

Chemical, Mineral, Pasting and Sensory Properties of Spiced Ogi (Gruel)

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Abstract Maize is the most abundant and available component of the locally prepared gruels for human consumption in Nigeria. It has been the basic source of meal for infants and breakfast for the average family. The compositional, mineral and sensory attributes of cereal gruel (Ogi) prepared with different spices, ginger (*Zingiber officinale*), uda (*Xylopiya aethiopicum*) and Clove (*Syzygium aromaticum*) were evaluated to determine chemical, pasting and sensory properties. Chemical composition of spiced ogi samples showed significant differences ($p < 0.05$) in all the twelve parameters evaluated. Ash content increased with the addition of spices (clove, ginger+ uda, ginger + clove). Fat content also increased with the addition of ginger as in sample B, while protein content increased for all samples with the addition of spices in singles and when combined. Carbohydrate content decreased with the addition of ginger in sample (B), Uda in sample (C) and a combination of ginger + clove in sample (F), while the other samples showed no significant difference with the control. Energy (Kcal) increased most with sample (H) which had a combination of the three spices, which is a reflection of its protein (8.01%) and carbohydrate (81.51%) respectively. Mineral content showed that magnesium ranged from 0.030 to 0.334mg/100g with the control as the lowest and sample E (Maize + Ginger + Uda) as the highest. Potassium showed no significant difference in all the samples with the addition of spice, while phosphorus had 0.071mg/100g for sample H (Maize + Ginger + Uda + Clove) as the highest. Sodium content ranged from 7.77 to 11.41mg/100g, with all the ginger containing samples having less sodium content. Pasting properties of spiced ogi (gruel) samples showed that peak, breakdown, final and setback viscosities increased with the addition of the different spices, while the pasting time and temperature reduced for all spiced ogi samples, with the control having a longer pasting time at a higher temperature. Sensory analysis result of both unsweetened and sweetened spiced ogi samples showed a significant difference ($p < 0.05$) in all the samples with the ginger spice (sample B) been the most preferred.

Keywords: ogi, spices, chemical, composition, pasting, mineral sensory, properties

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1. Introduction

Starches are the main sources of nutritive energy; the principal constituent of edible carbohydrate is starch together with some sugars, the proportion depending on the crop. The physical properties of starch grains influence the digestibility and processing qualities. Starch is the major storage carbohydrate of cereals and an important part of nutrition. In many cereal manufacturing processes, flour and also starch is usually dispersed in water and finally heated. Heating induces a series of structural changes. This process has been termed gelatinization [1]. Depending on water content, water distribution, and intensity of heat treatment the molecular order of the starch granules can be completely transformed from the semi crystalline to an amorphous state.

Ogi is a popular breakfast cereal gruel product in West Africa with high acceptability, low cost and shelf life stability characteristics. It is widely consumed by Infants,

children and adults in Nigeria [2], and described as the food for the poor due to its cost and availability. It is usually consumed by children as a weaning food and adults as breakfast with achara balls (a fried product made from beans), bread, porridge beans or fried plantain.

Ogi a fermented cereal based gruel could be made from maize (*Zea mays*), millet (*Pennisetum glaucum*) and sorghum (*Sorghum bicolor*). Its fermentation involves lactic acid bacteria converting the carbohydrates in the cereals during ogi production to organic acids which contribute to softness in the product and the characteristic flavor and sour taste [3].

Traditionally, ogi is prepared by steeping cereal (maize, sorghum, millet) in cold water for three days (72hours) and thereafter wet milled and wet sieved through muslin cloth. The filtrate is then allowed to sediment, supernatant discarded and the resultant sediment described as 'Ogi'. During steeping and sieving of the maize paste, a lot of nutrients including protein, vitamins, minerals are lost [4,5]. In addition, ogi is usually stored in the wet form and requires water to be changed periodically to avoid further

fermentation which impact more sourness. This practice proved to be inconveniencing and so necessitates an improved and more convenient form of storing the product in order to provide adequate shelf life, easy and quick to prepare and a microbiologically safe product. This therefore calls for drying which is one of the most important preservation method used in the food industry [6].

Conventionally, ogi (pap) is processed, prepared and consumed without addition of spices. In the recent time, local consumption pattern has moved towards the inclusion of different single or combined spices by the local processors with the view to improving the nutritional value and taste of the products. Spices are culinary herbs which have aromatic or pungent flavor. They are dried seeds, fruit, root or vegetable substances used in preparation of soups to enhance the flavor of such food [7]. Spices do not only excite taste, they are composed of high quality phytonutrients, essential oils, antioxidants, minerals and vitamins that are essential for overall health sustenance [8].

Ginger (*Zingiber officinale*) is a spice native of Asia. It is valued for its wide array of medicinal uses. Ginger contains health benefiting oil such as gingerols and zingerone. Ginger is high in antioxidants which help in preventing cell damage caused by free radicals.

Uda (*xylopia aethiopica*) is typically used as a spice and in traditional medicine. In Eastern Nigeria uda is an essential ingredient in preparation of local soups to aid nursing mothers in breastfeeding. It remains an important item of local trade throughout Africa as a spice and flavouring of food [9].

Clove (*Syzygium romaticum*) is aromatic dried flower bud of a tree in the family myrtaceae. It is a spice native of India. Clove has antioxidant, antiseptic, anti-inflammatory and anti-flatulent properties. It contains health benefit essential oil such as eugenol. It increases gastro intestinal secretion thus improving digestion of food and relieving constipation.

There is little or no information on the effect of spices on the quality of ogi. Therefore the objective of the study is to evaluate the effect of different local spices on the compositional, mineral and sensory properties of Ogi a local gruel.

2. Materials and Methods

2.1. Sources of Materials

Maize (*Zea mays*) yellow variety, ginger, galic and Ehuru were purchased from mile 3 market in Port Harcourt, Rivers State, Nigeria.

2.2. Chemicals

Chemicals used for this analysis were of analytical grade and were all obtained from the Biochemistry laboratory, Department of Food and Technology, Rivers State University of Science and Technology.

2.3. Processing of Spiced 'Ogi'

Maize (*Zea mays*) was sorted; two kilogram of the clean maize was soaked in 225ml of water. The maize was

steeped for 72hours at room temperature ($30 \pm 2^\circ\text{C}$). Soaking water was decanted and the grains washed in preparation for milling. Different quantities of the various spices ginger (40g), uda (4g) and clove (3g) were added singly and in combination and subsequently wet milled using a mechanical blender into paste. Addition of spices was based on monetary values in relation to the weight of the grain. The paste was sieved using a muslin cloth and allowed to sediment and supernatant decanted. The sediments of the paste were oven dried at 50°C and stored for further analysis.

2.4. Chemical Analysis of Ogi Samples

The chemical analysis of ogi samples was determined using the AOAC [10] methods for moisture, ash, protein, fat and fibre. Total carbohydrate was calculated by difference of moisture, ash, protein, fat and fiber.

2.5. Mineral Analysis of Ogi (gruel) Samples. [11]

Total mineral determination was done using the Atomic Absorption Spectrophotometer (AAS), for the determination of micro and macro elements in food and feed. The dry ashing method was used. 1g of a well-blended sample was pre ashed at 300°C and further ashed at 600°C for 2hrs in a muffle furnace and allowed to cooled. 25ml of 3M HCl was added and filtered into a 100ml volumetric flask and diluted to volume with deionized water. Sample was vortexed and centrifuged at 3000rpm for 10mins. Supernatant was decanted into clean vials for micro and macro element determination using AAS at each elements set wavelength for detection.

2.6. Preparation of Ogi (gruel) for Sensory Analysis

2.6.1. Sensory Evaluation

The Eight ogi samples were prepared into gruel and were presented to twenty semi trained panelists (adults), who are familiar with ogi (gruel) as breakfast cereal food and were neither sick nor allergic to the consumption of maize or any of the spices under review at the time of the evaluation. The analysis was done in two stages, with and without the addition of milk and sugar. For the sweetened samples, 100g sugar and 200g milk powder were dissolved in 600ml water, to form the milk/sugar solution. Subsequently, 30ml each was dispensed into 100ml portion of gruel for evaluation. The panelists were presented with water and instructed to rinse their mouth after each tasting. The samples were scored for color/appearance, flavor, texture, taste and overall acceptability using 9 point hedonic scale where 9 = like extremely, 5 = like moderately and 1 = dislike extremely [12].

2.7. Statistical Analysis

Data obtained were statistically analyzed by using analysis of variance (SPSS version 2.0) technique. Level of significance within means was separated using the Duncan Multiple Range Test [13].

3. Results

3.1. Chemical Analysis Result of Spiced Ogi Samples

Table 1 shows results of the chemical composition of ogi samples. Moisture content ranged from 6.54 to 11.20%, with sample B (Maize + ginger) having the highest moisture. Farinde [14] reported a moisture content of 8.25% for sieved plain ogi sample. Low moisture content is an indication of a better shelf life and storability of product. There was significant difference ($p \geq 0.05$) in the moisture content of spiced ogi samples.

Ash content of samples ranged from 0.19 to 0.49% with sample D (Maize + clove) as the highest. Ash content increased with the addition of single spices, but significantly decreased with the combination of the three spices. The report of the present study is lower than that reported by Farinde [14] for sieved plain ogi (0.83%). The process of starch extraction may have a significant effect on the ash content of a starch based product.

Crude fat content ranged from 3.13 to 4.48% with sample B recording the highest value. The study showed that the ginger containing samples had higher fat content. All the ogi samples were significantly different at $p \geq 0.05$ in their fat (ether extract) content. The increase may be as a result of the spices added which are good sources of oil.

Protein content of the ogi samples ranged from 5.13 to 8.01% with sample A (control) as the least and sample H (Maize + Ginger + uda + clove) as the highest. Protein content showed a significant increase with the addition of spices, showing an improvement in the nutritional quality of the spiced ogi samples. The quality of the protein will depend on the severity of heat-treatment during the processing [15].

Crude fibre content of the ogi samples ranged from 0.19% -0.59%, with the control sample A having the highest fibre content. There was significant difference ($p \geq 0.05$) in the fibre content of all the ogi samples.

Total available carbohydrate content of the ogi samples

ranged from 77.01% to 82.27% with sample G (Maize + Uda + clove.) as the highest. The carbohydrate result in this study is higher than that reported by Farinde [14] of 72.35% for sieved plain ogi. All the chemical parameters determined showed significant $p \geq 0.05$ difference in the samples.

Sugar content ranged from 0.22% in sample H (Maize + ginger+ Uda + Clove) to 0.42% in sample F (Maize + ginger +clove), while starch content ranged from 39.04 to 45.59% with sample F as the highest in both cases. The physical properties of starch grains influence the digestibility and processing qualities of crops. The starch granules of some grains are very small which makes them more suitable as diets for all.

Amylose content ranged from 32.83 to 37.82%, for E (Maize + Ginger + Uda) and G (Maize + Uda + clove) as lowest and highest respectively, while amylopectin ranged from 62.16 – 67.1% for samples G (Maize + Uda + clove) and E (Maize + Ginger + Uda) respectively, showing a reverse trend. The higher the amylase content, the less expansion potential and the lower the gel strength for the same starch concentration Amylose is a tightly packed structure that is more resistant to digestion than other starch molecules and therefore an important form of resistant starch, which has been found to be an effective probiotic [16].

Color analysis showed a range of 78.14 to 84.78% with samples D (Maize + clove) having the least value and sample A (control) as the highest. Color reduced with the addition of spices especially with the inclusion of clove. This is expected because of the dark color of the clove seed.

Energy values ranged from 374.16 to 385.67kcal/g for samples C (Maize + uda) and H (Maize + Ginger + uda + clove) as lowest and highest respectively.

Results of mineral content of ogi samples are presented in Table 2. Mineral content of all the samples showed a significant different ($p < 0.05$) except potassium. Spiced ogi samples ranged from 0.030 – 0.039mg for magnesium (Mg) with sample C (maize + Uda) recording the highest.

Table 1. CHEMICAL PROPERTIES (%) OF OGI SAMPLES

Samples	MC (%)	Ash (%)	Fat (%)	Protein (%)	Fibre (%)	CHO (%)	Sugar (%)	Starch (%)	Amylose (%)	Amylopectin (%)	Colour (%)	Energy (kcal)
A	8.69 ^b	0.19 ^b	3.76 ^{ab}	5.13 ^d	0.59 ^a	81.59 ^a	0.23 ^{cd}	40.84 ^b	37.61 ^a	62.38 ^f	84.78 ^a	380.78 ^{abc}
B	11.20 ^a	0.39 ^{ab}	4.48 ^a	6.16 ^c	0.39 ^b	77.01 ^b	0.26 ^{bcd}	40.51 ^b	36.57 ^b	63.43 ^e	84.76 ^a	378.28 ^{bc}
C	10.23 ^{ab}	0.19 ^b	3.32 ^b	7.07 ^b	0.19 ^c	78.99 ^b	0.27 ^{bcd}	38.90 ^c	34.64 ^d	65.36 ^c	82.41 ^b	374.16 ^{bc}
D	7.86 ^{cd}	0.49 ^a	3.26 ^b	6.74 ^{bc}	0.19 ^c	81.45 ^a	0.21 ^d	37.98 ^d	33.89 ^e	66.09 ^b	78.14 ^c	382.14 ^{abc}
E	7.62 ^{cd}	0.39 ^{ab}	3.85 ^{ab}	6.52 ^{bc}	0.39 ^b	81.22 ^a	0.29 ^{cd}	45.59 ^a	32.83 ^f	67.17 ^a	82.32 ^b	385.67 ^{ab}
F	10.68 ^a	0.39 ^{ab}	3.13 ^b	6.69 ^{bc}	0.19 ^c	78.91 ^b	0.42 ^a	39.41 ^c	35.24 ^c	64.76 ^d	78.53 ^c	370.64 ^c
G	7.14 ^c	0.19 ^b	3.35 ^b	6.46 ^{bc}	0.58 ^a	82.27 ^a	0.33 ^b	39.04 ^c	37.82 ^a	62.18 ^f	78.69 ^c	385.13 ^{ab}
H	6.54 ^d	0.19 ^b	3.55 ^{ab}	8.01 ^a	0.19 ^c	81.51 ^a	0.22 ^d	40.59 ^b	35.24 ^c	64.76 ^d	78.51 ^c	390.05 ^a

A = Maize alone (control)

B = Maize + ginger

C = Maize +uda

D = Maize + clove

E = Maize + Ginger + Uda

F = Maize + Ginger + clove

G = Maize + Uda + clove

H = Maize + Ginger + uda + clove

MC= Moisture content

CHO=Carbohydrate

Table 2. MINERAL COMPOSITION OF OGI (GRUEL) mg/100g SAMPLES

Samples	Magnesium	Potassium	Phosphorus	Sodium	Iron
A	0.030 ^b	0.020 ^a	0.052 ^b	11.41 ^a	10.43 ^a
B	0.033 ^b	0.017 ^a	0.053 ^b	9.54 ^b	6.88 ^c
C	0.039 ^b	0.016 ^a	0.056 ^b	11.34 ^a	9.98 ^b
D	0.037 ^b	0.013 ^a	0.055 ^b	8.88 ^c	3.42 ^e
E	0.334 ^a	0.016 ^a	0.054 ^b	7.77 ^d	2.77 ^f
F	0.032 ^b	0.017 ^a	0.052 ^b	8.63 ^c	9.81 ^b
G	0.035 ^b	0.018 ^a	0.053 ^b	11.06 ^a	5.97 ^d
H	0.033 ^b	0.015 ^a	0.071 ^a	10.98 ^a	10.50 ^a

Key:

A = Maize alone (control)

B = Maize + ginger

C = Maize + uda

D = Maize + clove

E = Maize + Ginger + Uda

F = Maize + Ginger + clove

G = Maize + Uda + clove

H = Maize + Ginger + uda + clove

Phosphorus ranged from 0.05 - 0.07mg with sample H (maize + ginger + Uda +clove) having the highest. All the other samples showed no difference in phosphorus. Sodium content ranged from 7.77 – 11.41mg/100g, with sample A (control) as the highest, while Iron content ranged from 2.77 – 10.50mg/100g with sample H (maize + ginger + Uda +clove) as the highest. The low mineral content may be as a result of the processing method for ogi production.

3.2. Pasting Properties Result of Spiced Ogi Samples

Table 3 shows the pasting properties of the various ogi (gruel) samples, such as peak viscosity, trough, breakdown, final viscosity, set back viscosity, pasting time and pasting temperature. Pasting properties are dependent on the rigidity of starch granules, which in turn affects the granule swelling potential [17] and amount of amylose leaching out in the solution [18].

Peak viscosity ranged from 239.28 to 304.79 RVU with sample G (Maize + Uda + clove) and F (Maize + ginger +clove) as lowest and highest respectively, while trough viscosity ranged from 97.05 to 124.79 RVU with sample G (Maize + Uda + clove) as the lowest and sample D (Maize + clove) as highest value. Peak viscosity is indicative of the strength of the pastes which are formed from gelatinization during processing in food application and higher peak viscosity corresponds to a higher thickening power of the starch [19]. Peak viscosity is the maximum viscosity developed during or soon after heating.

Breakdown viscosity (BV) which is the measure of the cooked starch to disintegration, was found to be lowest in sample G (Maize + Uda + clove) with a value of 141.56 RVU and highest in sample F (Maize + ginger +clove) with a value of 188.33 RVU. Breakdown viscosities reflect the stability of the peak viscosity during processing [20].

Final viscosity ranged from 232.65 to 292.25RVU, with sample G (Maize + Uda + clove) having the lowest and sample A (100% maize) the highest value with no significant difference from F (Maize + ginger +clove). A final viscosity (FV) indicates the ability of the starch to form a viscous paste for the different starches and is important in determining processing potential. Miles *et al* [21] reported that increase in final viscosity might be due to the aggregation of the amylose molecules.

Setback viscosity (SV) is a measure of syneresis of starch upon cooling of the cooked starch paste. The present study showed that setback viscosity ranged from 132.71 to 175.95RVU, with sample G (Maize + Uda + clove) and A (100% maize) as the highest. In support of the above definition of setback, Niba *et al.* [22] stated that setback viscosity indicates gel stability and potential for retrogradation. This further determines the ability to form gel during processing [23].

Pasting time ranged from 4.56 to 4.76 min, while pasting temperature ranged from 79.10°C to 81.15°C with ogi sample E (Maize + Ginger + Uda) recording the lowest and sample A (control) the highest in both cases. Seelharaman *et al* [24] reported pasting temperature of 74.9 to 84.7°C for corn landraces.

The pasting temperature (PT) is the temperature at which the viscosity starts to rise [19,25]. The higher pasting temperature of sample A (Control) indicates higher resistance towards swelling, which in turn has affected the pasting time to 4.76mins. The attainment of the pasting temperature is essential in ensuring swelling, gelatinization and subsequent gel formation during processing.

The results of pasting properties showed that peak, trough, breakdown and final viscosities of the samples were lowest in sample that contained the spices ‘ Uda + clove’ meaning that the addition of these spices negatively affected the samples, while samples containing ‘ginger + clove were significant difference (p < 0.05) in all the pasting properties determined.

Table 3. PASTING PROPERTIES (RVU) OF OGI (PAP) SAMPLES

Samples	Peak	Trough	Break down	Final viscosity	Setback	Pasting Time	Pasting Temperature
A	288.08 ^b	116.29 ^{ab}	171.79 ^{ab}	292.25 ^a	175.95 ^a	4.76 ^a	81.15 ^a
B	289.87 ^b	122.70 ^a	166.21 ^{bc}	279.20 ^{ab}	156.50 ^b	4.60 ^b	79.60 ^{cd}
C	267.62 ^c	116.91 ^{ab}	150.71 ^{cd}	263.75 ^{bc}	146.83 ^{bc}	4.67 ^{ab}	80.35 ^{abc}
D	275.46 ^{bc}	124.79 ^a	150.67 ^{cd}	283.37 ^a	158.58 ^b	4.67 ^{ab}	80.02 ^{bcd}
E	276.16 ^{bc}	119.54 ^a	156.62 ^{bcd}	273.62 ^b	154.08 ^b	4.56 ^b	79.10 ^d
F	304.79 ^a	116.45 ^{ab}	188.33 ^a	291.21 ^a	174.75 ^a	4.60 ^b	80.75 ^{ab}
G	239.28 ^d	97.05 ^b	141.56 ^d	232.65 ^d	136.06 ^d	4.62 ^{ab}	79.97 ^{bcd}
H	271.58 ^c	120.37 ^a	151.21 ^{cd}	253.08 ^c	132.71 ^d	4.56 ^b	79.52 ^{cd}

Key:

A = Maize alone (control)

B = Maize + ginger

C = Maize + uda

D = Maize + clove

E = Maize + Ginger + Uda

F = Maize + Ginger + clove

G = Maize + Uda + clove

H = Maize + Ginger + uda + clove

3.3. Sensory Evaluation Result of Spiced Ogi Samples

Table 4 and Table 5 shows the sensory evaluation results of spiced ogi samples with and without sweeteners.

Color/appearance of spiced ogi samples ranged from 4.00 to 7.80 and from 6.20 to 8.90 for unsweetened and sweetened, with sample D (Maize + clove) as the lowest and sample A (control) as the highest respectively. This color variation in the ogi gruel samples is expected because of the natural dark color of clove spice. All the ogi samples were significantly different ($p < 0.05$) in terms of color

Ogi (gruel) flavor and taste ranged from 4.00 to 7.00 and from 3.90 to 6.60 for unsweetened, with sample D (Maize + clove) as lowest and sample B (Maize + ginger) as the highest respectively, while flavor and taste for the sweetened samples ranged from 6.60 to 8.80 and from 6.50 to 8.70 with samples F (Maize + ginger +clove) and H ((maize + ginger + Uda +clove) as lowest and A

(control) as highest respectively. The sweeteners masked the original flavor and taste of the gruels.

Texture and consistency of Ogi samples ranged from 4.80 to 7.20 and from 4.50 to 7.70 with sample A (100% maize) as most preferred for the unsweetened samples, while for the sweetened Ogi, texture and consistency ranged from 6.30 to 8,70 and from 6.10 to 8.60 respectively, with samples A(control- 100%maize), B (Maize + ginger) and C (Maize +uda) showing no significant difference ($p < 0.05$)

Overall acceptability of the ogi samples ranging from 4.60 to 7.70 for unsweetened and 6.10 to 8.80 for sweetened samples with sample B (maize + ginger) showing same preference as the controls

Sensory analysis result showed significant differences in the color, flavor, taste, texture, consistency and overall acceptability of gruel samples prepared with different spices. However, all the ogi samples exhibited different levels of consumer preferences and acceptance, with the spiced Ogi been the most preferred in flavor and taste.

Table 4. MEAN SENSORY CHARACTERISTICS OF OGI (GRUEL) SAMPLES UNSWEETENED

Samples	Color	Flavor	Taste	Texture	Consistency	Overall Acceptability
A	7.80 ^a	5.80 ^{ab}	5.90 ^{ab}	7.20 ^a	7.60 ^a	7.70 ^a
B	7.80 ^a	7.00 ^a	6.60 ^a	6.80 ^{ab}	7.10 ^{ab}	7.60 ^a
C	6.10 ^b	5.30 ^b	5.40 ^{ab}	6.30 ^{abc}	6.30 ^{bc}	6.10 ^b
D	4.00 ^c	4.00 ^c	3.90 ^c	4.80 ^c	4.50 ^d	4.60 ^c
E	6.50 ^b	5.40 ^b	5.30 ^{bc}	5.60 ^{bc}	6.00 ^{bc}	6.20 ^b
F	4.10 ^c	5.10 ^{bc}	4.90 ^{ab}	5.90 ^{abc}	5.40 ^{cd}	5.00 ^{bc}
G	5.60 ^b	5.80 ^{ab}	5.90 ^{ab}	5.80 ^{abc}	5.70 ^{cd}	5.80 ^{bc}
H	5.30 ^b	5.60 ^b	5.80 ^{ab}	5.40 ^c	6.00 ^{bc}	5.80 ^{bc}

Key:

A = Maize alone (control)

B = Maize + ginger

C = Maize + uda

D = Maize + clove

E = Maize + Ginger + Uda

F = Maize + Ginger + clove

G = Maize + Uda + clove

H = Maize + Ginger + uda + clove

Table 5. MEAN SENSORY CHARACTERISTICS OF OGI (GRUEL) SAMPLES (SWEETENED)

Samples	Color	Flavor	Taste	Texture	Consistency	Overall Acceptability
A	8.90 ^a	8.80 ^a	8.70 ^a	8.70 ^a	8.60 ^a	8.80 ^a
B	8.50 ^{ab}	8.60 ^a	8.50 ^a	8.10 ^a	8.60 ^a	8.60 ^a
C	7.90 ^{bc}	8.10 ^{ab}	7.90 ^{ab}	8.00 ^a	7.50 ^b	7.90 ^{ab}
D	6.20 ^d	7.50 ^{bc}	7.00 ^c	6.80 ^b	6.90 ^{bc}	6.90 ^{bc}
E	7.50 ^c	7.30 ^{bc}	7.20 ^{bc}	6.90 ^b	7.20 ^b	7.20 ^{bc}
F	6.20 ^d	6.60 ^c	6.50 ^c	6.50 ^b	6.90 ^{bc}	6.20 ^c
G	6.40 ^d	6.90 ^c	6.70 ^c	6.30 ^b	6.10 ^c	6.10 ^c
H	6.20 ^d	6.60 ^c	6.80 ^c	6.50 ^b	6.60 ^{bc}	6.10 ^c

Key:

- A = Maize alone (control)
 B = Maize + ginger
 C = Maize + uda
 D = Maize + clove
 E = Maize + Ginger + Uda
 F = Maize + Ginger + clove
 G = Maize + Uda + clove
 H = Maize + Ginger + uda + clove

4. Conclusion

The present study showed that ogi from maize (*Zea mays*) with spices such as Ginger (*Zingiber officinales*), Uda (*Xylopi aethiopic a*) and Clove (*Syzygium aromaticum*) improve significantly ($p > 0.05$) the nutrient composition of the samples in terms of chemical and mineral content. Sensory evaluation also showed acceptability of the spices in ogi, with improvement in taste and flavor especially with the ginger spiced sample, comparable to the commonly consumed plain ogi. The oil content of the spices especially with the ginger containing samples improved the fat content of the spiced ogi samples. This is in agreement with the findings of Farinde [14]. This may have also influenced the total energy of the combined spiced samples.

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