



STUDY OF SENSORY AND NUTRITIONAL PROPERTIES OF WATER YAM - COMPOSITE BREAD

A. S. Ajala*, F. A. Morufu and K. O. Lawal

Department of Food Science and Engineering, Ladoke Akintola University of Technology,
Ogbomoso P.M. B 4000 Ogbomoso, Oyo State.

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***Corresponding Author**

A. S. Ajala

Department of Food
Science and Engineering,
Ladoke Akintola University
of Technology, Ogbomoso
P.M. B 4000 Ogbomoso,
Oyo State.

ABSTRACT

Water yam is a perennial herbaceous vines cultivated for the consumption of their starchy tubers and also serve as a source of income for people in West Africa. The principal problem in water yam is that it underutilized and its price is lower compare to other yam varieties in the market. Thus it is necessary to develop other means of utilizing it to check its low value price so that farmers can earn better money from planting and sale of the yam. In this study, water yam (D.

alata) flour was prepared using standard milling process. The flour was evaluated for proximate composition, functional (loose density, packed density and swell capacity) and anti-nutritional (phytate, saponin and tannin) properties. It was mixed with wheat flour at varying proportion (100:0, 90:10, 80:20, 70:30, 50:50) and baked as breads. The composite breads were evaluated for minerals (Ca, P, Zn, Mg and Na) and sensory attributes. The results of the proximate composition of yam flour are as follows: moisture (12.26-14.60) %, protein (3.50-6.73) %, fat (0.45- 0.83) %, ash (1.94-2.59) %, crude fibre (1.57-1.74) % and carbohydrate content (75.85-77.92) %. The results of physico-chemical properties of yam flour are as stated; swelling capacity (13.81-15.51)cm³/g, loose bulk density (0.51-0.56) g/cm³ and packed bulk density (0.65-0.70) g/cm³. The results of anti-nutritional are: phytate (0.01-0.02) mg/kg, saponin (0.14- 0.16)mg/kg and tannin (0.01- 0.04)mg/kg . The results of minerals in the bread are as stated: Ca (380-620) mg/ kg, P (1195-1405) mg/ kg, Zn (7.40-9.65) mg/ kg, Mg (25.90-35.35) mg/ kg and Na (101.01-333.02)mg/ kg. The sensory results of the bread are: aroma (1.25-2.60), colour (1.30-3.40), taste (1.4-3.50), texture (1.55-3.45),

appearance (1.40-3.80) and overall acceptability (1.25-3.50). The varied proportion of water yam flour to wheat flour had a significant effect on colour, aroma, taste, texture of the bread. The result of the research showed that up to 10% inclusion water yam flour could be used in composite breads and still be acceptable sensorially. This indicates that water yam hitherto underutilized could be inculcated into wheat flour to produce composite bread. This will add value to the yam locally and reduce dependence on wheat importation into the country.

KEYWORDS: Water yam, composite bread, proximate, anti-nutrients, sensory.

INTRODUCTION

Yam is a common name for some species in the genus *Dioscorea*. These are perennial herbaceous vines cultivated for the consumption of their starchy tubers in Africa, Asia, Latin America and Oceania.^[1] There are over 150 species of yam grown throughout the world.^[2] and one of them is water yam. It is the most widely distributed species, having comparatively better agronomic characteristics such as ease of propagation and yields, higher nutritive value, and a longer storage life and thus plays a very significant role when other food crops are in short supply. Water yam (*D. alata*), has been less studied when compared to other root and tuber crops.^[3] This is because of its composition and acceptability. In Nigeria, sensory properties of yam such as texture, appearance and flavor/taste are the main acceptability factors used by consumers to evaluate the quality of yam tuber. Therefore, because water yam is higher in moisture content, less firm in the mouth during mastication and less viscous when pound in mortar to get pounded yam which is rated as one of the best delicacies in South Western Nigeria. Therefore, most consumers prefer other yam types to water yam. As a result, its price is cheaper in the market which does not favour farmers who are major planters. Hence, although it is grown in Nigeria, it is still one of the lesser utilized and unexploited root and tubers.

Therefore the purpose of the research is to improve the utilization of this product. This is logically achievable by putting it into a food consumed by majority either as a supplement or composite such as bread. In Nigeria, bread has become staple food and is made mainly from wheat imported into the country. Thus, by incorporating locally available material such as water yam into the bread will improve its utilization and reduction in importation of wheat into the country which will be of benefit to improve economy.

MATERIALS AND METHOD

Water yam (*Dioscorea alata*) tubers used was purchased at a local market in Odo-ori Market, Iwo, Osun state.

Preparation of samples

Yam tubers were washed with clean water to remove adhering soil and other undesirable materials. The yam was hand-peeled using kitchen knives and sliced into sizes of 2mm thickness. The slices of yam were blanched in water at 50 °C for 2 hours after which the yam was removed. The blanched yam was steeped for 24 hours to allow the yam attain a flabby nature. The steeped yam was drained and transferred into the tunnel dryer to dry with different temperature of 50 °C, 60 °C, and 70 °C. The dried yam slices were milled using locally fabricated hammer mill and sealed in polythene for further analysis. Sample that gave the best proximate values was used further to bake bread for sensory and mineral analyses.

Determination of proximate, functional properties of the flour

Proximate composition, functional, anti-nutritional properties of the flour were determined using official method.^[4]

Determination of physio-chemical properties of the bread

Functional properties of the breads were determined using official method.^[4]

Sensory Evaluation of the bread

The bread gotten from composite flour was subjected to sensory evaluation. A total of 40 semi-trained panelists of age 19 years and above were involved in the evaluation for crust and crumb colour, aroma, taste, texture and overall acceptability. Panelists were asked to evaluate the bread made from composite flour using the questionnaire provided for scoring difference test. Sensory evaluation based on the sensory attributes was conducted with the aid of standard 9 points hedonic scales method (where 1 = dislike very much and 9 = like very much).^[5] Among these panelists, 18 were males and 22 were females. The bread samples were sliced into uniform pieces of 2cm thickness, coded with 3-digit random number using statistical random tables. These were then served to the panelists at around 10.30 a.m with distilled water for rinsing the mouth after every sample taste in a randomized order. The panelists were instructed to rate the attributes indicating their degree of liking or disliking by putting a number as illustrated in the hedonic scale.

Statistical analysis

All values were carried out in triplicates and subjected to statistical analysis. In each case, a mean value was calculated and analysis of variance (ANOVA) was also performed. Separation of the mean values was done by Duncan's multiple range tests at $p \leq 0.05$ using Statistical Analysis System (SAS) software, version 10.0.

RESULT AND DISCUSSION

(a) Proximate, functional and anti-nutrient properties of water yam flour

The value of protein ranged from 3.57- 6.73 % and significantly different at $p < 0.05$. Fat also ranged from 0.45 - 0.83% and exhibited significant difference at $p < 0.05$, Fibre also varied from 1.57 – 1.74% and exhibited significant difference at $p < 0.05$. Ash varied from 1.94 - 2.59% as temperature increased from 50-70 ° C, moisture and carbohydrate also exhibited significant difference at $p < 0.05$ as shown in Table 1. The values of proximate composition is similar to those reported by.^[6] Sample C gave the highest protein content and this was further processed to make composite bread.

Table 1: Proximate composition of Yam flour (%).

Sample	Protein	Fat	Fibre	Ash	Moisture	CHO
A	3.53±0.09 ^a	0.45±0.02 ^a	1.57±0.03 ^a	1.94±0.02 ^a	14.60±0.05 ^c	77.92±0.07 ^b
B	5.78±0.13 ^b	0.59±0.03 ^b	1.65±0.21 ^a	2.35±0.01 ^b	13.82±0.04 ^b	75.81±0.06 ^a
C	6.73±0.08 ^c	0.83±0.01 ^c	1.74±0.01 ^b	2.59±0.04 ^c	12.26±0.03 ^a	75.85±0.07 ^a

Mean value of different superscript along the same column are significantly different from each other at ($p < 0.05$).

Sample A = Dried at 50 ° C, Sample B = Dried at 60 ° C, Sample C = Dried at 70 ° C

The loose bulk density and packed bulk density of the samples ranged from 0.51-0.56 and 0.62-0.65 g/cm³, respectively, and exhibited no significant difference at $p < 0.05$ as shown in Table 2. These values are lower than the results obtained by.^[7] Bulk density is generally affected by the moisture content, particle size and the structure of the starch polymers as reported by.^[7]

Swelling capacity of the flour ranged from 13.8-15.5 cm³/g which increased with increase in temperature. The results gotten for swelling capacity was in agreement with the earlier finding of^[7] and it provides evidence of magnitude between starch chains within the amorphous and crystalline domains and also evidence of association bonding within granules of yam starches.^[8] The swelling capacity is an indication of presence of amylase which

influences the quantity of amylopectin present in yam flour. Therefore, the higher the swelling power, the higher the associate forces which indicates the degree of exposure of the internal structure of starch present in the flour to the action of water.^[8]

Table 2: Functional properties of yam flour.

Samples	LBD (g/cm ³)	PBD (g/cm ³)	Swelling capacity (cm ³ /g)
A	0.56±0.01 ^a	0.65±0.00 ^a	13.80±0.04 ^a
B	0.53±0.01 ^a	0.63±0.00 ^a	14.58±0.02 ^b
C	0.51±0.01 ^a	0.62±0.00 ^a	15.51±0.02 ^c

Mean value of different superscript along the same column are significantly different from each other at (P <0.05).

Note: LBD = Loosed bulk density, PBD = Packed bulk density.

Sample A = Dried at 50 °C, Sample B = Dried at 60 °C, Sample C = Dried at 70 °C.

The results of tannin, phytate and saponin of the water yam flour is as demonstrated in Table 3. There was no significance difference among the samples. The values of the anti-nutrition factor in this work were lesser than the values reported by.^[9] The low values of these anti-nutrients indicated save consumption of the flour.

Table 3: Anti-nutritional analysis of Yam Flour.

Samples	%Tannin	%Phytate	%Saponin
A	0.01±0.004 ^a	0.01±0.00 ^a	0.14±0.00 ^a
B	0.03±0.00 ^a	0.02±0.00 ^a	0.15±0.00 ^a
C	0.04±0.00 ^a	0.02±0.00 ^a	0.16±0.00 ^a

Mean value of different superscript along the same column are significantly different from each other at (p<0.05).

Sample A = Dried at 50 °C, Sample B = Dried at 60 °C, Sample C = Dried at 70 °C'.

(b) Minerals and sensory analysis of composite bread

The values of minerals composition of the composite bread are as shown in Table 4. The values of minerals increased as the level of water yam flour increased in composite bread. The values indicated that the breads were rich in calcium, phosphorus, sodium but less rich in magnesium and zinc. The values of these minerals are in close range with those reported by.^[13]

Table 4: Mineral analysis of Bread (mg/kg).

Samples	Ca	P	Zn	Mg	Na
A	380±10.10 ^a	1195±10.21 ^a	7.40±0.14 ^a	25.90±0.28 ^a	101±5.00 ^a
B	430±12.50 ^b	1240±12.14 ^{ab}	7.80±0.14 ^a	29.70±0.14 ^b	220±10.220 ^{ab}
C	510±43.00 ^c	1300±14.28 ^b	8.65±0.21 ^b	32.55±0.21 ^c	261±10.30 ^{bc}
D	570±32.00 ^d	1350±15.14 ^{cd}	9.05±0.21 ^{bc}	33.80±0.14 ^d	293±14.00 ^c
E	620±23.00 ^e	1405±21.21 ^d	9.65±0.21 ^c	35.35±0.21 ^e	333±15.10 ^c

Means with the same superscript along the same column are not significantly different ($p>0.05$).

Key: Sample A – 100% wheat flour, Sample B – 90% wheat flour to 10% water yam flour
Sample C – 80% wheat flour to 20% water yam flour, Sample D – 70% wheat flour to 30% water yam flour, Sample E – 50% wheat flour to 50% water yam flour.

The results of sensory evaluation of the composite bread are as displayed in Table 6. The composite bread were not significantly different in aroma in all levels of substitution but different from 100% wheat flour. The colour of sample A (100% wheat bread) and sample B (90% wheat flour to 10% water yam flour) were not significantly different at $p<0.05$. Also, values of appearance indicated that sample A and B were not significantly different at $p<0.05$ but differed from other samples. The same trend occurred in texture but taste values took a different pattern because sample A was significantly different from all others. The overall acceptability of the bread showed that sample A and B were not significantly different at $p<0.05$ but were different from other samples. That means bread up to 10% inclusion of water yam were not different from 100% wheat bread.

Table 6: Sensory evaluation analysis.

Sample	Aroma	Colour	Appearance	Texture	Taste	Overall acceptability
A	1.25±0.72a	1.30±0.57a	1.40±0.15a	1.55±0.94a	1.40±0.75a	1.85±0.55a
B	2.45±0.30b	1.85±0.93a	1.80±0.03a	2.05±0.27ab	2.35±0.88b	2.05±0.93a
C	2.75±0.25b	2.95±0.28b	3.10±0.02b	3.10±0.33bc	3.00±0.86bc	2.70±0.87bc
D	3.20±0.24b	2.90±0.41b	3.15±0.66b	3.45±0.43c	2.90±0.74bc	3.05±0.70bc
E	2.60±0.27b	3.40±0.98b	3.80±0.46b	3.45±0.45c	3.50±0.33c	3.50±0.09c

Means with the same superscript along the same column are not significantly different ($p<0.05$)

Key: Sample A–100% wheat flour, Sample B – 90% wheat flour to 10% water yam flour
Sample C – 80% wheat flour to 20% water yam flour, Sample D – 70% wheat flour to 30% water yam flour, Sample E – 50% wheat flour to 50% water yam flour.

CONCLUSION

From the results obtained in this study, it can be concluded that 10% inclusion of water yam flour compared favourably with 100% wheat bread in terms of aroma, colour, taste, appearance, texture, taste and overall acceptability.

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