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Evaluation of the nutritional composition and acceptability of powdered *ogi* enriched with date palm fruits

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ABSTRACT: This study was carried out to evaluate the nutritional composition and acceptability of powdered *ogi* enriched with date palm fruits. *Ogi* is a fermented slurry made with maize. *Ogi* enriched with date palm fruits was formulated in order to develop a nutrient dense product and an alternative to the available products, by increasing the usage of these crop materials. The prepared powdered *ogi* (POD) was enriched with the inclusion of different proportions of powdered dates (0, 5, 10 and 15%, which were labeled control, POD1, POD2 and POD3 respectively). Proximate analysis and sensory evaluation were then carried out on the samples. The results showed that there was a significant difference ($p< 0.05$) in the proximate composition of the enriched *ogi* samples, with sample POD3 having relatively higher values for ash (12.07%) and crude fibre (3.51%) when compared to the control. From the result of the mineral analysis, the concentration of minerals (Na, K, Fe, and P) increased significantly ($p<0.05$) with increasing level of dates, with POD3 having the highest concentration of P (768.16 ppm), K (728.00 ppm) and Fe (127.00 ppm). POD2 had a significantly high ($p<0.05$) concentration of Na (146.00 ppm). The sensory properties of the samples were generally liked by the panelist, but the overall acceptability of POD3 was highly rated and preferred. This study revealed that the enriched samples were nutrient dense and therefore recommended for homes to alleviate hidden hunger.

Keywords: Crop utilization, maize meal, nutrient content, nutritional enrichment.

INTRODUCTION

Cereal grains are staple foods in the tropics providing about 75% of the total caloric intake and 67% of the total protein intake. In sub-sahara Africa, maize *(Zea mays)* is a major staple food for an estimated 50% of the population and globally, it remains the most important agricultural crop for over 70 million households (Makanjuola et al*.,* 2017). In Nigeria, maize constitutes about 90% of cereals widely consumed and processed into maize flour for *tuwo* or fermented meal for *ogi* (gruel) among others (Alamu et al., 2014).

Akin-Osanaiye and Oladele (2017) reported that *ogi* is the most popular fermented health food and its consumption cuts across the various segments of the society, including all age groups in many West African countries. This is mainly due to its availability, high digestibility and the fact that it supplies the necessary calories required (Awoyale et al., 2016). Research has shown that a diet based on maize may be deficient in micronutrients such as potassium, iron, B complex vitamins, amongst others (Kean et al., 2008). The processing of maize ultimately increases its shelf life; however, a significant loss of micronutrients may occur via heat degradation and/or leaching during processing and this may be associated with undernutrition and hidden hunger (Al-Awwadi, 2017; Makanjuola et al., 2017). This therefore adversely affects the nutritional quality of *ogi*. Hence, the need for nutritional enrichment with a potential plant material which is important and beneficial in the

improvement of value-added food products.

Date palm fruit *(Phoenix dactylifera)* is a delicious fruit, with enormous nutritional value. It has been listed in Africa as a crop that plays a role in food security (Anon 2010; Ashraf and Hamidi-Esfahani*,* 2011). Date fruits are rich in dietary fibres, which are associated with low incidence of colon cancer, heart disease, diabetes and other diet-related diseases and disorders. Also, date fruit contains high amount of micronutrients and bioactive compounds known to be beneficial to health (Ashraf and Hamidi-Esfahani*,* 2011). It serves as a natural and healthy alternative to added refined sugars, which are known to be unsafe for consumption as they pose deleterious health issues (Sani et al.*,* 2016). Since date palm fruits are regarded as safe and beneficial to human health, it may be a potential material in the enrichment of powdered *ogi*. In view of the fact that it is important to make its nutrients available to consumers by ultimately utilizing the fruits, it is therefore imperative to evaluate the nutritional composition and acceptability of powdered *ogi* enriched with date palm fruits, hence the study.

MATERIALS AND METHODS

Sample collection

The white maize grains *(Zea mays)* and date palm fruits *(Phoenix dactylifera)* used in this study were purchased from Dugbe and Sabo markets, Ibadan, Oyo State, Nigeria respectively. All reagents used were of analytical grade.

Preparation of powdered ogi

Two hundred and fifty (250) grams of maize was prepared according to the traditional wet milling process, in which the maize grains were sorted to remove extraneous materials, washed thoroughly and steeped in sufficient potable water for 72 hours at room temperature (25±2^{o}C). The water for steeping was changed every 24 hours and drained on the third day, after which it was wet milled using a 1500T/24H milling machine. The wet milled slurry was sieved using a muslin cloth. The slurry was allowed to stand for 48 hours for sedimentation before the supernatant was decanted. The wet cake (*ogi*) obtained was recovered by squeezing excess water with cheese cloth and sun-dried for 7 days. The dried meal was sieved using a 1.19 mm mesh to get fine ogi powder. The fermented *ogi* powder was packed in an air tight jar and stored at ambient temperature. The procedure followed was a slightly modified method described by Farinde (2015) and Awoyale et al. (2016).

Preparation of date powder

The wholesome date palm fruits were rinsed in clean water and pat dry using a clean towel. The fruits were then de-pitted, cut into small pieces, sun-dried for 7 days and pulverized for 2 minutes using a 3D electric blender. The date powder was sieved using a 1.19 mm mesh. The fine powder obtained was stored in a clean and air tight jar until needed.

Formulation and production of powdered ogi and date fruit blends

The prepared powdered *ogi* (POD) was enriched with the inclusion of different proportions of powdered dates (0, 5, 10 and 15%) as shown in Table 1. These were blended together to obtain the formulations. The blend without the inclusion of date powder served as the control sample.

Determination of proximate composition

The proximate composition of the samples was determined using the standard methods of the Association of Official Analytical Chemists (2005). Crude protein was determined using micro-Kjeldahl method (Method No 978.04), crude fat was determined by the Soxhlet extraction method (Method No 989.05) and moisture content was determined using air oven at 105°C to a constant weight according to Method No 926.08 (Plus 11 Sanyo Gallenkamp UK). The ash content was determined by ashing the sample in a muffle furnace (Gallenkamp 3) at 550°C for 4 hours (Method No 942.05), crude fibre (Method No 958.06). The total carbohydrate was determined by using the difference method according to Equation 1:

$$Total\ carbohydrate = 100 - (\%\ moisture + \%\ fat + \%\ protein + \%\ fibre + \%\ ash \text{----------} 1$$

Mineral analysis

The ash of each sample (obtained in a crucible, by igniting 2 g of the samples in a muffle furnace) was digested by adding 5 ml of 2 M HCl, heated slowly for 20 minutes. After heating, it was filtered into a 100 ml volumetric flask. The filtrate was used for the determination of the concentration of each mineral element (phosphorus, potassium, sodium and iron). Buck Scientific - 200 Atomic Absorption Spectrophotometer -AAS (Buck Scientific, Norwalk) was used. The composition of minerals was determined according to the standard method of the Association of Official Analytical Chemists (2005).

Sensory evaluation

Thirty screened panelists with the ability to differentiate food sensory properties were asked to assess the coded

Table 1. Blends for the production of powdered *ogi* and powdered dates.

Code	Ogi (%)	Dates (%)
POD1	95.00	5.00
POD2	90.00	10.00
POD3	85.00	15.00
Control	100.00	0.00

samples for the following sensory quality indices – appearance, colour, aroma, taste and overall acceptability using a 9-point hedonic scale (from 1 = extremely dislike to 9 = extremely like) according to Iwe (2002). The coded samples were randomly served in clear transparent disposable cups at 25°C. Each panelist was provided with a glass of clean water to rinse their mouths at intervals during the evaluation session.

Statistical analysis

Analyses were carried out in triplicates and the data obtained were subjected to Analysis of Variance (ANOVA), using Statistical Package for Social Sciences (SPSS) version 20.0. The means were separated using Duncan's New Multiple Range Test (DNMRT) at $p<0.05$. Results were expressed as Mean ± Standard Deviation (SD).

RESULTS AND DISCUSSION

Proximate composition of the enriched and control samples

The results of the proximate analysis of the samples presented in Table 2 shows that the crude protein content of POD1 (12.17%) was significantly higher ($p<0.05$) than that of the other formulations, except the control (13.83%). This same trend was observed for the crude fat and carbohydrates content, with POD1 respectively having values of 10.42% and 62.03%; significantly higher than the other formulations of powdered *ogi* and powdered date blends. The moisture content of POD3 (3.93%) significantly increased ($p<0.05$) when compared to the control sample (1.51%). As the quantity of date increases, the moisture content was significantly affected. This may be due to the fact that the moisture content of date fruit is higher than that of *ogi*, which conferred higher moisture content with increasing level of date. Previous research has shown that moisture content determines the shelf life of a food product because the higher the water activity, the more susceptible the food will be to interactions with microorganisms (Isengard, 2001; Peluola-Adeyemi et al., 2019). The moisture content observed for all the samples is therefore a good indication of their potential to have a long shelf life.

The ash which is the inorganic compound in food ranged from 5.14 to 12.07% for all samples, revealing that the higher the level of date, the higher the ash content. The significant increase ($p<0.05$) in the level of ash content can be attributed to the high level of minerals present in date palm fruits (Ashraf and Hamidi-Esfahani, 2011). For crude ash and crude fibre, POD3 had the highest contents of 12.07% and 3.51% respectively. The increase in crude fibre content of the various formulations with increasing level of enrichment with date palm is an indication of high level of fibre in date fruit. The formulations are consequently regarded as good products because fibres facilitate bowel movements, thereby preventing gastrointestinal diseases (Ashraf and Hamidi-Esfahani, 2011; Sani et al., 2016).

Mineral composition of the enriched and control samples

The result of the mineral composition of the powdered *ogi* enriched with dates is presented in Figure 1. The addition of date powder had a significant effect on the mineral composition of the samples. The phosphorus content ranged from 663.42 to 768.16 ppm, potassium content ranged from 89.00 to 728.00 ppm, sodium and iron content ranged from 117.00 to 146.00 and 76.00 to 127.00 ppm respectively. There was a significant increase ($p<0.05$) in the concentrations of phosphorus, potassium and iron. There was progressive increase in the concentration of both potassium and iron as the level of inclusion of powdered date increased. Also, it was observed that POD3 had the highest concentration of these minerals. However, the general trends as shown in the research work revealed that increasing levels of powdered date to the blends led to increasing amount of minerals present in the samples. Research has shown that inadequate intakes of iron and other beneficial mineral are associated with severe malnutrition, increased disease conditions and mental/cognitive impairment. Iron is regarded as an essential nutrient of public health importance (Wardlaw 2004; Mannay and Shadaksharaswan, 2005).

Sensory evaluation of the enriched and control *ogi* samples

The result of the sensory evaluation of different formulations is presented in Table 3. The results indicated that the mean score for appearance ranged from 7.08 to 7.28, with POD1 having the highest mean score. There were no significant differences ($p<0.05$) in the mean scores of colour, between the formulated blends and the control sample. However, sample POD3 was ranked lowest in terms of colour, when compared to the control. For aroma on the other hand, significant differences were recorded ($p<0.05$) between means, with values ranging from 6.45 to 7.73 with POD3 being the most preferred

Table 2. Proximate composition of *ogi* powder enriched with date palm fruit

Sample	Moisture (%)	Crude protein (%)	Crude ash (%)	Crude fat (%)	Crude fibre (%)	Carbohydrate (%)
POD1	2.41±0.17^{bc}	12.17±0.49^{b}	10.13±0.35^{b}	10.42±0.72^{b}	2.84±0.32a^{b}	62.03±0.90^{c}
POD2	3.16±0.40^{ab}	11.12±0.15^{c}	11.75±0.40^{a}	10.21±0.29^{b}	3.11±0.00^{b}	60.65±0.89^{b}
POD3	3.93±0.35^{a}	10.50±0.20^{d}	12.07±0.41^{a}	10.07±0.28^{b}	3.51±0.03a^{b}	59.92±0.16^{b}
Control	1.51±0.49^{c}	13.83±0.10^{a}	5.14±0.13^{c}	11.12±0.26^{a}	2.50±0.29^{a}	65.90±0.52^{a}

Values are represented as means of triplicate determinations ± SD. Means with the same superscript within the same column indicate no significant difference ($p<0.05$). POD1: 95 % ogi + 5 % Date, POD2: 90 % ogi + 10 % Date, POD3: 85 % ogi + 15 % Date, Control: 100 % ogi

Table 3. Sensory evaluation of *ogi* powder enriched with date palm fruits

Sample	Appearance	Colour	Aroma	Taste	Overall acceptability
POD1	7.28±0.19^{a}	7.21±0.12^{a}	7.23±0.23^{b}	6.98±0.24^{b}	7.12±0.11^{b}
POD2	7.16±0.16^{a}	6.98±0.28^{a}	7.58±0.21^{b}	7.37±0.40^{b}	7.33±0.18^{b}
POD3	7.08±0.21^{a}	6.97±0.05^{a}	7.73±0.21^{c}	7.58±0.23^{bc}	7.69±0.22^{bc}
Control	7.23±0.12^{a}	7.23±0.23^{a}	6.45±0.18^{a}	5.92±0.11^{a}	6.41±0.26^{a}

Values are represented as means of triplicate determinations ± SD. Means with the same superscript within the same column indicate no significant difference ($p<0.05$). POD1: 95 % ogi + 5 % Date, POD2: 90 % ogi + 10 % Date, POD3: 85 % ogi + 15 % Date, Control: 100 % ogi.

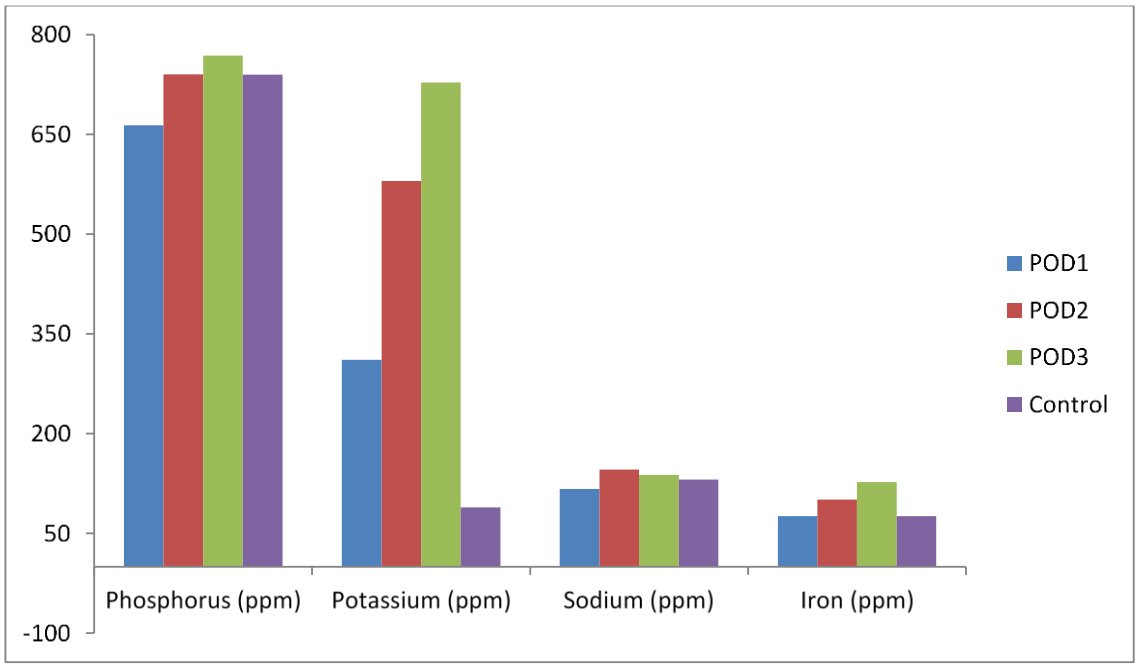

Figure 1. Minerals composition of *ogi* poweder enriched with date fruit.

sample. A similar trend was therefore observed for taste and overall acceptability, with POD3 having significantly high ($p<0.05$) mean scores of 7.58 and 7.69 respectively. This implies that POD3 was the most preferred sample in terms of aroma, taste and overall acceptability.

The result obtained showed that aroma, taste and overall acceptability were positively affected by the inclusion of different percentages of powdered date. Obviously, the sensory evaluation of the various formulations of powdered *ogi* and date showed better results and was much preferred to the control (100% powdered *ogi*). This can be attributed to the naturally sweetening ability (Al-Shahib and Marshall, 2003) and thickening property of date palm fruits (Khan and Khan, 2016).

Conclusion

The findings of this study have indicated evidently that the addition of date powder to *ogi* during processing is a good way of enriching the slurry. This combination is good in an attempt to make a nutritious product that can combat micronutrient deficiency in developing countries like Nigeria. Furthermore, the results showed that people find *ogi* with a relatively high amount of date fruit (as a natural sweetener) very palatable and delicious. The consumption of *ogi* enriched with date palm fruits is thus not only an easy-to-make staple food, it is also a nutrient dense food good for both young and old.

CONFLICT OF INTEREST

The authors declare that there are no conflicts of interests.

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