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Physiochemical and Consumer Acceptability of Biscuit Produced from Wheat and African Oil Bean Flour Blends

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ABSTRACT

Wheat flour (WF) was substituted with African oil bean seed flour (AOBF) at 0, 20, 30 and 40% in biscuit. The chemical and functional properties of the flours and their blends, as well as the physicochemical and sensory attributes of the Biscuit, were determined. The flour blends had higher fat, ash and protein than the 100% wheat flour. The level of these nutrients improved as the amount of AOBF in the blend increased. Gross energy also increased as AOBF increased in the blend, with WF having 398.91 and AOBF 676.01kcal/100g. Water absorption increased while the oil absorption generally decreased with increasing substitution levels. Wheat flour exhibited the highest foaming capacity and stability, followed by the 10% AOBF substitution and then the 100% AOBF. AOBF had the highest bulk density of 0.87 g cm-3, while that of WF was 0.78 g cm-3. There were no significant differences (P>0.05) in the weight and height of the biscuit. Also, no significant difference (P>0.05) existed for the taste, aroma, and texture of the wheat biscuit and the composite biscuit, but a considerable difference (P<0.05) existed for colour. All the composite biscuits were as acceptable as the 100% wheat biscuit.

Keywords: Biscuit, Composite flour, Flour, Blends, Sensory properties.

INTRODUCTION

Biscuit is one of Nigeria's most commonly consumed baked food products (Farheena *et al.*, 2015). Biscuit, a chemically leavened product, is often regarded as a heated or otherwise baked meal that is possibly little, flat and sweet and generally comprises flour, sugar, and some oil or fat. In addition, it may contain other additives such as raisins, oats, chocolate chips, nuts, etc. On the other hand, biscuits produced through heat applications in the oven and transformed into appealing products contain high nutrients (Olaoye *et al.*, 2021). Wheat flour is a significant ingredient for biscuit production because gluten is not available in other cereals. Biscuits have some advantages compared with other snacks: they are cheaper, have a good shelf life, and are available in different sizes, tastes, colours, and packs (Chandra *et al.*, 2015).

Wheat is essential among cereals mainly because of its grains, which comprise protein with exclusive physical and chemical attributes. It also encompasses other valuable components, such as minerals (Cu, Mg, Zn, Fe, and

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P), protein, and vitamins (riboflavin, thiamine, niacin, and alpha tocopherol). It is also a valuable source of carbohydrates (Garg *et al.,* 2021). However, wheat proteins have been found to lack vital amino acids; for example, lysine and threonine (Urade *et al.*, 2018; Siddiqi *et al.,* 2020). The wheat, as produced by nature, contains several medicinal virtues. Every part of the whole-wheat grain supplies elements needed by the human body. Starch and gluten in wheat provide heat and energy; the inner bran coats, phosphates and others. The whole wheat, which includes the bran and wheat germ, therefore, protects against diseases such as constipation, ischaemic heart disease, and diseases of the colon, including diverticulitis, appendicitis, obesity, and diabetes.

African oil bean (*Pentadhera macrophylla* Benth) is native to tropical regions of Africa and contains 44% protein, with 20 essential amino acids. Within the seed oils are essential fatty acids and many minerals, particularly magnesium, iron, manganese, copper, phosphorus, calcium, and trace amounts of vitamins (Achinewhu, 2013). Onabolu *et al.* (2018) produced bread made from an 80:20 wheat/cassava flour blend, as well as 100% cassava bread, with egg serving as the binding agent. Onwuka (2020) used raw as well as processed mucuna bean flour to make bread in a 50:50 wheat/mucuna flour composite. Research conducted at the International Institute of Tropical Agriculture (IITA) showed that replacing wheat flour with water yam (*D. alata*) flour at 40% produced acceptable products (IITA, 1988). Osibanjo *et al.* (2017) reported that a combination of cassava flour, wheat, sorghum, and soya flour in the ratio 45:30:20:5, with a quality score of 72%, yielded acceptable bread. Therefore, this research aims to evaluate the proximate composition, functional properties of flour, and sensory characteristics of biscuits produced from wheat and African oil bean composite flour.

MATERIALS AND METHODS

Collection of Raw Material

Wheat (*Triticum aestivum*) was bought, and African oil beans (Ugba) were obtained from Ogbese market, Akure North Local Government Area in Ondo State, Nigeria.

Preparation of African oil bean seed Flour

The African oil bean seed flour was prepared according to the method described by Enujiugha and Akanbi (2008), where par-boiling of the whole seeds was done for a period of 6 h using a heating plate; this was followed by dehulling and slicing (using a kitchen knife). Cooking of the dehulled cotyledons was done for 8hours, and the cooked oil slices were soaked in tap water overnight, washed in three changes of water and dried using a cabinet dryer. During drying, the dehulled seeds were stirred at intervals of 20 minutes to ensure uniform drying. The dried slices were comminuted using an attrition mill and sieved to get a fine African oil bean seed flour.

Formulations of Blends

The wheat and African oil bean flour were grated to prepare five samples. Sample A contains 100% wheat flour, Sample B includes 20% wheat flour and 20% African oil bean flour, Sample C comprises 70% wheat flour with 30% African oil bean flour, and Sample D consists of 60% wheat flour with 40% African oil bean flour. The flour was thoroughly mixed with the ingredients and baked.

Preparation of Biscuit using African Oil Bean and Wheat Flour

During the course of the production, all ingredients used were weighed separately in a bowl, after which the wheat flour and African oil bean seed flour were mixed in the proportions of 80:20, 70:30 and 60:40, respectively. Thereafter, baking powder and milk powder were rubbed in until uniform; water was added to form a dough. The dough was flattened and cut into various sizes and shapes, and baked on a greased tray in the baking oven at 160°C for 10 to 15 minutes. It was cooled and sealed until it was used for analysis.

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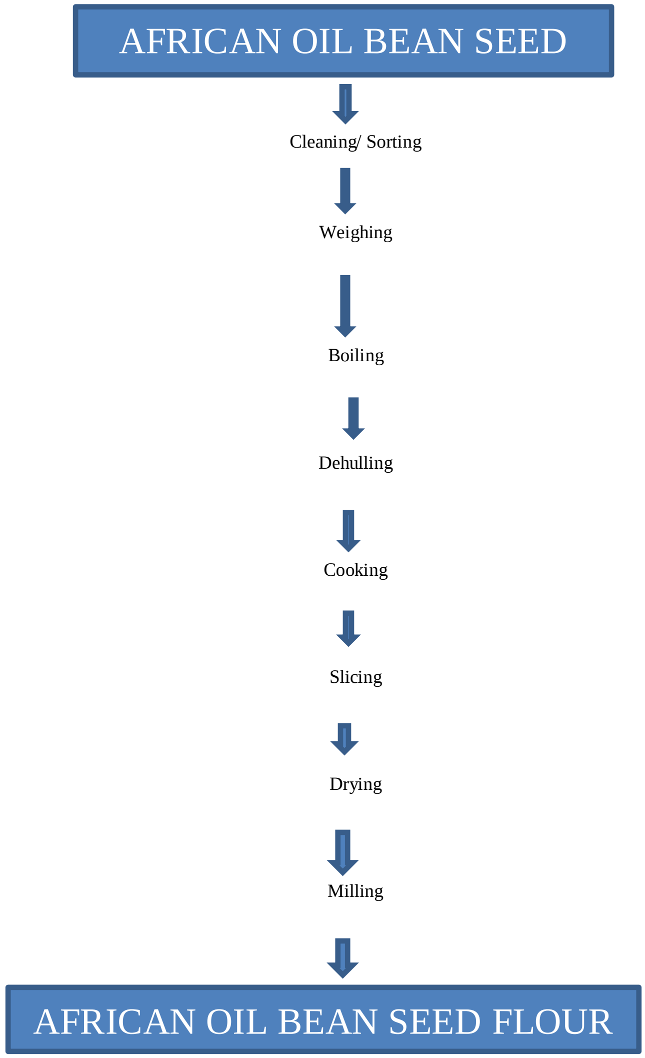

Figure 1: Production of African Oil Bean Flour

Source: Enujiugha and Akanbi (2008)

Proximate Analysis

Protein, fat, fibre, moisture and ash were determined by the method of analysis of the Association of Official Analytical Chemists (2005), while carbohydrate was determined by difference.

Functional Properties

Water absorption capacity determination

Water absorption capacity is an index of the amount of water retained within a food matrix under certain conditions (Ayinde *et al*., 2012).

Oil Absorption Capacity Determination

Oil absorption capacity is an index of the amount of oil retained within a protein matrix under certain conditions. It was determined using the method of Sathe and Salunkhe (1982) as modified by Adebowale *et al*. (2005).

Bulk density determination

The method of Sathe and Salunkhe (1982) was used with slight modification by Adebowale *et al*. (2005).

Swelling index determination

The swelling index of the samples was determined by the method of Ukpabi and Ndimele (1990).

Sensory Evaluation of Product Samples

A twenty-man panelist was used, and selection was made based on familiarity with cake. The samples were presented to panelists in a randomised order and were evaluated for appearance, taste, aroma, mouthfeel and overall acceptability on a 7-point hedonic scale (Larmond, 1977).

Statistical Analysis

Data were generated in triplicate, and analysis was performed using one-way analysis of variance (ANOVA) with the Statistical Package for the Social Sciences (SPSS) version 10.0 for Windows. Means were separated using Duncan's multiple range test.

RESULTS AND DISCUSSION

Results and Discussion

The results of the proximate and functional properties of flour produced from wheat-African oil bean flour, and the sensory properties of biscuits produced from the blends are shown in the tables below.

Table 1: Proximate Composition of Wheat-African Oil Bean Seed Flour Blends.

	WF : AOBF			
Proximate Composition	**100:00**	**80:20**	**70:30**	**60:40**
Moisture (%)	$10.56±0.21^a$	$10.34±0.71^a$	$10.30±0.25^a$	$9.97±1.07^b$
Ash (%)	$0.30±0.14^a$	$1.00±0.28^b$	$1.20±0.00^c$	$1.25±0.07^c$
Protein (%)	$8.82±0.12^a$	$11.44±0.09^b$	$12.43±0.25^c$	$13.54±0.05^d$
Fat (%)	$8.47±0.37^a$	$10.50±0.29^b$	$13.69±0.38^c$	$14.65±0.52^c$
Carbohydrate (%)	71.85^a	66.72^b	62.39^c	60.59c
Energy value (Kcal)	398.91^a	407.14^b	422.59^b	428.37^b

MMean ± SD of three replicates. Mean values within a column with the same letter were not significantly different (p>0.05)

Keys:WF: Wheat Flour AOBF: African Oil Bean Flour

Table 2: Functional Properties of Wheat-African Oil Bean Seed Flour Blends

	WF: AOBF			
Functional Properties	**100:00**	**80:20**	**70:30**	**60:40**
Bulk Density (g/cm^{-3})	$0.78±0.02^a$	$0.73±0.02^b$	$0.69±0.01^c$	$0.67±0.01^c$

Water Absorption Capacity (g/cm^{-3})	1.27±0.05^{a}	1.30±0.14^{a}	1.46±0.06^{b}	1.56±0.12^{b}
Oil Absorption Capacity (g/cm^{-3})	0.92±0.04^{a}	1.02±0.07^{b}	0.77±0.03^{c}	0.74±0.16^{c}
Foaming Capacity (%)	31.0±1.41^{a}	12.0±0.90^{b}	12.0±0.40^{b}	10.0±0.20^{c}
Foam Stability	54.79±2.05^{a}	41.67±11.7^{b}	33.33±0.52^{c}	30.00±1.14^{c}

Mean ± SD of three replicates. Mean values within a column with the same letter were not significantly different ($p>0.05$)

Keys:WF: Wheat Flour AOBF: African Oil Bean Flour

Table 3: Mean Scores of Sensory Properties of Biscuits from Wheat-African Oil Bean Seed Flour Blends

	WF : AOBF			
Sensory Properties	**100:00**	**80:20**	**70:30**	**60:40**
Colour	6.75^{a}	7.35^{a}	5.30^{d}	6.05^{c}
Taste	6.80^{a}	7.50^{a}	6.85^{a}	6.70^{a}
Flavour	6.85^{a}	7.10^{a}	5.95^{a}	6.50^{a}
Texture	6.05^{a}	7.35^{a}	6.35^{ab}	6.55^{a}
General Acceptability	6.85^{b}	7.75^{a}	6..75^{b}	7.10^{b}

Mean values in the same row with different superscripts are significantly different ($p\leq0.05$)

Keys:WF: Wheat Flour AOBF: African Oil Bean Flour

The chemical compositions of wheat flour (WF), African oil bean seed flour (AOBF), and their blends are shown in Table 1. The AOBF contained higher amounts of fat, ash, and protein than WF, which was reflected in the blends as every increase in the level of AOBF resulted in a direct rise in fat, ash, and protein content. This was likely due to the addition effect (Lagnika *et al.*, 2019), since AOBF was richer in these nutrients compared to WF. Only traces of crude fibre were detected in the WF, AOBF, and their blends, probably because of the milling process to which they were subjected. However, the moisture and nitrogen-free extract (nfe) levels of the WF, AOBF, and the blends decreased with an increase in WF substitution. WF contained 10.56% moisture and 71.85% NFE, while AOBF had 3.66% moisture and 12.20% NFE. The energy content of WF was 398.91 kcal per 100 g, which is adequate, whereas AOBF had a higher energy content of 676.01 kcal per 100 g, within the recommended dietary allowance.

The energy values of the blends increased with the addition of AOBF, likely due to the higher fat content compared to WF. The energy value of a food is much more related to the fat content (Christiana and Nkemakonam, 2018). The mean caloric value of the blends was 424.69 kcal/100 g. The AOBF contained a relatively large amount of protein, which was reflected in the blends, causing an increase in protein level with every increase in WF substitution. Biscuits made from these blends will therefore be good sources of protein, which are better than all wheat biscuits (Ujong *et al.,* 2023).

Table 2 shows the functional properties of the wheat flour, African oil bean seed flour and their blends. The bulk density of WF and AOBF was 0.78 and 0.87 g cm-3, respectively, and varied from 0.73 to 0.65 for the blends. The foam capacity recorded for wheat flour was 31.0% and AOBF 12.0%. This conforms to a previous work where WF, African breadfruit kernel flour and their blends were analysed (Okpala *et al.,* 2018). Foaming

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capacity of the blends ranged between 9 and 12%, reducing as the level of AOBF increased in the blends. This shows that the foaming capacity was affected by the level of fat in the samples. The high foaming capacity of WF indicates that its protein can form a large interfacial area (Ujong et al., 2023); the lower values of the AOBF (foaming capacity) can be attributed to its high fat content and lipids acting as foam depressants (Poole, 1989). Lipids, especially phospholipids, have been shown to impair the foaming properties of proteins when present at a concentration greater than 0.5% (Ujong *et al.,* 2023).

This is because lipids are more surface-active than proteins and therefore readily adsorb at the air-water interface and inhibit the adsorption of proteins during foam formation. Anosike *et al.* (2023) had demonstrated that foaming capacity is not dependent on the amount of lipid alone but also on the type of lipid present. The highest foam stability was recorded (54.79%), which decreased with an increase in WF substitution with AOBF up to 15% substitution, and then finally to AOBF, where it showed excellent stability again. Proteins that possess good foaming power cannot stabilise the foam. Foam ability and stability seem to be influenced by two different sets of molecular properties of proteins that are often antagonistic (Ogueke *et al.,* 2010). This could account for the high foam stability of the AOBF and even the blends. Stability is said to depend on the rheological properties of the protein film.

The water and oil absorption properties exhibited by WF and AOBF are 1.27 and 1.80 g cm-3, 0.92 and 0.73 g cm-3 for the water and oil, respectively. The property increased in the blends with an increase in AOBF. It has been suggested that the high water and oil absorption capacities of the blends, compared to WF, display the presence of a high amount of polar amino acids and hydrophilic carbohydrates in the blends (Ujong *et al.,* 2023). The mechanism of fat absorption has been attributed mainly to the physical entrapment of oil and the binding of fats to the polar chain of protein (Anosike *et al.* 2023). The oil and water entrapment of AOBF was low, probably because of the level of saturation of its particles (because of high fat content), which prevents oil and water entrapment.

Table 3 shows that biscuits made with 20% and 30% wheat substitution were rated lowest for all the sensory attributes evaluated. The biscuits appeared darker in colour and softer, especially at the 20% substitution, due to the high oil content, and had rough surfaces caused by oil accumulation. The sensory scores for all samples did not differ significantly in taste, aroma, and texture. The 20% substitution level received the highest scores across all sensory attributes, performing comparably to wheat flour. This indicates that 20% is the optimal substitution level. For all sensory attributes, the 20% substitution was not significantly different from the wheat biscuit, except for overall acceptability, where it was significantly lower ($P<0.05$). This suggests that the 5% substitution level was more acceptable than the wheat biscuit. The biscuit prepared with this level of substitution was golden in colour and had a good diameter. Biscuits made from all other blends (20%, 30%, 40%) were as acceptable as the wheat biscuit, with no significant difference.

CONCLUSION

Biscuits prepared from wheat-African oil bean seed flour blends are nutritious. The cookie could serve as a rich source of protein, minerals and energy. Except for the 'sleeping oil' appearance exhibited by wheat flour substitution levels of 20 and 30%, all levels of substitution produced biscuits of acceptable quality. This study has shown that a biscuit fortified with African oil bean flour at the 10% substitution level gave a product that compared well and above the all-wheat biscuit, thus making this ratio (80% WF: 20% AOBF) the best of all the substitution levels.

REFERENCES

1. Achinewhu, S.C. (2013). Protein quality of African oil bean seed. J. Food Sci. 48:1374-1375.
2. Adebowale, A.A., Sanni, L.O. and Awonorin, S.O. (2005). Effect of texture modifiers on the physicochemical and sensory properties of dried fufu. Food Sci. Tech. Int. 11, 373–382.

3. Anosike FC, Okwuowulu RC, Nwigboji AN, Mofunanya GN, Inyang P, Chinaka I, Onye-Chinedu CB, Onyeji GN, Prince-Osuji, CE. (2023). Evaluation of baking qualities, functional and physicochemical properties of wheat supplemented with cassava and mung bean flour blends for bread making. Food Bioeng; 2(3):264-272.
4. AOAC (2005), Official methods of analysis, 18th Edition, Association of Official Analytical Chemists, Washington, D. C., U.S.A.
5. Ayinde, F.A., Bolaji, O.T., Abdulsalaam, R.B. and Osidipe O. (2012). Functional properties and quality evaluation of kokoro blended with beniseed cake (Sesame indicum). African Journal of Food Science 6(5): 117 – 123.
6. Chandra, S., Singh, S. and Kumari, D. (2015). Evaluation of functional properties of composite flours and sensorial attributes of composite flour biscuits J. Food Sci. Technol., 52 (6), pp. 3681–3688,
7. Christiana OE, Nkemakonam OC. (2018). Production and Quality Evaluation of Enriched Cookies from Wheat, African Yam Bean, and Carrot Composite Flours. Ann Food Sci. Technol.; 4(3):1-8.
8. Enujiugha VN, Akanbi CT (2008). Quality evaluation of canned fermented oil bean seed slices during ambient storage. Afr. J. Food Sci. 2:054-059.
9. Farheena I, Avanish K, Uzma A. (2015). Development and quality evaluation of biscuits fortified with Date paste (Phoenix dactylifera L*). International Journal of Science and Technology*. 3(4):2395-4752.
10. International Institution of Tropical Agriculture (IITA) (1988). Flours from roots and tuber crops for bread making, Annual Report and Research Highlights IITA, Ibadan, Nigeria, pp. 130-131.
11. Lagnika C, Houssou PAF, Dansou V, Hotegni AB, Amoussa AMO, Kpotouchedo FY, Doko SA, Lagnika L. (2019). Physico-functional and sensory properties of flour and bread from composite wheat-cassava. Pak J Nutr.; 18(6):538-547.
12. Larmond, J. (1977). All about the "coconut palm" (Cocos nucifera) (2nd edition).
13. Ogueke CC, Nwosu JN, Owuamanam CI, Iwouno J. (2010): Ugba fermented African oil bean seeds, their production, chemical composition, preservation, safety, and health benefits. Pak J Biol Sci.; 13(10):489–496.
14. Okpala LC, Ofoedu PI. (2018). Quality Characteristics of Cookies Produced from Sweet Potato and Wheat Flour Blend Fortified with Brewer's Spent Grain Flour. Curr Res Nutr Food Sci. 6(1).
15. Olaoye OA, Onilude AA, Idowu OA. (2021): Quality characteristics of bread produced from composite flour of wheat, plantain and soybean. *African Journal of Biotechnology*. 5:1102-1106.
16. Onabolu A, Abass A, Bokanga M (2018). New food products from cassava. IITA publications, Ibadan, Nigeria. pp. 15-16.
17. Onwuka GI (2020). Evaluation of baking potentials of soybean and mucuna bean in composite bread. Proceedings of the 24 th Annual NIFST Conference, Bacuhi, Nigeria. pp. 43-44.
18. Osibanjo AA, Muhammed YO, Olatunji OO, Odunfa SA (2017). Bread making using high dilution composite flours. Unpublished FIIRO Interim Research Report. p. 32.
19. Sathe, S. K. and Salunkhe, D. K. (1982). Effects of germination on proteins, raffinose oligosaccharides and anti-nutritional factors in the Great Northern beans (*Phaseolus valganis, L.*). *Journal of Food Science*, 18, 234–245.
20. Ujong AE, Emelike NJT, Woka FI, Otekeiwebia Jnr F. (2023). Formulation of fiber enriched crackers biscuit: Effect on nutritional composition, physical and sensory properties. Heliyon; 9(5):e15941.
21. Ukpabi, U.J. and Ndimele, C. (1990) Evaluation of Gari Production in Imo State Nigeria. *Nigeria Food Journal*, 8, 105-110.