Chemical Composition, Functional and Pasting Properties of Cashew Pomace and Wheat Flours

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ABSTRACT:
The study investigated the quality of cashew pomace flour. Ripe cashew fruits were washed and the juice was extracted. The residue known as cashew pomace was cut into thin slices (2.3 mm thick) blanched in 1% (w/v) sodium metabisulphite solution (100°C, 10 min), oven dried (50°C), milled and sieved through 60 mesh sieve. Wheat flour was also obtained from a reputable store. Each flour was analyzed separately for chemical composition, functional and pasting properties. The cashew pomace flour contained higher ash (2.6 %), crude fiber (4%) and carbohydrate (78.2%) but lower crude fat (1.2%) and crude protein (6%) contents than wheat flour. The ash, crude fiber, carbohydrate, fat and crude protein contents of wheat flour were 0.9, 3.2, 75.5, 3.2 and 10% respectively. The cashew pomace flour had significantly higher (P <0.05) water and oil absorption capacities but lower emulsion and foaming properties than wheat flour. The cashew pomace flour possessed lower peak viscosity, final viscosity, trough viscosity, breakdown viscosity and setback viscosity than wheat flour. These properties improved in the wheat/cashew pomace flour blends. The study showed that cashew pomace flour has potential for use in various food systems.

Keywords: Cashew Pomace, Functional properties, Proximate composition, Pasting Characteristics, Wheat Flour

INTRODUCTION
Many types of waste are generated during production, distribution, preparation and consumption of foods. These wastes range from 8 to 65% of the raw material (Enwere, 1998). Food wastes create disposal and pollution problems and contribute to loss of valuable biomass and nutrients (Enwere, 1998). However, several by-products of plant foods are utilized in the food industry after evaluation of the chemical composition and functional properties (Akpata and Akubor, 1999). Cashew apple pomace has not been evaluated for this purpose. Cashew (Anacardium occidentale) tree is ranked second only to almond among the nine tree nuts that is of importance in the world trade. The cashew tree produces cashew apple which is attached to the cashew nut. The weight of cashew apple is about 5 to 10 times the weight of the nut (Aderiye et al., 1991). The nut is processed into kernel which is used for various food products. However, use of cashew apple is of minor economic importance, the greater part being wasted. Products processed from cashew apple on experimental basis...
include fruit paste, candied fruit, canned fruit, jam, jelly, juice, wine and vinegar. The residue after expression of juice from the apple is called cashew pomace. Fresh cashew pomace has been reported to contain 72% moisture, 2.3% protein, 10.9% carbohydrate, 1.4% fat, 1.5% crude fiber, 1.1% ash, calcium, phosphorus and iron (Akpata and Akubor, 1999; Akubor et al., 2013). In several countries, including India, fresh cashew pomace is used to feed pigs. However, Aderiye et al. (1991) suggested that the pomace could be processed into flour and used as one of the ingredients in food and animal feed formulations. Similarly, Adeyeri et al., (1991) reported producing high quality single cell protein from cashew pomace.

Cashew pomace adequately processed into flour could be used in similar manner other flours from plant by-products are used. However, for efficient utilization and acceptance of cashew pomace flour, studies on its desirable functional properties are important. Functionality as applied to food ingredients is any property on which the utility of foods depends. Therefore, this study was undertaken to assess the chemical composition, functional and pasting properties of cashew pomace flour and wheat flour for comparison.

MATERIALS AND METHODS

Healthy, mature and ripe cashew (Anacardium occidentale) fruits were harvested from a local farm in Idah Township, Kogi State, Nigeria. Commercial wheat flour was purchased from a local shop in Idah Township, Nigeria. The fruits and the wheat flour were stored in a deep refrigerator not longer than two weeks prior to use.

Preparation of cashew pomace flour

The fruits were sorted and washed in enough tap water contained in a basin. The nuts were removed and the juice was extracted from the apple by squeezing. The cashew pomace was cut into thin slices (2 cm thick), blanched in 1% (w/v) sodium metabisulphite solution at 100°C for 10 min, drained and then oven dried at 50°C to constant weight. The dried slices were milled in an attrition mill, sieved through 60 mesh sieve (British standard), packed in high density polyethylene HDPE bags and stored in a refrigerator at 10°C prior to use.

Flour blending

The cashew pomace flour was to used to substitute wheat flour at 10, 20, 30, 40 and 50% in a food blender that was operated at full speed (1200 rpm) for 10 min.

Evaluation of chemical composition

Moisture was determined by hot air oven drying at 105°C to constant weight (AOAC, 2010). Ash, protein (micro-Kjeldahl, N x 6.25), crude fiber and crude fat (solvent extraction) were determined by the AOAC (2010) methods. Calorie was calculated using Atwater factors of 4x% protein, 4x% carbohydrate and 9x% crude fat and then taking the sum (AOAC, 2010).

Evaluation of functional properties

Bulk density for each flour sample was determined as described by Onimawo and Akubor (2012). Water and oil absorption capacities were determined following the methods of Onimawo and Akubor (2012).
Emulsion activity and emulsion stability were determined by the methods of Onimawo and Akubor (2012). Foaming Capacity (FC) and Foam Stability (FS) were measured by the method of Onimawo and Akubor (2012). The volume of foam at 30 sec of whipping was expressed as FC. The volume of foam was recorded one hour after whipping to determine FS as percent of the initial foam volume. The least gelation concentration was determined as described by Onimawo and Akubor (2012).

**Evaluation of pasting characteristics**

Rapid Visco Analyser (RVA) (Model RVA-3D +, Newport Scientific pty Ltd, Sydney, Australia) was used to determine the pasting properties of the flours as described by Adebowale et al. (2005) Flour sample (2.5 g) was weighed into a dry empty canister containing 25 ml distilled water. The mixture was mixed thoroughly and the canister was then fitted into the RVA. The slurry was heated from 50 to 90°C with holding time of 2 min. This was followed by cooling to 50°C with 2 min holding time. Heating and cooling were carried out at constant rate of 11.25°C/min. Peak viscosity, trough viscosity, breakdown viscosity, final viscosity, set back viscosity, peak time and pasting temperature were read from the pasting profile with the aid of thermocline for windows software connected to a computer.

**Statistical analysis**

Data were subjected to analysis of variance in completely randomized design using Statistical Package for Social Sciences (SPSS) software (version 15, 2007). Means were significantly different were separated by the least significant difference (LSD) test (Steel and Torrie, 1980) and significance was accepted at P < 0.05.

**RESULTS AND DISCUSSION**

**Chemical composition**

The chemical composition of cashew pomace flour and wheat flour are presented in Table 1. The moisture content of cashew pomace flour was 8.0% which was lower than the 10.0% moisture content of the wheat flour. The moisture contents of cashew pomace flour and wheat flour were within the limit of not more than 10% suitable for stable storage of flours (Onimawo and Akubor, 2012). Mold growth and moisture dependent biochemical reactions are reduced in low moisture foods on storage. Moisture content above 15% was reported to cause mold growth in foods (Onimawo and Akubor, 2012.) The ash content of cashew pomace flour was 2.6% and was higher than 0.9% for wheat flour. This indicates higher mineral elements in cashew pomace flour. Drying employed in the processing of cashew pomace into flour, concentrated the protein content from 2.3% reported for fresh cashew pomace by Adeyeri et al., (1991) to 6.0% in the cashew pomace flour. The protein content of cashew pomace flour could be improved by blending it with wheat flour which contained 10.0% protein for baking purposes as has been documented for other composite flours (Badifu et al., 2000). Akubor and Badifu (2004) showed that the protein quality and quantity of individual proteins can be greatly improved by combining it with another protein source. Wheat flour contained...
significantly (p<0.05) higher amount of crude fat (3.2%) than cashew pomace flour (1.2%). Fruit pulps are not good sources of fat (Enwere, 1998). The low level of fat in cashew pomace flour and wheat flour would enhance storage stability as they are unlikely to develop rancidity if adequately packaged. The crude fiber and carbohydrate contents of cashew pomace flour were 4.0% and 78.2%, respectively. These values were significantly higher (P <0.05) than 0.4% crude fiber and 75.5% carbohydrate for wheat flour. The high level of crude fiber in cashew pomace flour could be of potential usefulness for enriching cereal diets. The therapeutic effects of fiber in prevention of heart diseases, colon cancer and diabetes and their role in the treatment of digestive disorders (diverticulosis) and constipation are widely documented (Dosumu et al., 2012).

**Functional properties**

The functional properties of cashew pomace flour and wheat flour are shown in Table 2. The bulk density of cashew pomace flour was 0.69 g/cm$^3$, which was slightly lower than 0.72 g/cm$^3$ for wheat flour. The lower bulk density of cashew pomace flour may be due to its lower moisture content. However, bulk density of food powder also depends on combined effects of factors such as intensity of attractive inter particle forces, geometry, particle size and method of preparation (Onimawo and Akubor, 2012). The bulk density of cashew pomace flour and wheat flour (0.69 - 0.72 g/cm$^3$) indicate that the flours have similar particle size which would be economical with respect to packaging cost. The low bulk density of the flours would be of advantage in their use for formulation of complementary foods (Badifu et al. 2000). However, high bulk density is a good physical attribute for determining mixing quality of flour for some food applications (Onimawo and Akubor, 2012).

The cashew pomace flour had significantly higher (P <0.05) water absorption capacity (164.0%) than wheat flour (75.0%), probably due to higher amounts of hydrophilic constituents such as carbohydrate and fiber in cashew pomace flour (Table 1). Fiber is characterized by high water holding capacity as reported by Holloway and Grieg (Holloway et al., 1984). The high water absorption capacity of cashew pomace flour may be attributed to loose association of the starch polymers and starch of small granule sizes (Aderiye et al., 1991). However, these need to be affirmed. These factors have been reported to influence water absorption. Onimawo and Akubor (2012) reported that small granules have higher solubility and thus, enhanced water absorption capacity which has implications for functionality of flours. Water absorption capacity is important in bulking and consistency of products as well as in baking applications. High water absorption capacity of fiber is thought to be important determinant of faecal bulking and intestinal transit times with influence on gastrointestinal diseases (Onuegbu et al., 2013). However, high water absorption of pasta is not desired as it makes the pasta softer and less firm (Badifu et al., 2000). The oil absorption capacity of cashew pomace flour was 95.0% which was not significantly higher (P<0.05) than 91.0% for wheat flour. The results suggest the presence of high apolar amino acids in both cashew pomace and wheat flour (Onimawo and Akubor, 2012). Products such as cashew pomace flour with high oil absorption capacity have the
advantage of improving mouth feel and retention of flavor of the food products in which they are incorporated. High oil absorption capacity means that various kinds of mutagen and cholesterol can be adsorbed effectively by cashew pomace flour because most of these components are lipophilic (Akubor and Badifu, 2004). However, high oil absorption capacity is undesirable in some food applications such as those involving deep frying of legume based products like bean ball (akara).

Wheat flour possessed higher foaming and emulsion properties than cashew pomace flour. The foaming capacity and foam stability of cashew pomace flour were 20.0% and 16.5%, respectively as compared to 61.0% foaming capacity and 40.0% foam stability for wheat flour. The low protein (6%) and high carbohydrate (78.2%) contents of cashew pomace flour may be linked to the low foaming and emulsion properties. The foam capacity of yam flour was also reported previously to be influenced by protein content (Adegunwa et al., 2012) and the presence of carbohydrate adversely affected emulsion capacity of groundnut flour (Onimawo and Akubor, 2012). Foam stability is related to the amount of native proteins, being low in denatured proteins (Onimawo and Akubor, 2012). Heat used to process cashew pomace flour probably denatured the proteins and caused the low foam stability of the flour. Foaming capacity is also dependent on configuration of protein molecules where flexible proteins have good foaming capacity but highly ordered globular molecules gave low foamability (Chima et al., 2009). Thus, cashew pomace flour probably contained adequate amount of highly ordered globular proteins which were resistant to surface denaturation.

Chavan et al. (2001) earlier showed that low foaming capacity could be due to inadequate electrostatic repulsion of protein molecules. Food ingredients with good foaming capacity and foam stability are used in baked products (Kinsella, 1987). The emulsion activity (29.13%) and emulsion stability (6.27%) of cashew pomace flour were low in relation to emulsion capacity (37%) and emulsion stability (40%) of wheat flour. The low protein content of cashew pomace flour may also explain its low emulsion properties (Onimawo and Akubor, 2012).

The cashew pomace flour may have contained large amount of insoluble proteins. Soluble proteins are surface active and promote formation and stabilization of oil-in-water emulsion (Onimawo and Akubor, 2012). It is also likely the high insoluble components; including fiber in cashew pomace flour may have discouraged formation of emulsion (Badifu et al., 2000). These results suggest that 100% cashew pomace flour would not be suitable for preparing sausage, cakes, mayonnaise and salad dressing because of the high emulsion requirements of these products (Onuegbu et al., 2013). However, these properties of cashew pomace flour could be improved by blending it with wheat flour. The least gelation concentration of cashew pomace flour was 8% (w/v) and that of wheat flour was 10% (w/v).

Variations in gelling properties of flours are due to the different ratios of protein, fat and carbohydrates in flours (Badifu et al., 2000). Flours with low value of least gelation concentration would be good thickening agent (Kinsella, 1987).
Pasting characteristics

The pasting characteristics of cashew pomace flour, wheat flour and the blends are presented in Table 3. Wheat flour had significantly higher (P<0.05) peak viscosity (121.25 RVU) and final viscosity (146.17 RVU) than cashew pomace flour. The peak viscosity and final viscosity of cashew pomace flour were 5.42 and 5.50 RVU, respectively. The absence of gluten in cashew pomace flour and its low starch content (Danbaba et al., 2012) may have been responsible for the low peak viscosity and final viscosity. The peak viscosity and final viscosity decreased with increased level of cashew pomace flour in the blends, probably due to dilution of starch and wheat flour gluten. Peak viscosity is closely associated with degree of starch damage with high starch damage giving high viscosity (Sanni et al., 2004). It is likely that interaction of oil and protein in cashew pomace flour with wheat flour starch lowered the peak viscosity of the blends. Sanni et al. (2004) reported restriction in swelling, solubilization and viscosity due to the presence of lipid and other non-carbohydrates in starch suspension. Peak viscosity is an important characteristic of starch granule and reflects ability of starch to swell freely before physical breakdown (Adebowale et al., 2005). It is the maximum viscosity developed during or soon after the heating stage. High peak viscosity correlates well with high swelling power which provides indication of the viscous load to be encountered during mixing (Adebowale et al., 2005). Final viscosity is useful in determining the ability of flour to form gel during processing (Adebowale et al., 2005). The 100% cashew pomace flour cannot form good gel and would not be useful in products requiring gelling and thickening. However, the peak viscosity and final viscosity increased to 67.67 RVU and 76.26 RVU, respectively in the blend containing 20% cashew pomace flour. Such blend would find applications in products requiring high gel strength and elasticity (Adebowale et al., 2005).

The trough viscosity of wheat flour was 66.67 RVU and increased from 4.17 RVU in the 100% cashew pomace flour (CPF) to 41.30 RVU for the blend containing 20% CPF. Thereafter, the trough viscosity decreased to 18.17 RVU in the blend containing 50% CPF. Trough viscosity is the minimum viscosity value in the constant temperature phase of the RVA profile. It measures the ability of gel to withstand break down during cooling (Adebowale et al., 2005). The cashew pomace flour had significantly (P<0.05) lower break down viscosity (1.25 RVU) than wheat flour (54.58 RVU). However, the breakdown viscosity of the blend containing 20% cashew pomace flour (26.34 RVU) was higher than that of 100 % cashew pomace, but lower than that of the 100% wheat flour. Low break down viscosity indicates that the starch possesses cross linking properties (Onimawo and Akubor, 2012). The decrease in dough stability may be due to dilution of wheat flour gluten protein. This may also be due to interaction between fibrous materials and gluten, which affects dough mixing properties (Sanni et al., 2004). Less stability of starch paste after cooling is accompanied by high viscosity breakdown (Sanni et al., 2004). Adebowale et al., (2005) showed that the higher the break down viscosity, the lower the ability of flour to withstand heating and shear stress during cooking. Thus, wheat/cashew pomace flour blends have the potential to withstand heating and mechanical stirring. The rate of starch
breakdown depends on nature of the material, temperature and degree of mixing and shear applied to the mixture (Adebowale et al., 2005).

The setback viscosity of wheat flour was 79.50 RVU and increased from 1.33 RVU in cashew pomace flour to a range of 13.83-34.92 RVU for the blends. Set back viscosity is a range where retrogradation (re-ordering of starch molecules) occurs (Onimawo and Akubor, 2012). Low setback viscosity indicates greater resistance to retrogradation and products with low setback viscosity would have low staling rate (Onimawo and Akubor, 2012). Thus, products containing cashew pomace flour/wheat flour blends would have higher resistance to staling than the 100% cashew pomace flour or wheat flour. The pasting temperatures of cashew pomace flour and wheat flour were 80.4°C and 82.5°C, respectively and increased steadily to 84.5°C for the blend containing 50% cashew pomace flour. Pasting temperature indicates the range of temperatures whereby at least 90% of starch granules swell irreversibly in hot water without loss of crystallinity and birefringence (Adebowale et al., 2005). The lower gelatinization temperature of cashew pomace flour suggests it contains some starch portions resistance to swelling (Aderiye et al., 1991). It took cashew pomace flour 6.60 min to reach peak viscosity and wheat flour 5.67 min. The pasting time decreased from 6.6 min for the cashew pomace flour to 5.13 min for the blend containing 50% cashew pomace flour. Gelatinization temperature provides indication of the minimum temperature for sample cooking, energy cost involved and other components stability (Adebowale et al., 2005). These results indicate that wheat flour with lower gelatinization temperature and peak time is likely to cook easier than cashew pomace flour and their blends when applied in food systems. The blend containing 20% cashew pomace flour had higher gelatinization temperature but lower peak time than 100% cashew pomace flour. The increase in the gelatinization temperature with increase in the level of cashew pomace flour might be due to change in the amylose and amylopectin ratio following the addition of cashew pomace flour. However, this needs to be investigated. Adebowale et al., (2005) reported increase in gelatinization temperature of wheat flour on incorporation of millet flour.

CONCLUSION

The cashew pomace flour had higher ash, crude fiber, carbohydrate, water and oil absorption capacities but lower protein content, emulsion and foaming properties than wheat flour. The protein content, functional and pasting properties of cashew pomace flour were improved by blending it with wheat flour. The cashew pomace flour/wheat flour would find applications in various food systems.

REFERENCES


2. Adegunwa MO, Bakare HA and Akinola OF. (2012). Processing effects on chemical, functional and pasting properties of cowpea flour from


Table 1: Proximate composition of cashew pomace flour and wheat flour

<table>
<thead>
<tr>
<th>Parameter (%)</th>
<th>Cashew Pomace flour</th>
<th>Wheat flour</th>
</tr>
</thead>
<tbody>
<tr>
<td>Moisture</td>
<td>8.0 ± 0.08&lt;sup&gt;b&lt;/sup&gt;</td>
<td>10.0 ± 0.07&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td>Ash</td>
<td>2.6 ± 0.07&lt;sup&gt;a&lt;/sup&gt;</td>
<td>0.9 ± 0.04&lt;sup&gt;b&lt;/sup&gt;</td>
</tr>
<tr>
<td>Crude protein</td>
<td>6.0 ± 0.12&lt;sup&gt;b&lt;/sup&gt;</td>
<td>10.0 ± 0.09&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td>Crude fat</td>
<td>1.2 ± 0.09&lt;sup&gt;b&lt;/sup&gt;</td>
<td>3.2 ± 0.07&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td>Crude fiber</td>
<td>4.0 ± 0.07&lt;sup&gt;a&lt;/sup&gt;</td>
<td>0.4 ± 0.05&lt;sup&gt;b&lt;/sup&gt;</td>
</tr>
<tr>
<td>Carbohydrate</td>
<td>78.2 ± 0.06&lt;sup&gt;a&lt;/sup&gt;</td>
<td>75.5 ± 0.10&lt;sup&gt;b&lt;/sup&gt;</td>
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</table>

Values represent means± SD of 3 replications. Means within a row with the same superscript were not significantly different (P>0.05). SD = standard deviation

Table 2. Functional properties of cashew pomace flour and wheat flour

<table>
<thead>
<tr>
<th>Property</th>
<th>Cashew pomace flour</th>
<th>Wheat flour</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bulk density (g/cm&lt;sup&gt;3&lt;/sup&gt;)</td>
<td>0.69 ± 0.12&lt;sup&gt;a&lt;/sup&gt;</td>
<td>0.72 ± 0.02&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td>Water absorption capacity (%)</td>
<td>164 ± 0.14&lt;sup&gt;a&lt;/sup&gt;</td>
<td>75.0 ± 0.09&lt;sup&gt;b&lt;/sup&gt;</td>
</tr>
<tr>
<td>Oil absorption capacity (%)</td>
<td>95 ± 0.09&lt;sup&gt;a&lt;/sup&gt;</td>
<td>91.0 ± 0.24&lt;sup&gt;b&lt;/sup&gt;</td>
</tr>
<tr>
<td>Emulsion activity (%)</td>
<td>29.13 ± 0.21&lt;sup&gt;b&lt;/sup&gt;</td>
<td>37.0 ± 0.07&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td>Emulsion stability (%)</td>
<td>6.27 ± 0.12&lt;sup&gt;b&lt;/sup&gt;</td>
<td>40.0 ± 0.13&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td>Foaming capacity (%)</td>
<td>20 ± 0.12&lt;sup&gt;b&lt;/sup&gt;</td>
<td>61.0 ± 0.4&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td>Foam stability (%)</td>
<td>16.5 ± 0.08&lt;sup&gt;b&lt;/sup&gt;</td>
<td>40.02± 0.21&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td>Least gelation concentration (%)</td>
<td>8.0± 0.08&lt;sup&gt;b&lt;/sup&gt;</td>
<td>10.0 ± 0.21&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
</tbody>
</table>

Values represent means ± SD of 3 replications. Means within a row with the same superscript were not significantly different (P>0.05). SD = standard deviation.
Table 3. Pasting characteristics of cashew pomace flour, wheat flour and the blends

<table>
<thead>
<tr>
<th>Property</th>
<th>0:100</th>
<th>20:80</th>
<th>30:70</th>
<th>40:60</th>
<th>50:50</th>
</tr>
</thead>
<tbody>
<tr>
<td>PV (RVU)</td>
<td>121.25 ± 0.1&lt;sup&gt;a&lt;/sup&gt;</td>
<td>5.42 ± 0.3&lt;sup&gt;e&lt;/sup&gt;</td>
<td>67.67 ± 0.2&lt;sup&gt;b&lt;/sup&gt;</td>
<td>52 ± 0.1&lt;sup&gt;c&lt;/sup&gt;</td>
<td>26.4 ± 0.3&lt;sup&gt;d&lt;/sup&gt;</td>
</tr>
<tr>
<td>PTE (°C)</td>
<td>80.4 ± 0.3&lt;sup&gt;b&lt;/sup&gt;</td>
<td>82.5 ± 0.1&lt;sup&gt;ab&lt;/sup&gt;</td>
<td>83.6 ± 0.4&lt;sup&gt;a&lt;/sup&gt;</td>
<td>83.95 ± 0.2&lt;sup&gt;a&lt;/sup&gt;</td>
<td>84.5 ± 0.1&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td>PTI (Min)</td>
<td>5.67 ± 0.4&lt;sup&gt;b&lt;/sup&gt;</td>
<td>6.6 ± 0.2&lt;sup&gt;a&lt;/sup&gt;</td>
<td>5.47 ± 0.1&lt;sup&gt;b&lt;/sup&gt;</td>
<td>5.3 ± 0.1&lt;sup&gt;b&lt;/sup&gt;</td>
<td>13 ± 20.2&lt;sup&gt;b&lt;/sup&gt;</td>
</tr>
<tr>
<td>TV (RVU)</td>
<td>66.67 ± 0.2&lt;sup&gt;a&lt;/sup&gt;</td>
<td>4.17 ± 0.1&lt;sup&gt;e&lt;/sup&gt;</td>
<td>41.33 ± 0.2&lt;sup&gt;b&lt;/sup&gt;</td>
<td>31.4 ± 0.2&lt;sup&gt;c&lt;/sup&gt;</td>
<td>18.2 ± 0.4&lt;sup&gt;d&lt;/sup&gt;</td>
</tr>
<tr>
<td>BDV (RVU)</td>
<td>54.58 ± 0.1&lt;sup&gt;a&lt;/sup&gt;</td>
<td>1.25 ± 0.2&lt;sup&gt;e&lt;/sup&gt;</td>
<td>26.34 ± 0.3&lt;sup&gt;b&lt;/sup&gt;</td>
<td>20.24 ± 0.1&lt;sup&gt;c&lt;/sup&gt;</td>
<td>8.25 ± 0.1&lt;sup&gt;d&lt;/sup&gt;</td>
</tr>
<tr>
<td>FV (RVU)</td>
<td>146.17 ± 0.5&lt;sup&gt;a&lt;/sup&gt;</td>
<td>5.5 ± 0.1&lt;sup&gt;e&lt;/sup&gt;</td>
<td>76.26 ± 0.4&lt;sup&gt;b&lt;/sup&gt;</td>
<td>66.62 ± 0.2&lt;sup&gt;c&lt;/sup&gt;</td>
<td>32.20&lt;sup&gt;1d&lt;/sup&gt;</td>
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<tr>
<td>SBV (RVU)</td>
<td>79.5 ± 0.1&lt;sup&gt;a&lt;/sup&gt;</td>
<td>1.33 ± 0.4&lt;sup&gt;e&lt;/sup&gt;</td>
<td>34.92 ± 0.1&lt;sup&gt;b&lt;/sup&gt;</td>
<td>24.92 ± 0.1&lt;sup&gt;c&lt;/sup&gt;</td>
<td>13.8 ± 0.5&lt;sup&gt;d&lt;/sup&gt;</td>
</tr>
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</table>

Means ± SD of 3 replications. Means within a row with the same superscript were not significantly different (P>0.05). PV = Peak viscosity, PTE = pasting temperature, PTI = pasting time, TV = Trough viscosity, BDV = Break down viscosity, FV = Final viscosity, SBV = Set back viscosity, CPF = cashew pomace flour, WF = Wheat flour. SD=standard deviation.