IJMAAS International Journal of Microbiology and Applied Sciences
ISSN 1115-4004 Volume 4 issue 2 May, 2025 Research Article

Bacteriological and Proximate Composition of Ogi Fermented from *Zea mays*, *Sorghum bicolor* and *Pennisetum glaucum* Cereals

Alabere, Awengi* and Adias, Teddy Charles
Department of Microbiology,
Federal University, Otuoke.
Bayelsa State, Nigeria.
***Corresponding Author:** *alabereaa@fuotuoke.edu.ng*

ABSTRACT

The study assessed the bacteriological and proximate composition of ogi fermented from *Zea mays*, *Sorghum bicolor* and *Pennisetum glaucum* cereals. Ogi was fermented in four (4) setups (white *Zea mays*, yellow *Zea mays*, *Sorghum bicolor*, *Pennisetum glaucum*). The ogi was allowed to ferment by steeping in distilled for 4days. The effluents generated from the steeping water were collected daily for microbiological analyses. After the fermentation process which lasted for 4 days, the steeped grains were wet milled, sieved, allowed to sediment, decanted to produce the semi-solid ogi samples. The Proximate composition (moisture, ash, lipid, protein, carbohydrate and crude fibre contents) of the cereals and the ogi produced from them was determined. The study revealed the presence of *Enterobacter* sp., *Erysipelothrix* sp., *Pediococcus* sp., *Weisella* sp., *Veillonella* sp., *Proteus* sp. and *Priestia* sp. in the fermentation of ogi produced from yellow and white *Zea mays*, *Sorghum bicolor* and *Pennisetum glaucum*. It also revealed that the ogi had moisture, carbohydrate, protein, fat, fibre, ash contents of 51.3%, 78.5%, 4.8%, 0.4%, 0.2% and 0.6% respectively. The study revealed that ogi is a rich source of carbohydrate compared to other nutrients.

Keywords: Ogi, Bacteria, Proximate composition, *Zea mays*, *Sorghum bicolor*, *Pennisetum glaucum*

Introduction

Ogi is a popular fermented cereal porridge commonly consumed in Nigeria and the wider West African region, typically made from maize (*Zea mays*), sorghum (*Sorghum bicolor*), or millet (*Pennisetum glaucum*) (Adebukunola *et al*., 2015). It is especially favored by the elderly as a traditional breakfast food and is also used as a weaning food for infants. Known for its affordability, long shelf life, and widespread acceptance, Ogi is a staple breakfast gruel in West Africa (Eke-Ejiofor and Beleya, 2017). Also called pap, Ogi is an indigenous complementary food with different local names in Nigeria; ogi in Yoruba, koko in Hausa, and akamu in Igbo and is consumed by people of all ages, including infants, children, and adults (Afolabi *et al*., 2015). Ogi is recognized as a preferred morning porridge suitable for people of various ages and backgrounds, providing gentle nourishment for infants, the elderly, and those who are ill (Olaniran and Abiose, 2019).

Additionally, Ogi is known to support milk production in breastfeeding mothers and plays an important role in the livelihoods of mainly female producers in both rural and urban areas throughout sub-Saharan Africa (Noah, 2017; Olayiwola *et al*., 2017).

Maize (*Zea mays L*.) ranks third worldwide in terms of cultivation area and total production, following wheat and rice. It remains a vital cereal crop and a versatile seed. In Nigeria, maize is considered one of the most important cereal crops, predominantly grown by rural, peri-urban farm families and smallholder farmers with limited resources. While maize is a valuable source of carbohydrates, vitamins, and minerals, its nutritional content is somewhat lower compared to other cereals. Although botanically classified as a fruit, the maize kernel contains approximately 73% starch, 9% protein, 4% oil, and 14% other components such as fiber, providing an energy value of 365 Kcal per 100 grams (Olaniran and Abiose, 2019).

Citation: Alabere and Adias (2025). Bacteriological and proximate composition of Ogi fermented from *Zea mays*, *Sorghum bicolor* and *Pennisetum glaucum* cereals. *International Journal of Microbiology and Applied Sciences*. *4(2)*: 87 – 94.

Millet (*Pennisetum glaucum*) is a tropical crop known for its ability to produce grains even in challenging environmental conditions, outperforming many other crops in resilience. It is rich in important nutrients such as copper, manganese, phosphorus, and magnesium (Prathyusha *et al*., 2021). They play a vital role in food security across the semiarid regions of Asia and Africa, with developing countries like India, Mali, Nigeria, and Niger responsible for 97% of global millet production (Renganathan *et al*., 2020). Nutritionally, millets contain 60–70% carbohydrates, 7–11% proteins, 1.5–5% fats, and 2–7% crude fiber, along with a rich supply of vitamins and minerals (Ibrahim *et al*., 2021).

Sorghum (*Sorghum bicolor*) ranks as the fifth most important cereal crop worldwide, following rice, wheat, maize, and barley. It serves as the main staple cereal for more than 750 million people living in the semi-arid tropical regions of Africa, Asia, and Latin America (Bazie *et al*., 2023). Sorghum grains are a rich source of energy and various nutrients (Akin *et al*., 2021). In these areas, sorghum is commonly fermented into pasta, boiled meals, and traditional drinks (Thilakarathna *et al*., 2021). Like other cereals, grain sorghum is high in starch and protein (Birhanu, 2021).

Traditionally, ogi is made using a single cereal, typically maize, for everyday family consumption. However, the heavy reliance on maize for both food and animal feed has led to concerns about cost and availability (Okafor *et al*., 2018). Incorporating multiple cereals in ogi production can improve its nutritional profile and promote the use of a wider variety of grains (Zanariah *et al*., 2015). This study aimed at identifying the bacteria and the proximate composition of ogi fermented from yellow and white *Zea mays*, *Sorghum bicolor* and *Pennisetum glaucum* cereals.

Materials and Methods

Sample Collection

Yellow and white coloured maize (*Zea mays* L.), millet (*Pennisetum glaucum*) and guinea corn (*Sorghum bicolor*) cereals were obtained from Swali market in Yenagoa local government area of Bayelsa State.

The cereals were placed in sterile containers and transported to the Department of Microbiology laboratory, Federal University Otuoke for further analysis.

Sample Preparation

Ogi was prepared from white *Zea mays*, yellow *Zea mays*, *Sorghum bicolor* and *Pennisetum glaucum* cereals using the wet milling processing method as described by Omemu (2011) with modifications. The grains were sorted into four (4) groups which constituted the setups. The setups were: Cw (white *Zea mays*), Cy (yellow *Zea mays*), G (*Sorghum bicolor*) and M (*Pennisetum glaucum*). One hundred and fifty grams (150g) of the sorted grains in the four (4) setups were soaked in airtight containers with 300ml of distilled water for four (4) days at room temperature of 28ºC. The effluents generated from the steeping water were collected daily for physicochemical and microbiological analyses. The steeping water were decanted and changed daily. After the fermentation process which lasted for 4 days, the steeped grains were wet milled using a grinder. The milled slurry was then sieved through a fine mesh sieve to remove the over tails which were discarded. The slurry was allowed to stand and sediment for 48 hours at a temperature of 28 ºC. The souring water was decanted from the sediments and the ogi slurry obtained was collected in a muslin cloth and hand squeezed to remove the excess water leaving behind the semi-solid ogi samples.

Isolation and Identification of the Bacteria Isolates

The samples from the 4 setups were inoculated into Petri dishes containing sterile nutrient agar (NA) and were incubated at 37 ºC for 24 hours. They were identified using standard culture-dependent methods (Cheesbrough, 2006).

Determination of Proximate Composition

Proximate composition of the cereals (yellow *Zea mays*, white *Zea mays*, *Sorghum bicolor*, *Pennisetum glaucum*) before and after fermentation was determined using the official methods of AOAC, 2023. The analysis consists of determination of moisture, ash, lipid, protein, carbohydrate and crude fibre contents.

Citation: Alabere and Adias (2025). Bacteriological and proximate composition of Ogi fermented from *Zea mays*, *Sorghum bicolor* and *Pennisetum glaucum* cereals. *International Journal of Microbiology and Applied Sciences*. *4(2)*: 87 – 94.

Determination of Moisture Content

The principle for determination of moisture content was based on evaporation of moisture. Aluminum dishes were washed and oven-dried and cooled in desiccators. The weight of each aluminum dish was measured using a weighing balance. Five grams (5g) of ground samples were weighed into a sterile aluminum dish, the weight of the dish and weight of undried sample were taken in duplicate. This was transferred to an oven which was set at a temperature of 80 °C for 2 hours, and then the temperature was increased to 105 °C for 3 hours. The aluminum dishes were removed and cooled in desiccators, and then the weight was measured. It was transferred back into the oven for another 1 hour and the weight was reweighed. The process continued until a constant weight was obtained. The difference in weight between the initial and the final weight gained represents the moisture content. This process was carried out in duplicates.
The moisture content was determined using the formula:

$$Moisture\ content\ (g) = \frac{W2 - W3}{W2 - W1} \times 100$$

Where W_1= Initial weight of empty crucible
W_2= Weight of crucible + sample before drying
W_3= Final weight of crucible + sample after drying
%Total solid (Dry matter)= 100- moisture content (%)

Determination of Ash Content

Twenty grams (20g) of each of the samples were weighed into a clean, dried and cooled platinum crucible. It was placed into a furnace set at 550 °C and allowed to blast for 3 hours. After blasting, it was brought out and placed in a desiccator to cool and the weight was measured. The process was carried out in duplicates and the ash content was determined as:

$$Ash\ content = \frac{W2-W3}{W2-W1} \times 100$$

Where W_1= Initial weight of empty crucible
W_2= Weight of crucible + sample before drying
W_3= Final weight of crucible + sample after drying

Determination of Lipid Content

Soxhlet extraction technique was used for the determination of the lipid content. Fifteen grams (15g) of the samples were weighed and carefully placed inside a fat-free thimble. The thimble was covered with cotton wool in order to avoid loss of the sample. The thimble containing the sample was placed in a Soxhlet extractor, 200ml of petroleum ether was poured into a weighed fat-free Soxhlet flask and the flask was attached to the extractor. The flask was placed on a heating mantle so that there is reflux in the petroleum ether in the flask. Cooling was achieved by a running tap which was connected to the extracted for at least 6 hours after which the solvent was completely siphoned into the flask. A rotary vacuum evaporator was used to evaporate the solvent leaving behind the extracted lipids in the Soxhlet. the flask was removed from the evaporator and dried to a constant weight in the oven at 60 °C. The flask was placed in a desiccator to cool and weighed. This was done in duplicates and the lipid content was calculated as:

$$\%\ Fat = \frac{Weight\ of\ extracted\ lipids}{Weight\ of\ dry\ sample} \times 100$$

Determination of Protein

The total protein was determined by the Kjedahl method. Twenty grams (20g) of the samples were weighed into a filter paper and put into a kjedahl flask. Ten (10) tablets of Na_2SO_4 were added with 1g of $CuSO_4$. Twenty milliliters (20mL) of concentrated H_2SO_4 were added and digested in a fume cupboard until the solution became colourless. It was cooled overnight and transferred into a 500mL flat bottom flask containing 200mL of water. This was cooled with the aid of ice packs. 60-70mL of 40% NaOH was poured into the conical flask which was used as the receiver with 50mL of 4% boric acid using 3-days screened methyl red indicator. Ammonia gas was distilled into the receiver until the whole gas evaporated. Titration was carried out using the receiver and 0.01M HCl until the solution became colourless. This was done in duplicates and the percentage of protein was calculated as:

$$\%Protein = Vs - Vb \times 0.01401 \times N\ acid\ (6.25)$$

Where Vs = Volume of acid required to titrate sample
Vb = Volume of acid require to titrate blank
N acid = Normality of acid.

Determination of Crude Fibre

Twenty grams (20g) of the different samples were defatted with diethyl ether for h hours and boiled under reflux for exactly 30 minutes with 200mL of 1.25% H_2SO_4. It was then filtered through cheese cloth on a flutter funnel. This was later washed with boiling water to completely remove the acid.

Citation: Alabere and Adias (2025). Bacteriological and proximate composition of Ogi fermented from *Zea mays*, *Sorghum bicolor* and *Pennisetum glaucum* cereals. *International Journal of Microbiology and Applied Sciences*. *4(2)*: 87 – 94.

The residue was then boiled in around bottom flask with 200mL of 1.25% NaOH for another 30 minutes and filtered through previously weighed couch crucible. The crucible was ten dried with samples in an oven at 100 °C, left to cool in a desiccator and later weighed. This was later incinerated in a muffle furnace at 600 °C for 2-3 hours and later allowed to cool in a desiccator and weighed. This was carried out in duplicates. The crude fibre was determined by:

$$\%\ Crude\ fibre = \frac{Weight\ after\ drying}{Weight\ of\ original\ sample} \times 100$$

Determination of Carbohydrate

The available carbohydrate (%) = 100- (Protein (%) + Moisture (%) + Ash (%) + Fibre (%) + Fat (%).

Statistical Analysis

Statistical Package for Social Science (SPSS) version 26 was used to analyze the data obtained. One-way analysis of variance (ANOVA) was used for multiple comparison, an error probability value $p \leq 0.05$ was considered significant.

Results

Table 1 presents results of the biochemical identification of the bacteria present in the fermentation of the ogi. The bacteria isolated from the fermenting white *Zea mays* belong to the genus *Enterobacter*, *Erysipelothrix*, *Pediococcus* and *Weisella*. The bacteria isolated from the fermenting yellow *Zea mays* belong to the genus *Enterobacter*, *Veillonella* and *Proteus*. The bacteria isolated from the fermenting *Sorghum bicolor* belong to the genus *Proteus* and *Pediococcus*. The bacteria isolated from the fermenting *Pennisetum glaucum* belong to the genus *Proteus*, *Priestia* and *Pediococcus*.

Table 2 presents the results of the proximate composition of the raw cereals before fermentation and the ogi produced.

The raw *Soghum bicolor* cereal had a moisture content of 8.5%, crude protein content of 9.0%, fat content of 3.5%, crude fibre content of 2.1%, ash content of 2.0%, carbohydrate content of 75.0%. The raw *Pennisetum glaucum* cereal had a moisture content of 8.2%, crude protein content of 10.5%, fat content of 3.2%, crude fibre content of 1.8%, ash content of 1.1%, carbohydrate content of 75.2%. The raw yellow *Zea mays* cereal had a moisture content of 7.8%, crude protein content of 8.3%, fat content of 2.6%, crude fibre content of 1.7%, ash content of 1.0%, carbohydrate content of 78.5%. The raw white *Zea mays* cereal had a moisture content of 7.9%, crude protein content of 5.7%, fat content of 3.1%, crude fibre content of 1.7%, ash content of 0.8%, carbohydrate content of 78.4%.

The ogi fermented from *Soghum bicolor* had a moisture content of 51.2%, crude protein content of 5.7%, fat content of 0.8%, crude fibre content of 0.4%, ash content of 0.8%, carbohydrate content of 41.1%. The ogi fermented from *Pennisetum glaucum* had a moisture content of 48.6%, crude protein content of 6.5%, fat content of 0.7%, crude fibre content of 0.3%, ash content of 0.6%, carbohydrate content of 43.4%. The ogi fermented from white *Zea mays* had a moisture content of 51.3%, crude protein content of 4.8%, fat content of 0.6%, crude fibre content of 0.4%, ash content of 0.6%, carbohydrate content of 42.3%. The ogi fermented from yellow *Zea mays* had a moisture content of 49.5%, crude protein content of 5.2%, fat content of 0.4%, crude fibre content of 0.2%, ash content of 0.8%, carbohydrate content of 44.0%.

Statistically, there was a significant difference between the raw *Sorghum bicolor* cereal, raw *Pennisetum glaucum* cereal, raw yellow *Zea mays* cereal, white *Zea mays* cereal, ogi fermented from *Sorghum bicolor*, ogi fermented from *Pennisetum glaucum*, ogi fermented from white *Zea mays*, ogi fermented from yellow *Zea mays* for the moisture, crude protein, fat, crude fibre, ash, carbohydrate contents and energy value $p<0.01$.

Citation: Alabere and Adias (2025). Bacteriological and proximate composition of Ogi fermented from *Zea mays*, *Sorghum bicolor* and *Pennisetum glaucum* cereals. *International Journal of Microbiology and Applied Sciences*. *4(2)*: 87 – 94.

Table 1: Morphological and Physiological Characteristics of the Bacteria Isolated from the Fermenting Cereals*

Isolate Code	Gram's Reaction	Shape	Arrangement	Catalase	Citrate	TSI: Slant	TSI: Butt	TSI: Gas Production	TSI: H_2S Production	Motility	Indole	Urease	Coagulase	Oxidase	Methyl red	Voges Proskaeur	Probable Organism
Cw_1	-ve	Rods	Clusters	+ve	+ve	Y	Y	+ve	-ve	+ve	-ve	+ve	-ve	-ve	-ve	+ve	*Enterobacter* sp.
Cw_2	+ve	Rods	Chains	-ve	-ve	Y	R	-ve	-ve	+ve	+ve	+ve	-ve	-ve	+ve	-ve	*Erysipelothrix* sp.
Cw_3	+ve	Cocci	Chains	-ve	-ve	Y	Y	-ve	-ve	+ve	+ve	+ve	-ve	-ve	+ve	-ve	*Pediococcus* sp.
Cw_4	+ve	Cocci	Chains	-ve	-ve	Y	R	-ve	-ve	+ve	+ve	+ve	-ve	-ve	+ve	-ve	*Weisella* sp.
Cy_1	-ve	Rods	Clusters	+ve	+ve	Y	Y	+ve	+ve	+ve	-ve	+ve	-ve	-ve	-ve	+ve	*Enterobacter* sp.
Cy_2	-ve	Cocci	Clusters	+ve	+ve	Y	Y	+ve	-ve	+ve	+ve	+ve	-ve	-ve	+ve	-ve	*Veillonella* sp.
Cy_3	-ve	Cocci	Clusters	+ve	+ve	Y	Y	+ve	+ve	+ve	-ve	+ve	-ve	-ve	-ve	-ve	*Proteus* sp.
G_1	-ve	Cocci	Clusters	+ve	+ve	Y	Y	+ve	+ve	+ve	+ve	+ve	-ve	+ve	-ve	+ve	*Proteus* sp.
G_2	+ve	Cocci	Clusters	-ve	-ve	Y	Y	-ve	-ve	+ve	+ve	+ve	-ve	-ve	+ve	-ve	*Pediococcus* sp.
M_1	-ve	Cocci	Clusters	+ve	+ve	Y	Y	+ve	+ve	+ve	+ve	+ve	-ve	-ve	-ve	+ve	*Proteus* sp.
M_2	+ve	Rods	Clusters	+ve	+ve	R	Y	-ve	-ve	+ve	+ve	+ve	-ve	-ve	+ve	+ve	*Priestia* sp.
M_3	+ve	Cocci	Clusters	-ve	-ve	Y	Y	-ve	-ve	+ve	+ve	+ve	-ve	-ve	+ve	-ve	*Pediococcus* sp.
M_4	+ve	Cocci	Chains	-ve	-ve	Y	R	-ve	-ve	+ve	+ve	+ve	-ve	-ve	+ve	-ve	*Pediococcus* sp.

Key: Cy= Isolate obtained from Yellow *Zea mays* setup; Cw= Isolate obtained from white *Zea mays* setup; G= Isolate obtained from *Sorghum bicolor* setup; M= Isolate obtained from *Pennisetum glaucum* setup
-ve= Negative; +ve= Positive; Y= Yellow/Acidic; R= Red/Alkakline; MR= Methyl red; VP= Voges-Proskaeur; TSI= Triple sugar ion; MIU= Motility, Indole, Urease; S=Slant; B=Butt; G=Gas; H_2S= Hydrogen Sulphide.

Citation: Alabere and Adias (2025). Bacteriological and proximate composition of Ogi fermented from *Zea mays*, *Sorghum bicolor* and *Pennisetum glaucum* cereals. *International Journal of Microbiology and Applied Sciences*. *4(2)*: 87 – 94.

Table 1: Proximate Composition of the Cereals before Fermentation and the Ogi Produced*

Proximate parameter	Raw Cereal				Fermented Cereal				*p-Value*
	G (Raw)	M (Raw)	Cy (Raw)	Cw (Raw)	G (Pro)	M (Pro)	Cw (Pro)	Cy (Pro)	
Moisture Content	8.5±0.1	8.2±0.02 A	7.8±0.01 AB	7.9±0.03 ABC	51.2±0.01 ABCD	48.6± 0.1 ABCDE	51.3±0.02 ABCDEF	49.5±0.04 ABCDEFG	
Crude Protein	9.0±0.02	10.5±0.01 A	8.3±0.01 AB	8.1±0.02 ABC	5.7±0.00 ABCD	6.5±0.01 ABCDE	4.8±0.01 ABCDEF	5.2±0.03 ABCDEFG	
Fat	3.5±0.02	3.2±0.03 A	2.6±0.03 AB	3.1±0.02 ABC	0.8±0.01 ABCD	0.7±0.01 ABCDE	0.6±0.02 ABCDE	0.4±0.02 ABCDEFG	
Crude Fibre	2.1±0.02	1.8±0.01 A	1.7±0.01 AB	1.7±0.01 ABC	0.4±0.02 ABCD	0.3±0.02 ABCDE	0.4±0.02 ABCDF	0.2±0.02 ABCDEFG	
Ash	2.0±0.02	1.1±0.02 A	1.0±0.01 AB	0.8±0.02 ABC	0.8±0.02 ABC	0.6±0.02 ABCDE	0.6±0.03 ABCDEF	0.8±0.03 ABCDEFG	
Carbohydrate	75.0±0.05	75.2±0.01 A	78.5± 0.06 AB	78.4±0.08 AB	41.1±0.10 ABCD	43.4±0.06 ABCDE	42.3±0.05 ABCDEF	44.0±0.03 ABCDEFG	<0.01

Key: *Results are reported as Mean±SD; #p-values were determined by one-way ANOVA (p ≤.0.05 was considered significant) G=*Sorghum bicolor*; M=*Pennisetum glaucum*; Cy= Yellow *Zea mays*; Cw= White *Zea mays*; Pro=Fermented Group G (Raw)=A; Group M (Raw)=B; Group Cy (Raw)=C; Group Cw (Raw) = D; Group G(Pro)=E; Group M (Pro)=F; Group, Cw (Pro)=G

Discussion

The study revealed the presence of the isolated bacteria belonging to the genus *Enterobacter*, *Erysipelothrix*, *Pediococcus*, *Weisella*, *Veillonella*, *Proteus* and *Priestia* present in the fermentation of ogi produced from yellow and white *Zea mays*, *Sorghum bicolor* and *Pennisetum glaucum*. Anumudu *et al*. (2018); Olatunde *et al*. (2018) conducted a similar study and isolated similar bacteria from fermenting Ogi.

Determination of the proximate composition of the different cereals is important so as to detect the varieties that are good sources of basic nutrients required for proper growth and development of either man or animals. Moisture content of food is of high economic importance to both the processor and consumer because the amount of moisture present in food is inversely related to the amount of dry matter it contains. Moisture content is also significant to the stability and quality of food. Grains that contain high moisture content are subject to rapid deterioration from mold growth, and insect damage (Suleiman *et al*., 2013; Sweets, 2018).

The moisture content obtained in this study was higher in the fermented ogi than in the raw cereals with the raw yellow *Zea mays* having the least moisture content of 7.8% and the ogi fermented from white *Zea mays* having the highest moisture content of 51.3%. Bello *et al*. (2018); Adeniyi and Ariwoola (2019) carried out a similar study and recorded lesser and higher moisture content of 7.11-9.22% and 11.10-12.45% respectively in raw cereals. Obi and Okoronkwo, (2022) also carried out a similar study but had lower values of moisture content of 9.04-9.13% in fermented Ogi.

Proteins provide amino acids (for building and maintenance of the body) and energy occasionally. They are also used to produce nitrogen containing substances such as antibodies ad enzymes which are important for normal body functions.

The protein content in this study was higher in the raw cereals than in the fermented ogi with ogi fermented from white *Zea mays* having the least protein content of 4.8% and raw *Pennisetum glaucum* cereal having the highest protein content of 10.5%. Bello *et al*. (2018) reported similar protein content of 9.01-12.11%. Adeniyi and Ariwoola (2019); Obi and Okoronkwo (2022), also conducted similar studies but reported a higher protein content of 9.32-15.75% and lower protein content of 7.03-7.24% in raw cereals and in fermented ogi respectively.

Citation: Alabere and Adias (2025). Bacteriological and proximate composition of Ogi fermented from *Zea mays*, *Sorghum bicolor* and *Pennisetum glaucum* cereals. *International Journal of Microbiology and Applied Sciences*. *4(2)*: 87 – 94.

Crude fat is an important component of cereal grains. Improvement of fat content aids good human health as they act as vehicle for fat soluble vitamins (Reboul, 2017). The fat content obtained in this study was lower in the fermented ogi than in the raw cereals with the ogi fermented from yellow *Zea mays* having the lower fat content of 0.4% and the raw *Sorghum bicolor* cereal having the highest fat content of 3.5%. Adeniyi and Ariwoola (2019) carried out a similar study and recorded similar values of fat content of 1.29-4.25% in raw cereals but contrary to the fat content obtained in this study, Bello *et al*. (2018), recorded lesser fat content of 2.32-2.54% in raw cereals and Obi and Okoronkwo (2022) recorded higher fat content of 3.56-3.59% in fermented Ogi.

Food is analyzed for their ash content so as to determine the non-organic matter component of the dry matter which is the remainder after oven drying, ignition or complete oxidation of organic matter present in the food. The ash content gives an idea of the total mineral amount present in the food.

Crude fibre largely composed to cellulose and hemi cellulose provides beneficial effects in humans by increasing water retention capacity during passage of food along the gut. A diet rich in crude fibre is considered healthy because it helps in producing larger and softer faeces (Capuano, 2017). The crude fibre determined in thus study was higher in the raw cereals than in the fermented ogi with ogi fermented from yellow *Zea mays* having the least fibre content of 0.2% and the raw *Sorghum bicolor* cereal having the highest fibre content of 2.1%. Similar studies were carried out by Bello *et al*. (2018); Adeniyi and Ariwoola (2019) and they recorded higher and lower fibre content of 2.15-3.76% and 0.86-1.74% respectively in raw cereals. Obi and Okoronkwo (2022) also conducted a similar study and recorded a higher fibre content of 2.03-2.32% in fermented ogi.

The ash/ mineral content obtained in this study was lower in the fermented ogi than in the raw cereals with ogi fermented from *Pennisetum glaucum* and white *Zea mays* having the least ash content of 0.6% and the raw *Soghum bicolor* cereal having the highest ash content of 2.0%. Bello *et al*. (2018); Adeniyi and Ariwoola (2019); Obi and Okoronkwo (2022) reported similar values of ash content of 1.77-2.53%, 0.49-1.93% and 1.61-1.70% respectively in a similar study.

Cereals are known to be rich in carbohydrate and as such, it provides energy, aid in utilization of body fats through metabolic process and help in the functioning of the intestinal tract. The carbohydrate content determined in this study was lower in the fermented ogi than in the raw cereals with the ogi fermented from *Soghum bicolor* having the least carbohydrate content of 41.1% and the raw yellow *Zea mays* cereal having the highest carbohydrate content of 78.5%. Bello *et al*. (2018); Adeniyi and Ariwoola (2019) recorded lesser carbohydrate content of 71.30-74.89% and 67-74% respectively in raw cereals in a similar study. Obi and Okoronkwo (2022) also conducted a similar study and recorded a higher carbohydrate content of 72.05-72.23% in fermented Ogi.

Conclusion

This study has shown that bacteria belonging to the genus *Enterobacter*, *Erysipelothrix*, *Pediococcus*, *Weisella*, *Veillonella*, *Proteus* and *Priestia* are present in the fermentation of ogi produced from yellow and white *Zea mays*, *Sorghum bicolor* and *Pennisetum glaucum*. It also revealed that the ogi had higher moisture content than the raw cereals while the ogi had a lesser protein, fat, fibre, ash, carbohydrate content than the raw cereals. It had high moisture and carbohydrate contents of up to 51.3% and 78.5% respectively. The ogi had low protein, fat, fibre, ash contents of as low as 4.8%, 0.4%, 0.2% and 0.6% respectively. The study revealed that ogi is a rich source of carbohydrate compared to other nutrients.

References

Adebukunola, M., Omemu, A. M. and Mobolaji, O. B. (2015). Consumer's knowledge, attitude, usage and storage pattern of ogi –a fermented cereal gruel in South west, Nigeria. *Food and Public Health* 5(3): 77-83.

Adeniyi, O. O. and Ariwoola, O. S. (2019). Comparative proximate composition on maize (*Zea mays* L.) varieties grown in South- Western Nigeria. *International Annals of Science* 7(1): 1-5.

Afolabi, F., Alabi, M. A, Babaniyi, R. B, Obagunwa, M. P. and Ojo, F. A. (2015). Nutrient loss during traditional ogi production. *Journal of Chemical and Pharmaceutical Research* 7(12): 246-249.

Citation: Alabere and Adias (2025). Bacteriological and proximate composition of Ogi fermented from *Zea mays*, *Sorghum bicolor* and *Pennisetum glaucum* cereals. *International Journal of Microbiology and Applied Sciences*. *4(2)*: 87 – 94.

Akin, P. A., Sezer, B., Bean, S. R., Peiris, K., Tilley, M., Apaydin, H. and Boyaci, I. H. (2021). Analysis of corn and sorghum flour mixtures using laser-induced breakdown spectroscopy. *Journal of the Science of Food and Agriculture* 101(3): 1076-1084.

Anumudu, C. K., Omeje, F. I. and Obinwa, G. N. (2018). Microbial succession pattern in ogi fermentation. *International Journal of Advanced Research in Biological Sciences* 5(7): 247-251.

Association of Official Analytical Chemists (AOAC) (2023). *Official method of analysis*. 18th Ed. Washington DC.

Bazie, D., Dibala, C. I., Kondombo, C. P., Diao, M., Konate, K., Sama, H., Kayode, A. P. P. and Dicko, M. H. (2023). Physicochemical and nutritional potential of fifteen sorghum cultivars from Burkina Faso. *Agriculture* 13: 675.

Bello, O. O., Bello, T. K., Amoo, O. T. and Atoyebi, Y. O. (2018). Comparative evaluation of microbiological and nutritional qualities of various cereal-based paps (ogi) in Ondo State, Nigeria. *International Journal of Environment, Agriculture and Biotechnology* 3(2): 676-685.

Birhanu, S. (2021). Potential benefits of sorghum (*Sorghum bicolor* L. Moench) on human health: a review. *International Journal of Food Engineering Technology* 5: 8-18.

Cheesbrough, M. (2006). District Laboratory Practice in Tropical Countries. Part 2. Cambridge University Press. 143-157.

Eke-Ejiofor, J. and Beleya, E. A. (2017). Chemical, mineral, pasting and sensory properties of spiced ogi (Gruel). *Journal of Food Science and Technology* 5(5): 204-209.

Ibrahim, A., Bashir, M., Idi, A. and Buhari, H. H. (2021). Proximate analysis, sensory evaluation and production of bread from finger millet and wheat flour. *Bayero Journal of Pure and Applied Sciences* 14(2): 101-107.

Obi, C. N. and Okoronkwo, W. O. (2022). Production, microbiological and proximate analysis of akamu produced from different varieties of maize. *Nigerian Journal of Microbiology* 36(1): 6001-6012.

Okafor, U. I., Omemu, A. M., Obadina, A. O., Bankole, M. O. and Adeyeye, S. A. (2018). Nutritional composition and antinutritional properties of maize ogi co-fermented with pigeon pea. *Food Science and Nutrition* 6: 424–439.

Olaniran, A. F. and Abiose, S. H. (2019). Nutritional evaluation of enhanced unseived ogi paste with garlic and ginger. *Preventive Nutrition and Food Science* 24(3): 248-356.

Olatunde, O. O., Obadina, A. O., Omemu, A. M., Oyewole, O. B., Olugbile, A. and Olukomalya, O. O. (2018). Screening and molecular identification of probiotic lactic acid bacteria in effluents generated during ogi production. *Annals of Microbiology* 68: 433-443.

Omemu, A. M. (2011). Fermentation dynamics during production of ogi, a Nigerian fermented cereal porridge. *Report and Opinion* 3(4).

Prathyusha, N., Lakshmi, V. and Manasa, T. (2021). Review on consumer awareness and health benefits about millets. *The Pharma Innovation Journal* 10(6): 777-785.

Renganathan, V. G., Vanniarajan, C., Karthikeyan, A. and Ramalingam, J. (2020). Barnyard millet for food and nutritional security: current status and future research direction. *Frontiers in Genetics* 11: 500.

Suleiman, R., Rosentrater, K. A. and Bern, C. (2013). "Effects of deterioration parameters on storage of Maize: A Review". *Journal of Natural Sciences Research*, 3(9): 147 –165.

Sweets, L. (2018). "Stored Grain Fungi", Agricultural Electronic Bulletin Board–University of Missouri Extension-CAFNR.

Thilakarathna, R. C. N., Madhusankha, G. D. M. and Navaratne, S. B. (2022). Potential food applications of sorghum (*Sorghum bicolor*) and rapid screening methods of nutritional traits by spectroscopic platforms. *Journal of Food Science* 87(1): 36-51.

Zanariah, U. N., Ordin, N. I. and Subramaniam, T. (2015). Ginger spices and their traditional uses in modern application. *Journal of Industrial Technology* 23(1): 59-70.

Citation: Alabere and Adias (2025). Bacteriological and proximate composition of Ogi fermented from *Zea mays*, *Sorghum bicolor* and *Pennisetum glaucum* cereals. *International Journal of Microbiology and Applied Sciences*. *4(2)*: 87 – 94.