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Quality Evaluation of Cookies Produced from Wheat-Yellow Root Cassava Flours, Enriched with Pumpkin Seed

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Abstract

Cassava is an important crop with high potentials and contributes to the caloric intake of a large number of people. It serves as a staple food in most developing countries such as Nigeria. This study evaluated the quality of cookies produced from wheat-yellow root cassava composite flour, enriched with pumpkin (*Curcubita*) seed flour. The wheat, yellow root cassava and pumpkin seed were subjected to relevant preparatory operations and converted into flours. The flours obtained were formulated into different ratios of five proportions; 90:10:0(wheat: cassava: pumpkin seed); 90:0:10 (wheat: cassava: pumpkin seed); 80:10:10(wheat: cassava: pumpkin seed); 70:10:20(wheat: cassava: pumpkin seed); and 60:10:30(wheat: cassava: pumpkin seed), while 100% wheat flour served as control. The different composite flours including the control were used to produce cookies. Functional properties of the flour samples, proximate composition, total carotenoid content, physical and sensory properties of the cookies were evaluated using standard methods. The results of the functional properties showed that composite flour had higher values in all the functional attributes investigated than the control except bulk density. Moisture content of the cookies (5.40-10.07%) was within acceptable moisture level for cookies that will not support microbial proliferation. Increase in protein content (8.74-11.36%) was observed with decreasing wheat flour (60%, 70%, 80%, 90% and 100% the protein content are 11.36, 10.51, 9.62, 9.62, 8.74 and 8.74 respectively, while energy value ranged from 444.76-468.04 kcal. Inclusion of yellow root cassava flour in the composite flours resulted to cookies with high total carotenoid content. Physical properties of the cookies ranged from 15.00-15.83kg breaking strength, 4.91-7.50 spread ratio, 15.49-23.94cm^3 volume and 14.33-16.13g weight. This study revealed that acceptable cookies in terms of sensory properties were produced from the composite flours. It is deduced that nutrient enriched cookies produced in this study would aid in combating protein energy malnutrition, alleviate vitamin A deficiency and other nutrition related ailments.

Keywords: Enriched cookies, yellow root cassava, composite flour, evaluation, pumpkin seed

Introduction

Urbanization has increased the consumption of processed foods and bakery products leading to high cost of production as well as increase in the demand for importation of wheat (Dotsey, 2009). Wheat (*Triticum aestivum*) is a leading cereal crop which is mainly utilized for human consumption and in the baking industries. Wheat is a temperate crop that does not thrive well under tropical conditions (Adbelghafor *et al*., 2010). The presence of gluten makes it a unique crop for baking of bead. Various studies have shown its uniqueness and potential in the production of biscuits, cookies, doughnuts, rolls (hamburgher, muffins), soft cakes, pizza and chinchin of desirable texture and flavour (Adebayo-Oyetoro *et al*., 2017).

Cookies are small, flat, sweet, baked goods, usually containing flour, egg, sugar, and either butter, cooking oil or fat (Abayomi *et al*., 2013). They are nutritious ready-to-eat baked snacks available in different shapes and sizes at an affordable cost (Vijerathna *et al*., 2019). Previous researchers reported that cookies are one of the most popular baked goods consumed among all age groups in many countries due to their creamy taste and low water activity which defines their long shelf life (Chauhan *et al*., 2015; Usman *et al*., 2015). Petrovic *et* *al*. (2016), in their findings, also reported that cookies are popular confectionery product with a unique texture and taste and have extended shelf life. Conventionally, cookies are produced from wheat flour due to its gluten content which improves its texture (Oluwafemi and Seidu, 2017). However, several studies have reported the use of composite flour in cookies production (Akusu *et al*., 2019; Obinna-Echem and Robinson, 2019; Ukeyima *et al*., 2019; Bello *et al*., 2020). All these efforts were aimed at reducing dependence of bakeries on wheat flour, improving the nutritional values of cookies and finally, to add value to indigenous crops.

Pumpkins are a member of *Cucurbitaceae* family, which also includes squash, cantaloupes, cucumbers, watermelons and gourds. *Cucurbitaceae (cucurbit)* is an important family comprising one of the most genetically diverse groups of food plants. They are characterized by prostate or climbing herbaceous vines with large fleshy fruits (Karanja *et al.,* 2013). The seed is an excellent source of protein and also has pharmacological activities such as anti-diabetic, antifungal, antibacterial, anti-inflammation activities and antioxidant effects (Nkosi and Opaku, 2006).

Cassava *(Manihot esculenta Crantz)* is a major root crop and an important staple food for over 500 million people in the developing world (Falade, 2010). Some cassava varieties are naturally low in cyanogenic glycosides, thus, enhancing their utilization in several food formulations (Ubbor *et al.,* 2006). Cassava (*Manihot esculenta Grant*) root is a staple food that serves as the main source of carbohydrates in the form of starch and energy for more than 2 billion people in the world (Ferraro *et al*., 2015). Yellow-fleshed cassava genotypes rich in provitamin A (pVA), are part of the outputs of an International Bio-fortification effort by HarvestPlus, the International Institute of Tropical Agriculture (IITA), the International Center for Tropical Agriculture (CIAT) and other National Agricultural Research Institutions, to reduce vitamin A and other micronutrient deficiencies through the development of staple food crops with enhanced micronutrient content. Previous research revealed that biofortified yellow cassava possesses great potential to alleviate vitamin A deficiency complementary to other interventions such as vitamin A supplementation and fortification (Bouis *et al*., 2011).

Composite flour refers to the mixture of different concentrations of non-wheat flours from cereals, legumes, roots and tubers with wheat flour or can be a mixture of flours other than wheat flour (Okpala and Okoli, 2011). A previous study has shown that composite flour has often been used with the intent of reducing importation of wheat and improving its nutritional value (Ubbor and Akobundu (2009), most especially in countries where wheat is not grown. A study showed that the use of composite flour promotes the use of locally available crops as flour and enriches the nutritional value of the food products (Hasmad *et al*., 2014).

According to Ubbor and Akobundu (2009), composite flours are recently manufactured not only to improve the desired functional properties of end product but also to improve nutritional composition which result to better balance in essential amino acid, thus, higher protein quality. The use of composite flours had a few advantages for developing countries such as Nigeria in terms of enhancement of nutritional quality of food, utilization of under-exploited crops and reduction in the importation of wheat flour, thereby saving of foreign exchange (Hugo *et al*., 2000; Hasmadi *et al.,* 2014). FAO reported that the application of composite flour in various food products would be economically advantageous if the imports of wheat could be reduced or even eliminated, and that demand for bread and other confectioneries could be met using domestically grown products instead of wheat (Jisha *et al*., 2008).

The need to reduce over dependence on wheat flour for confectionery and baked products like cookies and enrich the products nutritionally necessitated this work. Therefore, the aim of this study was to evaluate the quality of cookies produced from flour blends of wheat, yellow root cassava and pumpkin seed.

Materials and Methods

Source of raw materials

The yellow root cassava was procured from National Root Crops Research Institute (NRCRI) Umudike. The Pumpkin (*Cucurbita maxima*) fruit, wheat grains and other ingredients such as egg, sugar, butter, flavouring agents, baking powder etc. used for the work was purchased from Cemetery Market Aba, all in Abia State, Nigeria.

Production of Flours

In the production of cassava flour, wholesome cassava roots were harvested from Biotechnology Programme of NRCRI, Umudike, sorted to remove decayed ones and other debris. The cassava roots were then washed (with clean water) to remove adhering soil and then peeled manually with sharp stainless steel kitchen knife. The peeled roots were rewashed with clean water using a clean sponge to remove debris and thereafter mechanically grated (using Henry West, 6.5hp, 1500rpm grater made in China) that disintegrated the cassava tissue into mash, bagged, dewatered (with hydraulic press), granulated and sifted. The sifted semi dried mash and the chipped cassava samples were then dried at 65°C for 48 hours using hot air electric drying oven (Memmert Gmbt, type UNB 500, 8.7A, 2000W Nen temperature 220 ° C made in Germany). The dried samples were then milled using attrition mill (Yoshita model GX 390, 13.0 HP, made in China) and sieved into resultant flour through a 250 mm mesh sieve to obtain smooth flour with a uniform particle size. The flour was then packaged in a polypropylene bag and kept at ambient temperature until further needed (Ubbor and Nwose, 2021). In the production of wheat flour, sound wheat grains were cleaned by sorting to remove stones and other debris. The clean grains were washed, drained with plastic perforated screen and dried in a hot air electric drying oven. The dried seeds were then milled with attrition mill and sieved into fine flour through a 250mm mesh sieve. The flour was then packaged in a polypropylene bag and kept at ambient temperature until further needed. In the production of pumpkin seed flour, the pumpkin fruits were, sorted washed and cut into two with stainless kitchen knife, the seeds were then extracted, sorted to remove spoiled ones. The sound seeds were dehulled, washed with clean water, drained through a plastic container. The clean seeds were sliced into pieces of 1-1.2cm and then oven dried at 60°C for 48h in a hot air electric drying oven(Memert Gmbt, type UNB 500, 8.7A, 22WNen temperature 220°C, made in Germany). The dried sliced seeds were milled with an attrition mill, and sieved through a 250 mm mesh sieve into resultant fine flour. The flour was then packaged in a polypropylene bag and kept at ambient temperature until further needed.

***Formulation of composite flour*:** The flours obtained from wheat, cassava and pumpkin seed were formulated into different ratios of five proportions;
90:10:0(wheat:cassava:pumpkin seed),
90:0:10(wheat:cassava:pumpkin seed),
80:10:10(wheat:cassava:pumpkin seed),
70:10:20(wheat:cassava:pumpkin seed),
60:10:30(wheat:cassava:pumpkin seed),
A100% wheat flour served a control.

Production of Cookies

The method as described by Ayo *et al*. (2018) was adopted in the production of the cookies. The following ingredients were used: Flour (500g), fat (200g), sugar (150g), whole egg (125ml), water (75ml), salt (2.5g), baking powder (5g), flavour (5 ml), nutmeg (5g). In the production of cookies, margarine and sugar were creamed to a smooth consistency; eggs and milk were added and mixed. The dry ingredients; flour, baking powder, nutmeg, salt and vanilla were mixed together and added to the cream followed by mixing to form dough**.** The dough was kneaded to uniform thickness and cut into circular shapes of 5 cm diameter. They were placed in greased baking pans and baked at 150ºC for 20 minutes until they were brown in colour. The cookies were rapidly cooled and stored at ambient temperature in a hermetically sealed plastic container with lid prior to analysis.

Functional properties of flour blends

The flour blends were analysed for bulk density, oil absorption capacity, water absorption capacity, wettability and swelling index using the method of AOAC (2010).

Physical properties of cookies

The method described by Ayo *et al*. (2007) was adopted for the determination of weight, height, diameter and thickness, volume and density. The spread ratio was determined using Gomez *et al*. (1997) method**,** while the breaking strength was determined using Okaka and Isieh (1990) method.

Determination of proximate composition of the cookies

The method described by Onwuka (2018) was used for the determination of proximate composition(moisture, ash, fat, fiber, protein, carbohydrate, of the cookies samples except for carbohydrate content and caloric value which was determined by difference and Atwater factor respectively.

Determination of Total Carotenoid Content of Cookies

The spectrophotometric method described by Onwuka (2018) was employed in the determination of carotenoid contents of the cookie samples.

Sensory Evaluation of Cookies

The method described by Iwe (2012) was adopted. The organoleptic properties of the cookies samples were tested by 25 semi trained panelists selected from the Department of Food Science and Technology, Michael Okpara University of Agriculture, Umudike. The panelists were instructed prior to the exercise. All cookies samples were put in different plates and served to the panellists with portable water to rinse their mouth after each testing so as not to interfere with the taste of the preceding samples. Quality attribute such as appearance, taste, aroma, texture, crispiness and general acceptability of the products was scored in a 9 point hedonic scale. The degree of likeness was expressed as follows from 9 = Like extremely, 5 = neither like nor dislike 5 and 1 = dislike extremely.

Statistical Analysis

One Way Analysis of Variance was carried out using the Statistical Product of Service Solution (SPSS) version 23.0. Treatment means were separated using Duncan multiple range test at 95% confidence level ($p<0.05$).

Results and Discussion

Functional Properties of the Flour Samples

The functional properties of the composite flour samples are presented in Table 1. The bulk density ranged from 0.67 to 0.94g/m. Sample 111(100% Wheat flour) had the highest value (0.94g/ml) and was significantly different ($p<0.05$) from the other samples, while Sample 777(60% Wheat flour: 10% Cassava flour: 30% Pumpkin seed flour) had the least value (0.67g/ml). There was gradual reduction in bulk density as the proportion of yellow root cassava flour increased. Bulk density gives an indication of the relative volume of packaging material required. According to Ubbor and Nwose (2021) the variation in bulk density could be attributed to differences in moisture content, cultivar and maturity of cassava roots. Lower bulk density of the flour samples has been reported to be useful for food formulation when used and such products have less retrogradation (Oladele and Aina, 2009). Agunbiade and Sanni (2001) also reported that low bulk density of flour samples is a good attribute when determining transportation and storability and since the products could be easily transported and distributed to required location. The oil absorption capacity ranged from 1.70

to 1.95 g/ml. There was significant ($p<0.05$) difference in terms of the oil absorption capacity amongst the samples. Sample 777(60% Wheat flour: 10% Cassava flour: 30% Pumpkin seed flour) had the highest value (1.95g/ml) while 333(90% Wheat flour: 10% Cassava flour: 0% Pumpkin seed flour), 555(90% Wheat flour: 0% Cassava flour: 10% Pumpkin seed flour), and 222(70% Wheat flour: 10% Cassava flour: 20% Pumpkin seed flour) had the least value (1.70) respectively. Some of the values of oil absorption capacity obtained in this study is lower than the range of 1.48 to 2.17g/ml reported by Ubbor and Akobundu (2009) for flour blends of watermelon seed, cassava and wheat. The flour blends with the highest oil absorption capacity in this study as observed in sample 777 could be attributed to the presence of hydrophobic proteins which show superior binding of lipids (Lawal and Adebowale, 2004). According to previous study, high oil absorption capacity will improve mouth feel and flavour retention (Peter *et al*., 2017). Due to these properties, the composite flour probably could be used as functional ingredients in foods such as whipped toppings, sausages, chiffon dessert, angel and sponge cakes etc. The water absorption capacity of the flour samples ranged from 2.05 to 2.50g/ml. Significant differences ($p<0.05$) exhibited amongst the samples in terms of water absorption capacity. Sample 555(90% Wheat flour: 0% Cassava flour: 10% Pumpkin seed flour) had the highest value (2.50g/ml) while sample 111(100% Wheat flour (control) and sample 222(70% Wheat flour: 10% Cassava flour: 20% Pumpkin seed flour) had the least value (2.05g/ml) respectively while. Water absorption capacity represents the ability of a product to associate with water under conditions where water is limited (Singh, 2001). However, this will not only aid in bulking application (Niba *et al*., 2001) but will also be very useful in bakery products, as this could prevent staling by reducing moisture loss (Okpala and Okoli, 2013). The range of water absorption capacity of the flour samples is in line with the values of 2.05 to 2.52 g/ml reported by Onuegbu *et al*. (2013) for flour blends of wheat and maize. The wettability of the flour ranged from 0.14-0.28 sec. Sample 555(90% Wheat flour: 0% Cassava flour: 10% Pumpkin seed flour) had the highest value (0.28sec.) while sample 777(60% Wheat flour: 10% Cassava flour: 30% Pumpkin seed flour) had the least value for wettability (0.14sec.). The implication is that sample 777(60% Wheat flour: 10% Cassava flour: 30% Pumpkin seed flour) with low wettability would be dispersed so easily in water than the other samples. There was significant ($p<0.05$) difference in wettability of the flour blends. Wettability is a function of ease of dispersing flour samples in water. The swelling index (SI) of the flour samples ranged from 1.03 to 1.07 %. Sample 777(60% Wheat flour: 10% Cassava flour: 30% Pumpkin seed flour) had the highest value while Sample 333(90% Wheat flour: 10% Cassava flour: 0% Pumpkin seed flour), 555(90% Wheat flour: 0% Cassava flour: 10% Pumpkin seed flour), 444(80% Wheat flour: 10% Cassava flour: 10% Pumpkin seed flour), 222(70% Wheat flour: 10% Cassava flour: 20% Pumpkin seed flour) had the least value (1.03%) respectively. There was no significant ($p>0.05$) difference among the samples in terms of the swelling index.

Proximate Compositions of the Cookies Samples

The proximate compositions of the cookies are presented in Table 2. The moisture content of the cookies ranged from 5.40 to 10.07 %. There was significant ($p<0.05$) difference between the moisture content of the cookies samples. Sample 777(60% Wheat flour: 10% Cassava flour: 30% Pumpkin seed flour) had the highest value (10.07%) while sample 555(90% Wheat flour: 0% Cassava flour: 10% Pumpkin seed flour) had the least value (5.40%) It was observed that moisture content increased as the proportion of pumpkin seed flour increases. This suggests that the pumpkin seed flour had higher moisture content than the other flour samples. However the range of the moisture content was in agreement with the report of Smith (1972) who established that cookies should not exceed the moisture content of 14%. From the result, the moisture content of cookies was low, which is an indication that the products will have longer shelf life. Ash content of the cookies ranged from 2.05 to 3.44%. There was significant ($p<0.05$) difference between the ash content of the cookies samples. Sample 111(100% Wheat flour) had the highest value (3.44%) while sample 333(90% Wheat flour: 10% Cassava flour: 0% Pumpkin seed flour) had the least value (2.05%). It was observed that as the proportion of wheat flour decreased the ash content reduces. Moreover, the sample without pumpkin seed flour apart from control had the lowest value of ash. This implies that both wheat and pumpkin seed flours contributed to the ash content of the cookies. The ash content represents the assessment of mineral in foods (Onwuka, 2018). In this study, it could be said that cookies samples with higher ash content would have more minerals than the others. The fat content of the cookies significantly ($p<0.05$) increased from 17.52 to 22.76%. Sample 777(60% Wheat flour: 10% Cassava flour: 30% Pumpkin seed flour) had the highest value (22.76%) while sample 111(100% Wheat flour) had the least (17.52%). There was progressive increase in the fat content of the cookies as the proportion of pumpkin seed flour increased. This could be deduced that pumpkin seed is a good source of fat. The crude fiber content of the cookies ranged from 0.27 to 3.57%. Sample 777(60% Wheat flour: 10% Cassava flour: 30% Pumpkin seed flour) had the highest value (3.57%) while sample 111(100% Wheat flour) had the least value (0.27%). The result recorded progressive increase in the crude fibre as the proportion of pumpkin seed flour increases. This implies that pumpkin seed possesses high crude fibre in comparison with the other flours in this study. The presence of high fiber in food products is essential owing to its ability to facilitate bowel movement, bulk addition to food and prevention of many gastrointestinal diseases in man (Satinder *et al*., 2011). The crude protein content of the cookies ranged from 8.74 to 11.36%. There was significant difference ($p<0.05$) between the crude protein content of the cookies samples. The result of the protein content follows the same trend as observed in fat and crude fibre of the cookies. A progressive increase in protein content was observed as the proportion of pumpkin seed flour increases, except for sample 555(90% Wheat flour: 0% Cassava flour: 10% Pumpkin seed flour), and 777(60% Wheat flour: 10% Cassava flour: 30% Pumpkin seed flour) which was significantly ($p<0.05$) different from the other samples. Sample 777(60% Wheat flour: 10% Cassava flour: 30% Pumpkin seed flour) had the highest value (11.36%) while sample 111(100% Wheat flour) and 333(90% Wheat flour: 10% Cassava flour: 0% Pumpkin seed flour) had the least value (8.74%) respectively. This could be attributed to the incorporation of pumpkin seed flour and baking ingredients which are proteinous such as milk and egg. However, the range of protein obtained in this study is lower than the range (11.55-28.66%) reported by Ubbor and Akobundu (2009) for cookies produced from water melon seeds, cassava and wheat flour. Protein is crucial to the regulation and maintenance of the body. Higher protein content obtained in this study is of great importance to human health as frequent consumption of the cookies will go a long way to alleviate protein malnutrition in the developing countries such as Nigeria. The carbohydrate content of the cookies ranged from 49.79 to 63.03%. There was significant ($p<0.05$) difference amongst the cookies samples. Cookies sample produced from 100% wheat flour (sample 111) had the highest carbohydrate content (63.03%), while sample 777(60% Wheat flour: 10% Cassava flour: 30% Pumpkin seed flour) had the least value (49.79%) However, sample 333(90% Wheat flour: 10% Cassava flour: 0% Pumpkin seed flour) and 555(90% Wheat flour: 0% Cassava flour: 10% Pumpkin seed flour) were not significantly different ($p>0.05$) amongst each other. The carbohydrate content of the cookies were generally low compared to the range (88.2-90.45%) reported by Abayomi *et al.* (2013) for cookies produced from sweet potato and fermented soybean flour. This could be due to variation in the carbohydrate content of the raw materials used in the different studies. Sweet potato possesses high carbohydrate content than wheat. The energy value of the cookies samples ranged from 444.76kcal [sample 111(100% Wheat flour) to 468.04 kcal (90% Wheat flour: 0% Cassava flour: 10% Pumpkin seed flour). High energy value of the cookies is of importance to human health. Wardlaw (2004) reported that high-energy foods tend to have protective effect in the optimal utilization of other nutrients.

Total Carotenoid Content of the Cookies Samples

The total carotenoid contents of the cookies are presented in Table 3.The total carotenoid (pro-vitamin A) content of the cookies ranged from 22.57-72.16µg/100g. Cookies sample 333(90% Wheat flour: 10% Cassava flour: 0% Pumpkin seed flour), had the highest (72.16µg/100g) while cookies produced from 100% Wheat flour (Sample 111) had the least value of carotenoid. The highest value of carotenoid recorded for the cookies sample produced from flour without pumpkin seed flour could be attributed to the fact that yellow root cassava is a good source of carotenoid. However, there was progressive increase in carotenoid content of the cookies as the proportion of pumpkin seed flour increases. This also implies that pumpkin seed flour contributed to the carotenoid content of the cookies samples comparable to the control sample (100% wheat). The high values of carotenoid recorded in cookies produced in this study shows that they are good sources of pro-vitamin A and can significantly contribute towards reducing vitamin A deficiency among 50 million children less than 5 years of age in sub-Saharan Africa (Low *et al.,* 2001). The low value observed in sample 111(100% Wheat flour) shows that wheat is a poor source of carotenoid. The presence of carotenoid in the cookies is largely attributed to the addition of yellow root cassava flour to the blends. This is an indication that the yellow root cassava variety is a good source of vitamin A.

Physical Properties of the Cookies Samples

The results of the physical properties of the cookies are presented in Table 4. The weight of the cookies ranged from 14.33g for sample 555(cookies from 90% Wheat flour: 0% Cassava flour: 10% Pumpkin seed flour) to 16.13g for sample 222(cookies from 70% Wheat flour: 10% Cassava flour: 20% Pumpkin seed flour). There was no significant ($p>0.05$) difference in the weight of the cookies from different flour blends. The value obtained for weight of the cookies in this study is lower than 29.44 to 30.62g reported for cookies from flour blends of wheat, yam and soybean (Apotiola and Fashakin, 2013). Cookies diameter ranged from 5.16cm to 5.82cm. There was no significant ($p>0.05$) difference among the samples except for sample 111(100% Wheat flour) that was significantly ($p<0.05$) different from other samples. Cookies and sample 111(100% Wheat flour) had the highest diameter value (5.82cm) while sample 444(80% Wheat flour: 10% Cassava flour: 10% Pumpkin seed flour) had the lowest diameter (5.16cm). The diameter of the cookies is important in determining the packaging material to be used for the cookies. The thickness of the cookies ranged from 0.71 to 1.08 cm. Sample 555(90% Wheat flour: 0% Cassava flour: 10% Pumpkin seed flour) had the highest value of 1.08 cm while sample 222(70% Wheat flour: 10% Cassava flour: 20% Pumpkin seed flour) had the least value of 0.71 cm. Samples 555(90% Wheat flour: 0% Cassava flour: 10% Pumpkin seed flour), 222(70% Wheat flour: 10% Cassava flour: 20% Pumpkin seed flour), and 777 were significantly ($p<0.05$) different from other samples. The density of the cookies was also not significantly different ($p > 0.05$) from each other except for sample 222(70% Wheat flour: 10% Cassava flour: 20% Pumpkin seed flour) that was significantly ($p<0.05$) different from other samples. The density of the cookies ranged from 0.59g/cm^3 to 1.03g/cm^3. Sample 222(70% Wheat flour: 10% Cassava flour: 20% Pumpkin seed flour) had the highest value (1.03g/cm^3) while sample 555(90% Wheat flour: 0% Cassava flour: 10% Pumpkin seed flour) had the least value (0.59g/cm^3).nThe volume of the cookies was also not significantly different ($p > 0.05$) from each other. The volume of the cookies ranged from 15.49 cm^3 to 23.94cm^3. Cookies 555(90% Wheat flour: 0% Cassava flour: 10% Pumpkin seed flour) had the highest mean value ($23.94cm^3$) while sample 222(70% Wheat flour: 10% Cassava flour: 20% Pumpkin seed flour) had the least value ($15.49cm^3$). The spread ratio of the cookies ranged from 4.91 to 7.50. There was significant ($p<0.05$) difference in the spread ratio of the cookies. Cookies sample 222(70% Wheat flour: 10% Cassava flour: 20% Pumpkin seed flour) had the highest spread ratio (7.50) while sample 555(90% Wheat flour: 0% Cassava flour: 10% Pumpkin seed flour) had the least spread ratio (4.91). The breaking strength of the cookies ranged from 15.00 to 15.83 kg. The breaking strength of the cookies was not significantly ($p>0.05$) different from each other. Sample 222(70% Wheat flour: 10% Cassava flour: 20% Pumpkin seed flour) had the highest breaking strength value (15.83), while sample 555(90% Wheat flour: 0% Cassava flour: 10% Pumpkin seed flour) and 444(80% Wheat flour: 10% Cassava flour: 10% Pumpkin seed flour) had the least breaking strength value (15.00).

Sensory Properties of the Cookies Samples

The results for sensory evaluation of the cookies are presented in Table 5. The result obtained showed significant ($p<0.05$) difference in appearance. The appearance values ranged from 6.15 to 7.80. The result showed that sample 111 (100% Wheat flour) was most preferred with highest mean value of 7.80 while sample 222(70% Wheat flour: 10% Cassava flour: 20% Pumpkin seed flour) had was the least value (6.15). However, it was observed that the range of rating for cookies appearance translates to like slightly and like very much respectively in 9 point hedonic scale of Iwe (2012). The textures of the cookies ranged from 6.45 to 7.25. Sample 555(90% Wheat flour: 0% Cassava flour: 10% Pumpkin seed flour) had the highest mean value of 7.25% while 222(70% Wheat flour: 10% Cassava flour: 20% Pumpkin seed flour) had the least mean value of 6.45%. The textures of food products reflect the mouth feel. There was no significant ($p>0.05$) different in texture of the cookies products. The scores for the texture of the cookies was higher than 2.15 to 4.75 reported for cookies produced from composite flours of watermelon seed, cassava and wheat (Ubbor and Akobundu, 2009). The result of the cookies in terms of texture translates to like slightly and like moderately respectively in 9 point hedonic scale of Iwe (2012). The crispness of the cookies ranged from 6.35 to 7.25% Crispness is desirable quality of cookies. There was no significant ($p>0.05$) difference in the crispness of the cookies. Cookies sample 555(90% Wheat flour: 0% Cassava flour: 10% Pumpkin seed flour) had the highest mean value of 7.25% while sample 222(70% Wheat flour: 10% Cassava flour: 20% Pumpkin seed flour) had the least mean value of 6.35%. The result of the cookies crispness translates to like slightly and like moderately respectively in 9 point hedonic scale of Iwe (2012). The taste of the cookie samples ranged from 6.20 to 8.05%. Sample 222(70% Wheat flour: 10% Cassava flour: 20% Pumpkin seed flour) had the least mean value of 6.20% while sample 333(90% Wheat flour: 10% Cassava flour: 0% Pumpkin seed flour) had the highest mean value of 8.05%. The scores for the taste of the cookies was similar to the range (4.3 to 8.3) reported for cookies produced from wheat flour and malted barley bran blends (Ikuomola *et al*., 2017). Aroma is another attribute that influences the acceptance of baked goods even before they are tasted. Aroma of the cookies ranged from 6.40 to 7.85%. Cookies sample 444(80% Wheat flour: 10% Cassava flour: 10% Pumpkin seed flour) had the highest mean value of 7.85% while sample 222(70% Wheat flour: 10% Cassava flour: 20% Pumpkin seed flour) had the least mean value of 6.40. General acceptability of the cookies samples ranged from 6.60 to 7.90%. Cookies sample 333(90% Wheat flour: 10% Cassava flour: 0% Pumpkin seed flour) had the highest mean value of 7.90% which translates to Like moderately while sample 777(60% Wheat flour: 10% Cassava flour: 30% Pumpkin seed flour) had the least mean value of 6.70% which translates to Like slightly according to the hedonic scale of Iwe (2012). The result of the sensory properties of the cookies shows that all the cookies samples were liked and accepted by the panelists.

Conclusion

High quality and acceptable cookies were produced from composite flour of wheat, yellow root cassava and pumpkin seeds. The result of this present study shows that substitution of wheat with yellow root cassava and pumpkin seed improved the protein content of the cookies which could play an important role in combating or reducing Protein Energy Malnutrition (PEM) in developing countries. The inclusion of yellow root cassava flour increased the beta-carotene content of the cookies samples which is an indication that the products will give appreciable vitamin A when consumed. The content of vitamin A cookies could also tackle vitamin A deficiency which is a serious public health problem in Africa. The increase in energy value, protein content and total carotenoid will go a long way to help alleviate protein/energy malnutrition and blindness in Africa especially amongst young children.

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Table 1: Functional properties of the composite flour of wheat-yellow root cassava and pumpkin seed

WF:CF:PSF	Bulk density(g/cm^3)	Oil absorption Capacity (g/ml)	Water absorption Capacity (g/ml)	Wettability (sec)	Swelling index(%)
111(100:0:0)	$0.94^{a}\pm0.01$	$1.75^{b}\pm0.07$	$2.05^{c}\pm0.35$	$0.24^{ab}\pm0.01$	$1.04^{b}\pm0.01$
333(90:10:0)	$0.69^{cd}\pm0.01$	$1.70^{c}\pm0.14$	$2.25^{b}\pm0.35$	$0.15^{bc}\pm0.00$	$1.03^{c}\pm0.01$
555(90:0:10)	$0.80^{b}\pm0.00$	$1.70^{c}\pm0.14$	$2.50^{a}\pm0.00$	$0.28^{a}\pm0.08$	$1.03^{c}\pm0.01$
444(80:10:10)	$0.73^{bcd}\pm0.03$	$1.80^{ab}\pm0.14$	$2.10^{bc}\pm0.14$	$0.15^{bc}\pm0.01$	$1.03^{c}\pm0.01$
222(70:10:20)	$0.75^{bc}\pm0.06$	$1.70^{c}\pm0.00$	$2.05^{c}\pm0.35$	$0.17^{b}\pm0.01$	$1.03^{c}\pm0.01$
777(60:10:30)	$0.67^{d}\pm0.01$	$1.95^{a}\pm0.07$	$2.10^{bc}\pm0.14$	$0.14^{c}\pm0.01$	$1.07^{a}\pm0.01$

Values are Means ± standard deviation of duplicate determinations $^{a-d}$ Means with the same superscripts within the same columns are not significantly (p>0.05) different. Where WF: Wheat flour, CF: Cassava flour, PSF: Pumpkin seed flour. KEYS: 111 = 100% Wheat flour (100:0:0); 333 = 90% Wheat flour: 10% Cassava flour: 0% Pumpkin seed flour (90:10:0) ; 555 = 90% Wheat flour: 0% Cassava flour: 10% Pumpkin seed flour (90:0:10) ; 444 = 80% Wheat flour: 10% Cassava flour: 10% Pumpkin seed flour (80:10:10); 222 = 70% Wheat flour: 10% Cassava flour: 20% Pumpkin seed flour (70:10:20) ; 777 = 60% Wheat flour: 10% Cassava flour: 30% Pumpkin seed flour (60:10:30)

Table 2: Proximate composition of cookies produced from composite flour of wheat-yellow root cassava and Pumpkin seed

Sample	Moisture (%)	Ash (%)	Crude fat (%)	Crude fiber (%)	Protein (%)	Carbohydrate (%)	Energy value (kcal)
111(100)	$7.00^{bc}\pm0.77$	$3.44^{a}\pm0.21$	$17.52^{c}\pm0.61$	$0.27^{f}\pm0.04$	$8.74^{d}\pm0.00$	$63.03^{a}\pm0.02$	$444.76^{c}\pm5.44$
333(90:10:0)	$8.02^{ab}\pm0.74$	$2.05^{c}\pm0.07$	$19.96^{b}\pm1.31$	$0.43^{e}\pm0.04$	$8.74^{d}\pm0.00$	$60.80^{b}\pm0.62$	$457.80^{b}\pm9.36$
555(90:0:10)	$5.40^{c}\pm1.41$	$2.35^{b}\pm0.70$	$20.84^{b}\pm0.21$	$1.37^{d}\pm0.04$	$9.62^{c}\pm0.01$	$60.42^{b}\pm1.17$	$468.04^{a}\pm6.57$
444(80:10:10)	$7.20^{bc}\pm1.34$	$2.17b^{c}\pm0.11$	$22.42^{a}\pm0.61$	$1.67^{c}\pm0.03$	$9.62^{c}\pm0.01$	$56.92^{c}\pm0.64$	$467.76^{ab}\pm8.10$
222(70:10:20)	$9.95^{a}\pm0.56$	$2.30b^{c}\pm0.07$	$22.69^{a}\pm1.41$	$2.63^{b}\pm0.04$	$10.51^{b}\pm0.01$	$51.92^{d}\pm0.52$	$453.93^{b}\pm10.75$
777(60:10:30)	$10.07^{a}\pm0.95$	$2.45^{b}\pm0.07$	$22.76b^{a}\pm0.74$	$3.57^{a}\pm0.04$	$11.36^{a}\pm0.02$	$49.79^{e}\pm0.23$	$449.44^{bc}\pm5.83$

Values are Means ± standard deviation of duplicate determinations $^{a-f}$ Means with the same superscripts within the same columns are not significantly (p>0.05) different. Where WF: Wheat flour, CF: Cassava flour, CSF: Pumpkin seed flour. KEYS: 111 = 100% Wheat flour (100); 333 = 90% Wheat flour: 10% Cassava flour: 0% Pumpkin seed flour (90:10:0); 555 = 90% Wheat flour: 0% Cassava flour: 10% Pumpkin seed flour (90:0:10); 444 = 80% Wheat flour: 10% Cassava flour: 10% Pumpkin seed flour (80:10:10); 222 = 70% Wheat flour: 10% Cassava flour: 20% Pumpkin seed flour (70:10:20); 777 = 60% Wheat flour: 10%; Cassava flour: 30% Pumpkin seed flour (60:10:30)

Table 3: Total carotenoid content of the cookies produced from composite flour of wheat- yellow root cassava and Pumpkin seed

WF:CF:PSF	Total carotenoid (µg/100g)
111(100:0:0)	$22.57^{d}\pm2.07$
333(90:10:0)	$72.16^{a}\pm7.50$
555(90:0:10)	$27.57^{c}\pm1.35$
444(80:10:10)	$54.33^{bc}\pm6.14$
222(70:10:20)	$56.83^{b}\pm6.03$
777(60:10:30)	$67.10^{ab}\pm3.79$

Values are Means ± standard deviation of duplicate determinations $^{a-d}$ Means with the same superscripts within the same columns are not significantly (p>0.05) different. Where WF: Wheat flour, CF: Cassava flour, PSF: Pumpkin seed flour. KEYS: 111 = 100% Wheat flour (100); 333 = 90% Wheat flour: 10% Cassava flour: 0% Pumpkin seed flour (90:10:0); 555 = 90% Wheat flour: 0% Cassava flour: 10% Pumpkin seed flour (90:0:10) ; 444 = 80% Wheat flour: 10% Cassava flour: 10% Pumpkin seed flour (80:10:10) ; 222 = 70% Wheat flour: 10% Cassava flour: 20% Pumpkin seed flour (70:10:20); 777 = 60% Wheat flour: 10%; Cassava flour: 30% Pumpkin seed flour (60:10:30)

Table 4: Physical Properties of the cookies produced from composite flour of wheat-yellow root cassava and Pumpkin seed

Sample WF:CF:PSF	Weight (g)	Diameter (cm)	Thickness (cm)	Density (g/cm^3)	Volume (cm^3)	Spread ratio	Breaking strength (kg)
111(100)	$15.95^{ab}\pm0.22$	$5.82^{a}\pm0.14$	$0.80^{c}\pm0.00$	$0.75^{c}\pm0.02$	$21.86^{a}\pm1.64$	$7.28^{b}\pm0.16$	$15.43^{ab}\pm0.61$
333(90:10:0)	$14.60^{bc}\pm0.27$	$5.33^{bc}\pm0.11$	$0.81^{c}\pm0.01$	$0.81^{bc}\pm0.04$	$18.05^{b}\pm1.03$	$6.57^{c}\pm0.01$	$15.05^{b}\pm0.07$
555(90:0:10)	$14.33^{c}\pm0.29$	$5.31^{bc}\pm0.15$	$1.08^{a}\pm0.01$	$0.59^{d}\pm0.04$	$23.94^{a}\pm1.71$	$4.91^{f}\pm0.08$	$15.00^{b}\pm0.00$
444(80:10:10)	$14.47^{bc}\pm0.21$	$5.16^{c}\pm0.07$	$0.82^{bc}\pm0.01$	$0.85^{b}\pm0.02$	$17.05^{b}\pm0.62$	$6.33^{d}\pm0.04$	$15.00^{b}\pm0.00$
222(70:10:20)	$16.13^{a}\pm0.04$	$5.29^{bc}\pm0.07$	$0.91^{b}\pm0.01$	$1.03^{a}\pm0.04$	$15.49^{b}\pm0.57$	$7.50^{a}\pm0.03$	$15.83^{a}\pm0.00$
777(60:10:30)	$14.98^{b}\pm0.34$	$5.44^{b}\pm0.05$	$0.99^{b}\pm0.00$	$0.65^{d}\pm0.01$	$23.05^{a}\pm0.42$	$5.49^{e}\pm0.05$	$15.05^{b}\pm0.07$

Values are Means ± standard deviation of duplicate determinations $^{a-f}$ Means with the same superscripts within the same columns are not significantly (p>0.05) different. Where WF: Wheat flour, CF: Cassava flour, PSF: Pumpkin seed flour. KEYS: 111 = 100% Whe at flour (100:0:0); 333 = 90% Wheat flour: 10% Cassava flour: 0% Pumpkin seed flour (90:10:0); 555 = 90% Wheat flour: 0% Cassava flour: 10% Pumpkin seed flour (90:0:10) ; 444 = 80% Wheat flour: 10% Cassava flour: 10% Pumpkin seed flour (80:10:10); 222 = 70% Wheat flour: 10% Cassava flour: 20% Pumpkin seed flour (70:10:20) ; 777 = 60% Wheat flour: 10% Cassava flour: 30% Pumpkin seed flour (60:10:30)

Table 5: Sensory Properties of the cookies produced from composite flour of wheat-yellow root cassava and Pumpkin seed.

WF:CF:PSF	Appearance	Texture	Crispness	Taste	Aroma	General Acceptability
111(100)	$7.80^{a}\pm0.89$	$6.95^{abc}\pm0.88$	$6.90^{a}\pm1.33$	$6.60^{b}\pm1.43$	$7.55^{a}\pm1.19$	$7.60^{ab}\pm1.27$
333(90:10:0)	$7.20^{ab}\pm1.28$	$7.20^{ab}\pm0.83$	$6.80^{a}\pm1.44$	$8.05^{a}\pm1.27$	$7.25^{ab}\pm1.58$	$7.90^{a}\pm1.21$
555(90:0:10)	$7.20^{a}\pm1.21$	$7.25^{a}\pm1.02$	$7.25^{a}\pm1.52$	$7.70^{a}\pm1.22$	$7.15^{ab}\pm1.27$	$7.75^{a}\pm1.33$
444(80:10:10)	$6.75^{bc}\pm1.25$	$6.80^{abc}\pm1.01$	$7.15^{a}\pm1.27$	$7.90^{a}\pm1.02$	$7.85^{a}\pm0.87$	$7.80^{a}\pm0.89$
222(70:10:20)	$6.15^{c}\pm1.69$	$6.45^{c}\pm0.99$	$6.35^{a}\pm0.99$	$6.20^{b}\pm1.57$	$6.40^{b}\pm1.57$	$6.70^{c}\pm1.26$
777(60:10:30)	$6.90^{bc}\pm1.21$	$6.55^{bc}\pm1.19$	$6.40^{a}\pm1.23$	$6.55^{b}\pm1.70$	$6.60^{b}\pm1.64$	$6.60^{c}\pm1.25$

Values are Means ± standard deviation of duplicate determinations $^{a-c}$ Means with the same superscripts within the same columns are not significantly (p>0.05) different. Where WF: Wheat flour, CF: Cassava flour, PSF: Pumpkin seed flour. KEYS: 111 = 100% Wheat flour (100); 333 = 90% Wheat flour: 10% Cassava flour: 0% Pumpkin seed flour (90:10:0); 555 = 90% Wheat flour: 0% Cassava flour: 10% Pumpkin seed flour (90:0:10); 444 = 80% Wheat flour: 10% Cassava flour: 10% Pumpkin seed flour (80:10:10); 222 = 70% Wheat flour: 10% Cassava flour: 20% Pumpkin seed flour (70:10:20) ; 777 = 60% Wheat flour: 10% Cassava flour: 30% Pumpkin seed flour (60:10:30)

Plates 1-3: Flour samples

Plate 1: Wheat Flour

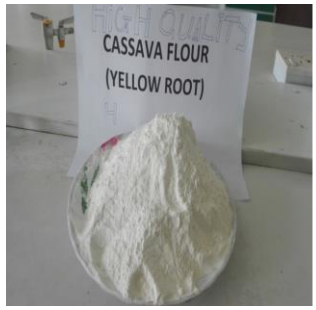

Plate 2: Yellow root cassava flour (TMS 01/1368)

Plate 3: Pumpkin seed flour

Description of the Cookies Samples (Plates 4-9)

Plate4: Sample 111(100% Wheat flour)

Plate 5: Sample 333 (90% wheat, 10%yellow root cassava, 0% cucurbita)

Plate 6: Sample 555 (90% Wheat flour: 0% Cassava flour: 10% Cucurbita seed flour)

Plate 7: Sample 444(80% Wheat flour: 10%Cassavaflour: 10% Cucurbita flour)

Plate 8: Sample 222(70:10:20)

Plate 9: Sample 777(60:10:30)