

Rheological properties and the evaluation of the effects of date syrup (*Phoenix dactylifera* L.) sugar substitute on food composition of Bambara flour (*Vigna subterranea*) composite bread.

Ekoja Omeyi Faith¹, Egbunu Moses Majiyebo², Adgidzi Asheobin Eunice³, Okoro Elechi Jasper⁴, Adamu Cornelius Smah^{5*}

¹Department of Agriculture, University of Basque Country, Basque, Spain

²Department of Agricultural and Bio-Environmental Technology, Federal University, Lokoja, Nigeria

³Department of Home Management, Nasarawa State University, Keffi, Nigeria

⁴Department of Food Science and Technology, Federal University of Agriculture, Makurdi, Benue, Nigeria

⁵Department of Agricultural and Environmental Engineering, Federal University of Agriculture, Makurdi, Benue, Nigeria

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Abstract

There is an increase advocacy on the consumption of functional foods by world nutrition bodies, due to different health challenges related to food consumption such as diabetes and heart disease, coupled with the recent WHO recommendations to reduce the overall consumption of sugar and foods that promote high glucose response. Date syrup as sugar substitute in the preparation of breads enhances the nutritional and health status of the consumers. Bread was developed using the Bambara nut bean legume (*Vigna subterranea*) where date syrup substituted for sugar (sucrose) significantly improve the physical characteristics and chemical composition. There was a significant increase in the concentration of date syrup at various levels with increase in the mineral concentration compared to the control (sucrose) and a notable increase in the rheological properties when date syrup was substituted with sucrose. The sensory evaluation revealed that bread developed with date syrup had a higher general acceptability score than the control.

Keywords: Bambara nut bread, Date syrup, Public health, Food safety introduction, Food consumption

Introduction

Bread is a staple food prepared from flour and water in addition to some ingredients, usually by baking. In Africa and most especially Nigeria, bread is considered as the most popular and the most consumed food. Bread is usually made from wheat flour that is cultured with yeast where it's allowed to rise and finally baked in an oven. Bread has been regarded as the most appealing food due to its texture, taste and flavour. Due to increased demand for functional products, attempts are being made to improve the nutritive value and functionality of bread by modifying its nutritive composition. This involves the use of non-wheat flours such as Bambara nut (*Vigna subterranea*) flour and an unconventional sweeteners such as date (*Phoenix dactylifera* L.) with attempts to enhance the nutritional quality of bread to reduce the prevalence incidence of diabetes and coronary heart disease and overcome the problems of high cost of wheat flour and conventional sugar due to their importation in Nigeria [1].

Bambara nut is from Bambara bean legume (*Vigna subterranea*), it's very rich in protein and the flour is used to make a nutritious steamed pudding meal locally known in Igbo speaking areas in South-East Nigeria as 'Okpa and date (*Phoenix dactylifera* L.) is a primal plant and it has been cultivated for its edible fruit. It is a nutritious and energy producing fruit. Date flesh contains substantial amount of carbohydrates, ash, protein and lipids. The sugar content of ripe dates is about 80% and is high in fiber. Date is food for diabetic patients because dates contain invert sugar, which is better utilized as source of energy by diabetic patients than glucose and sucrose dates provide about (8 g) 23 calories, 0.2 g of protein, 6 g of carbohydrates and 0 g of fat. Dates are a good source of potassium, magnesium and iron [2].

With the increase advocacy on the consumption of functional foods by world nutrition bodies due to different health problems related with food consumption such as diabetes and coronary heart disease, the recent, WHO recommendations to reduce the overall consumption of sugars and foods that promote high glucose responses and considering the health

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benefits of date, its incorporation as sugar substitute in the preparation of breads may enhance the nutritional and health status of the consumers, reduce total dependence on table sugar and prevalent incidence of diabetes and coronary heart disease. However to date a detailed composition of the bread produced with Bambara flour incorporated with date syrup, as well as the accompanying physico chemical changes that may affect quality and acceptability of bread has not yet been reported in Nigeria. Therefore, the objectives of this study were to evaluate the rheological properties of date syrup bread dough as well as the physical properties, proximate composition, mineral contents and sensory properties of breads prepared with Bambara flour with date syrup with a view of knowing the consumer acceptability of this product [3-5].

Materials and Methods

Sample procurement and preliminary treatments.

Exactly 4.0 kg of date fruits were bought from a local market in Lafia, Nasarawa state, Nigeria. Bread ingredients such as, Bambara nuts were purchased after sorting, washed and dried, it was thereafter grinded to flour. Sugar, salt, yeast and butter were purchased from a super market in Lafia, Nasarawa state, Nigeria. Sorting of foreign matters like stones, debris and some defective fruits that could affect the quality of the bread were removed. The cleaned date's fruits were packaged in four 5 L plastic buckets and were used for formulation of products within a week [6].

Preparation of date syrup

The preparation of the date syrup was done using the Tanseen method. Tanseen method was modified by pounding, milling sun drying. A sun drying moisture contents of 10% was achieved. The samples of dried dates were pounded in the mortar for size reduction of 0.5 mm to aid milling. At 100°C, the milled date was boiled for 30 minutes at (5%, 10%, 15%, 20% and 25%) concentration level to obtain slurry and was subsequently filtered and sieved using a muslin cloth.

Products development

Different concentration of dates syrups were used as sugar substitute among others ingredients for Bambara bread. At the level of 5%, 10%, 15%, 20% and 25% each concentration was incorporated into the bread where 100% sugar (50 g) served as the control. Other ingredients remaining the same (500 g Bambara flour, 15 g yeast, 10 g of margarine 5 g of salt, 400 ml of water for the control and 280 ml for various samples of dates syrup). Dough were made and baked in an oven using the standard procedure by Wouter [8-10].

Analyses

Physical characteristics of bread: The physical characteristics of the bread were evaluated by measuring the thickness, diameter, length and height of the loaf using measuring rule and veneer caliper. The loaf weight, volume,

specific volume and density were also determined by saheen method.

Gluten determination: 30 g was transferred to the dish and it was weighed. 30 g of Bambara dough was transferred to a bowl where 20 ml of distilled water was added was transferred into a clean. The contents were the determination of gluten was done by placing a dish on a weighing balance. Bambara sample of about prepared into a stiff dough ball. The Bambara dough ball was kept in a beaker to stand for an hour. After an hour, the dough was removed and it was placed in a sieve and it was gently washed with steam of tap water until it was free of starch [11]. The wet gluten thus obtained was weighed and its weight expressed as a percentage of the original flour sample (30 g). The wet gluten was then transferred into a dish and placed in a hot air oven at 100°C for 2 hours. After cooling in desiccators the dry gluten was weighed and its weight expressed as a percentage of the original flour sample. The paleographic assays were done using a Chopin oleograph following the standard method [12].

Proximate composition: The proximate composition in terms of carbohydrate, protein, fat, ash, crude fiber and moisture content were determined according to (AOAC, 1995) Nitrogen Free Extract (NFE) of Bambara flour (WF) and Alkaline Water Retention Capacity (AWRC) of the samples was determined according to the procedure followed by Millicent. Carbohydrate content of the samples was determined by the difference method as reported by Onuh, et al. Using the equation % carbohydrate=100-(% moisture+% ash+% protein+% crude fiber+crude fat). The caloric values was determined using the method described by Onwuka by using the Atwater factor of 4 × protein, 4 × carbohydrate, 9 × fat and summing the multiplied values for crude protein, crude fat and carbohydrate [13].

Determination of mineral contents: The atomic absorption spectrophotometer method was used for the determination of total mineral. The element included; Zinc (Zn) Iron (Fe), Magnesium (Mg), Calcium (Ca), Potassium (K), Sodium (Na) and Phosphorous (P).

Sensory evaluation: A 30 member panel was trained as panellists or judges and the prepared bread samples were presented to the judges who made up of 10 staff members and 20 students of the school of the college of engineering, department of agricultural and agricultural engineering, university of agriculture, Makurdi, Benue state. These panellists were familiar with the sensory properties of bread and its consumption. Samples were assessed for colour, texture, flavour, appearance and the general acceptability using a nine point hedonic scale ranging from ranging from 1=Dislike extremely and 9=Like extremely described by Lawless and Heymann.

Statistical analysis: SPSS version 22 was used for Analysis of Variance (ANOVA). The Duncan multiple range test was used to determine significant difference among the various samples.

Results

Effect of date syrup on the baking characteristics of bread

Table 1 shows the results of the physical properties of bread made from Bambara flour supplemented with date syrup. There is no significant difference in the result among the samples at probability level of ($p \geq 0.05$) for heights that ranges from (18.51 ± 0.03 - 19.85 ± 0.17), weight (387 ± 10.60 - 397.7 ± 3.56) and thickness (11.09 ± 0.142 - 11.52 ± 0.25) which decreased as the concentration of date syrup increases but not including the height which took an irregular pattern.

Table 1. Effect of date syrup on the baking characteristics of Bambara bread.

Parameters	Height	Weight	Thickness	Diameter	Volume	Specific vol.	Density
A	18.99 ± 0.73^a	397.7 ± 3.56^a	11.52 ± 0.25^a	7.73 ± 0.07^a	1852 ± 70.75^a	4.66 ± 0.14^a	0.29 ± 0.15^c
B	18.93 ± 0.58^a	397 ± 859^a	11.23 ± 0.22^a	7.46 ± 0.08^b	1807 ± 63.67^{ab}	4.56 ± 0.29^a	0.26 ± 0.01^{bc}
C	18.98 ± 0.09^a	396 ± 4.27^a	11.20 ± 0.22^a	7.37 ± 0.08^{bc}	1701 ± 0.02^{bc}	4.35 ± 0.06^{ab}	0.25 ± 0.07^{abc}
D	19.85 ± 0.17^a	395 ± 4.21^a	11.17 ± 0.19^a	7.20 ± 0.04^{cd}	1628 ± 35.67^{cd}	4.19 ± 0.16^b	0.24 ± 0.03^{ab}
E	18.51 ± 0.03^a	389 ± 9.21^a	11.17 ± 0.23^a	7.14 ± 0.09^c	1601 ± 0.03^{cd}	4.13 ± 0.09^b	0.32 ± 0.01^a
F	18.80 ± 0.43^a	387 ± 10.60^a	11.09 ± 0.142^a	7.06 ± 0.08^d	1527 ± 35.39^d	3.96 ± 0.19^b	0.35 ± 0.03^a
LSD	1.21	17.90	0.60	0.17	109.4	0.40	0.03

Note: Values for 3 replications. Mean values having the same superscript in a column are not significantly different ($p > 0.05$). A=100% sucrose in a dough without syrup (control). B=5% date syrup without sugar in a dough. C=10% date syrup without sugar in a dough. D=15% date syrup without sugar in a dough. E=20% date syrup without sugar in a dough. F=25% date syrup without sugar in a dough.

Effect of date syrup on the rheological properties of bread

The Table 2 below shows the mean for sugar control (100% sucrose) performance and also for various blends of Bambara flour with date syrup at 5%, 10%, 15%, 20% and 25%, on the percentage gluten and rheological properties like the extensibility (L); distortion (P/L); deformation energy (W) and tenacity (maximum overpressure P). From the table the percentage of wet gluten significantly increased at a probability levels at ($p \leq 0.05$) from sample A (29.84) to sample F (31.20). The measure of maximum pressure (Tenacity) was significant at the probability level at ($p \leq 0.05$) which is highest in sample F (128.6) and lowest in A-100% sucrose (99.25). The extensibility of the Bambara dough increased significantly at a probability level at ($p \leq 0.05$) with increasing level of date

Table 2. Effect of date syrup on the rheological properties.

Parameters	% W-gluten	P	L	W	P/L
A	29.85 ± 0.02^f	99.25 ± 0.37^f	98.0 ± 0.09^f	455.10 ± 0.14^a	0.95 ± 0.07^c
B	29.98 ± 0.01^e	109.4 ± 0.22^e	89.10 ± 0.14^e	371.10 ± 0.07^a	1.24 ± 0.01^b

There was a significant decrease on the volume of the loaf, the specific volume and diameter at the probability levels of ($p \leq 0.05$) with increase in date syrup. Sample A had significantly higher volume ($1853 \text{ cm}^3 \pm 70.75 \text{ cm}^3$), specific volume (4.66 ± 0.14) and diameter ($7.73 \text{ cm} \pm 0.07 \text{ cm}$). However, there was a significant ($p \leq 0.05$) increased in the density of the loaf with F (25% date syrup) having the highest value (0.35 ± 0.03) followed closely by E (0.32 ± 0.01). The highest reduction in loaf volume was in bread made with date syrup at the 25% level (1527 ± 35.39) [14,15].

syrup concentrations. The extensibility was highest and lowest at samples B (101.20) and F (88.05) respectively. The Length (L) or increase of Bambara dough which is one of the determinants of the rheological properties increases with increase in the date syrup which was found to be highest at 25%. There was no significant ($p \geq 0.05$) difference in the deformation (W) of the various bread dough samples. However, sample A was estimated to be the highest value at (454.10) which was followed closely by sample F (449.50). The Bambara dough distortion (P/L) increased significantly at probability level of ($p \leq 0.05$) with increasing level of date syrup concentrations. Samples E (1.34) and sample A (0.95) were recorded to be the highest and lowest distortion, respectively [16-18].

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C	29.97 ± 0.02 ^d	116.2 ± 0.12 ^d	91.15 ± 0.21 ^d	435.80 ± 0.35 ^a	1.28 ± 0.00 ^{ab}
D	31.17 ± 0.02 ^c	123.5 ± 0.77 ^c	96.10 ± 0.14 ^c	445.50 ± 0.71 ^a	1.29 ± 0.01 ^{ab}
E	31.18 ± 0.02 ^b	127.20 ± 0.14 ^b	97.10 ± 0.14 ^b	443.5 ± 0.73 ^a	1.34 ± 0.00 ^a
F	31.24 ± 0.02 ^a	129.60 ± 0.77 ^a	102.20 ± 0.21 ^a	447.50 ± 0.72 ^a	1.27 ± 0.01 ^{ab}
LSD	0.03	1.18	0.49	1.29	0.07

Note: Values for 3 replications. Mean values having the same superscript in a column are not significantly different (p>0.05). P: Tenacity; L: Extensibility; P/L: Distortion; W: Deformation energy; A: 100% sucrose in a dough without syrup (control); B: 5% date syrup without sugar in a dough; C: 10% date syrup without sugar in a dough; D: 15% date syrup without sugar in a dough; E: 20% date syrup without sugar in a dough; F: 25% date syrup without sugar in a dough.

Effect of date syrup on the proximate composition (%) of bread

Table 3 shows the proximate analyses such as moisture, protein, ash, fibre, fat, carbohydrates, dry matter and energy contents for Bambara bread composition which ranges from 13.89%-7.11%, 10.71%-11.71%, 1.44%-1.56%, 0.29%-4.53%, 7.43%-7.49%, 66.25%-67.62%, 76.92%-72.78% and

374.70%-384.8% respectively. From the analyses, there was a significant increase in protein, ash, fat, fibre, dry matter, carbohydrate and energy with increased in date syrup at a probability level of (p<0.05) with bread produced from 25% date syrup substitute constituting the highest value.

Table 3. Effect of date syrup on the proximate composition of date syrup bread samples (% dry weight basis).

Parameters	Moisture	Crude protein	Crude fat	Crude Fibre	Ash	Carbo hydrate	Dry matter	Energy (Kcal)
A	13.39 ± 0.70 ^a	10.71 ± 0.36 ^d	7.43 ± 0.04 ^b	0.29 ± 0.01 ^c	1.44 ± 0.04 ^b	66.25 ± 0.33 ^d	76.92 ± 0.24 ^a	374.70 ± 2.45 ^d
B	10.02 ± 0.36 ^b	10.91 ± 0.04 ^{cd}	7.45 ± 0.02 ^{ab}	3.46 ± 0.04 ^b	1.43 ± 0.03 ^b	66.72 ± 0.23 ^{cd}	74.16 ± 0.04 ^b	377.60 ± 1.21 ^{cd}
C	9.41 ± 0.06 ^{bc}	11.09 ± 0.05 ^{bcd}	7.47 ± 0.01 ^{ab}	3.69 ± 0.08 ^b	1.48 ± 0.01 ^b	66.89 ± 0.06 ^{bc}	73.82 ± 0.12 ^{bc}	379.10 ± 0.01 ^{bc}
D	8.96 ± 0.21 ^c	11.18 ± 0.05 ^{bc}	7.48 ± 0.01 ^{ab}	3.85 ± 0.07 ^b	1.49 ± 0.03 ^{ab}	67.05 ± 0.05 ^{7bc}	73.64 ± 0.11 ^c	380.20 ± 0.47 ^{bc}
E	8.71 ± 0.39 ^c	11.4 ± 0.08 ^{ab}	7.48 ± 0.00 ^{ab}	3.63 ± 0.41 ^b	1.51 ± 0.02 ^{ab}	67.28 ± 0.05 ^{ab}	73.69 ± 0.27 ^c	382.00 ± 0.14 ^{ab}
F	7.11 ± 0.35 ^d	11.71 ± 0.16 ^a	7.49 ± 0.01 ^a	4.53 ± 0.15 ^a	1.56 ± 0.04 ^a	67.60 ± 0.28 ^a	72.78 ± 0.04 ^d	384.70 ± 1.85 ^a
LSD	0.97	0.42	0.04	0.45	0.07	0.50	0.39	3.35

Note: Values are means of triplicate determinations. Mean values with same superscript in a row are not significantly different (p ≥ 0.05). A: 100% sucrose; B: 5% date syrup without sucrose; C: 10% date syrup without sucrose; D: 15% date syrup without sucrose; E: 20% date syrup without sucrose; F: 25% date syrup without sucrose.

Effect of date syrup on the mineral content

The mineral contents results of Bambara breads blended with date syrup are presented in Table 4. From the results, there was significant increase in magnesium (0.95 mg-1.40 mg/100 g), calcium (2.24 mg-2.97 mg/100 g), potassium (0.04 mg-9.04 mg/100 g), sodium (0.09 mg-6.29 mg/100 g), phosphorous

(0.06 mg-1.66 mg/100 g) and zinc (0.08 ppm-0.09 ppm) with no significant increase at a probability level at (p>0.05) in iron (3.01 ppm-3.02 ppm).

Table 4. Effect of date syrup on the mineral content of the date syrup bread samples.

Parameter	Calcium mg/100 g	Phosphorous mg/100 g	Sodium mg/100 g	Potassium mg/100 g	Magnesium mg/100 g	Iron ppm	Zinc ppm
A	2.24 ± 0.01 ^f	0.06 ± 0.00 ^f	0.09 ± 0.00 ^f	0.04 ± 0.01 ^f	0.95 ± 0.00 ^e	3.01 ± 0.00 ^a	0.08 ± 0.00 ^{abc}
B	2.46 ± 0.01 ^e	0.92 ± 0.00 ^e	4.12 ± 0.00 ^e	4.73 ± 0.00 ^e	0.97 ± 0.02 ^e	3.01 ± 0.00 ^a	0.08 ± 0.00 ^{ab}
C	2.46 ± 0.03 ^d	1.10 ± 0.00 ^d	5.14 ± 0.00 ^d	5.17 ± 0.00 ^d	1.01 ± 0.00 ^d	3.02 ± 0.01 ^a	0.8 ± 0.00 ^{bc}
D	2.70 ± 0.01 ^c	1.24 ± 0.00 ^c	5.48 ± 0.00 ^c	6.79 ± 0.00 ^c	1.12 ± 0.00 ^c	3.01 ± 0.00 ^a	0.08 ± 0.00 ^c
E	2.81 ± 0.01 ^b	1.44 ± 0.01 ^b	6.01 ± 0.00 ^b	7.09 ± 0.00 ^b	1.22 ± 0.00 ^b	3.02 ± 0.00 ^a	0.08 ± 0.00 ^{ab}
F	2.97 ± 0.02 ^a	1.66 ± 0.00 ^a	6.29 ± 0.00 ^a	9.04 ± 0.00 ^a	1.40 ± 0.00 ^a	3.02 ± 0.00 ^a	0.09 ± 0.00 ^a
LSD	0.05	0.01	0.004	0.02	0.02	0.01	0.004

Note: Values are means of triplicate determinations. Mean values with same superscript in a row are not significantly different ($p \geq 0.05$). A: 100% sucrose; B: 5% date syrup without sucrose; C: 10% date syrup without sucrose; D: 15% date syrup without sucrose; E: 20% date syrup without sucrose; F: 25% date syrup without sucrose.

Effect of date syrup on the organoleptic characteristics

Table 5 shows the mean value score of the sensory evaluation of Bambara bread blended with date syrup substitute. From the analyses, there was no significant difference in appearance,

crust colour, taste, flavour, crust texture, crumb structure, shape and the general acceptability between the substitute date syrup bread and the control made of sucrose at a probability levels of ($p < 0.05$).

Table 5. Effect of date syrup on the sensory scores of the date syrup samples.

Parameter	Appearance	Taste	Crust colour	Flavour	Crust texture	Crumb structure	Shape	Overall acceptability
A	6.60 ^{abc}	7.33 ^a	6.93 ^{ab}	7.33 ^a	6.67 ^a	6.80 ^a	6.33 ^a	7.20 ^a
B	7.20 ^a	6.67 ^{ab}	6.87 ^{ab}	6.67 ^{ab}	6.60 ^a	6.93 ^a	6.67 ^a	6.93 ^a
C	6.67 ^{abc}	6.53 ^b	6.80 ^{ab}	6.53 ^b	6.47 ^a	6.87 ^a	6.80 ^a	6.87 ^a
D	6.47 ^{bc}	6.60 ^b	6.20 ^b	6.60 ^b	6.33 ^a	6.47 ^a	6.40 ^a	6.93 ^a
E	6.33 ^c	6.73 ^{ab}	6.80 ^{ab}	6.73 ^{ab}	6.73 ^a	6.47 ^a	6.20 ^a	6.67 ^a
F	7.07 ^{ab}	6.87 ^{ab}	7.13 ^a	6.87 ^{ab}	6.93 ^a	7.00 ^a	6.93 ^a	7.07 ^a
LSD	0.65	0.63	0.71	0.63	0.59	0.64	0.72	0.71

Note: Values are means of triplicate determinations. Mean values with same superscript in a row are not significantly different ($p \geq 0.05$). A: 100% sucrose; B: 5% date syrup without sucrose; C: 10% date syrup without sucrose.

Discussion

Effect of date syrup on the baking characteristics of bread

There was no significant change in the weight of the Bambara bread from the controlled sample A to F *i.e.* 100% sucrose to 25% substitute of date syrup, which indicate that an amount of water was not retained in the Bambara breads after baking as reported by Nwanekezi, however, there was no significant difference at ($p \geq 0.05$) for the weight of Bambara bread. From Table 1, the weight decreases with increasing levels of date syrup. This could be due to gas retention in the sample, hence providing denser bread texture. The results in this study were comparable with those reported by earlier workers by Hussein,

Himani and Anita, et al. However, the findings differs from Obiegbuna, et al. where he stated that there was considerably increase in the weight of loaves of bread baked with date syrup, he further attributed the increase to the hygroscopic nature of invert sugars, proteins and pectic substances which are present in the date syrup preparations. The difference with the Bambara dough weights could be attributed to high concentration of sugar in the date syrup. Similarly, the diameter, volume, specific volume and density of Bambara bread decreases with increase in the concentrations of date syrup. Their result revealed that higher sugar concentration and the dilution effect on the strength of gluten with the addition of date syrup and less retention of CO₂ gas could cause the reduction in the loaf volume, specific volume and weight of the Bambara dough. From the analyses, the slight decrease in

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Bambara bread specific volume seems to be due to diluted gluten concentration of the dough as observed and reported by Ochuko, et al. [19].

Effect of date syrup on the rheological properties of Bambara dough.

The content of the gluten shows the strength of the flour and bread making potentialities. The capacity of the dough to produce gas and have a retention capacity depends on the quantity and quality of gluten. This forms a cellular network of crumb which imparts desirable characteristics to bread. K Naveen, et al. carried out a research using soy flour and white wheat flour; it was also observed that the contents of wet and dry gluten decrease on increasing the levels of sugar contents. However the result obtained in this study for Bambara bread showed that gluten content increases with increased level of date syrup concentration. This could be attributed to the high sugar and protein in date fruit as reported by Ochuko, et al.

Thulani Sibanda, et al. stated that the Bambara dough resistance to deformation or its tenacity (P value) is an indicator of the dough's ability to retain gas. From the result, the P values increased with increase in the quantity of date syrup. The tenacity and the retention of gas could be due to interactions between the fiber structure and the protein in the Bambara dough. Similarly, the elasticity of dough increases with increase in the date syrup. This could also be due to the interaction between the high content of fiber and maltose, which favours a strong interaction between fiber and the Bambara flour proteins. The deformation (W) of Bambara dough which is the indication of the dough strength before rupture. There was no significant increase as the date syrup increases at the probability level of ($p \geq 0.05$). It is clearly evident that the date syrup replacement level which contains a higher amount of sugar than that of the sucrose control treatment caused greater increase in the dough development time, maximum pressure and deformation values compared with the dough containing sucrose as control. Evidence indicating beneficial effect of sugar on gluten development in dough was reported by Julie, et al. The rheological results of this research agree with the findings made by Solomon, et al. [20].

Effect of date syrup on the proximate composition (%) of bread

The protein contents increases with increase in proportion of date syrup concentration which indicate that supplementation of date syrup greatly improve the protein nutritional quality of Bambara bread. A report was observed by Abu-Salem and Abou-Arab where significant quantity of protein in date syrup improved the nutritional contents of biscuits, a similar results by Maryam, et al. using soy flour, at the end of the findings, it was observed that the soy flour bread significantly increase in protein contents with increase in sucrose.

The high protein content in the date syrup Bambara breads would be of nutritional importance especially in most developing countries, such as Nigeria, where many people live

below poverty line and can hardly afford nutritious bread due to high cost.

There were similar trends to the increase in protein contents with increase in date syrup for the ash and fat contents of the Bambara breads were also noted to assume the same trend as with protein content. At different samples of Bambara bread, there were increase in the ash contents and these could probably be due to the increase of the minerals content as a result of the addition of date syrup which has higher amounts of minerals. It has been reported by ABM Sharif, that date fruit contains high minerals which include zinc, magnesium, potassium, iron, calcium and of course sugar.

The presence of high sugar content in the Bambara flour bread increases the water absorption capacity of the flour which causes the moisture content to decrease as the date syrup content increased. This result agreed with the findings of Alozie, et al. who stated that lower moisture contents enhances the quality and general acceptability of dough or bread.

James and Mark, 2010 stated that foods containing fibres serves as anti-constipation lowers the level of cholesterol in the blood and reduces the risk of cancer. The formulation of date syrup increases the fiber contents in the dough. The results showed that calorific increased with a progressive increase in date syrup. This result was contrary to the findings observed by Pasha, et al. who reported that increasing in the level of artificial sweeteners, decreases the calorific value of dough.

Effect of date syrup on the mineral content

High mineral contents of the date fruits increases the mineral contents of the Bambara date syrup bread. Table 4 shows the results of the mineral composition of bread indicated that Bambara breads prepared from date syrup are more nutritious than 100% sugar bread. The content of bread obtained in this study agreed with the research conducted by Chema, et al. for wheat tiger, nut pigeon pea biscuits and blends of soya bean and maize flours for cookies by Atobatele and Afolabi.

Effect of date syrup on the organoleptic characteristics

An important aspect in designing bread with improved nutritional quality is the maintenance of a product's sensory characteristics because consumers' acceptability remains the key factor which determines the successful application of newly developed product. There was no significant ($p < 0.05$) difference in appearance, crust colour, taste, flavour, crust texture, crumb structure, shape and overall acceptability between the control and date syrup breads [21].

Conclusion

Conclusively, the date syrup substituted for sugar (sucrose) in the development of Bambara bread significantly improves the physical characteristics and the chemical composition (ash, crude fat, crude fiber and crude protein). The analyses showed that there was a significant increase in the concentration of date syrup at various levels with increase in the mineral

concentration compared to the control (sucrose) which recorded low in all the parameters. There was a notable increase in the height, extension or length, distortion (P/L) and the deformation (W) when date syrup was substituted. Furthermore, there was an increase in the length of the processing characteristics of the dough by the substitution of date syrup up to 25% concentration level. Therefore, Bambara bread developed with date syrup as a substitute for sugar (sucrose) had higher rheological properties than the control sample. The sensory evaluation revealed that bread developed date syrup had a higher general acceptability score than the control.

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Conflict of Interest

The authors testified that there are no conflicts of Interest in this research work.

References

- Hossain AS. Dried dates fruit and its biochemical and nutrient content: Uses as diabetic food. *Asian J Clin Nutr.* 2015;7:90-5.
- Smah AC, Joshua IO, Enyi OS. Survey on the use of energy in ovens for baking bread in north central Nigeria. *Int J Energy Power Eng.* 2021;10(3):50-6.
- Alozie YE, Iyam MA, Lawal O, et al. Utilization of Bambara groundnut flour blends in bread production. *J Food Technol.* 2009;7(4):111-4.
- Abu-Salem FM, Abou-Arab AA. Effect of supplementation of Bambara groundnut (*Vigna subterranean L.*) flour on the quality of biscuits. *Afr J Food Sci.* 2011;5(7):376-83.
- Lawless HT, Heymann H. Sensory evaluation of food: Principles and practices. 2nd edition, Springer Publication, New York, 2010.
- Hillocks RJ, Bennett C, Mponda OM. Bambara nut: A review of utilisation, market potential and crop improvement. *Afr Crop Sci J.* 2012;20(1):1-16.
- Lalit H, Kochhar A. Development and organoleptic evaluation of bread formulated by using wheat flour, barley flour and germinated fenugreek seed powder for diabetics. *Chem Sci Rev Lett.* 2017;6(6):1728-34.
- Mirghani HO. Dates fruits effects on blood glucose among patients with diabetes mellitus: A review and meta-analysis. *Pakistan J Med Sci.* 2021;37(4):1230.
- Antvorskov JC, Josefsen K, Engkilde K, et al. Dietary gluten and the development of type 1 diabetes. *Diabetologia.* 2014;57(9):1770-80.
- Falade KO, Abbo ES. Air drying and rehydration characteristics of date palm (*Phoenix dactylifera L.*) fruits. *J Food Eng.* 2007;79(2):724-30.
- Naveen K, Singh KB, Ravinder K. Effect of reducing agents on wheat gluten and quality characteristics of flour and cookies. *Ann Univ Dunarea Jos Galati Fascicle VI: Food Technol.* 2013;37(2):68-81.
- Taghdir M, Mazloomi SM, Honar N, et al. Effect of soy flour on nutritional, physicochemical, and sensory characteristics of gluten free bread. *Food Sci Nutr.* 2017;5(3):439-45.
- Yeboah-Awudzi M, Lutterodt HE, Kyereh E, et al. Effect of Bambara groundnut supplementation on the physicochemical properties of rice flour and crackers. *J Food Sci Technol.* 2018;55(9):3556-63.
- Abdualrahman MA, Ali AO, Elkhalfia EA, et al. Effect of Bambara groundnut flour (*Vigna subterranea (L.) Verdc.*) supplementation on chemical, physical, nutritional and sensory evaluation of wheat bread. *Pak J Biol Sci.* 2012;15(17):845-9.
- Nwanekezi EC, Ekwe CC, Agbugba RU. Effect of substitution of sucrose with date palm (*Phoenix dactylifera*) fruit on quality of bread. *J Food Process Technol.* 2015;6(9):484.
- Obiegbuna JE, Akubor PI, Ishiwu CN, et al. Effect of substituting sugar with date palm pulp meal on the physicochemical, organoleptic and storage properties of bread. *Afr J Food Sci.* 2013;7(6):113-9.
- Erukainure OL, Okafor JN, Ogunji A, et al. Bambara wheat composite flour: Rheological behavior of dough and functionality in bread. *Food Sci Nutr.* 2016;4(6):852-7.
- Ojo RJ, Kajang DD, Adebayo GG, et al. Analysis of potassium bromate and hydrocyanic acid contents of commonly consumed loaves of bread and wheat flour samples in Karu, Nasarawa State, Nigeria. *J Environ Sci Toxicol Food Technol.* 2013;6(1):42-6.
- Onuh JO, Akpapunam MA, Iwe MO. Comparative studies of the physicochemical properties of two local varieties of sweet potato flours. *Niger Food J.* 2004;22(1):141-6.
- Nasir S, Allai FM, Gani M, et al. Physical, textural, rheological and sensory characteristics of amaranth based wheat flour bread. *Int J Food Sci.* 2020;2020:8874872.
- Chikpah SK, Korese JK, Hensel O, et al. Rheological properties of dough and bread quality characteristics as influenced by the proportion of wheat flour substitution with orange fleshed sweet potato flour and baking conditions. *LWT.* 2021;147:111515.

*Correspondence to

Adamu Cornelius Smah
 Department of Agricultural and Environmental Engineering,
 Federal University of Agriculture,
 Makurdi,
 Benue
 Nigeria
 E-mail: Cornyardamu@gmail.com