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Phytochemical and Proximate Composition of "Ogi" Produced from Sorhum, Millet, Maize and Spices

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Abstract

This study investigated the phytochemical and proximate composition of "ogi" produced from sorghum, millet, maize and spices. The sorghum, maize and millet were mixed in different ratios. The mixtures were soaked differently for four days, washed, drained and spices (uziza seeds, clove and ginger) were added at different ratios, wet milled, sieved, allowed to settle for 12h and then decanted. The slurry was squeezed with muslin cloth and then dried at 60^{o}C for 12h and dry milled. The samples were analysed for proximate and phytochemical compositions using standard methods. The result obtained showed that there was an increase in fat, carbohydrate, ash and crude fibre due to inclusion of ginger, clove and uziza seeds. The moisture content of the samples ranged from 12.15 -13.73%, ash 1.57 - 2.69%, fat 3.17 - 4.95%, crude fibre 3.62 - 5.34%, protein 8.72 - 10.96% and carbohydrate 65.03 - 68.27%.The inclusion of spices (ginger, uziza seed and clove) increased the phytochemical compositions of the samples. The phytochemical compositions revealed that "ogi" produced from sorghum, millet, maize with uziza seeds, ginger and clove contained saponin (20.72 - 64.54 mg/g), tannin (2.05 - 4.33 mg/g), terpenoid (10.68 - 18.70 mg/g), glycoside (0.90 - 1.50 mg/g), steroid (6.12 - 9.80 mg/g) and alkaloid (1.11 - 2.80 mg/g). Hence, "ogi" fortified with spices (uziza seed, clove and ginger) could provide some health benefit. Therefore the uses of spices such as ginger, clove and uziza seeds in fortification of "ogi" should be encouraged.

Keywords: Grains, "Ogi", spices, Phytochemical, Proximate.

Introduction

Cerealsare the major sources of energy and protein in the diets of most Africans. There are various types of cereals which include maize (*Zea mays*), sorghum (*Sorghum vulgar*) and millet (*Pennisetum specaatum*). In Nigeria, maize, sorghum and millet are grown mainly in northern part of the country (Banigo *et al.,* 2012).Maize is an important source of carbohydrate, protein, vitamin B and Minerals. Maize is deficient in two amino acids, lysine and tryptophan making it a poor proteinous food (Jay, 2015). "Ogi' is known as fermented non -alcoholic starchy food, and a major staple food widely consumed in West Africa. It is mostly prepared using traditional fermenting and malting technologies which are simple but do not guarantee quality and lack of

contaminations as well as lack of the appropriate nutritive value (Marero *et al*., 2009). It is prepared by soaking (steeping) in water for two to five days, grinding (wet milling) and sieved to remove the husk. The main reason for fermenting maize grains is to convert starch contents in the cereals such that it does not require dilution. The fermenting process also removes the pathogens. "Ogi" provides about 20 -26 kcal/kg per day to an infant who has an average density of 0.26 kcal/kg (Brown *et al*., 2008).In most parts of Africa especially in Nigeria, children are fed with mashed adult foods.

These foods are bulky and can cause malnutrition. The developments of nutritionally balanced calorie as dense weaning foods lead to the fermentation of maize to provide pap. The food must also be of the right quantity to satisfy the infant at one feeding. It is also a choice of meal for patients in need of soft and easily digestible foods (Jay, 2015). They are important energy food rich in carbohydrate with traces of vitamins, proteins, minerals (Achtenberg *et al*., 2004; FAO, 2009) and natural antioxidants (Eaton and Nelson, 2011). Its reputation as the most popular traditional weaning food and its consumption by convalescent in the West African regions calls for a safe product, free of pathogen and any potentially hazardous microorganisms. This study is to evaluate proximate and phytochemical composition of"ogi" produced from maize, millet and sorghum blends.

Materials and Methods

The grains (maize, millet, and sorghum), ginger, clove and uziza seed (Iyere) were purchased from "Oja Oba" in Ado-Ekiti, Ekiti State, Nigeria.

Preparation of "Ogi" Powder

The cleaned maize, sorghum, millet were weighed with other ingredient using weighing balance, washed in a portable water to remove contamination and soaked in clean water for four (4) days, then wet milled and sieved to obtain slurry, the slurry obtained was drained with muslin cloth and oven dried at 60^{o}C for 12h and milled into powdered with a blender. The blended samples were sieved through 0.5mm mesh size sieve and subsequently packaged in polyethylene bag, keep in air tight plastic containers with a lid and stored in cool dry place.

Formulation Table for the Samples

Sample	Sorghum (g)	Maize (g)	Millet (g)	Clove (g)	Ginger (g)	Uziza seed(g)
A	50	30	20	0	0	0
B	45	30	20	0	5	0
C	40	30	20	5	5	0
D	35	30	20	5	5	5
E	45	30	20	5	0	0
F	45	30	20	0	0	5

Keys
Sample A: 50%Sorghum+30%Maize+20%Millet
Sample B: 50%Sorghum+30%Maize+20%Millet+5%Ginger

Sample C: 50%Sorghum+30%Maize+20%Millet+ 5%Clove+5%Ginger
Sample D: 50%Sorghum+30%Maize+20%Millet+Uziza seed+ 5%Ginger+ 5%Clove
Sample E: 50%Sorghum+30%Maize+20%Millet+5%Clove
Sample F: 50%Sorghum+30%Maize+20%Millet+5%Uziza seed

Determination of Proximate

Composition

The ogi samples produced from the grains (sorhum, maize and millet) with the spices (uziza seed, gloves and ginger) were analysed for moisture, protein, fat, crude fibre and ash content according to the methods described by A.O.A.C (2012) while the total The moisture, crude protein, fat, ash and crude fibre contents of the "ogi" samples were determined in triplicate according to the standard analytical methods (AOAC, 2012). Carbohydrate was calculated by difference.

Determination of Terpenoid

0.5g of finely grounded dried African Apple was weighed into a 50ml conical flask 20ml of chloroform: methanol 2:1 was added the mixture was shaken thoroughly and allowed to stand for 15min at room temp. The suspension was centrifuge at 3000rpm the supernatant was discarded and the precipitate was re-washed with 20ml chloroform: methanol 2:1 and then re-centrifuge again the precipitate was dissolve in 40ml of 10% SDS solution. 1ml of0.01M ferric chloride was added and allowed to stand for 30min before taken the abs @ 510nm. The STD Terpenoid (alpaterpineol) concentration ranging from 0-5mg/ml from the stock solution.

Tannin Determination

About 0.2g of finely grounded dried African Apple was weighed into a 50ml sample bottle. 10ml of 70% aqueous acetone was added and properly covered. The bottle were put in an ice bath shaker and shaken for 2h at 30^{o}C. Each solution was then centrifuge and the supernatant store in ice. 0.2ml of each solution was pipetted into the test tube and 0.8ml of distilled water was added. Standard tannin acid solutions were prepared from a 0.5mg/ml of the stock and the solution made up to 1ml with distilled water. 0.5ml of Folin ciocateau reagent was added to both sample and standard followed by 2.5ml of 20% Na_2CO_3 the solution were then vortexed and allow to incubate for 40 min at room temperature, its absorbance was read at 725nm against a reagent blank concentration of the same solution from a standard tannic acid curve was prepared (Makkar and Goodchild. 2006).

Determination of Cardiac Glycosides

About 10ml of the extract pipetted into a 250ml conical flask. 50ml chloroform was added and shaken on vortex mixer for 1hour. The mixture was filtered into 100ml conical flask. 10ml of pyridine and 2ml of 29% of sodium nitroprusside were added and shaken thoroughly for 10min. 3ml of 20% NaOH was added to develop a brownish yellow colour. Glycosides standard (Digitoxin). A concentration which range from 0 – 50mg/ml were prepared from stock solution the abs was read @ 510nm.

Determination of Alkaloid

About 5g of the dried African Apple was weighed into a 250ml beaker and 200ml of 10% acetic acid in ethanol was added and allowed to stand for 4min. this was filtered and extract was concentrated on a water bath to one quarter of the original volume. Concentrated ammonium hydroxide added drop wise to the extract until the precipitation was completed. The whole solution was allowed to settle and the precipitated was collected and washed with dilute ammonium hydroxide and then filtered. The residue is then alkaloid which was dried and weighed.

Determination of Saponin

About 2g of the finely grinded sample will be weighed into a 250ml beaker and 100ml of Isobutyl alcohol or (But-2-ol) will be added. Shaker will be used to shake the mixture for 5h to ensure uniform mixing. The mixture will now be filter with No 1 whatman filter paper into 100ml beaker containing 20ml of 40% saturated solution of magnesium carbonate ($MgCO_3$). The mixture obtain again will be filter though No 1 whatman filter paper to obtain a clean colourless solution. 1ml of the colourless solution will be taken into 50ml volumetric flask using pipette, 2ml of 5% iron (iii) chloride ($FeCl_3$) solution will be added and made up to the mark with distilled water. It would be allow standing for 30min for the colour to develop. The absorbance is read against the blank at 380nm.

Statistical Analysis

The data obtained were analyzed using the analysis of variance (ANOVA) and means were separated using the Duncan multiple range test at the level of $p < 0.05$ (kin-kadari and Giami 2015).

Result and Discussion

Proximate Composition

Sample B (50%Sorghum+30%Maize+15%Millet+ 5%Ginger) had the highest moisture content (13.73%), followed by sample A which serve as control. There were significant differences in moisture content of samples. However, sample C and D had the highest moisture content of (12.15%). Samples C, D and E product were below the specified moisture content of 13%. High moisture content has been associated with short shelf life of ogi powder, as they encourage a microbial proliferation that lead to spoilage (Akhtar *et al*., 2008; Elleuch *et al*., 2011).This indicate that all the samples will be more stable and have long shelf life.There were significant differences in the fat content of all the samples at ($P < 0.05$).Sample A which serve as control had the maximum fat content (4.95%) while sample E (45%Sorghum+30%Maize+15%Millet+ 5%Clove) had the least value of (3.76%).The fat content of other samples were slightly closed to the fat content obtained in sample A and this indicate that ginger, uziza seed added to the production had no effect on the fat content except clove which drastically reduced the fat content of the sample. The low fat content obtained from all the sample prevent them from oxidative rancidity and increase the shelf stability (Potter and Hotchikiss, 2006). Sample A and F were in

agreement with what reported by Abiola and Sumbo, (2018) of (4.72%) produced from ogi flour from millet enriched with garlic and ginger. Fat is essential component of tissues and veritable source of fat soluble vitamins (A, D E and K). It is able to supply thrice amount of energy required by body (Wardlaw, 2004).The result of crude fibre showed that there were significant different in all the samples. Sample A which served as control had the minimum crude fibre of (3.62%) while sample C (40% Sorghum+30%Maize+10%Millet+ 5%Clove+ 5%Ginger) had the maximum crude fibre of (5.34%). This indicates that clove and ginger increased the fibre content. Fibre content of foods could be desires the risk of heart diseases by binding bile salt and cholesterol secreted in the bile, which are subsequently excreted out of the body (Felix *et al*., 2008). Rave *et al*., (2008) have earlier demonstrate the beneficial effect of fibre consumption in protection against heart disease and cancer, normalization of blood lipids, regulation of glucose absorption and insulin secretion and prevention of constipation and particular disease.

There were significant difference in the protein content of the samples and it ranged from (8.72-10.96%). Sample C had the minimum protein content (8.72%), while sample F (45%Sorghum +30%Maize+15%Millet+5%Uziza seed) had the maximum value of (10.96%).This indicates that uziza seed is rich in protein than ginger and clove. Protein values obtained were lower than that of what reported by Abiola and Sumbo, (2018) of (13.78-15.76%) produced from ogi flour from millet enriched with garlic and ginger. Protein is needed as building blocks for the body, necessary for growth and for the repair of damaged tissues (Wardlaw, 2004). It also plays an important role in nutrition by regulation, protecting, and repairing of worn out tissue.There were significant differences in the ash content of sample at ($p<0.05$) ranged from 1.57 – 2.69%.Sample E (45%Sorghum+30%Maize+15%Millet+5%Clove) had the highest ash content, followed by sample A which indicates that the addition of clove to the sample increased the ash content. Ash content of any food material is an indication of the non-organic compound containing mineral content of food.

Sample F had the least carbohydrate content of 65.03% and sample D had the highest value of 68.27%. All the value obtained were not similar to what reported by Abiola and Sumbo, (2018) of (73.63-74.72%) produced from "ogi" flour from millet enriched with garlic and ginger. However, the carbohydrate contents of sample D (35%Sorghum+30%Maize +5%Millet+5% Uziza seed+ 5%Ginger+5%Clove) showed the higher value of carbohydrate content than that of other samples. This indicates that ginger, clove and uziza seeds are source of carbohydrate as well. Nkwonta and Njoku, (2020) reported that high carbohydrate is important as it provides the energy needed to do work; however, low carbohydrate content in diets is also of advantage for diabetic patient that need very low carbohydrate content in their diet.

Table 1: Proximate Composition of Ogi Powder Produced from Maize, Millet and Sorghum blends

Sample	Moisture (%)	Ash (%)	Fat (%)	Crude Fibre (%)	Protein (%)	Carbohydrate (%)
A	13.64 ± 0.02^{b}	2.15 ± 0.03^{b}	4.95 ± 0.01^{a}	3.62 ± 0.02^{f}	9.58 ± 0.01^{c}	66.05 ± 0.05^{e}
B	13.73 ± 0.01^{a}	1.72 ± 0.11^{e}	4.26 ± 0.02^{b}	3.88 ± 0.01^{d}	10.21 ± 0.01^{b}	66.18 ± 0.04^{d}
C	12.15 ± 0.02^{d}	1.95 ± 0.02^{c}	3.76 ± 0.02^{d}	5.34 ± 0.01^{a}	8.72 ± 0.04^{c}	67.00 ± 0.01^{c}
D	12.93 ± 0.01^{c}	1.57 ± 0.02^{f}	4.19 ± 0.02^{c}	4.72 ± 0.01^{b}	8.26 ± 0.19^{f}	68.27 ± 0.02^{a}

E	12.19±0.01^{d}	2.69±0.01^{a}	3.47±0.02^{e}	4.56±0.01^{c}	9.15±0.02^{d}	67.86±0.03^{b}
F	13.51±0.01^{b}	1.80±0.10^{d}	4.94±0.02^{a}	3.72±0.02^{e}	10.96±0.02^{a}	65.03±0.10^{f}

Means in the same column followed by different superscripts are significantly different (P<0.05).

Keys

Sample A: 50%Sorghum+30%Maize+20%Millet

Sample B: 45%Sorghum+30%Maize+20%Millet+5%Ginger

Sample C: 40%Sorghum+30%Maize+20%Millet+ 5%Clove+5%Ginger

Sample D: 35%Sorghum+30%Maize+20%Millet+Uziza seed+ 5%Ginger+ 5%Clove

Sample E: 45%Sorghum+30%Maize+20%Millet+5%Clove

Sample F: 45%Sorghum+30%Maize+20%Millet+5%Uziza seed

Phytochemical Composition

Table 2 shows that"ogi" samples produced from maize, millet and sorghum blends fortified with ginger, clove and uziza seeds contains the following phytochemicals: tannin, terpenoid, steroid, alkaloid, saponin and glycosides.

The value of tannin ranged from 2.05 to 4.33mg/g. There was no significant difference (P>0.05) between sample B and sample D. Sample F (45%Sorghum+ 30%Maize+15%Millet + 5%Uziza seed) had the highest value of 4.33 mg/g while sample E (45%Sorghum+ 30%Maize +15%Millet+ 5%Clove) had the least value of 2.05mg/g. This indicates that uziza seeds and ginger had high value of tannin than clove. This was detected in all the samples fortified with ginger and uziza seeds. Tannins are a group of polymeric phenolic compounds and cause local tumours (Kapadia *et al.*, 2008). They are able to inactivate and kill microorganisms. They used in the treatment of varicose ulcers, hemorrhoids, minor burns (Cowan, 2009).

Alkaloids are group of naturally occurring chemical compounds that contain mostly basic nitrogen atoms. Alkaloids have pharmacological effects and are used as local anesthetic and stimulants (Manske, 2015).The value of alkaloid ranged from 1.11 to 2.80mg/g. sample D (35%Sorghum+30%Maize+5%Millet+5%Uziza seed+ 5%Ginger+ 5%Clove) had the highest value of alkaloid content than other samples and this could be as result of inclusion of clove, ginger and uziza seeds, followed by sample F and the high value obtained in sample was as a result of uziza seeds and this is an indication that uziza seeds possess the alkaloid compounds more than other spices used.

The value of steroids ranged from 5.90 to 9.80mg/g. Sample B (45%Sorghum +30% Maize+15%Millet+5%Ginger) had the highest value of 9.80mg/g while sample E (45%Sorghum+30%Maize+15%Millet+5%Clove) had the least value. This indicates that ginger contained high steroids value than other spices which is in agreement with Eke- Ejiofor and Beleya, (2007) for "ogi" spiced with ginger and cloves. Steroids are drugs that are structurally related to the cyclic steroid ring system and have similar effects to testosterone in the body. They increase protein within cells, especially in skeletal muscles. Anabolic steroids also have androgenic and virilizing properties, including the development and maintenance of masculine characteristics such as the growth of the vocal cords, testicles (primary sexual characteristics) and body hair (secondary sexual characteristics) (Raju *et al.*,2004).

Saponins are used in the manufacture of insecticides, various drugs preparation and in the synthesis of steroidal hormones (Dubrousky, 2005).However, excessive consumption of Saponins could be dangerous as they cause heamolysis of blood (Kar, 2007).The value ranged from 24.50 to 64.54 mg/g. Sample C (40%Sorghum +30%Maize+10%Millet +5%Clove + 5% Ginger) had the highest value of 64.54mg/g and sample with clove had the least value of 20.72mg/g. This indicates that "ogi" fortified with clove would have some health benefits to human when consumed. The value of terpenoids ranged from 10.68 to 18.70mg/g. Sample with inclusion of ginger had the highest value of 18.70mg/g while sample with clove showed the least value of 10.68mg/g. This indicates that ginger had high terpenoid value than other spices and it is in agreement with what reported by Eke-Ejiofor and Beleya, (2003) for production of "ogi" fortified with ginger and clove. Terpenoids was reported to be active against Staphylococcus aureus (Cowan, 2009). These compounds also have anticarcinogenic properties (Yun *et al.,* 2006).

Glycosides have a vast therapeutic efficacy as they are found in almost every medicinal plant (Yadav *et al*., 2014).The value ranged from 0.90 to 1.50mg/g. Control sample showed the highest value while sample with inclusion of clove, ginger and uziza seeds had the least value of 0.90mg/g. This showed that "ogi" from maize, millet and sorghum blends are good source of glycosides.

Table 2: Phytochemical Composition of "Ogi" Powder Produced from Maize, Millet, Sorghum and spices blends (mg/g).

Samples	Saponin	Tannin	Terpenoid	Glycoside	Steroid	Alkaloid
A	24.50±0.20^{e}	2.87±0.02^{d}	13.60±0.08^{d}	1.50±0.10^{a}	7.30±0.72^{c}	1.30±0.05^{c}
B	49.10±0.53^{c}	3.20±0.02^{bc}	18.70±0.02^{a}	1.40±0.09^{b}	9.80±0.26^{a}	1.20±0.05^{c}
C	64.54±0.45^{a}	3.06±0.03^{c}	14.50±0.03^{c}	1.20±0.05^{c}	6.12±0.55^{e}	1.13±0.00^{d}
D	52.40±0.50^{b}	3.30±0.04^{b}	16.12±0.08^{b}	0.90±0.10^{e}	8.55±0.40^{b}	2.80±0.01^{a}
E	20.72±0.90^{e}	2.05±0.01^{e}	10.68±0.06^{f}	1.10±0.07^{d}	5.90±0.50^{f}	1.11±0.10^{d}
F	28.36±0.54^{d}	4.33±0.02^{a}	12.28±0.06^{e}	0.99±0.10^{e}	6.65±0.36^{d}	1.60±0.10^{b}

Means in the same column followed by different superscripts are significantly different (P<0.05).
Keys
Sample A: 50%Sorghum+30%Maize+20%Millet
Sample B: 45%Sorghum+30%Maize+20%Millet+5%Ginger
Sample C: 40%Sorghum+30%Maize+20%Millet+ 5%Clove+5%Ginger
Sample D: 35%Sorghum+30%Maize+20%Millet+Uziza seed+ 5%Ginger+ 5%Clove
Sample E: 45%Sorghum+30%Maize+20%Millet+5%Clove
Sample F: 45%Sorghum+30%Maize+20%Millet+5%Uziza seed

Conclusion

"Ogi" fortified with ginger, clove and uziza seeds (iyere) showed some health benefit as a result of moderate value of phytochemical compounds found in them. The proximate composition of the study revealed that it contained appreciable amount of carbohydrate, protein, ash, fat and crude fibre. The study also demonstrates the potential of fortifying "ogi" with ginger, clove and uziza seeds, either singly or as a blend to enhance the nutritional quality of "ogi".

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