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EVALUATION OF BREAD MAKING PERFORMANCE OF SOME WHEAT FLOUR BRANDS AVAILABLE IN NIGERIAN MARKETS AS AFFECTED BY CASSAVA OR SWEET POTATO FLOUR INCLUSION

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ABSTRACT

The study examined the baking potential of wheat flour brands available in Nigerian markets and their performance in composite flour bread. Three flour brands were identified and selected based on availability and popularity: Dangote (DG) Bread flour, Golden penny (GP) Prime, and Honeywell(HW) Bakers Delight. Cassava (CV) and Sweet Potato (SP) flours were separately blended with each of the selected wheat flour brands in a ratio of 80:20 to obtain six formulations code named: DG, GP, HW, DGCV, DGSP, GPCV, GPSP, HWCV, HWSP. Breads were produced using AACC straight dough method. Physicochemical and sensory properties of the flours/flour blends were evaluated using approved procedures. The moisture, crude protein, crude fat, total ash, crude fibre and carbohydrate contents of the wheat and root flours were: 5.35-10.10%, 5.78-14.52%,1.79-3.15%, 0.80-2.59%, 1.77-3.15% and 70.83-81.16% respectively. GP flour had significant higher dry gluten (19.00%), water absorption capacity (2.0ml/g) and HW flour had the highest thoroughs (95%) through 212µm sieve followed by Sweet potato (92.50%) yet none met the Codex Alimentarius standard for wheat flour particle size. The specific volumes of the wheat breads varied significantly ($p<0.05$) from 2.55-3.28ml/g with GP leading, although DG had though had the highest absolute volume, those of composite flour bread (2.16-2.48ml/g) were lower and GP and HW flours produced better composite flour bread with cassava in terms of specific volume. The sensory attributes of GP and HW wheat breads were rated higher which also reflected in higher scores for GPCV and HWCV breads. This study has demonstrated that GP brand of wheat flour had superior bread baking performance either alone or in a blend with 20% cassava flour. It is recommended that further study be carried out involving other brands of wheat flour and other indicators of wheat flour quality.

Contribution/Originality: Some indices of quality for wheat flour brands available in Nigerian markets were characterized, in addition to evaluating their baking strength when blended with either cassava or sweet potato flour. The study provided decision making information for the miller and the end-user, and much needed baseline data for further study, even though the factors governing flour quality are dynamic.

1. INTRODUCTION

Wheat is the third largest grown cereal in the world with global production of about 735 million metric tons (2015/2016); China, India and Russia are the top producers (FAOSTA, 2017). Wheat is of major interest to Nigeria for many reasons, firstly it is an indispensable raw material for numerous wheat millers that furnish different brands of wheat flour available in the Nigerian markets for the production of wheat-based goods and these foods are the lifeline of ever increasing urban dwellers estimated at 50% of the population with heightened crave for ready-to-eat, nutritious and functional foods, consequently a great fortune is spent to satisfy Nigeria's wheat need, the largest consumer of wheat in sub-Saharan Africa behind South Africa (PROSHARE, 2018). Secondly, Nigeria spent between 1.5-1.7 billion US dollar for wheat importation in 2017/2018 and USDA consumption forecast of 5,26m metric tons for 2019/2020 and local production of approximately 60,000 metric tons (Index Mundi, 2017; Miller Magazine, 2019) consequently a recurring huge financial burden is created as a result of yawning gap between wheat supply and demand. Therefore, it is not an overestimation to link nutritional well-being of Nigerians to consumption of wheat-based foods which have displaced indigenous food products made from coarse cereals, roots and tubers. Wheat provides nearly 55% of CHO, 20% of food calorie to more than one-third of world population (Kumar, Yadava, Gollen, Vernma, & Yadava, 2011) on average a wheat kernel contains 78.10%, 14.7% protein, 2.10% fat, 2.10% minerals, and considerable proportions of vitamins (Kumar et al., 2011).

According to Hee-Moon, Joo-Hee, Kim, Jun-Ho, and Byung-Soo (2012) 100g of hard red winter wheat contains 12.6g protein, 1.5g fat, 71g carbohydrate, 12,2g dietary fibre. Prior to 1960, wheat flour and wheat-based food products were imported and the scenario changed with the establishment of Nigeria Flour Mills(FMN) which denominated the grain processing subsector of the economy for decades until new entrants such as Dangote Flour mills, Honeywell Flour mills, Crown Flour mills and other small players came on board, all were milling hard red winter wheat imported from U.S, 90% of wheat imports(2010/2011) and this market share has plunged to 35%(2017) (World-grain, 2018) due to availability of cheaper wheats from Russian, Australia, Argentina, Canada. Currently Nigeria wheat milling capacity is estimated at 8 million tons(wheat equivalent) with Flour Mills Nigeria leading (Miller Magazine, 2019).

According to Foraminifera Research (2016) six top wheat millers by installed capacity were FMN 38%, Dangote mills 18%, Honeywell mills 14%, Crown mills 8%, Ideal mills 7% and Standard mills 7%. Wheat flours of different physical and chemical composition are produced by wheat millers worldwide serving different end-use requirements but in Nigeria markets the commonest flour type is All-purpose flour, about 9-12% gluten content, perhaps produced from a blend of soft and hard wheat therefore suitable for yeast or steamed bread, breakfast cereal, couscous, cakes, biscuits, cookies, pasta and noodles (Araujo et al., 2008) which have become staples in Nigeria. The use of composite flour, a blend of wheat and non-wheat flours for production of wheat-based goods is borne out of necessity to reduce the foreign exchange earning drainage through wheat importation, the need for value addition through utilization of abundant local crops for the manufacture of varied food products, also the enhancement of nutritional profile of wheat-based foods and the need for production of functional foods to curb expanding modern life style related diseases.

Nigeria is the leading producer of such roots and tubers as yam, cassava, sweet potatoes in Africa. Both sweet potato (Ipomoea batatas (L.) Lam) and cassava(Manihot esculenta Crantz) share many common features apart from originating from tropical America, cultivated for their edible starch filled highly perishable modified tuberous roots, the two are important food security crops in Africa, Asia, Latin America. Sweet potato is a dicotyledonous early maturing herb with about 27% carbohydrate(fresh basis) and high concentration of carotenoids, fibre, minerals(calcium & iron), vitamins(A, C) and bioactive compounds such as phenolic acids and anthocyanins (Chandrasekara & Josheph, 2016; Udemezue, 2019). Nigeria is the second largest producer after China of sweet potato in the world with an annual output of 3.49 million tonnes (Udemezue, 2019). On the other hand, cassava is a draught resistant, shrubby perennial staple principally grown in tropical and subtropical areas of the world where under nutrition is endemic (Montagnac, Davis, & Tanumihardjo, 2009) and Nigeria is the leading producer of cassava since 1989, about 20% of global output, 70% of which is consumed as garri and fufu mainly and other forms of food (IITA, 2017). With the availability of high quality cassava flour, the long held idea of commercialization of wheat-cassava composite flour became official policy(Agricultural transformation agenda) in 2012, mandatory inclusion of cassava flour in wheat flour beginning with 10% and ending 40% in 2015. The policy fizzled out due to many factors mainly due to lack of cooperation from the millers despite government incentives and moreover the policy was not enforced. Apart from large scale cultivation of adapted tropical wheat under rain fed agriculture, commercialization of wheat based composite flour for the production of food products is also another viable option.

Many studies on the production of bread from a blend of wheat and tuber flours abound in the literature including wheat-sweet potato bread by Dhaka and Sangeetha (2017); Trejo-González, González, and Mazariegos (2014); Ijah, Auta, Aduloju, and Abiodun (2014); Adebowale, Idow, and Bankole (2009); Adeleke and Odedeji (2010) etc and also wheat-cassava bread by Eddy, Udofia, and Eyo (2007); Shittu, Raji, and Sanni (2007); Nindjin, Amani, and Sindic (2011); Nwosu, Owuamanam, Omeire, and Eke (2014); Oluwole et al. (2017); Agunbiade, Ojezele, and Eze (2017); Lagnika et al. (2019) in all these studies, despite the blending ratio of wheat and tuber flour the re-occurring finding is the drop in bread specific volume or higher density as a result of the dilution of wheat gluten on addition of non-wheat flour (Nindjin et al., 2011) therefore studies such as those of Eduardo, Svanberg, Oliveira, and Ahrné (2013); Sciarini, Ribotta, Leon, and Perez (2012) and Pasqualone et al. (2010) incorporated bread improvers such as hydrocolloids, modified starch, enzymes to mimic the functional role of gluten in order to offset this drawback through improvement of dough viscoelasticity and leavening gas retention (Velupillai, Nithyanantharajah, Vasantharuba, Balakumar, & Arasanratnam, 2010) With the availability of different brands of wheat flour in Nigerian markets, the only factor determining their bread baking strength is the quality and quantity of the gluten content which in turn is determined by the wheat type and the milling process involved. The present study was aimed to compare the bread making capacity of wheat flours brands available in the Nigerian markets and their performance when blended with either cassava or sweet potato flour to produce composite flour bread.

2. MATERIALS AND METHODS

2.1. Collection of Raw Materials

Fresh cassava and yellow fleshed sweet potatoes roots were purchased at Maiduguri Monday Market. Ingredients such as white granulated sugar, dried baker's yeast, common salt, baking fat were purchased at the same market. Three wheat flour brands: Golden penny (GP) Prime, Dangote (DG) Bread Flour and Honeywell Bakers Delight (HW) were deliberately selected based on availability and popularity in the Maiduguri metropolis, they were purchased from retailers at the Ramat shopping center in the months of April-May, 2016.

2.2. Preparation of Cassava and Sweet Potato Flour

The method of Gebremedhin, Kebede, Afework, and Prayya (2013) was applied with slight modification in the preparation of both sweet potato and cassava flour Fresh roots were cleaned, washed, peeled and sliced into irregular slices(approx., 1mm), sweet potato bits were blanched in 1% sodium metabisulphite solution for 5 min to check browning reaction. Cassava and sweet power were separately washed and dried in cabinet dryer at 60°C 10 h. The resulting dried slices were milled and sieved (300µm aperture) to obtain cassava and sweet potato flours, which were placed separately in low density polythene bags prior to use.

2.3. Composite Flour Formulation

Each wheat flour brand from three millers was blended with 20% sweet potato (SP) or cassava (CV) flour. There were six formulations with the following code names: DG, HW and GP were untreated samples flours and DG SP (80.20), DG CV (80.20), HW SP (80:20), HW CV (80:20); GP SP (80:20), GP CV (80:20) were treated. The blends were mixed thoroughly in a kitchen mixer and packaged in low density polyethylene used for physicochemical analysis and bread production.

2.4. Bread Preparation with the Wheat Flour Brands and the Blends

The recipe for the pan bread preparation was used, on 100g flour basis consisted of flour 100g, sugar 7g, yeast 1.5g, fat 5g, salt 1g, water 60-70 ml; the straight dough method of AACC (2005) was adopted to prepare the bread. The ingredients and flour were mixed in a mixing machine to obtain dough which was covered and fermented 90mins at room temperature (28±2°C). The fermented dough was degassed using a rolling pin on a greased board, dough pieces were were, rounded and placed in greased baking pans thereafter given a second fermentation (60 min). The proofed dough pieces were placed in preheated oven (240°C) and baked for 25-30 minutes. The loaves were allowed to cool at room temperature before their weight and volume were taken.

2.5. Gluten Content Determination

Method 38-12A of AACC (2005) was used to determine wet and dried gluten and calculate the yield, using 50-70ml of 2.0% common salt solution was used to prepare a dough using 20g of flour. The dough was immersed in water for 40 min and after which it was washed in a running water until the wash water was clear and the resulting wet gluten was placed between folded tissue and manually dewatered sufficiently to obtain wet gluten. It was weighed and later oven dried at 90°C 5 h to obtain the dried gluten which was dried at 105°C for 6h to obtain the dry gluten.

2.6. Bulk Density and Water Absorption Capacity of the Flours

Bulk density of the flour was determined using the method of Shafi, Baba, and Masoodi (2017) and water absorption capacity by the method of Beuchat, Cherry, and Quinn (1975).

2.7. Bread Weight and Volume Measurement

Cooled loaves of bread (room temperature) were weighed and volume determined using millet seed displacement method (Velupillai et al., 2010) and the specific volumes calculated (ml/g).

2.8. Proximate Composition of the Flours

Proximate composition of the flours was determined by the established procedures of AOAC (2005). The moisture, (oven-drying till constant weight), crude protein (N×6.25) micro-Kjeldahl method, crude fat (solvent extraction using petroleum ether in Soxhlet apparatus), ash (ashing in muffle furnace (550°C 5 h), crude fibre (alternate digestion with dilute acid and dilute alkali) and carbohydrate (obtained by 'difference') contents.

2.9. Sensory Evaluation of the Different Breads

Twenty people comprising of 10 females and 10 males of staff and students and students of FST University of Maiduguri evaluated the sensory attributes of the bread such as taste, crumb colour and texture, crust colour and flavour and level of acceptability on a 9-point hedonic scale where 1 represents dislike extremely, 5= neither liked nor disliked, 9 = extremely liked. Loaf of bread and sliced off pieces were presented to panelists on coded disposable plates and warm water was provided for mouth gargling.

2.10. Statistical Analysis

Mean and standard error of the mean were calculated and data subjected to single way analysis with 95% confidence interval were calculated using Microsoft Excel 2007 (Microsoft Corporation; Redmond, WA). Data was subjected to a single way analysis of variance (ANOVA).

3. RESULTS AND DISCUSSION

3.1. Proximate Composition of the Flours

The moisture, protein, fat, ash, fibre and carbohydrate contents of the different flours varied significantly ($p<0.05$) from 5.35-10.10%, 4.85-14.52%, 1.79-2.44%, 0.62-2.59%, 1.59-3.15% and 70.83-81.16% respectively, Table 1. The moisture contents of the flours were generally low, those of wheat flours were higher, with GP reaching leading (10.04%) and for those of non-wheat flours lower, cassava flour had the least (5.35%), lower than sweet potato flour (7.15%). Flour with finer texture or particles present greater surface area, therefore tends to more hygroscopic. A moisture content of less than 13.5% is needed for long storage of flour without negative physical and chemical changes. Therefore to maintain this low moisture range as obtained here requires adequate packaging and storage in low temperature and relative humidity conditions. Cassava flour is known to be coarse textured depending on many factors (ref), therefore the need for special milling regimen in order to obtain cassava flour that can easily homogenize with finer wheat flour. Protein contents of the flours varied from 4.85% to 14.52%, GP flour had significantly higher protein content (14.52%) than other wheat flours and protein contents of cassava and sweet potato flours were significantly not different as well as protein contents of DG and HW flours. Flour with a minimum protein content of 11% is needed for yeast leavened baked goods (ref). Bread making potential of flour is determined by its protein quality and quantity Most Nigerian Flour millers use imported hard red winter wheat protein of North American flour to produce all-purpose flours available in Nigerian markets. The higher protein flour is needed for yeast leavened breads and rolls. Ash represents the inorganic elements present in flour and indicate the extent of flour extraction but repeated grinding and sieving leads to lower ash content in wheat flours except fortified with bran reintroduction. Higher ash contents were observed in cassava (2.57%) and sweet potatoes flours (2.59%) which indicate higher contents of mineral elements. Sweet potato flour had significant higher content of crude fibre (3.15%) than cassava flour (2.78%) and wheat flours (1.59-1.91%). High content of ash and fibre are inimical to gluten structure and bread sensory properties. Higher amounts of protein(10.86-11.52%), bulk density(0.745-0.748ml/g), water absorption capacity(357.61-375g/100g) and lower ash(2.00-2.19%), crude fibre(1.63-1.81%) were reported by Jangchud, Phimolsiripol, and Haruthaithanasan (2003) for the flours of two varieties(exodus & spunta). Oluwalana, Malomo, and Ogbodogbo (2012) reported decrease in protein, fat and an increase in ash and crude fibre in wheat-sweet potato blends. The amounts of ash and crude fibre in flours are good indicators of the extent of flour refining. Both wheat and root flours are not rich sources of fat, however the three different wheat flour brands had significant higher fat contents (2.28-2.44%) than root flours (1.79-1.92%). Proximate composition of orange fleshed sweet potato as reported by Gebremedhin et al. (2013) is in agreement with the values obtained in this study except the reported ash and crude fibre contents are on the higher side however values obtained in this study were similar to values reported by Gowe, Tola, Mohammed, and Ramaswamy (2018) for different cultivars of sweet potato.

Table-1. Proximate composition (%) of the different flours.

Flour	Moisture	Crude Protein	Crude Fat	Ash	Crude fibre	CHO
DG	8.70±0.14^{b}	9.23±0.02	2.28±0.05b	0.80±0.01b	1.91±0.04b	77.02±0.14b
HW	8.95±0.07^{b}	10.04±0.02	2.44±0.007a	0.91±0.02b	1.77±0.03bc	75.99±0.09b
GP	10.10±0.14^{a}	14.52±0.01	2.39±0.05ab	0.62±0.01c	1.59±0.07c	70.83±0.11c
Cassava	5.35±0.01^{c}	5.78±0.01	1.92±0.07c	2.57±0.0.3a	2.78±0.06b	81.16±0.07a
Sweet Potato	7.15±0.21^{bc}	4.85±0.07	1.79±0.05cd	2.59±0.03a	3.15±0.08a	80.47±0.12a

Note: Values represent the mean ± standard error.
Values bearing the same letter in each column are not statistically different ($p>0.05$).
DG: Dangote; HW: Honeywell; GP: Golden Penny; CV: Cassava; SP: Sweet Potato Flours.

3.2. Gluten Content and Functional Properties of the Flours

According to Codex (1995) 98% of the material of wheat flour should pass through a 212µm sieve (US Standard Mesh No. 73) to be classified as flour. The percentage thorough varied from 84% for cassava to 95.31% for HW flour, indicating that cassava flour had greater coarse particles and HW the finest followed by sweet potato flour (92.50%), Table 2. None of the flours met this standard of identity. Blending and final fortification can lead to an increase in coarse particles in the flour. Flour hydration and mixing properties are affected by its granulation characteristics, the finer the better including the bread textural properties. Wet (31.35-35.65%) and dry gluten (12.00-19.70%) contents were generally high indicating the wheat flours brands were produced from hard wheat therefore suitable for bread making. GP flour had the highest wet or dry gluten yield and DG the least. Gluten content of wheat flour positively correlates with protein content and the determining factor of flour water absorption, dough viscosity, cohesiveness and elasticity (Wieser, 2007). Autran, Hamer, Plijter, and Pogna (1997) observed that pentosans and hamicellulose in flour have effect on gluten yield and flour processing properties. Kaushik, Kumar, Sihag, and Ray (2015) reported wet and dry gluten yield of 30.28-36.54% and 8.65-10.35% respectively different from 9.4 to 12.7%, dry gluten yield reported by Supekar, Patil, and Munjal (2005) still lower than the values obtained in this study. Among the flours HW had the highest weight per unit volume (bulk density) of 0.72g/ml next was GP 0.68g/ml and DG .0.63g/ml, the bulk densities of cassava and sweet potato flours were significantly similar and smaller. Oladunmoye, Aworh, Maziya-Dixon, Erukainure, and Elemo (2014) reported bulk densities of 0.52ml/g and 0.70ml/g for cassava and wheat flour respectively. Bulk density is related to textural characteristics and easy of rehydration, it is a function of particle size. According to Shafi et al. (2017) bulk density decreases with increase in flour fineness, it is linked to decreased protein, fibre and starch content. Water absorption capacity (WAC) of the wheat flours were higher than observed in cassava(1.00ml/g) or sweet potato flour (1.03ml/g), GP had significantly higher WAC (2.0ml/g) and DG had the least (1.31ml/g). Water absorption capacities reported by Nwosu et al. (2014) for wheat and cassava flours are in agreement to values obtained in this study, but a value of 66.44% was reported by Dhaka and Sangeetha (2017) for wheat flour was far below the values recorded here for the wheat flour brands. Amandikwa, Iwe, Uzomah, and Olawuni (2015) observed progressive increase in WAC with increase in increase addition of yam flour to wheat flour(1.50-3.90ml/g) confirming the belief that composite flour absorbs much water than wheat flour, however Adeleke and Odedeji (2010) reported 2.45ml/g and 1.24ml/g for wheat flour and wheat-sweet potato blend(1.24ml/g) WAC is considered as a critical function of protein in viscous food like soups, gravies, dough and baked products mainly bread and cakes (Kaushik et al., 2015; Singh & Singh, 2006). Therefore higher flour water absorption is a desirable quality indicator for higher dough yield and bread tenderness. Flour water absorption truly correlates positively with flour hydrophilic constituents, flour particle size and level of damaged starch.

Table-2. Gluten content, particle size and functional properties of the flours.

Flour	Wet gluten (%)	Dry gluten (%)	Bulk density (g/ml)	WAC (ml/g)	% thorough (212µm sieve)
DG	31.35±0.02	12.41±0.14	0.63±0.01^{b}	1.31±0.02^{c}	87.56±1.49^{ab}
GP	35.65±0.07	19.00±0.14	0.68±0.02^{ab}	2.0±0.01^{a}	89.43±2.20^{ab}
HW	33.50±0.11	16.70±0.14	0.72±0.01^{a}	1.7±0.04^{b}	95.31±2.06^{a}
Cassava	NA	NA	0.55±0.01^{c}	1.00±0.01^{d}	84.00±3.39^{c}
Sweet Potato	NA	NA	0.57±0.01^{c}	1.03±0.02^{d}	92.50±2.69^{a}

Note: Values represent the mean ± standard error.
Mean values bearing the same letter in each column are not statistically different (p>0.05).
DG: Dangote; HW: Honeywell; GP: Golden Penny; CV: Cassava; SP: Sweet Potato Flours, NA: Not available.

3.3. Physical Properties of the Wheat Bread and Composite Flour Bread

The weights, volumes and specific volumes of the bread varied 325-371g, 812-1102ml, and 2.16-2.92ml/g respectively Table 3. Among the wheat breads, DG bread had the highest volume (1102ml/g) with specific loaf volume of 2.92mlg and GP bread the highest loaf specific volume (3.28ml/g) because of its lesser weight (325g). Among the composite flour breads, the specific volumes dropped from the higher levels in the controls (wheat bread). GP blended with cassava or potato had equivalent specific volume of 2.48ml/g; composite breads produced from blends of HW with sweet potato flour (2.48ml/g) or cassava flour (2.32ml/g), higher than specific volume of composite flour bread produced from a blend DG and cassava (2.31) or DG and sweet potato bread (2.16ml/g) because of higher bread weighs and lower bread volumes. Pasqualone et al. (2010) reported specific loaf volume of 4.04ml/g for wheat bread which decreased in cassava- wheat bread. Velupillai et al. (2010) and Eriksson, Koch, Tortoe, Akonor, and Oduro-Yeboah (2014) similarly reported.

Table-3. Weight, volume and specific volume of the wheat and composite flour bread.

Bread	Weight(g)	Volume(ml)	Specific Volume (ml/g)
DG (100:0)	377^{a}	1102^{a}	2.92 ± 0.01^{b}
DG:CV (80:20)	350^{a}	812^{b}	2.31 ± 0.01^{cd}
DG:SP (80:20)	375^{a}	812^{b}	2.16 ± 0.06^{d}
HW (100:0)	350^{a}	893^{b}	2.55 ± 0.06^{c}
HW:CV (80:20)	375^{a}	870^{b}	2.32 ± 0.00^{cd}
HW:SP (80:20)	350^{a}	870^{b}	2.48 ± 0.02^{d}
GP (100:0)	325^{a}	1067^{ab}	3.28 ± 0.02^{a}
GP:CV (80:20)	350^{a}	870^{b}	2.48 ± 0.02^{c}
GP:SP (80:20)	350^{a}	870^{c}	2.48 ± 0.022^{c}

Note: Values represent the mean ± standard error.
Values bearing the same letter in each column are not statistically different (p>0.05)
DG: Dangote; HW: Honeywell; GP: Golden Penny; CV: Cassava; SP: Sweet Potato Flours.

3.4. Sensory Attributes of the Various Breads

Among the wheat breads, GP in particular and HW had significant higher taste, texture, crust colour, crumb colour and overall acceptability scores, acceptance scores greater than 7 on a 9-point hedonic scale, Table 4. Among the composite breads, cassava treated composite bread had better scores of the attributes evaluated more than sweet potato containing bread meaning lower scores were observed in DG: SP (80:20) bread, with scores less than 6. Therefore 20% cassava flour blended with GP or HW had better scores than 20% sweet potato bread with the same flours.

Table-4. Sensory attributes of the various breads.

Bread	Taste	Texture	Crust Colour	Crumb Colour	Overall acceptability
DG (100:0)	7.82 ± 0.00^{a}	7.31 ± 0.02^{a}	7.32 ± 0.01^{a}	7.57 ± 0.01^{a}	7.95 ± 0.07^{a}
DG:CV (80:20)	7.6 ± 0.02^{a}	7.23 ± 0.02^{a}	723 ± 0.02^{a}	7.08 ± 0.00^{bc}	7.52 ± 0.02^{b}
DG:SP (80:20)	7.1 ± 0.14^{b}	6.95 ± 0.07^{c}	7.07 ± 0.00^{b}	6.81 ± 0.02^{c}	7.57 ± 0.01^{b}
HW (100:0)	7.15 ± 0.02^{b}	6.74 ± 0.00^{b}	6.45 ± 0.07^{c}	6.91 ± 0.01^{c}	6.91 ± 0.01^{d}
HW:CV(80:20)	7.06 ± 0.02^{b}	6.74 ± 0.01^{b}	6.91 ± 0.01^{c}	6.82 ± 0.01^{c}	6.81 ± 0.02^{d}
HW:SP (80:20)	7.16 ± 0.01^{b}	6.91 ± 0.01^{b}	6.76 ± 0.01^{c}	7.25 ± 0.00^{b}	7.32 ± 0.01^{c}
GP (100:0)	6.43 ± 0.01^{c}	6.26 ± 0.01^{bc}	6.1 ± 0.14^{d}	6.18 ± 0.01^{d}	6.51 ± 0.01^{e}
GP: CV (80:20)	6.91 ± 0.0^{c}	6.75 ± 0.00^{b}	7.1 ± 0.14^{b}	7.16 ± 0.01^{bc}	7.24 ± 0.00^{c}
GP:SP (80:20)	5.25 ± 0.0^{d}	5.23 ± 0.00^{c}	5.06 ± 0.01^{e}	5.26 ± 0.01^{e}	5.42 ± 0.00^{f}

Note: Values represent the mean ± standard error.
Values bearing the same letter in each column are not statistically different (p>0.05).
DG: Dangote; HW: Honeywell; GP: Golden Penny; CV: Cassava; SP: Sweet Potato Flours.

4. CONCLUSION

There were many brands of wheat flours available in Nigerian market, the product of many wheat millers out of which less than five control more than 70% share of the market and they were those chosen for this study because of their popularity, wider distribution and ready availability. GP flour had superior bread making quality and out-performed others both in the wheat bread or 20% cassava or 20% sweet potato composite flour bread in most quality indicators investigated such as flour protein or gluten content, flour water absorption and loaf specific volume. It was observed that HW flour competed favourably with GP and surprisingly DG wheat bread had the highest absolute volume. Wheat type, blending ratio if any, milling operation regime and flour fortification are among the factors impinging on flour baking performance/ flour quality. The study concluded that GP flour had better bread making quality either alone or blended with cassava or sweet potato flour and recommends that further study be carried out with bigger sample size and investigation of other parameters of flour quality.

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