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Effect of Ginger and Cinnamon on the Proximate Composition and Sensory Properties of Corn Ogi

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Authors' contributions

This work was carried out in collaboration among all authors. Author NJTE designed the study and supervised the laboratory analyses. Author AEU managed the literature searches, performed statistical analysis and wrote the manuscript. All authors read and approved the final manuscript.

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ABSTRACT

Objective: Ogi is a fermented cereal gruel produced from maize, sorghum or millet. The objective of the study was to investigate the effect of ginger and cinnamon on the proximate composition and sensory properties of corn ogi.
Methodology: Ogi slurry was prepared from corn and fortified with 5% ginger, 5% cinnamon, 5% ginger: 5% cinnamon and 2.5% ginger: 2.5% cinnamon spices and 100% corn ogi as control. The samples were analyzed for proximate composition and sensory properties using standard methods.
Results: The results obtained from this study indicated that there was an increase in the moisture, ash, protein and fat contents of corn ogi spiced with ginger and cinnamon and a decrease in carbohydrate content. These increases were observed to be significant ($p<0.05$) with corn ogi samples spiced with ginger than for cinnamon except for crude fiber which was higher in ogi spiced with cinnamon. Moisture content of the ogi samples ranged from 8.53-9.79%, crude protein 5.13-6.37%, ash 0.19-0.30%, crude fiber 0.29-0.81%, carbohydrate 78.93-81.64% and energy contents 387.77-391.98 kcal. The inclusion of cinnamon and ginger had no significant ($p<0.05$) effect on the sensory properties of the unsweetened spiced ogi samples. Mean scores obtained for unsweetened ogi samples were low. Upon sweetening with sugar, these scores were increased for all sensory attributes. Sensory evaluation of sweetened ogi samples showed that the control

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sample was more preferred for all sensory attributes and this was followed closely by sample ogi spiced with 5% ginger.
Conclusion: This study recommends the use of ginger at 5% for the fortification of corn ogi which will result in ogi with sensory properties similar to 100% corn ogi. It also showed the potential of fortifying corn ogi with ginger and cinnamon, either singly or as a blend, to enhance the nutritional quality of corn ogi.

Keywords: Ogi; ginger; cinnamon; proximate; sensory.

1. INTRODUCTION

Ogi is an important staple fermented cereal gruel or liquid porridge produced from either maize, sorghum and millet grains [1]. Traditionally, its preparation involves soaking any of millet, sorghum or maize for 2-3 days followed by wet milling and sieving through a screen mesh to remove the bran, germs and hulls. The maize residue is then allowed to sediment and the supernatant decanted to obtain 'ogi' which is usually called '*pap*', '*akamu*' and '*koko*' by people of West Africa. The ogi which is produced can be processed into a slurry paste by heating in boiling water under constant stirring. The slurry may further be processed into varieties of products for infants, children and adult's meal [2]. It can also be used as infants supplement, breakfast meals and as food of choice for the sick [3].

During the processing of ogi, nutrients such as proteins and minerals are lost which reduces the nutritional quality of the final product [4]. The fortification of ogi with lost nutrients during its preparation is necessary. In an attempt to improve on the nutrient content of ogi, several studies have been carried out on the fortification of ogi with fresh crayfish [5], pigeon pea [6], okra seed meal [7] and groundnut seed [8]. Results obtained showed an improvement in the protein content of the ogi.

Ogi has a monotonous taste and flavour wherever and whenever it is consumed. Recently, due to increasing interest in finding functional foods, several studies have been reported on the use of spice blended with ogi based products as spices have been proven to be a good alternative to synthetic antimicrobial and antioxidants [9]. Osungbore [10] carried out a review on the fortification of ogi using several seeds to improve the nutrient content and sensory properties of ogi, but the effect ended up not been accepted because of unpleasant rheological and organoleptic properties. Adesokan et al. [11] reported that a high concentration of ginger (10%) adversely affected the acceptability of cooked ogi. Olaniran and Abiole [12] conducted a study on the nutritional evaluation of enhanced unsieved ogi paste with garlic and ginger and reported that garlic and ginger either alone or in combination have potential to enhance the nutritional value of ogi pastes.

Spices are widely used as seasoning or condiment and for medicinal purposes [13]. Ginger spice (*Zingiba officinale)* is an important medicinal plant which is indigenous to several countries and is consumed worldwide as a spice and flavouring agent from the ancient time [14]. It contains antibacterial compounds such as gingerol, shogaols, Vitamins A and B, Paradol and Zingerine [15]. It reduced oxidative rancidity during storage of ogi and the prevention of some food born disease [16]. The fortification of foods with ginger at 4% level showed to successfully improve the sensory attributes more than the unfortified sample [17]. Oluwafemi et al. [18] also reported that the use of ginger to fortify ogi would decrease the chances of food poisoning, reduce the risks of food contamination, protect consumers from aflatoxin contamination and improve health status.

Cinnamon (*Cinnamamum zeylanicum and Cinnamon cassia)*, is a versatile ingredient which have been used as flavor modifiers to make food more palatable. Its ingredients also impart characteristic flavor and spicy aroma to food [19]. The bark of various cinnamon species is one of the most important and popular spices used worldwide not only for cooking but also in traditional and modern medicines [20]. Despite the advantages of cinnamon in enhancing the sensory properties of foods, there is no information on its use to fortify ogi. This study aims at adding variety to the taste and flavour of already existing ogi using plant spices such as ginger and cinnamon that have some medicinal value apart from flavour. The addition of ginger and cinnamon to ogi may give a different brand of ogi with peculiar sensory characteristics that may be acceptable to consumers. This study therefore evaluated the effects of different

concentrations of ginger and cinnamon spices on the physicochemical and sensory properties of corn ogi.

2. MATERIALS AND METHODS

2.1 Materials

Corn (*Zea mays*) used for this study was purchased from Mile 3 Market, Port Harcourt. Ginger (*Zingiber officinale*) powder, Cinnamon (*Cinnamon Cassia*) powder and refined sugar were purchased from Spar supermarket, Port Harcourt. Chemicals and reagents used were of analytical grade and obtained from the Department of Food Science and Technology, Rivers State University.

2.2 Production of Ogi Spiced with Ginger and Cinnamon Powders

The method described by Adesokan et al. [11] was adopted for the production of ogi. The maize was washed and steeped in clean water in a plastic bucket with a cover. After three days, the water was decanted, and the maize wet-milled into the slurry. Using a muslin cloth, the slurry was sieved to give ogi as shown in Fig. 1. The sieved ogi was divided into 5 portions. The first portion was the control (without ginger/cinnamon). The second portion was spiced with 5% powdered ginger, and the third was supplemented with 5% cinnamon. Similarly, the fourth portion was spiced with 5% ginger and 5% cinnamon while the fifth portion was spiced with 2.5% ginger and 2.5% cinnamon powders.

2.3 Proximate Analysis of Ogi Samples

The percentage contents of moisture, ash, crude protein, fat, and crude fiber contents of the spiced ogi samples were determined using the AOAC [21] method while carbohydrate content was determined by difference. The energy content (E) was calculated using Atwater factor method as described by Adegunwa et al. [22].

E = (9 x Protein) + (4 x Fat) + (4 x Carbohydrate)

2.4 Sensory Evaluation

Three hundred milliliters (300 ml) of boiling water was slowly added to the slurry of the ogi samples (200 g each) under constant stirring using a clean stirrer until a thick paste was formed. Sensory evaluation of the prepared ogi samples (both sweetened and unsweetened) was done by 20-man panelists that are familiar with the product. The evaluated parameters were appearance, aroma, sourness, taste and overall acceptability. The ratings were presented on a 9-point hedonic scale ranging from 9= like extremely to 1=dislike extremely [23].

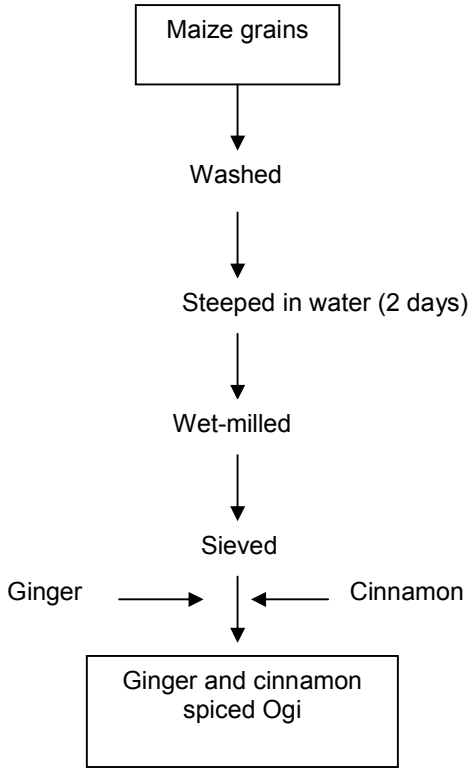

Fig. 1. Flow chart for the production of ginger and cinnamon spice ogi
Source: [11]

Table 1. Blend formulation for the production of ginger and cinnamon spiced ogi

Sample	Maize ogi (%)	Ginger (%)	Cinnamon (%)
A	100	-	-
B	95	5	-
C	95	-	5
D	90	5	5
E	95	2.5	2.5

2.5 Statistical Analysis

The data obtained were subjected to Analysis of Variance (ANOVA) and significant differences in mean values were calculated by Duncan Multiple Range Test (DMRT) at 5% level of probability using the Statistical Product for Service Solution (SPSS) version 23.0.

3. RESULTS AND DISCUSSION

3.1 Proximate Composition of the Ginger and Cinnamon Spiced Ogi

The result for the proximate composition of the ginger and cinnamon spiced ogi is shown in Table 2. Moisture content ranged from 8.40-9.79% with sample E (95% ogi, 2.5% ginger, 2.5% cinnamon) having the lowest and sample B (95% ogi, 5% Ginger) the lowest. Moisture content of ogi spiced with 5% ginger was significantly ($p<0.05$) higher than other samples. Moisture content of the ogi samples from this study is comparable with those reported for ginger, uda and clove spiced ogi (6.54-11.20%) as reported by Eke-Ejiofor and Beleya [13]. Kiin-Kabari et al. [1] reported 8.68-10.47% for ogi produced from whole grain corn and corn starch which is within the range from this study. The low moisture content of the spiced ogi samples is an indication of better shelf life and storability of the product.

The protein content of the ogi samples ranged from 5.13% in control sample to 6.37% in ogi spiced with 5% ginger. The protein content of the ogi samples increased significantly ($p<0.05$) following the inclusion of ginger and cinnamon. Ogi spiced with combined ginger and cinnamon spices at 5% and 2.5% were significantly ($p<0.05$) similar. The result showed that when ogi was spiced singly with cinnamon at 5% level, an increase in the protein content was observed but this value was not significantly ($p>0.05$) different from the control sample. However, when cinnamon was used in combination with ginger, the protein content of the ogi was significantly ($p<0.05$) improved. This is attributed to the low protein content in cinnamon (3.5%) as compared to 8.6% for ginger [24,25]. An increase in protein content (5.13-8.01%) was also reported by Eke-Ejiofor and Beleya [13] following fortification with spices such as clove, uda and ginger to ogi.

Fat content of the ogi samples increased (3.76-4.35%) significantly ($p<0.05$) on inclusion with ginger and cinnamon. This increase was found to be high in samples spiced with ginger but was not significantly ($p>0.05$) different from ogi samples fortified with a combination of ginger and cinnamon. The increase in fat content may be as a result of the spices added as they are good sources of essential oils. This trend was also reported by Eke-Ejiofor and Beleya [13] for ogi spiced with uda, ginger and clove. Fat content obtained from this study is higher than that for corn starch ogi (1.00-1.70%) as reported by Kiin-Kabari et al. [1].

There was a notable increase (0.19-0.30%) in the ash content of the ogi samples following the inclusion of ginger and cinnamon. Ogi samples spiced with combined spices at 5% had the highest while control sample was lowest. Samples spiced with 5% cinnamon and 2.5% cinnamon/ginger spices were not significantly ($p>0.05$) different from the control sample. The result showed that the ash content of the corn ogi was significantly improved with ginger more than samples spiced with cinnamon. This could be due to high ash content of ginger (6.30%) than for cinnamon (2.4%) reported by Otunola et al. [26] and Gul and Safdar [24], respectively. Ash content in a food sample is an indication of its mineral elements. This would mean that ogi spiced with ginger will contain more minerals than samples spiced with cinnamon. A similar trend was also observed by Eke-Ejiofor and Beleya (2016) who reported that ogi spiced with ginger and clove were high in ash (0.39 and 0.49%, respectively) and those spiced with uda (0.19%) was low.

Crude fiber content of the spiced ogi ranged from 0.29% in ogi spiced with ginger to 0.81% in ogi spiced with cinnamon. Ogi samples spiced with cinnamon had significantly ($p<0.05$) high a crude fiber content than other samples. This could be due to the high fiber content of cinnamon (33%) as compared to ginger (11%) as reported by Agu et al. [27] and Gul and Safdar [24]. Inclusion of corn ogi with 5% ginger resulted to a decrease in the fiber content, indicating that the addition of cinnamon had significant influence than cinnamon in terms of fiber increase. This trend was also reported by Eke-Ejiofor and Beleya [13] who reported decrease in fiber content of ogi samples spiced with ginger, clove and uda (0.59-0.19%).

Table 2. Proximate composition of ginger and cinnamon spiced ogi

Samples	Moisture (%)	Crude protein (%)	Fat (%)	Ash (%)	Crude fiber (%)	CHO (%)	Energy (kcal)
A	8.69±0.07^{b}	5.13±0.01^{b}	3.76±0.05^{c}	0.19±0.05^{b}	0.59±0.40^{c}	81.64±0.12^{a}	387.77±0.03^{b}
B	9.79±0.28^{a}	6.37±0.41^{a}	4.35±0.27^{a}	0.27±0.04^{a}	0.29±0.15^{d}	78.93±0.23^{c}	390.45±0.34^{a}
C	8.40±0.10^{b}	5.56±0.03^{b}	4.05±0.27^{b}	0.22±0.07^{b}	0.81±0.16^{a}	80.96±0.13^{ab}	390.08±0.15^{a}
D	8.80±0.03^{b}	6.02±0.03^{a}	4.28±0.14^{a}	0.30±0.07^{a}	0.65±0.69^{bc}	79.95±0.19^{bc}	391.10±0.09^{a}
E	8.53±0.08^{b}	6.02±0.03^{a}	4.15±0.03^{ab}	0.23±0.33^{b}	0.77±0.08^{ab}	80.30±0.11^{ab}	391.98±0.03^{a}

Values are expressed as mean ± standard deviation of duplicate determination. Means with the same letters along the same column are not significantly different (p>0.05). A = 100% Ogi, B = 95% Ogi, 5% Ginger, C = 95% Ogi, 5% Cinnamon, D = 90% Ogi, 5% Ginger, 5% Cinnamon, E = 95% Ogi, 2.5% Ginger, 2.5% Cinnamon

Carbohydrate content ranged from 78.93-81.64% with the control sample having the highest and ogi spiced with 5% ginger contained the lowest. Inclusion of corn ogi with ginger and cinnamon spices resulted in a slight reduction in the carbohydrate content of the ogi samples. However, these reductions were higher for ogi spiced with 5% ginger and combined ginger/cinnamon spices at 5%. Similar decrease in carbohydrate content was also reported by Eke-Ejiofor and Beleya [13] for ogi spiced with ginger and cloves.

Energy values ranged from 387.77-391.98 kcal with control sample as lowest and ogi spiced with combined ginger and cinnamon at 5% as highest. Energy values of the spiced ogi samples were not significantly ($p>0.05$) different from each other but was different from control sample. The protein, fat and carbohydrate contents of the ogi contributed to the energy value of the samples. Energy values from this study are comparable with those reported by Eke-Ejiofor and Beleya [13] for ogi spiced with ginger, clove and uda (374.16-390.05 kcal).

3.2 Sensory Properties of Unsweetened and Sweetened Spiced Ogi

Table 3 and 4 shows the mean sensory scores of unsweetened and sweetened spiced ogi, respectively. The inclusion of corn ogi with ginger and cinnamon had no significant ($p>0.05$) effect on all the sensory attributes of the plain spiced ogi samples, indicating that the samples were all liked by the panelists. However, the mean sensory scores obtained were low. These scores were improved when the ogi samples were sweetened with sugar. On sweetening with sugar, the control sample was highly preferred than all other samples for appearance, aroma, sourness, taste and overall acceptability. This could be due to the source of the sample which is 100% corn which the panelists were used to.

The appearance of the sweetened ogi samples ranged from 6.25-7.60. The ogi sample spiced with ginger, cinnamon, combined at 2.5 percent level of each, was the least preferred, and control sample was found to be the most preferred one. Samples spiced with 5% ginger, 5% cinnamon and sample spiced with ginger, cinnamon combined at 5% level each were significantly ($p<0.05$) similar.

The aroma of the sweetened ogi samples ranged from 5.85-7.90 with sample spiced with 5% cinnamon as least preferred. The control ogi sample and sample spiced with 5% ginger were significantly ($p<0.05$) similar. The sourness of the sweetened ogi samples ranged from 5.55 in sample spiced with 5% cinnamon to 7.50 in control sample. The control sample and sample spiced with 5% ginger were also significantly ($p<0.05$) similar in sourness.

Table 3. Mean sensory scores of ginger and cinnamon fortified ogi (Unsweetened)

Samples	Appearance	Aroma	Sourness	Taste	Overall acceptability
A	6.80^{a}	5.70^{a}	5.05^{a}	5.70^{a}	6.15^{a}
B	6.65^{a}	5.30^{a}	4.85^{a}	5.30^{a}	5.85^{a}
C	5.85^{a}	5.00^{a}	5.25^{a}	5.60^{a}	5.55^{a}
D	5.79^{a}	5.37^{a}	5.21^{a}	6.05^{a}	5.74^{a}
E	5.81^{a}	4.81^{a}	5.76^{a}	6.05^{a}	5.71^{a}

Means with the same letters along the same column are not significantly different ($p>0.05$).
A = 100% Ogi, B = 95% Ogi, 5% Ginger, C = 95% Ogi, 5% Cinnamon, D = 90% Ogi, 5% Ginger, 5% Cinnamon, E = 95% Ogi, 2.5% Ginger, 2.5% Cinnamon

Table 4. Mean sensory score of ginger and cinnamon fortified ogi (Sweetened)

Samples	Appearance	Aroma	Sourness	Taste	Overall acceptability
A1	7.60^{a}	7.90^{a}	7.50^{a}	7.60^{a}	7.75^{a}
B1	7.30^{ab}	7.05^{a}	6.60^{a}	7.10^{a}	7.20^{ab}
C1	6.35^{ab}	5.85^{b}	5.55^{b}	6.40^{a}	6.15^{c}
D1	6.68^{ab}	6.84^{ab}	5.79^{b}	6.58^{a}	6.63^{bc}
E1	6.25^{b}	6.71^{ab}	6.24^{ab}	6.48^{a}	6.62^{bc}

Means with the same letters along the same column are not significantly different ($p>0.05$).
A1 = (100% Ogi) + Sugar, B1 = (95% Ogi + 5% Ginger) + Sugar, C1 = (95% Ogi + 5% Cinnamon) + Sugar, D1 = (90% Ogi + 5% Ginger + 5% Cinnamon) + Sugar, E1 (95% Ogi + 2.5% Ginger + 2.5% Cinnamon) + Sugar

The taste of the sweetened ogi samples were all significantly ($p<0.05$) similar, indicating that they were all liked by the panelists. This could be due to the sweetener (sugar) added which helped to improve the taste of the spiced samples. The overall acceptability of the sweetened ogi samples ranged from 6.15-7.75 with ogi sample spiced with 5% cinnamon as least preferred and the control sample as most preferred. Control sample was significantly ($p>0.05$) different from all samples. However sample spice with 5% ginger had mean overall acceptability (7.20) close to that of control sample (7.75). Higher concentration of ginger and fortification with cinnamon significantly ($p<0.05$) affected the acceptability of the corn ogi samples. This is line with the findings of Adesokan et al. [11] who reported that high concentration of ginger (10%) adversely affected acceptability of cooked ogi. This study therefore shows that inclusion of corn ogi with 5% ginger led to a relatively improved sensory attributes comparable with the control sample. This study is also in agreement with the findings of Eke-Ejiofor and Beleya [13] who also reported that ogi spiced with ginger were preferable than other samples spiced with clove and uda.

4. CONCLUSION

The results obtained from this study indicated that there was an increase in the moisture, ash, protein and fat contents of corn ogi spiced with ginger and cinnamon and a decrease in carbohydrate content. These increases were observed to be notable with ogi samples spiced with ginger than for cinnamon except for crude fiber which was higher in ogi spiced with cinnamon. The fortification of corn ogi with ginger and cinnamon had no significant effect on the sensory properties of the unsweetened spiced ogi samples. However, upon sweetening with sugar, ogi sample spiced with 5% ginger and control sample were significantly similar for aroma and sourness. The sweetened control sample was more preferred for all sensory scores and this was followed closely by sample spiced with 5% ginger. This study therefore recommends the use of ginger at 5% for the fortification of corn ogi which will result in ogi with sensory properties similar to 100% corn ogi. The study also demonstrates the potential of fortifying ogi with ginger and cinnamon, either singly or as a blend, to enhance the nutritional quality of corn ogi.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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