

Chemical Composition, Physico-Chemical Properties, and Acceptability of Instant 'Ogi' from Blends of Fermented Maize, Conophor Nut and Melon Seeds

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Abstract

This study was carried out to evaluate the nutrient, anti-nutrient composition, physico-chemical properties and acceptability of 'ogi' from blends of maize, conophor nut and melon seed flours at different proportions. Results of analysis of fermented maize: melon: conophor nut -90:5:5, 80:10:10, 70:15:15, 100:0:0 showed an increase in protein, ash, fat and crude fiber contents with increased supplementation with conophor nut and melon seed flour. The physico-chemical properties also varied: pH ranged from 5.70-6.20, viscosity ranged from 0.61-0.71 dPa, bulk density ranged from 0.66-0.91 g/ml, water and oil absorption capacities ranged from 660% to 680% and 820% to 870% respectively. Emulsification capacity, reconstitution index, foaming capacity, foaming stability and least gelation concentration ranged from 50.20% to 78.15%, 3.61-5.05 ml/g, and 1.38% to 10.00%, 1.38% to 5.63% and 6% to 20% respectively. The solubility index of the flour increased as supplementation levels increased. There were variations in the pasting properties of the supplemented 'ogi'. Peak viscosity ranged from 161.17-213.83 RVU, breakdown ranged from 28.17-106.76 RVU, final viscosity ranged from 145.25-247.34 RVU. Peak time was averagely at 5 min and pasting temperature from 83.65°C to 94.75°C. Result of mineral contents showed a significant increase in iron, magnesium, copper and phosphorus contents while calcium and sodium contents decreased significantly. Increased supplementation with conophor and melon seed flour increased the anti-nutrient contents. Tannin, oxalate, and phytate contents ranged from 4.65-5.85 mg/g, 2.48-2.65 mg/g, and 5.25-5.96 mg/g respectively. Consumer acceptability of the instant 'ogi' was rated best at 5% supplementation level with conophor and melon seed flours (90:5:5) when compared with the control (100% fermented maize).

Keywords: Fermented maize; Instant 'ogi'; Supplementation; Acceptability; Nutritional value

Introduction

Maize (*Zea mays*) also referred to as corn, is the most important cereal in the world after wheat and rice with regard to cultivation areas and total production [1]. Apart from being consumed by humans, it is also used to prepare animal feeds, and useful in the chemical industry. Maize can be cooked, roasted, fried, ground, pounded or crushed [2].

The conophor nut plant (*Tetracarpidium conophorum*) commonly called the African Walnut, is a perennial climbing shrub found in the moist forest zones of Sub-Saharan Africa. It is cultivated principally for the nuts, which are cooked and consumed as snacks, along with boiled corn [3]. Conophor nut commonly called 'Ukpa', 'asala', and 'awusa' in some parts of southern Nigeria is one of the several high nutrients dense foods with the presence of protein, fiber, carbohydrate and vitamins [4]. Conophor nut is a rich source of minerals such as calcium, magnesium, sodium, potassium, and phosphorus [5]. A bitter after taste is usually observed upon drinking water immediately after eating conophor nut and this could be attributed to the presence of alkaloids and other anti-nutritional and toxic factors. Ripe conophor nuts are mostly consumed in the fresh or toasted form or used in cakes, desserts and confectionaries.

Melons are food crops with several varieties which serve as a major food source. Melon seeds are generally rich in oil and are a good source of protein. The seed contains about 44% oil and 32% protein [6]. It has both nutritional and cosmetic importance and is rich in vitamin C, riboflavin and carbohydrates. Melon seed is a good source of amino-acids such as isoleucine and leucine [7]. It also contains palmitic, stearic, linoleic and oleic acids important in protecting the heart. It can serve as an important supplementary baby food, helping to prevent malnutrition. The present study examines the effect of supplementing fermented maize flour at different levels with conophor nut and melon seed flours in the production of instant 'ogi'.

Materials and Methods

Raw material source and collection

White maize (*Zea mays*), melon seed (*Citrullus lanatus*) and conophor nut (*Tetracarpidium conophorum*) were obtained from the local Oba market in Akure, Ondo State, Nigeria.

Sample preparation

Four formulations were made in the following proportions (maize: melon seeds: conophor nut); 90:5:5, 80:10:10, 70:15:15, 100:0:0. The sample consisting of 100% 'ogi' flour was used as the control. The samples were then analyzed and subjected to sensory evaluation.

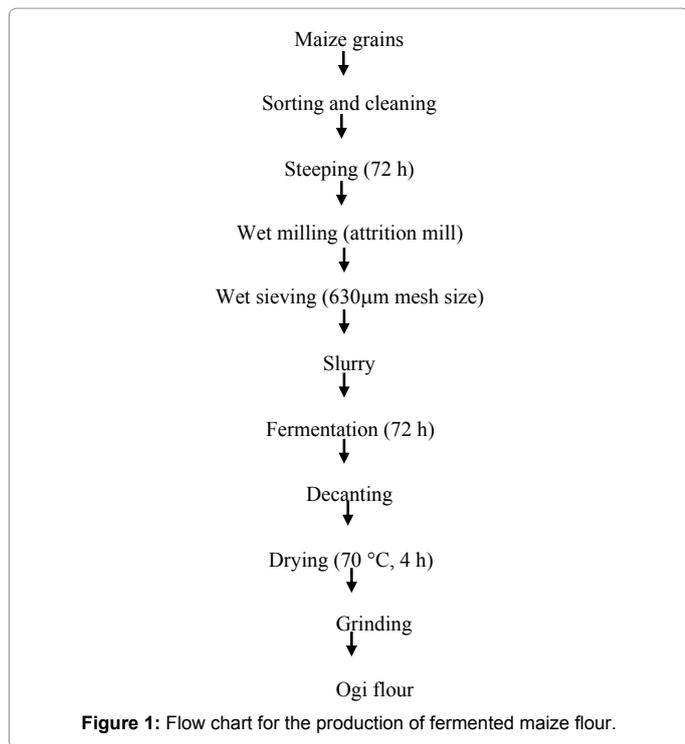
Processing of fermented maize flour: The maize grains were cleaned and sorted by removing the pest-infested grains and discolored ones. It was then steeped for 72 h at room temperature and the steep water was decanted while the fermented grain was washed with portable water and wet-milled. It was then wet-sieved and the slurry could ferment for 24 h. It was afterwards decanted, dried at 70°C for 4 h and milled using hammer mill. The fermented maize flour was then sieved to obtain a finer particle (630 µm mesh size) and packaged in air-tight containers prior to analysis. The production chart is presented on Figure 1.

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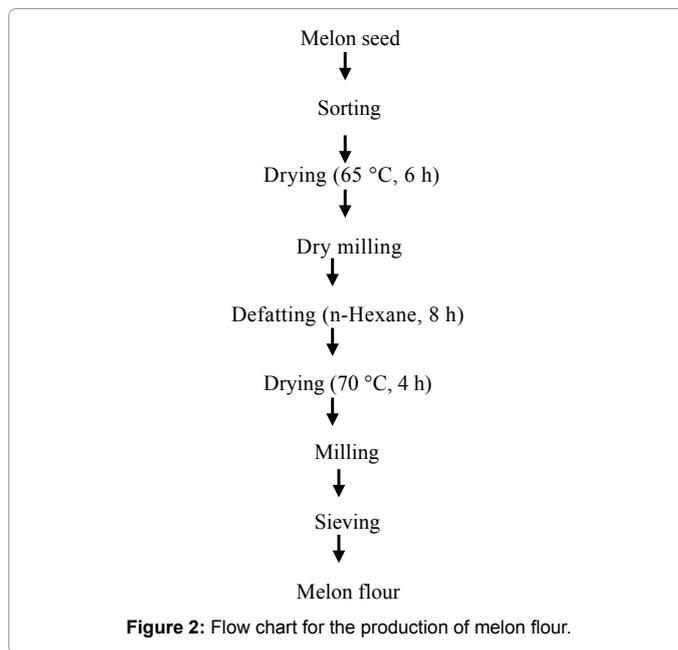
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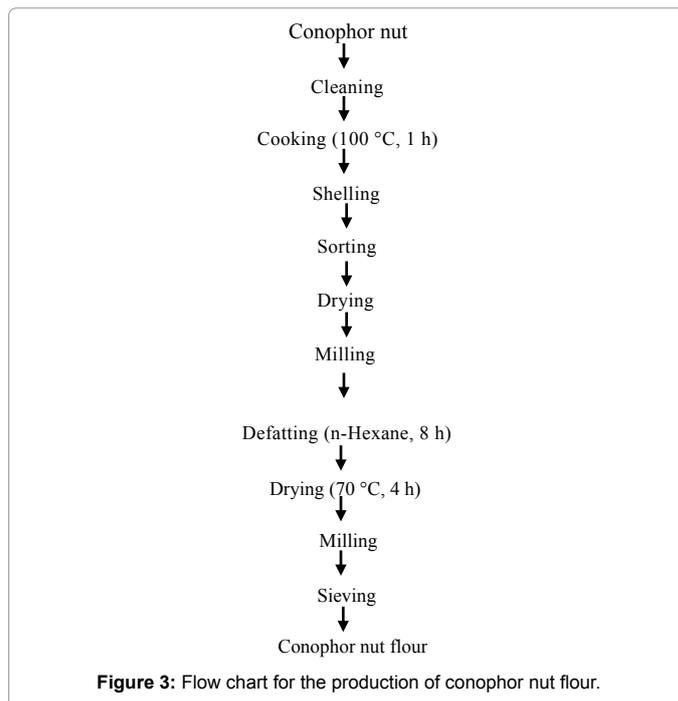
Processing of melon seed flour: The melon seeds were sorted to remove the discolored ones and then dried at 65°C for 6 h, milled with hammer mill and was defatted using n-hexane as the solvent for 6 h. The defatted melon was air dried and milled using hammer mill. The melon flour was then sieved to obtain a finer particle and packaged in air-tight containers prior to analysis. The production chart is shown on Figure 2.

of the foaming capacity and stability of the instant 'ogi' flour blends. Emulsion capacity was determined by the method of Yasumatsu et al. [12]. Least gelation concentration (LGC) of the flour blends was determined using the modified method of Coffman and Garcia [13]. Solubility index were determined as described by Takashi and Sieb [14] using SPECTRA, UK (Merlin 503) centrifuge. Reconstitution index were also determined as described by Banigo and Akpapunam [15].

Pasting properties analysis: The pasting properties of the samples were determined using a Rapid Visco-analyser (Newport Scientific Australia) as described by Adeyemi et al. [16]. The peak, viscosity, trough, breakdown, final viscosity, set back, peak time and pasting



Processing of conophor nut flour: The conophor nuts were cleaned to remove debris and dirt and cooked at 100°C for 1 h. It was then shelled to obtain the kernels. The kernels were dried at 50°C for 8 h, milled with hammer mill and defatted using n-hexane as solvent for 6 h. The defatted conophor nut cake was afterwards air dried at 70°C for 4 h and milled using hammer mill. The conophor nut flour was then sieved to obtain a finer particle and packaged in air-tight containers prior to analysis. The production chart is shown in Figure 3.



Analysis

Proximate chemical composition analysis: Proximate chemical composition of the samples was determined using the methods of AOAC [8]. Carbohydrate content was determined by subtracting the sum of the percentage weight of crude protein, crude fiber, ash, fat from 100%.

Functional properties analysis: For the determination of functional properties, the method of Onwuka [9] was used for the determination of Water/Oil absorption capacity. Bulk density and Swelling index were determined by the method described by Ukpabi and Ndimele [10]. The rotating spindle method described in the Encyclopedia of Industrial Chemical Analysis (E.I.C.A, 1971) was employed in viscosity determination. pH was determined using a Fischer Science Education pH meter (Model S90526, Singapore). The method of Jitngarmkusol et al. [11] with some slight modifications was used for the determination

temperature were read with the aid of Thermocline for Windows Software connected to a computer.

Mineral elements analysis: The mineral elements Ca, Mg, Fe, Zn, Cu, were determined using atomic absorption spectrophotometer (AAS Model: PYE UNICAMSP9). Flame photometer was also used to measure the values of Na and K in all the samples and Phosphorus (P) was determined using a spectrophotometer (Model: Lemfield Spectrulab 23A) as described by AOAC [8].

Anti-nutrients content analysis: For anti-nutrients content analysis, tannin content was determined by the method of Makkar and Goodchild [17]. Oxalate content was determined by the method of Nwika et al. [18] and phytate content was determined by the method of Latta and Eskin [19].

Sensory evaluation: The instant 'ogi' was made into slurry by adding water till it formed a paste and boiled water was added to it and stirred continuously till it became viscous and formed a gruel. The products were evaluated for taste, appearance, aroma, and overall acceptability by a panel of ten members using a 9-point Hedonic scale. The rating of the samples ranged from 1 (dislike extremely) to 9 (Like extremely).

Statistical analysis: The data obtained were analyzed using a one-way Analysis of Variance and the means separated by Duncan New Multiple Range Tests (DMNRT) at 5% significance level (SPSS version 19 computer software) [20].

Results and Discussion

Proximate chemical composition of the instant 'Ogi' flour blends

The proximate composition of instant 'ogi' from blends of fermented maize, conophor nut and melon seed flours is presented in Table 1. The increase in the protein value of the flour was due to the supplementation of the maize flour with melon seeds and conophor nuts. Low fat content of the flour coupled with the low moisture content of the flour blends is an indication that the samples will be stable during storage. According to Adeyeye and Adejuyo [21], the low moisture content of the samples would hinder the growth of micro-organism and increase the shelf life of the samples. Sample SPB had the highest crude fiber content. According to Norman and Joseph [22], fiber has an important function in providing roughage or bulk that aids in digestion, softens stool and lowers plasma cholesterol level in the body. Increased melon/conophor nut flour substitution gave progressively higher protein, crude fiber and ash contents of the samples while fat and carbohydrate contents were reduced. Crude protein, ash and crude

Samples	BPO	SPB	BPC	POS
Moisture	4.73 ± 1.09 ^b			
Ash	9.01 ± 0.72 ^a	1.80 ± 0.00 ^b	2.44 ± 0.00 ^a	2.98 ± 0.00 ^c
Crude fiber	5.94 ± 0.87 ^b	1.14 ± 0.12 ^c	3.96 ± 0.01 ^c	3.96 ± 0.01 ^b
Fat	5.55 ± 1.11 ^b	0.44 ± 0.12 ^d	5.20 ± 0.29 ^d	5.20 ± 0.29 ^a
Crude fiber	9.01 ± 0.72 ^a	1.80 ± 0.00 ^b	2.44 ± 0.00 ^a	2.98 ± 0.00 ^c
Carbohydrate	5.94 ± 0.87 ^b	1.14 ± 0.12 ^c	3.96 ± 0.01 ^c	3.96 ± 0.01 ^b

Values with different superscript in a row are significantly different (p<0.05). Values are means ± standard deviation of triplicate determinations.
Key: BPO = 70% fermented maize flour; 15% Melon flour; 15% Conophor nut flour; SPB = 80% fermented maize flour; 10% Melon flour; 10% Conophor nut flour; BPC = 90% fermented maize flour; 5% Melon flour; 5% Conophor nut Flour; POS = 100% fermented maize flour.

Table 1: Percentage proximate composition of instant 'ogi' from blends of fermented maize, conophor nut and melon seed flours.

fiber were significantly different in the four samples; however, there were no significant differences in the fat content of samples BPO and SPB (Table 1).

Functional properties of the instant 'Ogi' flour blends

According to Oyerekua and Adeyeye [23], high water absorption capacity (WAC) is desirable for the improvement of mouthfeel and viscosity reduction in food products. According to Afoadek and Sefadede [24], WAC and OAC in the blended flour might be due to the thickness of interfacial bi-layer model of protein to protein interaction. Sample BPC had the lowest oil absorption capacity. The reduced value of OAC in Sample BPC might be due to collapse of the flour blend proteins thereby increasing the contact between protein molecules leading to coalescence and thus reduce stability of the samples. Bulk density is an important factor in food products handling, packaging, storage, processing and distribution. It is particularly useful in the specification of products derived from size reduction or drying processes. Bulk densities of the samples were similar to that reported by Adeyemi and Becky [25]. The bulk densities ranged from 0.66-0.90 g/ml with sample POS having the highest value which indicate that its packaging would be economical. Plaami [26] reported that higher bulk density is desirable, since it helps to reduce the paste thickness which is an important factor in convalescent and child feeding. Viscosity ranged from 0.61-0.70 dPa with samples SPB and BPC having the highest value. pH is important in determining the acid factor which is an indicator of the rate of conversion of starch to dextrin. The pH value ranged from 5.70-6.60. The foaming capacity ranged from 1.38% to 10.00% with BPO having the highest value. The increase in foaming capacity with melon and conophor nut supplementation might be due to soluble proteins and higher emulsion capacity; this might make it a better flavor retainer and enhance mouthfeel [23]. It has also been reported that foam capacity is related to the rate of decrease of the surface tension of the air/water interface caused by absorption of protein molecules [27]. The foaming stability of the flour increased with increment in the supplementation level of the flour though sample SPB had the highest value. Sample BPC had the highest value for least gelation capacity. The emulsion capacity ranged from 50.20% to 78.15%, with sample BPO having the highest value. High level of least gelation capacity means less thickening capacity of food; the contents ranged from 6.0% to 18.0%. Reconstitution index ranged from 3.61-5.05 ml/g with Sample POS (control) having the highest value. The functional properties of the instant 'ogi' flour blends are shown in Table 2.

Pasting characteristics of the instant 'Ogi' flour blends

Table 3 shows the results of the pasting characteristics of the instant 'ogi' flour blends. The pasting properties of the samples BPO, SPB, BPC and control (POS) were significantly different (p<0.05). Peak viscosity of the instant 'ogi' samples ranged from 133.51-213.83 RVU, the values were observed to reduce with increase in supplementation levels. Final viscosity is a measure of stability of the cooked sample [28]. The final viscosity ranged from 145.67-243.59 RVU with BPO having the highest value; this implies that highly viscous paste can be formed during cooking. The setback value is a measure of retrogradation the cooked sample and it ranged from 60.17-108.58 RVU with SPB having the highest value. Pasting temperature is also a measure of the temperature at which flour viscosity begins to rise during cooking, it provides information on the cost of energy required to cook the instant 'ogi'. The pasting temperature of the instant 'ogi' ranged from 83.65°C to 94.75°C with BPC having the highest value. The pasting time ranged from 5.36-5.85 sec, with POS having the highest value (Table 3).

Samples	BPO	SPB	BPC	POS
Ph	6.60 ± 0.00 ^a	6.20 ± 0.00 ^b	5.70 ± 0.00 ^c	6.20 ± 0.00 ^b
WAC (%)	660.00 ± 0.70 ^a	680.00 ± 0.28 ^a	660.00 ± 0.56 ^a	665.00 ± 0.63 ^a
OAC (%)	830.00 ± 0.70 ^a	870.00 ± 0.21 ^a	800.00 ± 0.28 ^a	820.00 ± 0.00 ^a
EC (%)	78.15 ± 0.21 ^a	50.20 ± 0.28 ^b	75.25 ± 0.35 ^a	53.25 ± 2.47 ^b
Viscosity (dPa)	0.61 ± 0.01 ^b	0.70 ± 0.01 ^a	0.70 ± 0.01 ^a	0.61 ± 0.01 ^b
RI (ml/g)	3.61 ± 0.02 ^c	3.62 ± 0.03 ^c	4.35 ± 0.00 ^b	5.05 ± 0.07 ^a
BD (g/ml)	0.66 ± 0.00 ^d	0.71 ± 0.00 ^c	0.76 ± 0.00 ^b	0.90 ± 0.00 ^a
FC (%)	10.00 ± 0.01 ^a	9.85 ± 0.03 ^b	4.28 ± 0.02 ^c	1.38 ± 0.01 ^d
FS (%)	4.28 ± 0.03 ^a	5.63 ± 0.02 ^a	1.42 ± 0.01 ^c	1.38 ± 0.01 ^d
SI (v/v)	3.61 ± 0.02 ^c	3.62 ± 0.03 ^c	4.35 ± 0.07 ^b	5.05 ± 0.07 ^a
LGC (%)	18.00 ± 0.00	14.00 ± 0.00	20.00 ± 0.00	6.00 ± 0.00

Values with different superscript in a row are significantly different (p<0.05). Values are means ± standard deviation of triplicate determinations. WAC: Water Absorption Capacity; OAC: Oil Absorption Capacity; EC: Emulsion Capacity; RI: Reconstitution Index; BD: Bulk Density; FC: Foaming Capacity; FS: Foaming Stability; SI: Swelling Index; LGC: Least Gelation Capacity. **Key:** BPO = 70% fermented maize flour, 15% Melon flour, 15% Conophor nut flour; SPB = 80% fermented maize flour, 10% Melon flour, 10% Conophor nut flour; BPC = 90% fermented maize flour, 5% Melon flour, 5% Conophor nut Flour; POS = 100% fermented maize flour.

Table 2: Functional properties of instant 'ogi' from blends of fermented maize, conophor nut and melon seed flours.

Samples	BPO	SPB	BPC	POS
Peak viscosity (RVU)	163.17 ± 0.007 ^b	161.17 ± 0.007 ^c	133.51 ± 0.14 ^d	213.83 ± 0.28 ^a
Trough (RVU)	135.00 ± 0.014 ^a	123.25 ± 0.010 ^b	85.08 ± 0.007 ^d	107.08 ± 0.014 ^c
Breakdown (RVU)	28.17 ± 0.007 ^d	37.93 ± 0.014 ^c	48.41 ± 0.007 ^b	106.76 ± 0.014 ^a
Final viscosity (RVU)	243.59 ± 0.014 ^b	247.34 ± 0.007 ^a	145.25 ± 0.007 ^d	196.67 ± 0.010 ^c
Setback (RVU)	108.58 ± 0.014 ^b	124.09 ± 0.010 ^a	60.17 ± 0.010 ^d	89.57 ± 0.007 ^c
Pasting time (sec)	5.36 ± 0.010 ^d	5.68 ± 0.007 ^b	5.58 ± 0.007 ^c	5.85 ± 0.007 ^a
Pasting temperature (°C)	86.05 ± 0.014 ^b	85.95 ± 0.028 ^c	94.75 ± 0.007 ^a	83.65 ± 0.010 ^d

Values with different superscript in a row are significantly different (p<0.05). Values are means ± standard deviation of triplicate determinations. **Key:** BPO = 70% fermented maize flour; 15% Melon flour; 15% Conophor nut flour; SPB = 80% fermented maize flour; 10% Melon flour; 10% Conophor nut flour; BPC = 90% fermented maize flour; 5% Melon flour; 5% Conophor nut flour; POS = 100% fermented maize flour.

Table 3: Pasting characteristics of instant 'ogi' from blends of fermented maize, conophor nut and melon seed flour blends.

Mineral content of the instant 'Ogi' flour blends

Table 4 shows the mineral contents of the instant 'ogi' flour blends. Calcium value decreased with increase in supplementation level but magnesium content increased. Magnesium is well known to be important in cellular energy production and enzyme activity; its value ranged from 106.06-126.03 mg/100 g. Iron (Fe) ranged from 9.87-11.70 mg/100 g with the sample BPC having the lowest value. The instant 'ogi' flour blends provides a good amount of iron that is needed in the production of haemoglobin which carries oxygen in the blood. Zn ranged between 2.25 mg/100 g and 2.91 mg/100 g. The potassium content ranged from 195.68-198.37 mg/100 g and there were no significant differences between samples BPO, BPC and POS (p<0.05). A major function of potassium is to maintain the excitability of nerve and muscle tissue (Table 4).

Anti-nutrient content of the instant 'Ogi' flour blends

Table 5 shows the level of anti-nutrients in the instant 'ogi' flour blends. The phytate content of the 'ogi' flour blends ranged from 5.25-5.96 mg/g. Phytates are known to form complexes with iron, zinc, calcium and magnesium making them less available and thus inadequate in food samples especially for children [29]; however, the phytate content of the 'ogi' flour blends are far lower than the minimum amounts of phytic acid reported by Siddhuraju and Becker [30] to hinder the absorption of iron and zinc. Oxalates are also known to make complexes with calcium to form an insoluble calcium-oxalate salt. Siddhuraju and Becker [30] reported a safe normal range of 4-9 mg/ 100 g for oxalates. The oxalate content of the samples which range from 2.48-2.67 mg/100 g is quite lower than the reported value. Tannin content range from 4.65-5.85 mg/100 g. Tannins have been implicated in the interference of iron absorption; it usually forms insoluble complexes with proteins, thereby interfering with their bioavailability [31-33] (Table 5).

Sensory evaluation of the instant 'Ogi' flour blends

Table 6 shows the sensory evaluation results of the instant 'ogi' flour blends. Sensory evaluation was carried out by ten (10) untrained panelists and the parameters evaluated were taste, flavor, appearance and overall acceptability. Consumer evaluation of taste showed that there were no significant differences between sample BPC and SPB. Sample BPC were also rated higher than SPB in terms of appearance and aroma. In terms of overall acceptability, Samples BPC and SPB compared favorably with the control (POS) and there were no significant differences between them (Table 6).

Samples	BPO	SPB	BPC	POS
Iron	11.70 ± 0.63 ^a	11.53 ± 0.58 ^a	9.87 ± 0.17 ^b	10.87 ± 0.40 ^{ab}
Zinc	2.91 ± 0.10 ^a	2.64 ± 0.21 ^b	2.25 ± 0.14 ^{ab}	2.30 ± 0.35 ^{ab}
Calcium	140.68 ± 0.45 ^d	144.05 ± 0.63 ^c	145.77 ± 0.26 ^b	150.46 ± 0.37 ^a
Magnesium	126.03 ± 0.09 ^a	123.66 ± 0.43 ^b	120.06 ± 0.12 ^c	106.06 ± 0.38 ^d
Potassium	196.59 ± 0.50 ^b	198.37 ± 0.53 ^a	195.83 ± 0.25 ^b	195.68 ± 0.37 ^b
Sodium	111.88 ± 0.24 ^d	115.90 ± 0.14 ^c	122.65 ± 0.35 ^b	145.84 ± 0.44 ^a
Copper	1.87 ± 0.11 ^a	2.27 ± 0.35 ^a	2.07 ± 0.10 ^a	0.97 ± 0.35 ^b
Phosphorus	64.97 ± 0.25 ^a	63.67 ± 0.60 ^b	58.89 ± 0.21 ^c	56.57 ± 0.81 ^d

Values with different superscript in a row are significantly different (p<0.05). Values are means ± standard deviation of triplicate determinations. **Key:** BPO = 70% fermented maize flour; 15% Melon flour; 15% Conophor nut flour; SPB = 80% fermented maize flour; 10% Melon flour; 10% Conophor nut flour; BPC = 90% fermented maize flour; 5% Melon flour; 5% Conophor nut Flour; POS = 100% fermented maize flour.

Table 4: Mineral composition of instant 'ogi' from blends of fermented maize, conophor nut and melon seed flours (mg/100 g).

Samples	Phytate (mg/100 g)	Oxalates (mg/100 g)	Tannin (mg/100 g)
BPO	5.64 ± 0.01 ^c	2.66 ± 0.01 ^a	4.66 ± 0.02 ^d
SPB	5.76 ± 0.01 ^b	2.59 ± 0.02 ^b	5.37 ± 0.03 ^a
BPC	5.96 ± 0.03 ^a	2.48 ± 0.01 ^c	4.86 ± 0.01 ^b
POS	5.26 ± 0.02 ^b	2.67 ± 0.02 ^a	4.78 ± 0.01 ^c

Values with different superscript in a row are significantly different (p<0.05). Values are means ± standard deviation from triplicate determinations. **Key:** BPO = 70% fermented maize flour; 15% Melon flour; 15% Conophor nut flour; SPB = 80% fermented maize flour; 10% Melon flour; 10% Conophor nut flour; BPC = 90% fermented maize flour; 5% Melon flour; 5% Conophor nut Flour; POS = 100% fermented maize flour.

Table 5: Anti-nutritional properties of instant 'ogi' from blends of fermented maize, conophor nut and melon seed flours (mg/100 g).

Samples	Taste	Appearance	Aroma	Overall Acceptability
BPO	4.50 ± 1.26 ^c	6.10 ± 0.99 ^b	6.30 ± 0.94 ^b	5.30 ± 0.67 ^c
SPB	6.50 ± 0.70 ^b	6.10 ± 1.19 ^b	7.30 ± 0.94 ^b	6.30 ± 0.82 ^b
BPC	5.80 ± 0.42 ^b	7.00 ± 0.94 ^a	7.10 ± 0.31 ^a	6.80 ± 0.42 ^b
POS	7.50 ± 0.52 ^a	7.50 ± 1.26 ^a	7.70 ± 0.94 ^a	7.70 ± 1.15 ^a

Values with different superscript in a row are significantly different (p<0.05).
Values are means ± standard deviation from triplicate determinations.
Key: BPO = 70% Fermented maize flour; 15% Melon flour; 15% Conophor nut flour; SPB = 80% fermented maize flour; 10% Melon flour; 10% Conophor nut flour; BPC = 90% fermented maize flour; 5% Melon flour; 5% Conophor nut Flour; POS = 100% fermented maize flour.

Table 6: Sensory evaluation of instant 'ogi' from blends of fermented maize, conophor nut and melon seed flours.

Conclusion

The study has shown that conophor nut/melon/ogi flour with improved nutrient composition, sensory quality and pasting properties that is comparable to the traditional fermented maize 'ogi' flour can be obtained up to 80:10:10 ratio. Conophor and melon seeds which are under-utilized are suitable for use in instant 'ogi' flour production for improved nutritional and pasting characteristics.

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