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Physicochemical properties of *Gurasa* (traditional flat bread) using flour blends of wheat cultivars, pearl millet and cowpea

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Abstract

Gurasa is a traditionally flat bread in the northern part of Nigeria, particularly Kano State. The main objective of the study was to determine the wheat grain quality and to produce gurasa from the blends of wheat, pearl millet and cowpea. The wheat grain was evaluated for physical (test weight, weight and volume), particle size distribution, pasting and thermal properties, gluten index and alveograph properties of the flour samples. Composite flours of Atilla, millet and cowpea at ratio of 49:21:30% was used to produce gurasa. The test weight of the raw wheat grains had a moisture content of 13.11 to 10.90%, 1000 grain weight of 39.23 to 37.40g, density 0.82 to 0.80g/m^3, virtuousness (speckled appearance 5.13 to 4.97%, and starchy appearance 95.03 to 94.87%). The Atilla had low speckled appearance (4.97%) and high percentage of starchy appearance 95.03%, with a crude protein of 11.55%, fat 1.42% and higher carbohydrate and energy values of 73.23% and 351.90kcal respectively, while grain legume (cowpea) had the highest protein of 18.34% than the cereal grains. The blends (49:21:30%) flour colour had a lightness (L) values of (86.80), greenness (A*) of (0.59), and yellowness (B*) colour of 11.48, dough exerted pressure (P*) of 77.00 and dough extensibility (L*) of 43, and alveograph (elasticity resistance (Le*) of 56.60 and strength (W*) of 146.00), with gluten index of 68.32%, falling number 280.04 and starch damage matics of 8.18% and a pasting temperature of 87.30^{o}C, and the blends (49:21:30%) required the least amount of cooking time. Alveograph shows that atilla flour is suitable for bread, flat bread and bakery products. Atilla gan atilla and the blends had strong α-amylase activity, indicating that their falling number was within the range of 250 – 350, but Seri-M82 and Cetia exhibited low values. Atilla gan atilla possessed all the quality parameter of bread flour when compared with Seri-M82 and cetia. Atiila gan atilla had higher activity of α-amylase, with less starch damage and able to trap the gas produce during fermentation.*

***Key words**: Wheat, Millet, Cowpea, Alveograph, Pasting profile*

Introduction

The most important food crops in the world that provide more nutrients than any other single dietary source are cereals. The common cereal crops that are cultivated worldwide and most significant (FAO, 2015) are wheat, rice, maize, pearl millet, sorghum, barley, oats and rye. These cereal crops provide calories, proteins, vitamins and minerals to humans, particularly those in Asia and Africa. Wheat flour contains approximately72, 13, 12, 2.5, 1.5 and 0.5% carbohydrates, protein, moisture, sugar, fat and mineral salts respectively (Oberoi *et al.*, 2007).The flour is primarily utilized either as a whole wheat flour or refined flour or flour mixes with other flours in the production of leavened and unleavened bread, and other baked products (Gocmen *et al.*, 2009, Gujral and Pathak 2002). There are different types of flat bread based on their composition, technique, and quality such as *Tortilla, Chapati, Pita, Parotta, Yufka, Tandoori Roti, Kulcha, Chapathi, Parotta* and *Parotta* (Gocmen *et al.*, 2009). The common flat bread in Nigeria is *gurasa* which has been described by Dandago and Igwe (2012) as indigenous flat bread, produced by blending wheat flour, water, and salt or sugar and kneading to form dough. The dough is fermented using yeast (*Saccaromyces cerevisiae)* for a specific period of time to form a light and porous structure, baked in a clay pot known as *Tanderu*, heated from within with cornstalk fire or firewood. Inspite of the successive government in Nigeria spending a lot of money on wheat cultivation programmes; most of the wheat flour consumed is imported, which drains the foreign exchange. Attempts had been made to manufacture bread and other baked food products using composite flour by partial substitution of wheat flour with flours of cassava, pearl millet, sorghum or cereal grain/starchy materials, which can reduce the cost of production and increase the profit margin. The substitution of cereal grain with cowpea in baked foods will enhance the utilization of local crops as raw materials and improve the nutritive quality of baked products. The inherent deficiencies of essential amino acids in cereal flour (lysine, and tryptophan) are offset by supplementation with grain legumes such as cowpea (McWatters *et al.*, 2003). Information on effect of wheat, millet and cowpea composition on the quality of *gurasa* is lacking. There is therefore a research need to fill the gap. The main objectives are to determine the wheat grain quality and to produce *gurasa* from the blends of wheat, pearl millet and cowpea flours.

Materials and Methods

The study investigated three different wheat cultivars (seri-M82, Cettia, and Atilla gan Atilla), pearl millet, and cowpea. Cowpea was obtained from International Institute of Tropical Agriculture Kano, Kano State, Nigeria. While other grains were procured from Lake Chad Research Institute Maiduguri, Borno State Nigeria

Test Weight

The test weight of the wheat grains was determined using the procedure of American Association of Cereal Chemists (55-10 approved method), and recorded in grammes (Siddiq *et al*. 2009). One thousand kernel weight test was determined as reported by (Akpata, and Akubor, 2000). Degree of virtuousness was determined manually by sorting kernels into two groups; vitreous or free of starchy or speckled appearance, and mealy, or having a starchy appearance (Akpata, and Akubor, 2000, AOAC 2000).

Proximate Analysis

The proximate composition (moisture, crude fat, crude protein, ash, crude fibre and carbohydrate) of the raw materials was determined using AOAC (2006).

Determination of energy values

Atwater formula was to calculate energy as follows;

$$E = Protien\ \times 4\ + Carbohydrate\ \times 4\ + fat\ \times 9 = Energy\ \text{(kcal)}$$

Where, E is the energy value.

Determination of flour Alveograph properties

The procedure outlined by Wheat marketing center (2004) was used to determine the flour alveograph. 250 grammes of flour were sampled and combined with a salt solution to form five circular dough patties of about 4.5 cm in diameter, and they were allowed to rest in the alveograph for 20 minutes at 25°C in a temperature-controlled compartment. Each dough patty was examined separately. An air bubble that eventually bursed was formed when the alveograph blew air into a dough patty. On graph paper, a curve representing the pressure inside the bubble was recorded. The alveograph measures the force necessary to blow and burst a dough bubble in order to estimate the gluten strength of dough. The outcomes come with P, L, and W Values.

Determination of Gluten (Hand washing method)

Using this method of codex alimentarius standard established in (2008), 10g of wheat flour was weighted and placed in a dish, sufficient water of approximately 5 to 6mls added and mixed to form firm dough, allowed to rest for 20 to 30mins to permit complete hydration of the gluten proteins. The dough was placed under a gentle stream of water and washed carefully by hand to remove starch and water soluble materials, continue washing until the wash water is cleared and only the cohesive gluten mass remains. Excess water was removed by gentle pressing the gluten between the palms, weighed the recovered wet gluten. Evaluate the gluten quality manually by observing its elasticity, extensibility and cohesiveness.

$$\text{Wet Gluten (\%)} = \frac{\text{Total wet gluten weight (g)}}{sample\ weight\ (g)} \times \frac{100 - M}{100\ - 14} \times 100$$

Where, M is the actual moisture content of flour or wheat sample

Color Measurement of Flour blends and *Gurasa*

The colour of the crust was measured with a Minolta chroma meter colorimeter (CR-300, Minolta, Osaka, Japan). This gave a numerical definition of colour using the concepts of lightness or L* value, a chromatic colour from absolute black (0) to absolute white (100), a* means mixed red-to—green colour of samples ranging from negative value on the red side to positive on the green side (a+ = 0 to100 for red and a- = 0 to -100 for green) and b* value means mixed blue-to-yellow colour of samples ranging from negative to positive value (b+ = 0 to100) for yellow and b- = 0 to -100) for blue. Each sample of *gurasa* was placed in penetrometer that recorded the values of crust and crum colour appearance.

Determination of Falling Number

Using a method described by Wheat marketing center (2004). Falling number was determined by a glass of falling number tube with a stirrer, seven (7) grammes of milled flour sample were weighed, added to 25 ml of distilled water, and shaken to form slurry. The starch gelatinized and thickened when the blends were heated to100^{o}C in a water bath of warm temperature, while being constantly stirred. Values and time recorded while stirrer passed through the paste. The gadget measures the resistance of the mixture (flour and water) to a falling number stirrer to determine viscosity.

Determination of mean particle size

Using a sieve analysis approach and an Endecotts Test Sieve Shaker (model 1 MK11-11381, London, UK), the particle size distribution of flour (250 g) from each production method was determined. Pan and sieves with various apertures (500, 450, 320, 224, 180, 150μ) were employed after being shaken for10 minutes. The flour that was kept on each sieve was weighed and the mean particle size (MPS) was calculated using the. Arambula *et al.* (2000) method

The following formula for mean particle size

$$(MPS) = (W1d1 + W2d2 + \cdots + W5d5)/R$$

Where,

W1-5 = weight of flour through each sieve

d1-5 = diameter of mesh for each sieve
R = total recovery.

Determination of Pasting Profile and Thermal Characteristics

The Rapid Viscometer-Analyser (Model RVA series 4; Newport Scientific Pty Ltd., Warriewood, Australia) was used to determine pasting properties of the blends (wheat flour, pearl millet flour and cowpea flour), according to (Mesquita *et al*.,2016). An aluminum canister containing 25 g of distilled water was filled with a 3 g sample. The samples were examined in accordance with Standard Profile 1, which calls for the suspension of flour and water to stand at 50^{o}C for 1 minute before being heated to 95^{o}C for 10 minutes, cooled to 50^{o}C, and then held there for an additional 2 minutes. Pasting temperature, peak, breakdown, final, and setback viscosities were the starch viscosity parameters expressed as RVU while pasting temperature was given in ^{o}C.

Statistical Analysis

Data generated was subjected to analysis of variance, means and standard deviations were obtained with instant statistical software.

Results and Discussion

Test weight and virtuousness of the raw wheat grains

The test weight and virtuousness of the raw wheat grains are shown in Table 1. The moisture content of wheat grains, 1000 grain weight, density, speckled appearance and starchy appearance were 10.90 to 13.11%, 37.40 to 39.23g, 0.80 to 0.82g/m^3, 4.97 to 5.13%, and 94.87 to 95.03%, respectively. Between the raw wheat grains, there was a significant difference (p≥0.05) of percentage moisture content of the grain. According to Brennan *et al.* (2012), the variations in wheat grains are probably caused by genotypic variations. With values ranging from 37.40g (cetia) to 39.23g (atilla), the 1000grain weight shows a significant difference (p≥0.05).Table 1 showed that Atilla had the highest, but cetia had the least. Between the samples, atilla and Seri-M82, the grain density indicated no significant difference (P≤0.05), although there was a significant difference from cetia. According to El-Khayat *et al*. (2006), Asaleh and Gallant (1985), and El-Khayat *et al*. (2003), the degree of virtuousness (speckle and starchy appearance) is an important factor in the determining the grain quality since it represent the endosperm's texture and, thus, the final usage of the wheat. Atilla gan atilla had the lowest proportion of speckled appearance and had the highest proportion of starchy appearance of (95.03%). Variation in virtuousness both in the speckled and starchy appearance showed no significant difference (p≥0.05) with all the raw wheat grains in respect to virtuousness. The Atilla (4.97%), Seri-m82 (5.12%) and Cetia (5.13%) had low speckled appearance with atilla having the highest percentage of starchy appearance in all the wheat grains. The results showed that the higher the percentage of the starchy appearance, the less the percentage of the speckled appearance.

Table 1. Test Weight and Virtuousness of the Raw Wheat Grains

S/n	Sample	Moisture, %	1000grain weight, g	Grain density, g/m^3	Degree of virtuousness	
					Speckled appearance, %	Starchy appearance, %
I	Atilla gan atilla	10.90±0.10^c	39.23±0.05^a	0.82±0.07^a	4.97±0.05^a	95.03±0.05^a
II	Seri-M82	13.11±0.02^a	39.03±0.05^b	0.82±0.07^a	5.12±0.23^a	94.83±0.23^a
III	Cetia	12.43±0.03^b	37.40±0.10^c	0.80±0.07^b	5.13±0.11^a	94.87±0.11^a

Values are means ± standard deviation of three replicates. Means followed by the same superscripts within the column are not significantly different (P≥0.05).

Proximate composition of raw materials

The proximate composition of the cereals grains and grain legume (cowpea) as shown in Table 2 were significantly amongst the various samples. The moisture content varied from 10.12 to 13.11 %, with the cereal grains having the highest moisture content compared with the legumes. Crude protein ranged from 9.83 to 18.34% with the grain legume having the highest value when with the cereal grains. This is consistent with the findings of Hall *et.al* (2003) that reported the protein content of twelve (12) cultivars of legume grains from West Africa and the United States as ranging from 17 to 29%. However, there was no significant difference (P≥0.05), between Cetia (10.51%) and Pearl millet (10.60%). Crude fat values of 1.33 to 1.81% was recorded with the higher fat contents attributed to legume grain (cowpea) 1.81% and pearl millet 1.76% than with the wheat grains. Pearl millet and cowpea had the highest fibre contents when compared with the wheat grains 2.22 to 2.34%. Wheat grains fibre contents were significantly different (P≤0.05). Ash contents varied from 0.64 to 2.65%. With Atilla gan atilla and Seri-m82 showing no significant difference (P≥0.05). Carbohydrate contents varied from 63.03 to 73.23% with cowpea having the least value of 63.03%. The low carbohydrate content of cowpea was attributed to the high level of protein (23.34%). Energy values ranged from 341.97 to 351.90 kcal

Table 2. Proximate Composition and Energy Values of the Raw Materials

Raw materials	Moisture %	Crude protein %	Crude fat %	Fibre %	Ash %	Carbohydrate %	Energy (kcal)
Wheat cultivars							
Atilla gan atilla	10.90±0.10[c]	11.55±0.01[b]	1.42±0.01[c]	2.22±0.01[e]	0.68±5.77[c]	73.23±0.09[a]	351.90±0,10[a]
Seri-m82	13.11±0.02[a]	9.83±0.03[d]	1.33±0.01[e]	2.34±0.01[c]	0.70±5.77[c]	72.67±0.04[b]	341.97±0.02[e]
Cetia	12.43±0.03[b]	10.51±0.01[c]	1.36±0.01[d]	2.25±0.00[d]	0.64±5.77[d]	72.81±0.03[b]	345.52±0.03[c]
Pearl millet	10.50±0.02[d]	10.60±0.17[c]	1.76±0.02[b]	3.23±0.03[b]	2.65±0.03[a]	71.26±0.11[c]	343.28±0.04[d]
Cowpea	10.12±0.02[e]	18.34±0.14[a]	1.81±0.01[a]	4.25±0.05[a]	2.45±0.02[b]	63.03±0.14[d]	341.77±0.02[b]

Values are means ± standard deviation of three replicates. Means followed by the same superscripts within the column are not significantly different (P≥0.05).

Alveograph and colour measurement of the Flour and Flour blends

The colour measurements of the wheat flour and its composites (wheat, millet, and cowpea flour) are shown in Table 3. According to Amir *et al*. (2015), color is an important physical parameter that is directly associated to the acceptability of food and food products. The lightness (L*) values ranged from 86.80 to 89.90. The lightness (L*) values of *gurasa* blends; 49:21:30% and 100% atilla were higher than those or blend of 100% seri-m82 and 100% cetia. When compared to samples Atilla, seri-m82 and cetia, the blends sample of 49:21:30%, which was the flour composite with 86.80 (L*) value, was slightly lighter. This was due to the blends of atilla gan atilla, millet and cowpea flour when compared with samples atilla, seri-m82 and cetia at 100%. The greenness (a*) values ranged from 0.40 to 0.59. The greenness (a*) values for all the samples indicate that the colour is slightly green, which was due to the presence of green colour of millet while all the yellowness (b*) values show slightly yellow which ranged from 10.79 to 11.48. The colour measurement shows that blend formulation of 49:21:30% which was the flour composite was adjusted with spraying of white atilla flour during production to achieve a desirable light or bright colour of the product (*gurasa*). Significant (p≤0.05) variations were observed in all the colour parameters. This also shows that lightness and yellowness of the flour samples at 100% atilla, seri-m82 and cetia were greater than the blends sample of 49:21:30% of the flour composite. The composite flour had increased greenness (*A*)* and yellowness (*B*)* when compared with the 100% wheat flour. This was due to incorporation of millet and cowpea into the wheat flour. Singh *et al.,* (2008), incorporated sweet potato flour in to wheat flour to assess the quality of cookies. The composite flour had increased level of greenness (*A*)* and yellowness (*B*)* values when compared to the 100% wheat flour due to addition of millet and cowpea. Alveograph results showed that the flour samples had remarkable bread making potential, ranging from poor to very good. The alveograph test results show there was a significant difference (p≥0.05) in flour classification. The work (W) was the baking strength of the dough and or energy value. The baking strength depends on protein quantity and quality, starch damage, and enzymes interactions. Sample Atilla at 100% value (242.0) for W indicated very good strong flour, and samples Seri-M82 100% and Cetia 100% with 140.0 and 153.0 showed an intermediate (fairly strong and not weak), which was significant (p≥0.05). In addition, Atilla flour is suitable for bread, flat bread and bakery products. The W, P, and L values made a strong elastic dough, with excellent bread making potential with high pressure (P = 80.02) and a long time (L = 76.13) to burst. Seri-M82 and Cetia parameters show characteristics that made toughen elastic dough, with high pressure and a short time to burst. The alveograph of the flours and the blends test results indicates the flours behavior and its functional characteristic suitable for *gurasa* production.

Table 3. Alveograph and colour measurement of the Flour and Flour blends

FLOURS					COLOUR					Alveograph			
Atilla	Serim82	Cetia	Millet	Cowpea	L	A	B	P(mmH20)	L(mm)	G	W(10^{-4}J)	P/L	Le(%)
100	0	0	0	0	89.90±0.03^{a}	0.52±0.00^{b}	10.79±0.01^{d}	80.02±0.02^{c}	76.00±0.12^{a}	19.40±0.03^{a}	242.00±0.45^{a}	1.05±0.0^{d}	65.70±0.0^{a}
0	100	0	0	0	88.88±0.02^{c}	0.42±0.02^{c}	11.25±0.02^{b}	93.00±0.23^{a}	33.00±0.05^{d}	12.80±0.10^{d}	140.00±0.22^{c}	2.82±0.02^{a}	0.00±0.00^{c}
0	0	100	0	0	89.63±0.02^{b}	0.40±0.02^{d}	11.01±0.02^{a}	88.00±0.02^{b}	39.00±0.05^{c}	13.90±0.02^{c}	153,00±0.42^{b}	2.26±0.0^{b}	0.00±0.00^{c}
49	0	0	21	30	86.80±0.02^{d}	0.59±0.01^{a}	11.48±0.02^{c}	77.00±0.03^{d}	43.00±0.18^{b}	14.60±0.02^{b}	146.00±0.50^{d}	1.79±0.03^{c}	56.60±0.0^{b}

Values are means ± standard deviation of three replicates. Means followed by the same superscripts within the column are not significantly different (P≥0.05), * *L** lightness, *A** greenness, *B** yellowness, P* pressure, L* dough extensibility, Le* elasticity resistance, W* strength

Gluten Index and Falling Number of Wheat Flour and Blends

The gluten index and falling number of flour and flour blends are shown in Table 4. The wet gluten contents ranged from 24.42 to 29.30%, while dry gluten content varied from 8.40 to 9.45%, and gluten index varied from 62.46 to 68.32%. Falling number varied from 280.04 to 357.61% (P<0.05), and starch damage matics were between 7.23 and 8.18%. Wet gluten level in wheat flour typically ranged from 25% - 30%, but some exceed 35%, which showed that the wheat grain is extremely very weak and unable to hold onto gas during fermentation. This minimum gluten content of wheat flour was found by Singh (2006) to be 24% (wet) and 8% (dry). Falling numbers varied from 250 to 350, greater numbers have a negative impact on baking characteristics. Atilla gan atilla (325.39s) fell behind Seri-M82 (357.61s), Cetia (355.04s), and blends (49:21:30%), which was (280.04s). The dropping number was lower in the blends sample of 49:21:30%. Atilla gan atilla and the blends had strong α-amylase activity, indicating that their falling number was within the range of 250 – 350, but Seri-M82 and Cetia exhibited low. Amylase activity shows that their falling number was greater than 350, indicating weak dough. The degree of starch damage in the flour is displayed by starch damage matics. When compared to Cetia, which had the least starch damage, blends (49:21:30%) had the highest starch damage. These showed that, in line with the findings of León et al. (2006), wheat cultivars with lower falling number may have greater level of damaged starch content in wheat endosperm. Additionally, these correlations between starch degradation and the falling number were discovered after repeated milling, which produced statistically more flour than regular milling. It was confirmed that tightening the rollers and speeding up the feed lead causes more damaged starch to be present (Miller, 2017).

Table 4. Gluten Index and Falling Number of the Flour and Flour Blends

Atilla	Serim 82	Cetia	Millet	Cowpea	Wet gluten (%)	Dry gluten(%)	Gluten index (%)	Falling number (sec)	Starch damage matics(%)
100	0	0	0	0	27.02±0.02[b]	9.08±0.01[b]	65.72±0.03[b]	325.39±0.13[c]	7.90±0.01[b]
0	100	0	0	0	24.42±0.03[d]	8.40±0.04[d]	60.09±0.10[d]	357.61±0.09[a]	7.23±0.03[c]
0	0	100	0	0	26.52±0.02[c]	8.77±0.03[c]	62.46±0.04[c]	355.04±0.04[b]	8.08±0.02[a]
49	0	0	21	30	29.30±0.10[a]	9.45±0.02[a]	68.32±0.01[a]	280.04±0.01[d]	8.18±0.02[a]

Values are means ± standard deviation of three replicates. Means followed by the same superscripts within the column are not significantly different at (P≥0.05), level.

Particle Size (granulation) of the Wheat Flour and Blends

The Particle Size (granulation) of wheat flour and Blends used for the *gurasa* production are shown in Table 5. The granulation ranged from 0.00 to 0.06 at 550µ, 0.06 to 0.11 at 450µ, 0.02 to 0.84 at 320µ, 0.05 to 1.82 at 224µ, 0.24 to 5.68 at 180µ, 4.76 to 7.24 at 150µ, and 83.86 to 94.40 at base, respectively. At a sieve of 550µ, there was significantly different (p≤0.05). The sieves of 450µ, 320µ, 224µ, 180µ, 150µ and base have different pore size. Negligible amount of the flour blends flour of 0.06 was retained and weight with 550µ size. Atilla gan atilla, Seri-M82, Cetia, Millet and Cowpea at 100% granulation were successful milled and screen with 6.81, 4.76, 6.72, 7.24 and 5.26g that were retained in a 150µ sieves mesh, 7.08g was also retained in 150µ, significantly different (p≤0.05). The base consists of 92.27, 94.40, 93.33, 83.86, 90.13 and 89.39g collected. Some proportions of millet, cowpea and the blends (49:21:30%) were significantly (p≥0.05) retained at 320µ mesh with 0.84, 0.63 and 0.58g, respectively. the sieve of 224µ retained1.82, 0.74 and 0.66g, 180µ sieve mesh from 5.68, 2.45 and 1.81g and 150µ 7.24, 5.26 and 7.08g retained. Granulation retention from 320µ, 224µ, 180µ, 150µ was probably due to fibre present, that are harder to ground fine, resulting in larger particles size of millet, cowpea, and blends (49:21:30%). It was well known that the type and effectiveness of the machine used during a milling operation determine the degree of flour fineness (Oladunmoye *et al*., 2010). Wheat flour with smaller particles was produced because of the small grain size, and conditioning of wheat grains before milling. Table 5 shows that the proportion of the blends (49:21:30%) flour increase significantly (p≤0.05), which was due to increase in the proportion of millet and cowpea, which went from 0.84 to 7.24g and 0.63 to 5.26g, respectively, through sieves of 320µ, 224µ, 180µ, and 150µ . This is consistent with the report by Lesege (2014), who found that when morama beans composite flour, the pattern of particle size distribution with different sieve sizes was shifted from the lower size to the upper sieve size category. According to United Nations Economic Commission (1985), wheat flour meant for making bread, biscuits, and other pastries should have particle sizes of around 130 µm.

Table 5. Particle Size (granulation) of the Flours and Flour Blends

FFN	Flours					Particle size (µ)						
	Atilla	Serim82	Cetia	Millet	Cowpea	550µ	450µ	320µ	224µ	180µ	150µ	Base
I	100	0	0	0	0	$0.00{\pm}0.00^{a}$	$0.00{\pm}0.00^{d}$	$0.02{\pm}0.00^{e}$	$0.05{\pm}0.00^{e}$	$0.26{\pm}0.01^{d}$	$6.81{\pm}0.02^{b}$	$92.27{\pm}0.03^{c}$
II	0	100	0	0	0	$0.00{\pm}0.00_{a}$	$0.00{\pm}0.00^{d}$	$0.04{\pm}0.00^{d}$	$0.05{\pm}0.00^{e}$	$0.24{\pm}0.00^{d}$	$4.76{\pm}0.02^{d}$	$94.40{\pm}0.52^{a}$
III	0	0	100	0	0	$0.00{\pm}0.00^{a}$	$0.00{\pm}0.00^{d}$	$0.04{\pm}0.00^{d}$	$0.07{\pm}0.00^{d}$	$0.23{\pm}0.03^{d}$	$6.72{\pm}0.23^{b}$	$93.33{\pm}0.24^{b}$
IV	0	0	0	100	0	$0.00{\pm}0.00^{a}$	$0.11{\pm}0.02^{a}$	$0.84{\pm}0.02^{a}$	$1.82{\pm}0.02^{a}$	$5.68{\pm}0.02^{a}$	$7.24{\pm}0.03^{a}$	$83.86{\pm}0.15^{f}$
V	0	0	0	0	100	$0.00{\pm}0.00^{a}$	$0.08{\pm}0.00^{b}$	$0.63{\pm}0.02^{b}$	$0.74{\pm}0.02^{b}$	$2.45{\pm}0.02^{b}$	$5.26{\pm}0.05^{c}$	$90.13{\pm}0.03^{d}$
VI	49	0	0	21	30	$0.06{\pm}0.00^{a}$	$0.06{\pm}0.00^{c}$	$0.58{\pm}5.77^{c}$	$0.66{\pm}5.77^{c}$	$1.81{\pm}0.25^{c}$	$7.08{\pm}0.00^{a}$	$89.39{\pm}0.23^{e}$

Values are means ± standard deviation of three replicates. Means followed by the same superscripts within the column are not significantly different at (P≥0.05), level. *= Flour Formulation Number

Pasting and thermal characteristics of Flours and Flour Blends

The pasting and thermal properties of wheat flours and blends are shown in Table 6. Pasting temperatures ranged from 87.30 to 94.60°C, and the blends (49:21:30%) required the least amount of cooking time. This may be due to the proportions of the wheat flour with pearl millet and cowpea. However, the composite flour had the least pasting temperature of 87.30°C as compared with Atilla gan atilla (94.60°C), Seri-M82 (94.45°C) and Cetia (94.50°C) that exhibited higher pasting temperature. There was significantly different ($p \leq 0.05$) between the wheat flour and the blends. This result was in lined with Sim *et al*. (2009), who found that the addition of hydrochloride, ionic gum to commercial wheat flour delayed the swelling of starch granules and that the gel formation that occurred in all of the samples when the temperature was lowered. A higher pasting temperature led to a higher ultimate velocity, which ranged from 152.08 to 196.67RVU. When compared to samples Atilla gan atilla, Seri-M82, and Cetia, the blends exhibited a lower viscosity. The starch granules can swell to their maximal capacity at greater final viscosities. This shows that Atilla gan atilla (100%) had the highest final velocity showing that the starch granules can swell very quickly towards or above the gelatinization temperatures, resulting in an increased in the final velocity. This was not observed with blends (49:21:30%) due to substitution with pearl millet and cowpea flour, respectively. Greater ultimate velocity was shown by Atilla gan atilla than the blends. The starch granules in the flour may be competing with fiber, lipids, and ash for water absorption, preventing the starch granules from expanding (Nimsung *et al*, 2007).The lower the paste viscosity may be cause by the stirring effect. The starch granules in the paste rupture as a result of continual heating decreasing the paste viscosity. Blends had the lowest final viscosity value (49:21:30%), indicating that it has a lower ability than other samples to form a viscous paste. Additionally, blends made of millet and cowpea showed a lower final viscosity than the samples Seri-M82, Atilla gan atilla, and Cetia, respectively. The ease with which the enlarged granules can be broken-down is measured by the breakdown parameter (Kaur and Singh, 2005). The breakdown was in the 92.42 to 98.00RVU range. According to Kaur and Singh (2005), breakdown is a method for disintegrating swollen granules. Atilla gan atilla graph had a peak of 196.33 with a breakdown of 92.42; Seri-M82 graph had 183.75RVU with a breakdown of 95.17RVU, Cetia graph had 193.42RVU with a breakdown of 97.83RVU, and blends had a constant peak of 161.83RVU with a breakdown of 98.00RVU. The composites flours have different pasting qualities from wheat flour. Peak viscosity, which is determined as the highest value of viscosity obtained by the paste during the heating cycle (50- 95 ºC), is a sign of the strength of pastes that are formed from gelatinization during processing in culinary applications (Adebowale *et al*., 2008). Higher solubility due to starch degradation causes reduced paste viscosity, but higher solubility due to granule swelling (Table 6) and swelling capacity are predictive of higher peak viscosity (Shittu *et al*., 2001).

Table 6. Pasting and thermal characteristics of Flours and Flour Blends.

Atilla	Serim 82	Cetia	Millet	Cowpea	Peak 1	Trough 1	Breakdown	Final Viscosity(RVU)	Setback	Peak Time	Pasting Temp.(ºC)
100	0	0	0	0	196.33±8.19^{a}	103.92±7.92^{a}	92.42±0.53^{d}	196.67±6.82^{a}	92.75±1.00^{a}	6.20±0.06^{a}	94.60±0.59^{a}
0	100	0	0	0	183.75±7.13^{c}	88.58±5.00^{c}	95.17±2.00^{c}	176.83±5.23^{c}	88.25±3.00^{c}	5.93±0.20^{b}	94.45±0.30^{a}
0	0	100	0	0	193.42±7.88^{b}	95.58±6.01^{b}	97.83±3.00^{b}	187.42±6.81^{b}	91.83±2.00^{b}	6.07±0.01^{a}	94.50±0.10^{a}
49	0	0	21	30	161.83±5.80^{d}	63.83±4.90^{d}	98.00±3.45^{a}	152.08±4.91^{d}	88.25±0.03^{c}	5.00±0.03^{c}	87.30±0.02^{b}

Values are means ± standard deviation of three replicates. Means followed by the same superscripts within the column are not significantly different at (P≥0.05), level.

Conclusion

Atilla gan atilla had the lowest proportion of speckled appearance and highest starchy appearance. The grain legume had the highest protein of (18.34%) as compared with the cereal grains. Lightness and yellowness of the flour samples at 100% were greater than the blends sample (49:21:30%). Alveograph shows that atilla flour was suitable for bread, flat bread and bakery products. The W, P, and L values made a strong elastic dough, with excellent bread making potential with high pressure (P = 80.02) and a long time (L = 76.13) to burst. Atilla gan atilla and the blends had strong α-amylase activity, indicating that their falling number was within the range of 250 – 350. It was observed that Atilla gan atilla possessed all the quality parameter of bread flour when compared with Seri-M82 and cetia.

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