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

Oluwabukola Ojo D* and Ndigwe Enujiugha V

Federal University of Technology, Akure, School of Agriculture and Agricultural Technology, Department of Food Science and Technology, Akure, Ondo State, Nigeria

Abstract

'Ogi' is a popularly known fermented starch of staple cereala such as maize, sorghum and millet. Instant'ogi' production ariises from the need to meet the demand for 'ogi' among the urban populace in Nigeria and other developing countries. This study was carried out to evaluate the proximate, functional, pasting, mineral, anti - nutrient content and consumer acceptability of 'ogi' from blends of fermented maize, conophor nut and melon seed flours (90:5:5, 80:10:10, 70:15:15, 100:0:0). Pasting properties were determined by use of the rapid visco analyser. The mineral elements Ca, Mg, Fe, Zn, Cu, were determined by atomic absorption spectrophotometry while Na and K values were determined by flame photometry. 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

'Ogi', a fermented maize gruel, is a popular breakfast cereal and infant weaning food in West Africa. 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 Osagie and Eka [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 Abdulraharan, and Kolawole [2].

The conophor nut plant (*Tetracarpidum 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', 'awusa' in some parts of southern Nigeria is one of the several high nutrient dense food with the presence of protein, fibre, 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 objective of our study was to determine 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 (*Tetracarpidum conophorum)* were obtained from the local 'Oba' market in Akure, Ondo State, Nigeria.

Processing of fermented maize flour

The maize grains were cleaned and sorted by removing the pest-infested grains and discoloured 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 was allowed to 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 in Figure 1.

Processing of melon seed flour

The melon seeds were sorted to remove the discoloured 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 in Figure 2.

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

***Corresponding author:** Oluwabukola Ojo D, Federal University of Technology, Akure, School of Agriculture and Agricultural Technology, Department of Food Science and Technology, PMB 704, Akure, Ondo State, Nigeria, Tel: +2348034780116; E-mail: doojo@futa.edu.ng

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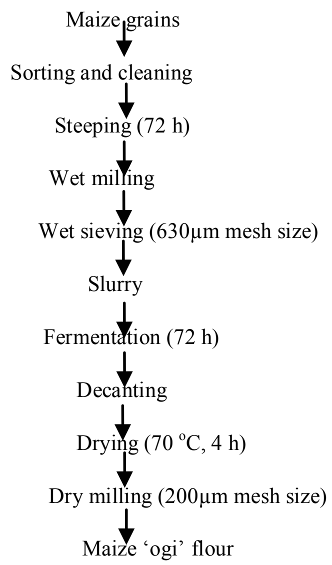

Figure 1: Flow chart for the production of fermented maize 'ogi flour.

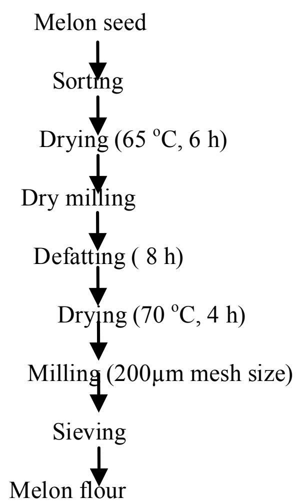

Figure 2: Flow chart for the production of melon seed flour.

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.

Blend formulation

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. A hand mixer (model: Kenwood, UK.) was used for mixing samples for 5 min to achieve uniform blending.

Analysis

Proximate chemical composition analysis

Proximate chemical composition of the samples were determined using the methods of AOAC [8]. Carbohydrate content was determined by substracting the sum of the percentage weight of crude protein, crude fibre, ash, fat from 100 percent.

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. The rotating spindle method described in the Encyclopedia of Industrial Chemical Analysis E.I.C.A [10] was employed in viscosity determination.

pH was determined using a pH meter (Model: S90526, Fischer Scientific Ltd., Singapore). The method of Jitngarmkusol et al. [11] with some slight modifications was used for the determination 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 a 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 (Model: NEWPORT SCIENTIFIC, NSW, Australia) as described by Adeyemi et al. [16] The peak, viscousity, trough, breakdown, final viscousity, set back, peak time and pasting 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 (Model: PYE UNICAM SP9, Cambridge, UK). Flame photometer (JENWAY PFP7, Bibby Scientific Ltd, Staffordshire, U. K.) was also used to measure the values of Na and

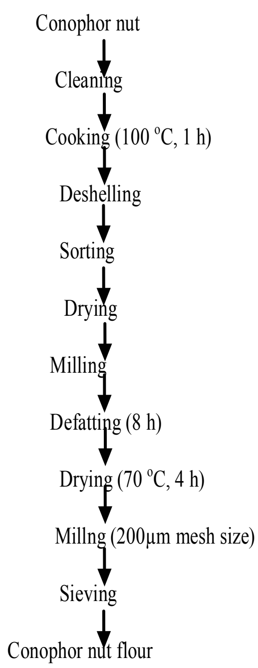

Figure 3: Flow chart for the production of conophor nut flour.

K in all the samples and Phosphorus (P) was determined 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 fibre content. According to Norman and Joseph [22], fibre has an important role 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 fibre and ash contents of the samples while fat and carbohydrate contents were reduced. Crude protein, ash and crude fibre were significantly different in the four samples; however, there were no significant differences in the fat content of samples BPO and SPB.

Functional properties of the instant 'ogi' flour blends

According to Oyerekua and Adeyeye [22] high water absorption capacity (WAC) is desirable for the improvement of mouth feel and viscosity reduction in food products. According to Afoadek and Sefa-Dedeh [23], 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 [24]. 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 [25] 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%-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 mouth feel [26]. 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%-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%-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 retrogadation the cooked sample and it ranged from 60.17-108.58 RVU with BPO 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' [24]. 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.

Mineral content of the instant 'ogi' flour blends

Table 4 shows the mineral contents of the instant 'ogi' flour

Samples	BPO	SPB	BPC	POS
Moisture	4.73 ± 1.09^b	4.73 ± 1.09^b	4.73 ± 1.09^b	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 fibre	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 fibre	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.

Samples	BPO	SPB	BPC	POS
Ph	6.60 ± 0.00ᵃ	6.20 ± 0.00ᵇ	5.70 ± 0.00ᶜ	6.20 ± 0.00ᵇ
WAC (%)	660.00 ± 0.70ᵃ	680.00 ± 0.28ᵃ	660.00 ± 0.56ᵃ	665.00 ± 0.63ᵃ
OAC (%)	830.00 ± 0.70ᵃ	870.00 ± 0.21ᵃ	800.00 ± 0.28ᵃ	820.00 ± 0.00ᵃ
EC (%)	78.15 ± 0.21ᵃ	50.20 ± 0.28ᵇ	75.25 ± 0.35ᵃ	53.25 ± 0.47ᵇ
Viscousity (dPa)	0.61 ± 0.01ᵇ	0.70 ± 0.01ᵃ	0.70 ± 0.01ᵃ	0.61 ± 0.01ᵇ
RI (ml/g)	3.61 ± 0.02ᶜ	3.62 ± 0.03ᶜ	4.35 ± 0.00ᵇ	5.05 ± 0.07ᵃ
BD (g/ml)	0.66 ± 0.00ᵈ	0.71 ± 0.00ᶜ	0.76 ± 0.00ᵇ	0.90 ± 0.00ᵃ
FC (%)	10.00 ± 0.01ᵃ	9.85 ± 0.03ᵇ	4.28 ± 0.02ᶜ	1.38 ± 0.01ᵈ
FS (%)	4.28 ± 0.03ᵃ	5.63 ± 0.02ᵃ	1.42 ± 0.01ᶜ	1.38 ± 0.01ᵈ
SI (v/v)	3.61 ± 0.02ᶜ	3.62 ± 0.03ᶜ	4.35 ± 0.07ᵇ	5.05 ± 0.07ᵃ
LGC (%)	18.00 ± 0.00ᵇ	14.00 ± 0.00ᶜ	20.00 ± 0.00ᵃ	6.00 ± 0.00ᵈ

Seed flours
Values with different superscript in a row are significantly different ($p < 0.05$).
Values are means ± standard deviation of triplicate determinations.
Abbrevations: Water absorption capacity: WAC; Oil absorption capacity: OAC; Emulsion capacity: EC; **Reconstitution index:** RI; Bulk density: BD; Foaming capacity: FC; Foaming stability: FS; Swelling index: SI; Least gelation capacity: LGC
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.

Samples	BPO	SPB	BPC	POS
Peak viscosity (RVU)	163.17 ± 0.07ᵇ	161.17 ± 0.17ᶜ	133.51 ± 0.14ᵈ	213.83 ± 0.21ᵃ
Trough (RVU)	135.00 ± 0.14ᵃ	123.25 ± 0.01ᵇ	85.08 ± 0.07ᵈ	107.08 ± 0.14ᶜ
Breakdown (RVU)	28.17 ± 0.07ᵈ	37.93 ± 0.14ᶜ	48.41 ± 0.07ᵇ	106.76 ± 0.14ᵃ
Final viscosity (RVU)	243.59 ± 0.14ᵇ	247.34 ± 0.07ᵃ	145.25 ± 0.07ᵈ	196.67 ± 0.10ᶜ
Setback (RVU)	108.58 ± 0.14ᵇ	104.09 ± 0.10ᵃ	60.17 ± 0.10ᵈ	89.57 ± 0.07ᶜ
Pasting time (sec)	5.36 ± 0.10ᵈ	5.68 ± 0.07ᵇ	5.58 ± 0.07ᶜ	5.85 ± 0.07ᵃ
Pasting temperature (°C)	86.05 ± 0.14ᵇ	85.95 ± 0.28ᶜ	94.75 ± 0.07ᵃ	83.65 ± 0.10ᵈ

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 flours.

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.

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. Phytate are known to form complexes with iron, zinc, calcium and magnesium making them less available and thus inadequate in food samples especially for children however, the phytate content of the ogi flour blends are far lower than the minimum amounts of phytic acid reported by Siddhuraju and Becker [29] 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 [29] 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 [30-32].

Sensory evaluation of gruel of instant 'ogi' from blends of fermented maize, conophor nut and melon seed flours

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

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

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 ± 0.01ᶜ	2.66 ± 0.01ᵃ	4.66 ± 0.02ᵈ
SPB	5.76 ± 0.01ᵇ	2.59 ± 0.02ᵇ	5.37 ± 0.03ᵃ
BPC	5.96 ± 0.03ᵃ	2.48 ± 0.01ᶜ	4.86 ± 0.01ᵇ
POS	5.26 ± 0.02ᵇ	2.67 ± 0.02ᵃ	4.78 ± 0.01ᶜ

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, 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 ± 1.26ᶜ	6.10 ± 0.99ᵇ	6.30 ± 0.94ᵇ	5.30 ± 0.67ᶜ
SPB	6.50 ± 0.70ᵇ	6.10 ± 1.19ᵇ	7.30 ± 0.94ᵇ	6.30 ± 0.82ᵇ
BPC	5.80 ± 0.42ᵇ	7.00 ± 0.94ᵃ	7.10 ± 0.31ᵃ	6.80 ± 0.42ᵇ
POS	7.50 ± 0.52ᵃ	7.50 ± 1.26ᵃ	7.70 ± 0.94ᵃ	7.70 ± 1.15ᵃ

Values are means ± standard deviation from triplicate determinations.
Values with different superscript in a row are significantly different ($p < 0.05$).
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 gruel of instant 'ogi' from blends of fermented maize, conophor nut and melon seed flours.

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 favourably with the control (POS) and there were no significant differences between them.

Conclusion

The study has shown that fermented maize- conophor nut-melonogi flour with improved nutrient s, pasting properties and sensory quality compared 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. The production of instant 'ogi' from fermented maize- conophor nut-melon flour makes the the local food product 'ogi' readily available for consumption, increases its variety, hence, consumer choice of 'ogi'.

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