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Evaluation of Physicochemical and Sensory Properties of Bread Samples Produced from Blends of Rice, Wheat and Winter-squash Seed Flours

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Abstract

The study evaluated the physicochemical and sensory properties of bread from composite flour of wheat (W), rice (R) and winter-squash (S) seeds. Flours were blended in the ratios of 100:0:0, 80:10:10, 60:20:20, 40:30:30, 50:50:0 and 50:00:50 for W, R and S respectively and bread samples produced were designated as W_{100}, WRS_{811}, WRS_{622}, WRS_{433}, WR_{55} and WS_{55}. The result of proximate showed low moisture content, increased carbohydrate content with addition of rice (from 68.71 % in W_{100} to 70.68 % in WR_{55}) and decreased protein content (from 11.23 % in W_{100} to 9.71 % in WR_{55}). The loaf volume for sample WRS_{811} (823.50 cm^3) compared favourably with the sample W_{100} (845.77 cm^3). Bread samples W_{100} and WRS_{811} had the best overall acceptance with 7.34 and 7.29 scores in 9-point hedonic scale.

Key words: Wheat, Rice, Winter-Squash, Composite and Bread.

Introduction

Food security exists when all people at all times have physical, social and economic access to sufficient safe and nutritious food. This indicates that availability of food alone does not mean food security in a country (Ojo and Adebayo, 2012). Nutrition security means access to adequate utilization and absorption of nutrients in food to live a healthy and active life (FAO, 2009). Bread, a staple food prepared from dough of flour and water, usually by baking is popular around the world and is one of the oldest convenient foods. It is eaten by people of all ages, served in all meals, used as snacks, as staple depending on the social status of the individual; and therefore can be used to fight food insecurity. There are wide varieties of types, shapes, sizes, and textures of breads in various regions. Bread may be leavened by many different processes ranging from the use of naturally occurring microbes (for example in sour dough recipes) to high-pressure artificial aeration methods.

Wheat flour is unique for bread and other baked products because of its unique gluten protein which is not present in other cereal and legume seeds. Gluten protein forms elastic dough during fermentation and baking to trap substantial amount of air either from yeast or from artificial leavening agent. This permits substantial increase in volume of baked products (Ihekoronye and Ngoddy, 1985; Gil-Hamanes, Piston, Altamirano-Fortoul, Real, Comino, Sousa, Rosell and Barro, 2014). Unfortunately, wheat, like every other cereal, is deficient in some essential amino acids, namely lysine and tryptophan which are high in legumes.

The current high demand for bread, particularly in Nigeria, as regular food requires demands that enriched bread with high protein and increased dietary fibre, low glycaemic index and of low calorie counting quality is in circulation for consumers (Branlard and Dardevet, 1985; Dowell, Maghirang, Pierce, Lookhart, Bean, Xie, Caley, Wilson, Seabourn,, Ram, Park and Chung, 2008). Again, the scarcity and cost of wheat as an imported product limits its utilisation in Nigeria. Wheat has also been implicated to celiac disease, a type of food allergy common among regular wheat consumers.

There is need to supplement wheat with numerous under-utilized, rich indigenous crops in bakery products (Sanful and Darko, 2010). Currently many indigenous cereals, legumes, roots and tubers are being complemented with wheat for bakery products in Nigeria.

Rice *(Oryza glaberrima*; African rice) is one of such indigenous cereals with high food value and of high yield in Nigeria. Rice provides 20% of the world's dietary energy supply. It is high in vitamins (thiamine, riboflavin, niacin, vitamin D and vitamin B_6) and minerals (Ca, Fe, Mg, Mn, P, K and Zn) (Oko, Ubi and Etisue, 2012). This quality supports its supplementation to wheat for bread production.

Cucurbita maxima D. (winter-squash) is one of the profusely grown legumes in the Tropics. The pod is the part mostly consumed in Nigeria. Fortunately, the seeds which are usually discarded have been shown to be non-toxic and have high food value. The seeds have malleable, chewy texture, subtly sweet, nutty flavour, and can be eaten dried or roasted throughout the year (Sanjur, Piperno, Andres and Wessel-Beaver, 2002; Ferriol, Pico, and Nuez, 2004). The seed confers good health to consumers and is used in the treatment of many ailments such as kidney, prostate and gallbladder cancers; to expel tapeworms and roundworms from infested persons (Stevenson, Eller, Wang, Jane, Wang and Inglett, 2007). The seeds are high in protein, potassium, magnesium, zinc, iron, copper and essential fatty acids with strong antioxidant activity (Stevenson *et al.*, 2007; Leila, Moncef, Kamel and Salem, 2012). This seed needs to be exploited for its food value, particularly as a legume for high protein and fibre source.

The high cost and over dependency on wheat, the absence of some essential amino acids in wheat flour and the motivation towards utilization of indigenous food crops have led to the use of composite flour in bread production thereby making food abundant for the populace. This study will encourage the utilization of winter-squash seed a legume high in protein and fat to replace a portion of wheat in bread production. Also the study will evaluate the physicochemical and sensory properties of the bread samples.

Objective of the study

The general objective of the study was to evaluate the physicochemical and sensory properties of bread samples produced from blends of rice, wheat and winter-squash seed flours. Specifically, the study:

1. produced bread samples from blends of rice, wheat and winter-squash seed flours,
2. determined composites (proximate) properties of the bread samples,
3. determined the physical properties of the bread samples and
4. evaluated sensory characteristics of the bread samples.

Materials and Methods

Materials

***Sourcing of Materials*:** Dehulled paddy rice, wheat grains, winter-squash seeds, granulated sugar, hydrogenated vegetable oil were purchased from commercial stocker at Ndi-Oru market, Ikwuano Local Government Area of Abia State while analytical reagents were bought from authorised Dealer on analytical reagents in Umuahia.

***Preparation of materials*:** Dehulled paddy rice (2kg) was sorted, washed and steeped in excess clean water (1:5, w/v) for 20 min to soften the pericarp. The steeped water was decanted and the rice washed out of clean water. This was air-dried for 8h, oven dried (55^{O}C, 24h), milled into powder using Attrition Mill and then sieved into fine flour using 4µm sieve size. The flour was packaged in black polyethylene bags, put in air-tight bottles and stored for use.

Winter squash pods (pumpkin pods) were cut with a kitchen knife and the seeds handpicked, washed with water and air dried for 8 h. About 2kg of the dried seeds were shelled (manually) to remove the kernels, oven dried (55^{O}C, 24h),milled into powder using Attrition Mill and then sieved into fine flour using 4µm sieve size. The fine flour of the whole seeds was packaged in a black polyethylene bags, put in an air tight bottles and stored for use.

Wheat flour was prepared using the conventional method. The whole wheat (2kg) was cleaned, sorted and washed with warm water. The washed grains were drained, air dried (8 h), oven dried (55^{O}C, 24h), milled into powder using Attrition Mill and then sieved into fine flour using 4µm sieve size.

Table 1: Flour blend Formulation

Blends	Wheat (%)	Rice (%)	Winter squash (%)
W_{100}	100	-	-
WRS_{811}	80	-	-
WRS_{622}	60	20	20
WRS_{433}	40	30	30
WR_{55}	50	50	-
WS_{55}	50	-	50

W_{100}=100% wheat; WRS $_{811}$=80% wheat, 10%rice and 10% winter-squash; WRS_{622}=60% wheat, 20% rice and 20% winters-quash; WRS_{433}=40% wheat, 30% rice and 30% winter-squash; WR_{55}=50% wheat and50% rice; WS_{55}=50% wheat and 50% winter-squash;

Preparation of bread samples

Recipes: Blends of flours (450g) as in Table 1, active dried yeast (12g), granulated sugar (180g) (Dango, Nigeria), common salt (5g), warm water (150ml), liquid peak milk (150ml) (WAMCO, Nigeria Ltd) and melted hydrogenated fat (120g) (Simas) were used for each of the bread samples.

Procedure: Baking was done in the Processing Laboratory of the Department of Food Science and Technology, Michael Okpara University of Agriculture, Umudike. Each of the bread samples from different flour samples was produced using straight dough method as described by Potter and Hotchkiss (2007). In each preparation with particular flour, the dry ingredients were first sieved and mixed together. The yeast was, however, rehydrated in warm water and then added with the liquid components, milk and vegetable oil into the mixture. This was manually mixed and kneaded for about 10min and then allowed to ferment for 1h. The dough was knocked back, cut into 125g sizes and then placed in greased bread pans to proof for 20 min. These were baked in an electric oven (Thermocool, G3031, Italy) maintained at 225^{o}C for 45 min. After baking, bread samples were cooled in the open air in the Processing Laboratory and subjected to sensory and physicochemical analysis the next day

Proximate (Nutrient) analysis: Protein content was determined using Kjeldahl method AOAC (2005). A half gram (0.5g) of sample in 10ml of H_2SO_4 and a tablet of selenium catalyst was digested. The digest was diluted to 100ml and 10ml from the digest was mixed with equal volume of 45% NaOH in a Kjeldahl distillation apparatus. The mixture was distilled into 10ml of 4% boric acid containing 3 drops of mixed indicators (Beomocressol green and methyl red) colour changed from green to deep red. The titration value was used for calculating the percentage nitrogen. The nitrogen value obtained was multiplied by a factor (6.25) to obtain the percentage protein content.

Fat content was determined according to AOAC (2005) using Soxhlet lipid extraction apparatus as described by Onwuka (2005). About 5g of the sample was wrapped in filter paper and place in Soxhlet reflux flask which was mounted on extraction flask containing the petroleum ether and heated to boiling point for four hours. The filter paper was removed, dried at 105 °C and weighed after cooling; the difference in weight was used in calculating percentage fat content.

Ash content was determined by furnace incineration gravimetric method described by James (1995). About 2g of the sample was weighed into a porcelain crucible of known weight. The sample was incinerated in a furnace (muffle China Sx2-25-10) at 550°C. Ash content was calculated from the difference between the weight of sample and ash.

Crude fibre was determined using acid and alkaline hydrolysis followed by incineration according to AOAC (2005). About 5g of the sample was boiled in 15ml of 1.25% H_2SO_4 for 30 min under reflux. After washing through a twofold muslin cloth it was returned to the flask and boiled with 150ml of 1.25% NaOH under the same conditions. After washing it was dried in oven at 105°C and incinerated in a furnace (muffle China Sx2-25-10) at 550°C. The difference in weight of the crude fibre and sample was expressed as percentage of the crude fibre.

Moisture content was determined by gravimetric method of AOAC (2005). Five grams of the sample was weighed into a moisture can and dried in the oven at 105°C until constant weight was obtained. The moisture content was calculated as percentage of the weight of the sample analysed.

Carbohydrate content was estimated by arithmetic difference. % Carbohydrate= (100- moisture+ protein+ ash+ fat+ fibre contents).

Physical parameter determination of the bread (Weight, volume and specific volume): The weight of the bread samples was determined using a digital electronic weighing balance (A&D, HR-60, Japan) of 0.1 accuracy. The loaf volume and specific loaf volume were determined using the seed displacement method as described by Onwuka (2005).

The loaf volume was determined by filling a four litre (4000cm^3) bucket with wheat seeds until the seeds start dropping from the container at about 15cm above the rim of the container, a straight ruler edge was used to cut off all the seeds above the rim. The seed inside the bucket was weighed and was used to fill the same bucket to one third of the volume, the loaf sample was placed flat at the centre of the bucket and the bucket filled with the remaining seeds and levelled with ruler edge. The seed displaced by the loaf sample was weighed and used in calculating loaf volume and specific loaf volume.

Sensory evaluation of bread samples

***Instrument for data collection*:** A sensory evaluation questionnaire on colour, taste, texture, chewiness, fibrousness and general acceptability of the bread samples using a 9- point hedonic scale where 1= extremely disliked, 2= very disliked, 3= moderately disliked, 4= slightly disliked, 5= neither disliked nor liked, 6= slightly liked, 7= moderately liked, 8= very liked, 9= extremely liked was used to assess the acceptability of the bread samples (Melligard, Carville and GV 1999; Iwe, 2002).

Selection of panellists: A 25-member untrained panellists who were regular consumer of bread were randomly drawn from students and staff of Michael Okpara University of Agriculture Umudike. Prior to final selection, panellists were examined to ascertain the level of their liking and regular consumption of bread. Only those that have flare for bread and consume bread very regularly for at least thrice weekly were selected.

Data collation: The panellists were arranged in rows at about 2.5m apart; they were given coded sensory evaluation questionnaires and presented with coded saucers containing equal 5 slices of each bread samples. They were also provided with portable water to rinse mouths between samples after each test. Panellists analysed the bread samples and completed the questionnaire.

Data analysis: Analysis of Variance (ANOVA); means and Duncan multiple range test at 0.05 confidence level were used for data analysis. Each analytical determination was carried out in triplicates.

Results

Proximate composition of bread samples

Table 2: Proximate composition of bread samples

Bread samples	Moisture (%)	Carbohydrate (%)	Protein (%)	Fat (%)	Ash (%)	Fibre (%)
W_{100}	$8.17^{a}\pm0.04$	$68.71^{bc}\pm0.14$	$11.23^{ab}\pm0.09$	$5.13^{a}\pm0.36$	$4.46^{bc}\pm0.03$	$1.24^{a}\pm0.02$
WRS_{811}	$8.05^{a}\pm0.07$	$69.00^{b}\pm0.50$	$11.00^{b}\pm0.06$	$6.17^{b}\pm0.02$	$4.17^{ab}\pm0.12$	$1.25^{a}\pm0.01$
WRS_{622}	$8.17^{a}\pm0.06$	$69.38^{b}\pm0.22$	$10.85^{bc}\pm0.18$	$5.95^{ab}\pm0.10$	$4.32^{b}\pm0.05$	$1.33^{a}\pm0.01$
WRS_{433}	$8.24^{a}\pm0.02$	$68.85^{bc}\pm0.10$	$10.78^{bc}\pm0.10$	$6.67^{c}\pm0.08$	$4.17^{ab}\pm0.18$	$1.29^{b}\pm0.02$
WR_{55}	$8.17^{a}\pm0.06$	$70.68^{a}\pm0.30$	$9.71^{c}\pm0.05$	$6.08^{b}\pm0.16$	$4.04^{a}\pm0.12$	$1.23^{bcd}\pm0.02$
WS_{55}	$8.15^{a}\pm0.01$	$68.00^{c}\pm0.73$	$11.59^{a}\pm0.10$	$6.78^{c}\pm0.08$	$4.09^{a}\pm0.13$	$1.30^{bc}\pm0.03$

Values are mean ± S.D. Values in the same column with different superscripts are significantly difference ($p<0.05$). W_{100}=100%wheat; WRS_{811}=80%wheeat, 10%ricce and 10%winter-squash;WRS_{622}=60%wheat, 20%rice and 20%winter-squash; WRS_{433}=40% wheat, 30% rice and 30%winter-squash; WR_{55}=50% wheat and 50% rice; WS_{55}=50%wheat and 50% winter-squash.

Bread samples were produced according to the flour blends in Table 1. The results of laboratory analysis of the bread samples were shown in Tables 2-4.

Tables 2 showed the proximate composition of the bread samples. All the bread samples were low in moisture content which ranged from 8.05% in WRS_{811} (bread with 80% wheat, 10% paddy rice and 10% winter squash) to 8.24% in WRS_{433} (bread with 60% wheat, 30% rice and 30% winters quash) while the control bread sample (100% wheat) had 8.17% moisture content. There was no significant difference ($p>0.05$) in moisture contents among the bread samples. The carbohydrate content (%) of the bread samples ranged from 68.00 in WS_{55} (bread with 50% wheat and 50% winter squash) to70.68 in WR_{55} (bread with 50% wheat and 50% rice). Thus, while winter squash addition significantly ($p<0.05$) decreased carbohydrate content, rice addition significantly ($p<0.05$) increased carbohydrate content of the bread. The protein content (%) of the bread samples ranged from 9.71 in WR_{55} to 11.59 in WS_{55} and 11.23 in the control sample with 100% wheat flour. Again, rice addition decreased protein content while winter squash addition improved protein content of the bread.

Protein content (%) of the bread samples range from 9.71 in the bread with 50% rice to 11.59 in bread with 50% winter-squash. Fat content (%) of the bread samples increased with rice or winter squash addition, and ranged from 5.13 in the 100% wheat bread to 6.78 in the bread with 50% winter squash addition. Ash content ranged from 4.04 in bread with 50% rice addition to 4.46 in bread with 100% wheat bread. Also, fibre content (%) ranged from 1.24 to 1.33, and increased with substituting rice or winter squash for wheat in the bread samples.

Physical parameters of bread samples

Table 3. Physical properties of bread samples

Sample	Volume (cm^3)	Weight (g)	Specific Volume (cm^3/g)
W_{100}	$845.77^a \pm 2.45$	$367.53^a \pm 13.89$	$3.17^a \pm 0.15$
WRS_{811}	$823.50^c \pm 6.50$	$268.67^d \pm 8.11$	$3.07^{ab} \pm 0.12$
WRS_{622}	$814.16^e \pm 2.84$	$271.38^d \pm 0.97$	$3.00^b \pm 0.00$
WRS_{433}	$825.33^b \pm 1.527$	$275.11^d \pm 0.51$	$3.03^{ab} \pm 0.06$
WR_{55}	$816.00^d \pm 1.00$	$318.03^b \pm 6.91$	$2.57^c \pm 0.06$
WS_{55}	$795.33^f \pm 0.58$	$293.75^c \pm 3.65$	$2.02^d \pm 0.02$

Values are means ± S.D, Values in the same column with different superscripts are significantly different at 5% level. W_{100}=100%wheat; WRS_{811}=80%wheeat, 10%ricce and 10%winter-squash; WRS_{622}=60%wheat, 20%rice and 20%winter-squash; WRS_{433}=40%wheat, 30%rice and 30%winter-squash; WR_{55}=50% wheat and 50% rice; WS_{55}=50%wheat and 50%winter-squash.

The physical properties of the bread samples were shown in Table 3. There were significant differences ($p<0.05$) in the loaf weight of the bread samples which ranged from 268.67g to 367.53g. Sample W_{100} (100% wheat) had the highest score (367g) and WS_{811} the lowest (268.67g).

There were significant differences ($p<0.05$) in the loaf volume of the bread samples. Bread volume ranged from 845.77cm^3 to 795.33cm^3 with sample W_{100} (845.77cm^3) having the highest ($p<0.05$) loaf volume and WS_{55} (795.33cm^3) the lowest. The specific volume of the bread samples decreased with increasing addition of rice and winter squash.

The control bread had the highest specific volume (3.17cm^3/g) while the bread sample with 50% rice addition had the lowest specific volume ($2.02cm^3/g$). The 20% substitution of wheat flour (10% rice and 10% winter squash addition) decreased specific volume of bread from 3.10 to $3.07cm^3/g$. specific volume decreased while the 50% winter squash substitution decreased the specific volume to $2.10cm^3/g$.

Sensory evaluation

Table 4: Sensory scores of bread samples

Samples	Taste	Texture	Chewiness	Fibrousness	Colour	Overall Acceptability
W_{100}	$6.65^h\pm0.03$	$6.65^e\pm 0.02$	$6.47^d\pm 0.04$	$6.96^h\pm 0.04$	$6.60^d\pm 0.02$	$7.34^g\pm 0.04$
WRS_{811}	$7.64^i\pm 0.02$	$7.36^g\pm 0.04$	$6.68^e\pm 0.04$	$6.44^g\pm 0.02$	$7.68^h\pm 0.02$	$7.29^g\pm 0.03$
WRS_{622}	$5.84^f\pm 0.02$	$6.85^f\pm 0.02$	$7.43^f\pm 0.03$	$6.53^f\pm 0.03$	$7.29^f\pm 0.03$	$6.41^f\pm 0.03$
WRS_{433}	$5.99^g\pm 0.03$	$4.85^a\pm 0.03$	$5.43^b\pm 0.03$	$4.87^a\pm 0.06$	$5.08^a\pm 0.08$	$5.04^b\pm 0.02$
WR_{55}	$3.85^a\pm 0.03$	$5.64^c\pm 0.02$	$5.17^a\pm 0.03$	$5.08^b\pm 0.02$	$6.92^e\pm 0.02$	$5.47^d\pm 0.06$
WS_{55}	$5.48^e\pm 0.02$	$6.16^d\pm 0.02$	$6.66^e\pm 0.07$	$5.60^d\pm 0.06$	$7.60^g\pm 0.02$	$5.64^e\pm 0.04$

Values are mean ± S.D, Values in the same column with different superscripts are significantly different at 5% level. W_{100}=100%wheat; WRS_{811}=80%wheat, 10% rice and 10%winters-quash; WRS_{622}=60%wheat, 20%rice and 20%winter-squash;WRS_{433} =40% wheat 30% rice and 30%winter-squash;WR_{55}=50%wheat and 50%rice; WS_{55}=50%wheat and 50%winter-squash;

The sensory scores of the bread samples are shown in Table 4. Scores for each sensory attribute among samples differed ($p<0.05$) significantly. The sensory scores by the panellist ranged from 3.85 in taste for WR_{55} (50% wheat and 50% rice) to 7.68 in colour for WRS_{811} (80 wheat, 10% rice and10% winter squash) for taste, texture, chewiness, colour and overall acceptability of the bread samples. The control sample W_{100} (100% wheat flour) was the most acceptable but was not significantly different ($p>0.05$) from WRS_{811} (80 wheat, 10% rice and 10% winter squash) in overall acceptability. The least overall acceptability score (5.04) was for sample WRS_{433} (40% wheat, 30% rice and 30% winter squash). The sensory scores decreased with increasing substitution of rice, winter squash or both for wheat in the bread samples.

Discussion

The low moisture content (< 12%) of the bread samples indicates high shelf stability, easily adaptable to packaging and general acceptability to consumers (Okaka and Okaka, 2001). There was no significant difference ($p>0.05$) in the moisture contents among the bread samples, implying that that they might have almost the same shelf life. The moisture content was low enough to prevent any microbial proliferation during ambient storage.

Bread is ideally an energy giving food, and this is evidenced in the high carbohydrate content in all the samples. Bread samples from rice blended flour showed higher carbohydrate content than 100% wheat, this was in line with the high starch content (75-80%) of the rice grain (Daudu, Yakubu and Sambo, Okworie, Adeosun and Onyibe. 2014). Even though sample with 50% winter-squash substitution had the least carbohydrate content yet 90% of the energy value of the seed is from starch and it contains homogalacturonan unit which have antioxidant, anti-inflammatory anti diabetic and insulin regulated properties (Nara, Kamaguchi and Maeda, 2009).

Substituting rice flour for part of wheat in bread production did not significantly ($p>0.05$) improve nutrient composition of the bread samples. The low protein contents of WRS_{433} (40%w, 30%r and 30%s) and WR_{55} (50% and 50%r) was as a result of the low protein contents of rice flour. Substituting rice and/or winter-squash seed flours for part of wheat flour in bread making produced low gluten-protein bread suitable for consumers having gluten intolerance and prevents inflammation in the digestive system and autoimmune problems associated with wheat gluten (Jayakasam, Seeram, and Nair, 2003; Gil-Hamanes, *et al.,* 2014). The bread samples had approximately protein contents of 10 to 12%. High quality breads are supposed to have protein content of 12 – 14% (Branlard and Dardevet, 1985; Dowell *et al*., 2008).

The improved fat contents of the wheat-rice-winter-squash composite bread was as a result of the high oil content in the winter-squash seed flour. However the fat content of the bread could contribute only about 15% of total calorie in the bread. The winter-squash seed oil is composed of mainly about 75% of linoleic acid (the polysaccharide omega -6-fatty acid) and Oleic acid (monounsaturated fatty acid) proven to be of health promoting to consumers (Maltra, *et al.,* 2009; Leila, *et al.,*2012).

High specific volume of bread implies good aeration during fermentation and high numbers/large sized air cells in the bread. High specific breads volume is an indication of good physical quality of bread. However, too high specific volume may imply cheating the consumers where high sized-volume bread of small weight is sold to the consumers. This also implies that excess raising agent (yeast) or longer fermentation time was used during the bread production. The bread may be sour or bland in taste, indicating poor quality and high level of fermentation. Thus, improving the bread quality can be addressed from this perspective.

The controlled bread samples (100% wheat flour) with the highest specific loaf volume implies the best physical quality in comparison to the other bread samples of blended flour. This assumed that wheat gives the best loaf volume in bread. Samples with rice composition gave a fair loaf volume. From the result it was observed that winter-squash was responsible for the high weight of the bread because it possessed a significant fat content. This means that the bread sample would weigh more than conventional bread due to the incorporation of the seed germ in the production of the flour. The means of the specific volume range did not conform to the specification of Standard Organization of Nigeria.

The high sensory scores for taste, texture and chewiness in winter-squash substituted bread samples may be attributed to high fat content of winter-squash seed which according to Ahsan, Shahangir, Addul, Manirujjaman, Belal, Sahel, Khan, Maftah, Minaral, Mahadi, Muedar, Asaduzzaman, Sohanur, Islam, Khatun, and Matiar. (2015) is about 36.70% of the proximate composition.

Similar variations were recorded in chewiness and colour scores. Colour as an important criterion in determination of the acceptability of products as it has to do with the aesthetic value of the products. Notwithstanding the variations, the bread samples scored high in their acceptability rankings.

Conclusion

Bread samples from the composite flours, WRS_{811} (80% wheat, 10% rice and 10% winter-squash) and WRS_{622} (60% wheat, 20% rice and 20% winter-squash) were of comparable quality with that of the 100% wheat bread and may be used in the production of the bread for commercial purposes.. This has added value to winter-squash seeds which were actually discarded while using the pod for food. The incorporation of rice and winter-squash into bread can serve as a booster to the utilization of both as well as the reduction in the post-harvest losses associated with winter-squash.

Recommendation

From the findings,

1. Food processors and manufacturers are encouraged to in co-operate winter-squash seed flour in bread and other baked products to improve on their weight, fat and protein contents.
2. The awareness created through this research on winter-squash seed should motivate farmers to plan towards increasing their production to meet with future demands on the crop.
3. Rice flour substitution of wheat flour (up to 10%) in baked products should be encouraged to boost the production and reduce the countries exchange rate.

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