



SPAS & SA 7th National Conference 2025

PROXIMATE, FUNCTIONAL AND SENSORY PROPERTIES OF OGI PRODUCED FROM MAIZE (*Zea mays*) AND GREEN PEA (*Pisum Sativum L*) SPICED WITH GINGER (*Zingiber officinal*)

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Abstract

This study aimed to evaluate the proximate, functional, and sensory properties of ogi made from composite flour blends of yellow maize, green pea, and ginger. The flours were combined in various proportions: MDA1 (100% sieved yellow maize), MDA2 (65% sieved yellow maize and 30% green pea and 5% ginger), MDA3 (65% unsieved maize and 30% green pea and 5% ginger), MDA4 (70% sieved maize, 25% green pea, and 5% ginger), and MDA5 (70% un-sieved maize, 25% green pea, and 5% ginger). The proximate composition, functional properties, and sensory attributes were analyzed using standard methods. The moisture, fat, ash, fiber, carbohydrate, and protein content ranged from 7.50% to 12.11%, 6.25% to 8.5%, and 2.18% to 6.84%, respectively. Functional properties such as water absorption capacity, oil absorption capacity, solubility, and bulk density varied between 90.00%–230%, 88.07%–94.00%, 20.22%–32.49%, and 0.39–0.66g/ml, respectively. Sensory attributes such as appearance, colour, taste, flavour, sweetness, willingness to buy, and overall acceptability ranged from 7.10 to 8.35, 7.10 to 8.20, 6.55 to 7.10, 6.85 to 7.65, 6.09 to 7.55, 5.11 to 7.45, and 6.75 to 7.40, respectively. These results revealed that ogi made from these flour blends may provide essential nutrients such as protein, fiber, ash, and carbohydrates, which are needed for growth and well-being of infants and adults.

Keywords: Yellow maize, green pea, ginger, proximate and sensory

Introduction

Ogi is a traditional gruel meal made from fermented cereal grains especially maize. It is a staple meal weaned to infants and a soft meal for elderly people as well as recuperating mothers in under-developed countries. In Nigeria tribes, due to diversity in local dialect ogi is called by different names; Akamu by Ibo's, Koko by Hausa's, Agidi by Edo's, Epkan by Efik's while Itsekiri, Urhobo and Yoruba's called it ogi respectively. Ogi is made by soaking the corn for 72 hours (3 days), decanting the fermented water, washed and wet milled. It can be further processed to sieved ogi using either muslin cloth or screen mesh Echem, (2017). Ogi is rich in carbohydrate, energy, vitamins and minerals, low in protein especially lysine and tryptophan. During processing of maize to ogi, nutrient (soluble vitamins and some minerals) are lost through soaking, sieving and decanting of the

supernatant (Ajanaku *et al.*, 2012). There is need to fortified ogi with animal or plant source to replenish lost or low nutrient in ogi. The continuous taking of ogi as an infant and family gruel meal posed some nutritional set back if not fortified.

Maize (*Zea mays*) is a domesticated plant from the grass family *gramineae*. It is one of the most significant cereal crops worldwide. This versatile crop is a valuable source of human nourishment and animal feed. The products of Maize are starch, Corn oil, corn syrup. (Kumar *et al.*, 2022). It is a staple food for many people worldwide due to their high nutrient content. A range of natural processes employing microorganism e.g. (yeast and lactic acid bacteria) convert maize grains into an Intermediate or final product that has a stable shelf life, enhanced digestibility, and desired organoleptic qualities (Itaman & Nwackukuw; 2021).



Green pea (*Pisum sativum L*) is considered as herbaceous vine by botanist. It is a member of the family *legumisea fabaceae* (Wani & Kumar, 2014). Peas are highly nutritious, offering a concentrated source of plant-based protein fiber and other vitamin and mineral as well as bioactive compounds like antioxidant (Millar, 2019). Green peas when combined with cereals provides a well-balanced essential amino acids. The pulse flour are good source of protein, folate (vitamin B9), Vitamin K, magnesium, and iron. It contains anti-nutrients such as phytic acid and lecithin (Campos-Vega *et al.*, 2010). Thus, green pea can become integral part of human and animal food. Soaking or boiling of peas reduce their anti-nutrient level, making them safe for consumption.

Ginger (*Zingiber officinal rose*) is an herb from *Zingiberaceae* family. The spicy scent of the ginger is due to the presence of ketones, specifically gingerol. It has an aromatic or pungent flavor (Sangwan, Kawatra & Sehgal, 2014). It does not only have excite taste but they are also composed of high quality phytochemical, essential oils, antioxidants, mineral and vitamins (Sangwan, Kawatra & Sehgal, 2014) that are essential for overall health sustenance. It is a medicinal plant that has been used as a spice and flavoring agent for centuries (Cross *et al.*, 2021). This study investigate the level to which green pea can be substituted with maize. The specific objective is to determine the proximate, selected functional and sensory qualities of the *ogi* spiced with ginger powder.

Materials and Methods

Materials

Yellow maize, green pea and ginger were sourced from a retail market in Ilaro, Ogun State, Nigeria.

Methods

Preparation of Maize

Samples Formulation

The ratio of *ogi* powder produced from yellow maize, green pea and ginger are present in table 1.

Table 1: Sample proportion of *ogi* powder

Sample	Maize (%)	Green pea (%)	Ginger (%)
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The sample (*Ogi*) was prepared using the procedures described by Omar *et al.*, (2021) with a little modification. One thousand gram of Maize (*Zea mays*) was sorted and cleaned of any foreign matters. At ambient temperature (27 °C), the cleaned maize was steeped in 4 litres of water for 72 hours. The steeped water was decanted, and the grains were rinsed before being wet milled using attrition meal. The slurry was divided into two. One part was sieved through water using a muslin cloth, while the other was left unsieved. The sieved part was allowed to sediments to get filtrate and the supernatant collected separately on a sterile bucket. Both the sieved and the unsieved *ogi* were drained and then dried at 50 °C for 24 hours. After drying, they were both milled again into powdered form and collected in clean plastic container with lid

Preparation of Green Pea Flour

The method outlined by Wani & Kumar, (2014) was used. Green pea was sorted, cleaned of foreign grains and extraneous matters or particles present in it. The cleaned sorted green pea grains were soaked in warm water with the addition of bi- carbonate for 30mins to soften the peas in order to remove toxins. The soaking process was repeated with addition of bi- carbonate in warm water for 30mins to inhibit the toxin in it and activate the nutrient. The green peas were dehulled, oven dried at 70 °C for 8hours, milled, sieved and packaged in air tight container.

Preparation of Ginger Powder

The method described by (Olaniran & Abiose, 2019) with little modification was used. Ginger 500 g was washed under a running potable. It was then peeled using a sharp knife, rinsed again, sliced thinly (5 mm thick), and dried in a hot air oven at 65 °C for 12 hours. The dried ginger was milled into powder and stored in a sterile airtight container.



	Sieved	Unsieved		
MDA1	100	-	-	-
MDA2	65	-	30	5
MDA3	-	65	30	5
MDA4	70	-	20	5
MDA5	-	70	20	5

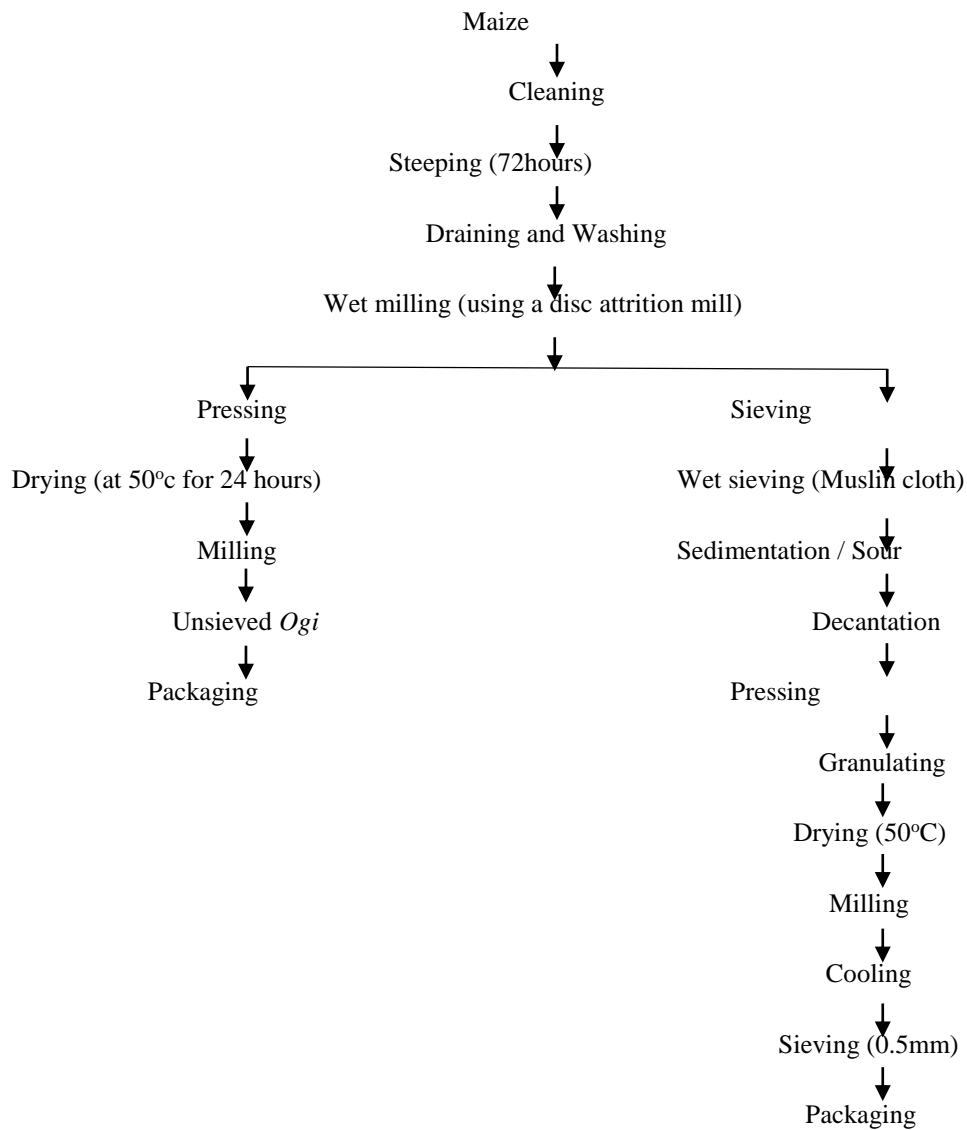


Fig 1: Sketch for the production of sieved and unsieved *ogi* flour

Analyses
Chemical Analysis

The moisture, fat, protein, fiber, and ash contents of the *ogi* samples were analyzed using the official



methods describe by the AOAC (2010), while carbohydrate content was calculated by difference.

Functional Properties

Bulk Density

Loosed and packed bulk density was determined using the method described by Onwuka (2005). 10 g the material was weighed into a 50 ml measuring cylinder (W_1), and its volume was recorded (V_1). For packed bulk density, the samples inside the cylinder were tapped many times for 10 minutes to eliminate voids within the flour until a constant volume (V_2) was achieved.

$$\text{Loosed bulk density} = \frac{W_1}{V_1}$$

$$\text{Packed bulk density} = \frac{W_2}{\text{Trapped volume (V2)}}$$

Water and Oil Absorption Capacity

Water absorption capacity of each *ogi* sample was determined using the method of (Wani & Kumar, 2014). Exactly 1 g powdered *ogi* was weighed into 25ml calibrated centrifuge tube stirred with 10ml of distilled water, or (10 ml of executive vegetable oil and agitated for 60 seconds. The suspensions were allowed rest at ambient temperature for 30 min, and centrifuge for 30 minutes at 3500 rpm. The free water or oil was carefully drained, and the volume of the water/oil was estimated. The water or oil absorbed by the powdered *ogi* was computed as the difference between the original water/oil utilized and the volume of the supernatant after centrifugation. The result was stated

as one gram of water or oil absorbed per gram of sample.

Solubility Index

The procedure outline by Obinna-Echem *et al.*, (2021) was used to determine the solubility index. Exactly 0.5 g sample was weighed into a test tube containing 10 ml of distilled water. The mixture was heated in a water bath at 50 °C for 30 minutes. It was centrifuged at 1500 rpm for 30 minutes. The supernatant were collected and dried to a consistent weight. The solubility index was calculated as the percentage (%) by weight of dissolved starch in the heated solution.

Sensory Evaluation

The cooked *ogi* was coded and served in small disposable cups to a twenty (20) semi trained panelist of staff and students of Food Technology department conversant with the *ogi*. The *ogi* was prepared by mixing *ogi* flour with Bambara nut flour and ginger powder in ratios with boiling water to gelatinization. Portable water was provided between samples to prevent carry over effect. A 9-points hedonic scale was used to rate the appearance, colour, flavour, taste, mouthfeel, sweetness, willingness to buy and overall acceptability of the samples, 9 denoted the extremely like, and 1 represented the extremely dislike.

Statistical Analysis

The results are shown as mean \pm standard deviations, and the trials were run in duplicate. ANOVA was applied to the collected findings using the Statistical Package for Social Sciences (SPSS version 20). Duncan's Multiple Range Test was used to separate the means (DMRT). A notable distinction was found at $P < 0.05$



Results and Discussion

Results

Table 1: Proximate Properties of *Ogi* Produced from Yellow Maize, Green pea and Ginger Powder

Samples	Moisture	Fat	Ash	Fiber	Protein	Carbohydrate
MDA1	7.50±1.41 ^a	6.25±0.35 ^b	0.84±0.00 ^c	0.20±0.00 ^c	5.91±0.42 ^e	79.25±0.04 ^a
MDA2	12.11±0.03 ^a	8.95±0.02 ^c	2.35±0.01 ^b	7.93±0.03 ^b	12.04±0.04 ^b	56.67±0.05 ^c
MDA3	12.06 ±0.03 ^a	9.04±0.03 ^{bc}	2.47±0.02 ^a	8.18±0.00 ^a	12.59±0.04 ^a	55.68±0.01 ^d
MDA4	11.17±0.02 ^b	9.13±0.02 ^b	2.18±0.02 ^c	6.84±0.03 ^d	11.05±0.04 ^d	59.65±0.13 ^d
MDA5	10.14±0.02 ^c	9.85±0.04 ^a	2.37±0.02 ^b	7.56±0.00 ^c	11.54±0.03 ^c	58.56±0.06 ^b

Values represent the mean of duplicate determinations ± SD (Standard deviation).

Means from the same row with different superscripts are significantly different (p<0.05).

Keyword

MDA1: 100% Seived ogi plain

MDA2: 65% Seived Ogi with 30% Green pea and 5% Ginger

MDA3: 65% unseived Ogi with 30% Green pea and 5% Ginger

MDA4: 70% sieved Ogi with 25% Green pea and 5% Ginger

MDA5: 70% Unseived Ogi with 25% Green pea and 5% Ginger

Table 2: Functional Properties of *Ogi* Produced from Yellow Maize, Green pea and Ginger Powder

Sample	Water Absorption Capacity (%)	Oil Absorption Capacity (%)	Solubility (%)	Bulk Density (g/ml)
MDA1	90.00±0.04 ^c	95.00±0.13 ^a	20.22±0.03 ^a	0.66±0.02 ^b
MDA2	218.57±0.03 ^c	89.63±0.04 ^c	22.67±0.04 ^e	0.71±0.00 ^a
MDA3	219.58±0.03 ^b	89.88±0.06 ^c	25.95±0.02 ^d	0.73±0.00 ^a
MDA4	198.91±0.50 ^d	88.07±0.04 ^d	28.96±0.23 ^c	0.72±0.42 ^a
MDA5	230.91±0.64 ^a	90.37±0.04 ^b	32.49±0.06 ^b	0.74±0.00 ^a

Values represent the mean of duplicate determinations ± SD (Standard deviation).

Means from the same row with different superscripts are significantly different (p<0.05).

Table 3: Sensory Evaluation of *Ogi* Produced from Yellow Maize, Green pea and Ginger Powder

Sample	Appearance	Colour	Taste	Flavour	Sweetness	Willingness To Buy	Overall Acceptability
MDA1	7.10±0.03 ^a	7.10±1.52 ^a	7.12±1.42 ^a	6.85±1.20 ^a	6.09±0.03 ^a	7.11±0.34 ^b	7.40±1.27 ^{ab}
MDA2	8.35±0.75 ^a	8.20±0.90 ^a	7.40±1.30 ^a	7.65±1.04 ^a	7.55±1.0 ^a	7.45±1.05 ^a	7.20±1.58 ^a
MDA3	7.90±0.9 ^a	7.65±1.02 ^a	6.55±1.00 ^a	7.10±1.41 ^a	7.30±1.08 ^a	6.80±1.20 ^a	7.15±1.63 ^a
MDA4	8.15±0.93 ^a	7.75 ^a ±1.02	6.80±1.54 ^a	6.85±1.31 ^a	6.75±0.37 ^a	6.70±1.34 ^a	6.75±1.37 ^a
MDA5	8.20±0.70 ^a	7.65±0.75 ^a	6.55±1.50 ^a	7.05±1.60 ^a	6.90±1.48 ^a	6.50±1.64 ^a	6.75±1.59 ^a



Values represent the mean of duplicate determinations \pm SD (Standard deviation).

Means from the same row with different superscripts are significantly different ($p < 0.05$).

Discussion

Table 1 shows the results of proximate analysis of *ogi* samples. The moisture content of *ogi* flour samples varied significantly ($p < 0.05$), ranging from 7.50% to 12.11%. Sample MDA1 had the lowest value (7.50%) while sample MDA2 had the highest (12.11%). The moisture content obtained is within the suggested range of 15% for good food storage stability (Omah *et al.*, 2021) and was higher when compared with the *ogi* produced from the blends of fermented maize and pigeon pea steeped for 48 hours (Okafor *et al.*, 2018). The protein level of the *ogi* samples varied significantly ($p < 0.05$), ranging from 5.91 to 12.59%. MDA1 had the least value (5.91%) while MDA3 had the highest value (12.59%). The result showed that the proportion of the green pea contribute to the protein variation in the samples while sample without green pea had low protein value. The protein value in this study was lower than the results (6.22-21.46%) reported by (Omah *et al.*, 2021) and the result (2.18-24.07%) reported by (Ogunjemilusi *et al.*, 2023). This affirm the green pea as one of the rich source of plant protein. The fat content ranged from 6.25 to 9.85%, with MDA1 having the lowest fat content while MDA5 had the highest. The increase in the fat content may be due to not sieving the slurry. The fat content in all samples was found to be higher than the values reported for mixed cereals *ogi* spiced garlic (Adepeju *et al.*, 2024). The ash content ranged from 0.84% to 2.47%, with MDA1 having the least and MDA3 having the highest. There was no significant difference ($p > 0.05$) between MDA2 and MDA 5. The findings of this study are within the range reported by (Adepeju *et al.*, 2024). The fiber content ranged from 0.20 to 8.18%, with MDA1 having the lowest value and MDA3 having the greatest value. The hull of cereals comprises around 64% of the total fiber, and during processing, the hulls are removed in the wet sifting process (for maize) and before drying, depriving the flour of a major proportion of the fiber that is concentrated in the hull. The fiber content in this were higher compared to the results reported by (Olaniran & Abiose, 2019 and Adepeju *et al.*, 2024). The carbohydrate varied between 55.68 to 79.25%; MDA3

had the lowest value, while MDA5 had the highest. The samples were statistically differ at ($p < 0.05$).

Table 2 presents the results of the functional properties of the *ogi* samples. The study found substantial ($p < 0.05$) differences across flour samples. The water absorption capacity (WAC) varies from 90.00 to 230.91%, with MDA4 having the lowest and MDA5 having the highest value. Water Absorption Capacity (WAC) refers to a food product capacity to interact with water in limited conditions in order to improve handling. The WAC result were within the range reported by (Omah *et al.*, 2021). Oil absorption capacity (OAC) ranged from 88.07 to 94.00%. MDA4 had the highest value, followed by MDA2, and then MDA3. The OAC in this study were higher compared to (60.67 – 68.00 g/ml) reported by Adepeju *et al.*, (2024). The solubility index ranged from 20.22 to 32.49%. MDA4 has the highest solubility at 32.49%, while MDA1 has the lowest solubility with a value of 20.22%. MDA3, there are significant differences between the samples. There was a significant difference in bulk densities ranging from 0.39 to 0.74 g/ml; MDA4 had the least value while MDA5 had the highest value. MDA1 had the least value. This may be due to exclusion of green pea flour.

The sensory qualities of *ogi* samples were presented in table 3. MDA1 (100%) yellow sieved was rated high in all the attributes tested, including appearance, taste, color, flavor, sweetness, willingness to buy, and overall acceptability. MDA2, MDA3, MDA4, and MDA5 have similar sensory ratings, particularly in terms of taste, flavor, sweetness, willingness to buy, and overall acceptability. The sensory attributes in this study were higher than the value reported by (Adepeju *et al.*, 2024 and Omar *et al.*, 2021).

Conclusion

In this study, powdered cereal gruel (*ogi*) was made from maize, green peas, and ginger. This composite flour product was found to have an ideal protein content of 12.95%. The findings of this study also revealed better functional qualities. The macronutrient



levels in the samples were also significantly increased. These macronutrient levels increased considerably with the addition of green peas. This value-added product has the potential to help alleviate malnutrition, particularly among children in underdeveloped nations who are typically fed ogi as an infant formula. The addition of 30% green pea to ogi resulted in significantly better sensory properties. Overall, this modified ogi could serve as a nutritious and versatile food option, suitable for various dietary needs and preferences, while promoting local agricultural products.

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