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Quality Evaluation of Blends and Cookies from Wheat/ African Fan Palm Shoot Flours

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ABSTRACT---- ***African fan palm shoots (AFS) were processed into flour. The flour was blended with wheat flour in the ratio of 100:0, 75:25, 50:50, 25:75, 0:100, wheat : African fan palm shoot flour. Functional and physico-chemical properties of the flours were evaluated. The flour blends were used to produce cookies using standard method. The physical properties, proximate and mineral compositions of the cookies as well as sensory properties of the cookies were determined. The vitamin C content generally increased while the total sugar decreased as the proportion of AFP increased in the blends. The titratable acidity increased while the pH decreased as the level of AFS increases in the blends. The functional properties of the flours and the blends showed that the water absorption capacities increased while the oil absorption capacities decreased as the level of AFP increased and ranged from 52.50 - 60.21% and 85.00 - 89.80% respectively. The emulsion capacity and gelation concentration increased while the bulk densities decreased as the proportion of AFS flour increased and the values ranged from 51.25-58.33%, 8.0 - 16% (w/v) and 0.79- 0.62 (g/cm3) respectively. The results for proximate showed that the moisture, fiber and protein content decreases as the proportion of (AFS) increased and ranged from 6.02 - 13 00%, 2.15 – 2.42% and 10.48 – 8.22% respectively. The ash, Fat and carbohydrates increases as proportion of AFS increased and ranged from 2.50 – 3.10%, 1.80 – 5.40% and 69.80 -75.11% respectively. The results of the mineral composition of cookie samples shows that Mg, Ca and Mn content ranged from 150.33 – 406.28mg/100g, 55.25 – 884.40 mg/100g, and 5.20 – 10.56mg/100g respectively. The control sample (100% wheat cookie) has the least (p<0.05) amounts of Mg, Ca and Mn. The values for Na, K and P shows that the amount ranged from 8.22- 24.32mg/100g 432.63 - 450.50 mg/100g and 107.05 – 350.12mg/100g respectively. The control sample (100% wheat cookie) has the highest (p<0.05) amounts of Na, K and P. The physical characteristics shows that AFP cookies (0%, 25% and 50%) were significantly (P<0.05) heavier than cookies with 75% and 100% AFP. The diameters and densities of the cookies generally increased as the proportion of AFP flour increased in the cookies and were significantly (P<.0.05) affected. The percent cook yield decreases as the proportion of APS flour increases in the cookies. The sensory evaluation results showed that there was progressive decreased in all the sensory ratings as the level of African fan palm flour increased but up to 50 % inclusion did not adversely affect the sensory ratings. The study indicates that vitamin C enriched composite flours, Mg, Ca and Mn enriched cookies can be prepared from blends of wheat/ APS flour and up to 25 % inclusion of African palm shoot flour in wheat does not adversely affect the sensory characteristics of the cookies.***

Keywords--- African fan palm shoots, wheat flour, cookies, Physico - chemical and functional properties, proximate and mineral compositions, sensory properties.

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1. INTRODUCTION

Over the past several decades there has been a growing trend towards adding value or increase utilization of raw agricultural products as human food or animal feed [1]. As population continues to increase and become more urban, the trend has accelerated. The need for stable and convenient foods has increased along with the demand for exotic food products for international business.. In this regard; several lesser known and underutilized agricultural products were analyzed for potential utilization or incorporated with conventional food crops in food preparation.

Over the years, the demand for pastry product in Nigeria has being on the increase. As the demand for pastry product increase, the cost of ingredients and products also becomes very expensive [2]. This high cost is due to the fact that the principal ingredient in making pastries is wheat which is imported into the country because the prevailing climatic conditions and soil type in Nigeria do not support local cultivation. Some fruits such as ripe bananas have been used together with wheat flour by some bakers to bake banana cakes and such products have been sold on commercial basis [3]. Presently, there is no reported research information on the use of processed African palm shoot flour in conventional baked products. Presently, the shoots of African fan palm are harvested and cooked for consumption. These shoots are eaten as delicacy. The setbacks associated with African fan palm shoot include under-utilization, lack of preservation and inadequate research on its composition, properties and very few persons know African fan palm as a food material.

African fan palm shoot could be processed into flour and used in similar manner other flours such as orange seed [4] mango kernel [5, 6], Pawpaw [7] are used. This will, however, depend on the knowledge of its chemical composition and functional properties. Quality attributes of developed food products are generally affected by the functional properties of the flour [4]. It was envisage that the incorporation of African fan palm flour into wheat flour in baking will improve its utilization and the over dependence of 100% wheat flour in baking will also reduce.

African fan palm could be preserved so as to make it available all year round and to incorporate it into wheat flour in the production of baked product (cookie) because of its economic and possible nutritional benefits. Cookies are consumed extensively all over the world probably due to increased advocacy on the consumption of functional foods by World nutrition bodies [8]. The objectives of this work were to preserve African fan palm and determine the functional and physico-chemical properties of the flours and the blends of African fan palm /wheat as well as physical, proximate, mineral and sensory properties of cookies prepared from the composite flour.

2. MATERIALS AND METHOD

2.1 Source and preparation of raw materials

The African fan palm shoots, flour (wheat), margarine, baking powder, corn starch, sugar, egg, salt and milk were purchased from Idah market in Idah Local government area of Kogi State, Nigeria.
The African fan palm shoots were sorted and properly washed. The African fan palm shoots were blanched in hot water at a temperature of 95^{o}C for 5 minutes [9]. It was then cooled, pulverized, spread thinly on a tray, sundry for 2 days and milled into flour with a milling machine. The flour obtained was sieved with an 80mm mesh sieve size to obtain a very fine particle size.

2.2 Blend formulation/ Cookie preparation

Blends of wheat and African fan palm shoot flour containing 0, 25, 50, 75 and 100% African fan palm shoots flour on replacement basis were prepared. The blends were thoroughly mixed in a food processor (Kenwood model km 201). Cookies were prepared according the formula of Nishibori and Kawakishi [10] as modified by Akpapunam and Darbe [11]. The basic formulation used was flour 49.5%, shortening 20%, sucrose 20%, baking powder 0.5% and beaten whole egg 10%.

2.3 Analytical methods

The bulk density, water absorption, oil absorption, emulsifies capacity and gelation concentration of the flours and their blends were determined according to the method described by Okaka and Poter, [12]. The ascorbic acid, titratable acidity, pH and the total sugars were determined according to AACC [13]. The minerals Na, K ,Ca, Mg, P , Mn and proximate analysis to determine how much of major or macro components which include Moisture , Ash , Fiber ,Fat , Protein and carbohydrate were determined according to standard methods AOAC, [14] . Physical properties such as weight, height, diameter and density were determined for all the cookies according the method described by Onwka, [15]. Percent cook yield was calculated using the formula. $\%\ \text{cook yield} = \frac{\text{Final weight of cookies}}{\text{Weight before cooking} \times 100}$

Sensory evaluation was conducted by 20 trained panelists made up of ten students and ten academic staff of Department of Food Science and Technology, Federal Polytechnic, Idah who were familiar with cookies. The panelists were trained in ten sessions until the panelists' were familiar with the range of characteristic intensities required for the study.

2.4 Statistical analysis

Data were analyzed using analysis of variance. Means were separated by the least significant difference (LSD) test. Significance was accepted at $P < 0.05$ [16].

3. RESULTS AND DISCUSSION

3.1 Functional properties

The results of functional properties are presented in Table 1. The water absorption capacity ranged between 52.50% - 60. 21%. The control cookie has the lowest water absorption capacity and 0% wheat cookie has the highest value. The value increases as the percentage of shoot of African fan palm increases. African palm shoot flour may have contained more hydrophilic constituents than wheat flour, which gave rise to higher water absorption capacity. The lower moisture content of African palm shoot flour also enhanced its water absorption capacity. Water absorption of flour is dependent mainly on the amount and nature of the hydrophilic constituents and to some extent on pH and nature of the protein [17]. Water absorption characteristic represents the ability of the product to associate with water under conditions when water is limiting. The results of this study suggest that African palm shoot flour would be useful in bakery products which require hydration to enhance handling characteristics.

The oil absorption capacity decreases as the percentage APS flour increases. It ranged from 89.80 – 85.00%. Oil absorption capacity is attributed mainly to the physical entrapment of oils. It is an indication of the rate at which protein binds to fat in food formulations [18]. %. Oil absorption capacity is useful in formulation of foods such as sausages [19].
The emulsify capacity increases as the percentage APS flour and it ranged from 51.25 – 58.33%. The increase in emulsify capacity could be associated with the starch and protein content respectively of the flours. There were significant (p<0.05) differences among the blends in emulsify capacity from the control sample (100% APS flour).
The bulk density decreases as the percentage APS increases but it shows no significant difference among the samples. Bulk density is a function of particle size, particle size being inversely proportional to bulk density [20]. The differences in the particle size of the flours may be the cause of variations in bulk density of the blends. Bulk density is an indication of the porosity of a product which influences package design and could be used in determining the type of packaging material required, material handling and application in wet processing in the food industry [21]. Bulk density is also important in infant feeding where less bulk is desirable. The least gelation concentration increases as the percentage APS flour increases in the blends. It shows significant difference between the control sample and APS substituted samples. The least gelation concentration varies for different flours. Sathe *et al.*, [22] associated the variations in the gelling properties of different flours to different ratios of components that make up the flours. Interactions among these components play a significant role in functional properties.

Table 1: Functional properties of wheat (W) flour, African palm shoot (APS) and their blends.

Blends W:APS	Water Absorption(%)	Oil Absorption(%)	Emulsifying capacity(%)	Bulk Density(g/cm^3)	Gelation (%)
100:0	52.50e	89.80a	51.25d	0.79a	8.0d
75:25	56.00d	88.50b	54.83c	0.76a	8.0d
50:50	57.50c	88.00b	56.25b	0.71a	10.0c
25:75	59.00b	87.50c	56.58b	0.66a	12.0b
0:100	60.21a	85.00d	58.33a	0.63b	16.0a
LSD	1.07	0.88	1.46	0.16	0.91

Readings within a column with same letters are not significantly (P <0.05) different

3.2 Physico-chemical properties

The results of the physico-chemical properties of the flour blends are shown in Table 2. The results for Ascorbic acid show that wheat flour has the lowest ascorbic acid while APS has the highest ascorbic acid. Ascorbic acid content increases as the percentage of APS inclusion increases. The values ranged from 0.32 – 1.84% . The increasing trend of ascorbic acid content with increasing level of APS suggests that APS could contain more vitamin C than the wheat flour. The titratable acidity increases as the percentage of flour from the shoot of African fan palm increases. It ranged from 2.21 - 3.45 %. The APS has the lowest pH value while wheat flour has the highest value. The rise in titratable acidity and decrease in pH indicates that the acid concentrations in the flour blends are appreciating and this has an advantage in the storage life of the flour blends. Similar trends of titratable acidity and P^H was reported by Yusufu and Akhigbe [7]. The sugar content increases as the percentage of flour from the shoot of African Fan palm decreases. The sugar content ranged from 4.52 - 6.80mg /100ml. This suggests low sugar content of the African fan palm shoot than the wheat flour.

Table 2: Physico-chemical properties of the flour blends

Blends Wheat: APS	Ascorbic acid (Mg/100g)	Titratable acidity (mg /100ml)	P^H	Total Sugar) (mg /100ml
100:0	0.32c	2.21b	5.87a	6.80a
75:25	1.12b	2.52b	5.60a	6.12b
50:50	1.44a	3.21a	5.01b	5.50c
25:75	1.76a	3.31a	4.85b	5.10c
0:100	1.84a	3.45a	4.50c	4.52d
LSD	0.49	0.46	0.46	0.58

Reading within a column with same letter is not significantly different (P < 0.05).

3.3 Proximate composition of the cookies

The results for the proximate composition of cookies made from blends of flour from the shoot of African fan palm and wheat are shown in Table 3. The moisture content of the cookies ranged from 6.02% to 13.00% with the control (100% wheat cookie) having the highest moisture content and 0% wheat having the lowest moisture content. The moisture increases as African fan palm shoot flour increases. The trend of moisture decrease could be related to the decreased protein content with increased in the proportion of APS flour .This is because the functional property such as water absorption of food is mainly attributed to its protein [19] The ash content increases with increase in African palm shoot flour and ranged from 2.50 – 3.10%. . This trend in ash content suggest high mineral in African fan palm shoot. The fiber content ranged from 2.15% for (0% wheat inclusion) to 2.42% for (100% wheat inclusion). The fat content ranged from 1.80% to 10.40% with (100% wheat) having lowest fat content (0% wheat) having highest fat content. The protein content ranged from 8.22 - 10.48%, with (100% wheat) having the highest value This is an indication that wheat flour contains a higher protein when compared with African fan palm shoot. The carbohydrate content is highest (P≤ 0.05) for African fan palm shoot (75.11%) and lowest for wheat flour (69.80 %) and decreases as the proportion of African palm shoot flour increases.

Table 3: Proximate composition of cookies samples

Blends Wheat:APS	Moisture%	Ash%	Fiber%	Protein%	Fat%	Carbohydrate%
100:0	13.00a	2.50b	2.42a	10.48a	1.80c	69.80d
75:25	10.10b	2.65b	2.30b	10.20a	3.00b	71.75c
50:50	9.20b	2.70b	2.22b	9. 32b	3.30b	73.26b
25:75	7.80b	2.90a	2.20c	8.88b	4.88b	73.34b
0:100	6.02c	3.10a	2.15c	8.22c	5.40a	75.11a
LSD	1.00	0.175	0.09	0.54	0.75	0.87

Readings within a column with same letters are not significantly different (P<0.05).

3.4 Mineral composition of the cookies

The results of the mineral composition of cookie samples are shown in Table 4. The value shows that Mg, Ca and Mn content ranged from 150.33 – 406.28mg/100g, 55.25 – 884.40 mg/100g, and 5.20 – 10.56mg/100g respectively. The control sample (100% wheat cookie) has the least (p<0.05) amounts of Mg, Ca and Mn. The inclusion of APS flour in cookie preparation significantly (p<0.05) increases the amount of these minerals in cookies. The values for Na, K and P shows that the amount ranged from 8.22 – 24.32mg/100g, 432.63 - 450.50 mg/100g and 1107.05 – 350.12mg/100g respectively. The control sample (100% wheat cookie) has the highest (p<0.05) amounts of Na, K and P. The inclusion of APS flour in cookie preparation significantly (p>0.05) decreases the amount of these minerals in cookies. The higher K to Na ratios of the cookies is desirable because for the control of diabetes as an average human diets are low in in K but high in Na [23].

Table 4 Mineral composition of cookie samples (mg/100g)

Blends Wheat:APS	K	P	Na	Mg	Ca	Mn
100: 0	450.50a	350.12a	24.32a	150.33e	55.25e	5.20e
75; 25	445.33b	289.33b	18.75b	224.50d	260.20d	6.25d
50; 50	441.52c	228.92c	12.18c	278.36c	456.92c	7.62c
75; 25	436.20d	167.20d	10.35d	325.80b	705. 75b	8.98b
100: 0	432.63e	107.05e	8.22e	406.28a	884.40a	10.56a
LSD	166	4.83	1.73	2.59	8.90	0.90

Readings within a column with same letters are not significantly different (P<0.05).

3.5 Physical characteristics of the cookies

The results for the physical properties of the cookies are shown in Table 5. The results shows that the weight of the samples ranged from 6.11g - 7.42g with control sample having the highest weight. There was no significant (P≤ 0.05) difference between the control cookie and 50% APS cookie. The height ranged from 0.15cm to 0.82cm. The addition of APS in wheat decreases the height of the cookies but there was no significant difference up to 50% addition. The diameter ranged from 2.80cm – 3.22cm. The density ranged from 0.75g/ml to 1.07g/ml and decreased as percentage APS flour increased. The percent cook yield decreases as the proportion of APS flour increases in the cookies and was no significant (P ≥ 0.05) difference in cook yield of the control cookie and cookie from 25% APS substitution. The decrease in weight and %cook yield with increase in APS may be attributed to decrease protein as APS increases. The protein and amino acids function in binding water and oil thereby reducing cooking losses. Similar observation was reported by Alobo [24].

Table 5: Physical properties of the cookies samples

Blends Wheat:APS	Weight(g)	Height(cm)	Diameter(cm)	Density(g/ml)	Cook yield(%)
100: 0	7.42a	0.82a	2.80c	0.76b	74.2a
75: 25	7.30a	0.77a	2.88b	0.76b	73.0a
50: 50	6.91a	0.54b	3.00b	0.76b	69.1b
25:75	6.52b	0.50b	3.11a	1.06a	65.2c
0:100	6.11b	0.15c	3.22a	1.07a	61.1d
LSD	0.67	0.22	0.13	0.14	1.45

Readings within a column with same letters are not significantly (P <0.05) different.

3.6 Sensory properties of the cookies

The results of sensory evaluation are shown in Table 6. The results shows that there is no significant (P ≥ 0.05) difference in taste, texture and general acceptability scores for the control cookie and cookie from 25% inclusion of APS in wheat flour. There is no significant (P ≥ 0.05) difference in flavor for the control cookie and cookie from 50% inclusion of APS in wheat flour. There is a progressive decrease in preference in the sensory parameters as the proportion of APS increases in the cookies. This is in agreement with Akpapunam and Darbe [11], Yusufu and Akhigbe [7] who reported decrease in sensory ratings at higher levels of maize/bambara groundnut and pawpaw/wheat cookies.

Table 6: Mean sensory scores for cookies samples

Blends Wheat:APS	Colour	Taste	Texture	Flavour	Gen.acceptability
100:0	4.70a	3.81a	3.42a	3.63a	4.03a
75: 25	4.10b	3.82a	3.40a	3.60a	4.00a
50:50	3.56c	3.22b	3.02b	3.20a	3.20b
25:75	2.10d	1.60c	2.41b	2.05c	2.60c
0:100	1.40e	1.43c	1.80c	1.60c	1.62d
LSD	0.56	0.86	0.71	0.63	0.73

Readings within a column with same letters are significantly (P< 0.05) different.

4. CONCLUSION

The study reveals that composite flour with enhanced magnesium, calcium, manganese, water absorption, emulsion capacity and bulk density could be produced from wheat/African palm shoot flour blend and also consumer acceptable cookies could be produced from up to 25% inclusion of African palm shoot flour in wheat flour.

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