranged between 9.50 RVU in sample C to 16.00 RVU in sample A. The reduction followed with increase in the percentage of soybean blend with cowpea. Increase in percentages of soybean subtitution resulted to increase in oil absorption capacity, total soluble solid and wettability.

Conclusion: In conclusion, the pasting properties of all the blends improved significantly over that of soybean alone, thus suggesting the trial of the blends for culinary uses such as the production of *akara,* and *moi-moi.*

Keywords: Pasting; functional properties; cowpea; soybean; culinary.

1. INTRODUCTION

Legumes are generally believed to be the cheapest source of plant protein available in West Africa. Cowpea (*vigna unguculata*) is a primary food legumes with more than 90% of the world crop being produced in west Africa region of the world [1]. Cowpeas (*vigna unguculata)* are probably the most porpular grain legume in West Africa unlike other legumes such as soybean and groundnut, which are oil-protein seeds, cowpeas are starch-protein seeds offering a wide parttern of utilization than any other legume in West Africa [2]. Protein and starch are the major macromolecules that contribute toward the functionality of cowpea flour. Pasting characteristic is the transition from a suspension of starch granules to paste when heat is applied, it is accomplished by a large increase in viscosity. It is a phenomenon that follows gelatinisation in the dessolution of starch. This involves granular swelling, exudation of molecular composnent from the granular and eventually total distruption of the granules [3]. Jideani [4] reported functional properties as intrinsic physico-chemical characteristics which affect the behaviour of a food ingredient in food systems during processing manufacturing, storage and preparation. The paste forms the basis of several popular food items such as *moi-moi* (a steamed baked cowpea pasted) and *akara* (a oil fried cowpea paste) which are prepared by steaming or deep-fat frying or baking in some special case or instances [5]. Henshaw et al. [2], expressed functional properties as physico-chemical properties that give information on how food ingredients will behave in a food system. Functional properties are therefore important in determining the quality (nutritional, sensory, physico-chemical and organoleptic properties) of the final product as well as facilitating processing such as improved machinability of cookie dough or slicing of processed meats. Functional properties of food protein are important in food processing and food product formulation [4]. The suitability of cowpea flour for use in food products is attributed to its functionality in terms of hydration, foaming, gelation and pasting properties [3,6]. Soybean (*Glycine max*) is a particularly great source of plant protein in the world. Its protein have high biological value while it cost is relatively low. Ajayi et al. [7] reported that several years of rigorous scientific and clinical research has establised that most of the components of soybean have beneficial health effect as characterised by its preventive pontential for the so-called life-style-related diseases. Futhermore, soybean proteins contain all amino acids essential to human nutrition which makes soy products almost equivalent to animal sources in protein quality but with less saturated fat and no cholesterol. Soybean is not only high quality protein, but it is now thought to play preventive and therapeutic roles for several diseases.In recent years, soybean, although high in protein and other nutrient has defiled its use in making food products such as moinmoin and akara. Athough its has been useful in making other food such as soycheese (*Tofu*), flours and soy milk. Soybean contains about 35% carbohydrates most of which is non-starch polysaccharides [7]. This may explain it poor pasting quality. It will be of great importance if protein present in soybean can be complimented with starch through the best local means i.e if soybean can be blended with cowpea for culinary uses. Blending cowpea with soybean will boost the starch component and increase the utilization of soybean for culinary purposes, hence the need to study the pasting and functional behaviour of different blends of cowpea and soybean.

2. MATERIALS AND METHODS

Cowpea and soybean were purchased at Owode market in Offa, Kwara State, Nigeria. Processing equipment and other materials were provided at the food processing laboratory of the department of food technology, Federal Polytechnic Offa, Kwara State, Nigeria. The pasting properties of samples were determined with a rapid viscoanalyzer unit (RVA, Model 3D, Newport Scientific-Warriewood, Australia).

2.1 Preparation of Samples

The cowpea and soybean samples were sorted to remove damaged ones and other extraneous materials. They were combined in the following ratios (90:10, 80:20 and 70:30) of cowpea and soybean respectively. Exactly 200 g of mixture were weighed for each sample. The samples were label A, B, and C respectively.

2.2 Preparation of Paste

Each sample was soaked separately in a litre of cold water for one hour in other to soften the seed coats. Thereafter, the seed coats were removed manually and the seeds rinsed in water until they were clean and free from impurities. The samples were blended separately with 200 ml of water using a Kenwood blender until a fine paste was obtained. Each paste was transferred into a clean bowl and dried at 70°C in hot air oven for 48 hrs and the flours were packaged in side polyethylene bag and store at room temperature for further analysis.

2.3 Determination of Functional Properties of Samples

The functional properties of samples were determined based on standard methods in the Association of Official Analytical Chemist [8].

2.4 Determination of the Pasting Properties of Samples

The pasting properties of each sample was determined using a Rapid Viscosity Analyser (RVA).

2.5 Statistical Analysis

All experiments were carried out in triplicate. Mean and standard deviation were calculated for each treatment. Data obtained from the pasting and functional properties results were subjected to analysis of variance (ANOVA) and the means were separated by lowest standard deviation test (SPSS version 16, [9]) Significant level was accepted at 5%.

3. RESULTS AND DISCUSSION

Table 1 showed the results of functional properties of the samples. The bulk density of all the samples were similar except little difference in value without significant differences at $p \le 0.05$. The bulk density is influenced by particle size and density of the flour and is important in determining the packaging requirment and material hardling [10]. Low bulk density is reported to be influenced by loose structure of the starch polymer. The result obtained for water absorption capacity ranged between 1.56-1.72%. Sample A which contained 90% cowpea flour and 10% soy flour gave the highest water absorption capacity followed by sample B and C respectively. This may be due to the percentage soy flour added to each sample. Osundahunse et al. [11] reported that good water absorption capacity is desirable in food system to improve yield and consistency and give body to the food. The low water absorption capacity of the cowpea-soyflour may be due to loose association of amylose and amylopectin in the samples. This result is supported by Lorenz and collin, [12] and Malomo et al. [10]. They both reported that water absorpton capacity will be low if there is loose association between amylose and amylopectin in the native granules of starch and weak associative forces maintainng the granules structure.

The oil absorption capacity of all the samples were also different with significant difference at $P \le 0.05$. Oil absorption capacity is an important property of cowpea flour that could be used as an extender in various culinary uses. The presence of soy flour in the sample reduced the rate of oil absorption of all the samples. This was shown in the reduction rate of the value obtained. Low oil absorption is highly desirable as far as flour product is concerned [13].

Total soluble soild of all the samples showed no significant difference at $P \le 0.05$. sample A recorded the lowest value, with the remain samples (i.e sample A and B) having the same value (5%). The total soluble solid is an indication of the rate at which such sample will dissolve in water. The result obtained were good for cowpea – soybean flour analysed.

Table 1. Functional properties of cowpea and soybean blends at different ratios

	Bulk densily g/ml	Water absorption capacity %	Oil absorbtion capacity g oil/g	Total soluble solid %	Wettability WETA(s)	Swell capacity (%)
A	0.851±0.02^{b}	1.72±0.01^{c}	1.46±0.02^{a}	4.501±0.71^{a}	5.50±0.71^{a}	3.57±0.01^{c}
B	0.84±0.01^{a}	1.67±0.01^{b}	1.50±0.01^{ab}	5.00±0.00^{a}	11.00±1.40^{b}	3.25±0.01^{b}
C	0.83±0.01^{a}	1.56±0.02^{a}	1.58±0.01^{c}	5.00±0.00^{a}	40.5±0.70^{c}	3.19±0.01^{a}

Number of replicate (N=3), values are means (LSD), common superscript letter in a column are Significally differentat p≤0.05

Table 2. Pastingproperties of cowpea and soybean blends at different ratios

	Peak viscosity 1 (RVU)	Peak temp 1 (°C)	Trough viscosity 1(RVU)	Trough temp (°C)	Peakviscosity 2(RVU)	Peak temp 2 (°C)	Final viscosity (RVU)
A	9.50^{b}±0.10	78.6^{a}±0.15	8.00^{c}±0.22	80.03^{a}±0.25	17.00^{b}±0.23	30.05^{a}±0.15	16.00^{b}±0.15
B	3.50^{b}±0.12	80.00^{b}±0.17	2.50^{b}±0.11	80.00^{a}±0.31	10.50^{a}±0.16	29.79^{a}±0.17	9.50^{a}±0.16
C	2.50^{a}±0.30	80.00^{b}±0.19	0.50^{a}±0.14	80.00^{a}±0.10	10.50^{a}±0.15	30.13^{a}±0.22	9.50^{a}±0.19

Number of replicate (N=3), values are means (LSD), common superscript letter in a column are Significally differentat p≤0.05

Wetability is the time taken for samples to absorb water. The wetability results revealed the effect of soy flour on the samples. The wetability of the samples increased with increase in ratio of soy flour. Sample C (90% cowpea, & 30% soy flour) had the highest value of 40.50%, followed by sample B (11%) and sample A (5.50%). It may be explained that soy flour showed the highest level of absorbing water but later released it which resulted in the increase of wetability of samples with the highest ratio of soy flour. This may also be explained that soy flour has strong wetting properties with poor retention power because of the weak oligosaccharide present which also related to weak starch granules.

The swelling capacity of the three samples followed the same trend of water absorption capacity with sample C having the lowest swelling capacity (3.10%), followed by sample B (3.25%) and highest in sample A (3.57%). The swelling capacity results of the three samples may be due to the ratio of soy flour to cowpea flour in all the samples. The swelling index or swelling capacity is largely cotrolled by the strength and character of the micellar network within the starch granules [14]. This result is in line with the result of Abioye et al. [15], who reported a decreases in swelling capacity of soy – plantain flour.

The result of the pasting characteristics are shown in Table 2 above. The pasting characteristics indicate that the addition of soy flour reduced the peak viscosity of all the samples. Sample A, which contained the smallest amount of soy flour had the highest peak viscosity value of 17.00 RVU followed by sample B and C with the same value (10.50RVU). The equal value of sample B and C indicates that there is particular ratio of subtitute that will affect the final peak viscosity. This result is in consonant with the result of Abioye et al. [15]. The trough viscosity, which is the minimum viscosity value, measures the ability of paste to withstand breakdown during cooling and it ranged from 0.50 to 8.00 RVU. This also followed the same trend with that of peak viscosity. The final viscosity is the most commonly used parameters to determine a particular starch based sample quality. It gives an idea of the ability of such material to gel after cooking [16]. The final viscosity decreased with increase in soy flour substitution. This is an indication that the ability of the material (i.e food substance) to form a viscous paste or gel after cooking and coolling, as well as the resistance of such paste to share stress during stirring is low.

The value obtained range from 16.00 RVU for sample A, 9.50RVU for sample B and C. This result is also suported by Abioye et al. [15], who reported a decrease in final viscosity of soy – plantain flour. The poor pasting behaviour of soybean was attributed to lower content of its oligosaccharide which is more in cowpea [17]. Most of this oligosaccharide such as sucrose, raffinose, starchyose and verbascose are very low and some (verbascose) is in trace. Cowpea will be able to compliment soybean because of it is own richness in oligosaccharide when compared with soybean [18].

4. CONCLUSION

This study showed that the addition of soybean to cowpea had a significant influence on the pasting and functional properties of the differents samples. When compared with the pasting and functional properties of cowpea the differences observed are not significant enough to discourage the use of the blend samples for culinary purposes such as the production of akara, moi-moi etc. Further more, when compared with the pasting properties of soybean there is a significant improvement with the addition of cowpea. This suggests that the blend up to 30% of soybean with cowpea can be used for culinary uses.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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