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Antioxidant Properties and Bacterial Load of Ready to Eat Fermented Cassava (Fufu) Sold in Ozoro, Nigeria

Okobia, B.U[1], Okpoghono, J[2]* and Orogu, J.O[1]
[1] Department of Microbiology, Faculty of Science, Delta State University of Science and Technology, Ozoro, Delta State, Nigeria
[2] Department of Biochemistry, Faculty of Science, Delta State University of Science and Technology, Ozoro, Delta State, Nigeria
*Corresponding author's email: okpoghonoj@dsust.edu.ng

Abstract
Ready to eat fermented cassava (fufu) is traditionally produced and consumed in Nigeria and other West African countries. Samples (40) of ready to eat fufu were purchased from different selling spots in Ozoro . The ready to eat fufu were divided into two groups. Group 1 (ready to eat fufu not pre-heated), and Group 2 (ready to eat fufu pre-heated at 60 °C for 45 minutes). Antioxidant properties (total phenol content (TPC), total flavonoid content (TFC), total antioxidant capacity (TAC) and 2,2-diphenyl-1-picrylhydrazyl (DPPH)) radical scavenging assay were determined using standard methods. Also, aerobic bacterial count was determined by counting the colonies on nutrient agar plates. Bacteria isolated were Staphylococcus spp. Escherichia coli, Campylobacter jejuni, Shigella, Closidium spp. Protease spp. and Enterococcus spp. The ready to eat fufu obtained revealed mean bacterial count ranged between 1.4 × 10^5cfu/g and 4.3 × 10^5cfu/g. Pre-heated ready to eat fufu revealed decreased mean bacterial count ranged between 0.4 × 10^5cfu/g and 0.9 × 10^5cfu/g. However, significant increase ($p>0.05$) was observed in TPC, TFC, TAC and DPPH radical scavenging property of ready to eat fufu pre-heated at 60 °C in dose dependent manner. It is advisable that ready to eat fufu should be pre-heated after its normal preparation before consumption. Also, good personal hygiene and sanitation from the handlers of fufu is highly recommended.
Keywords: *Antioxidant, Bacterial load, Cassava, Fufu, Pre-heated, Ozoro*

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1. Introduction

Food that has been commercially pre-made and needs little additional preparation on the part of the consumer is known as convenience food, and it has replaced traditionally cooked cuisine (Łepecka et al., 2022). Presently, there is increase in the demand for ready-to-eat fufu (RTEF) products. One of Nigeria's most popular ready-to-eat staple meals is fufu, a dish prepared from cassava that is especially popular in the southern regions of the country (Ogunoye et al., 2023). Cassava (*Manihot esculenta* crantz) is the staple food crop of over 800 million people in the humid tropics and ranks sixth in terms of overall global crop production (Scaria et al., 2024). It is a perennial woody shrub with an edible root, which grows in tropical and subtropical areas of the world. Cassava is one of the most important food security and income generation crops for many millions of people in the developing world (Parmar et al., 2017). It is one of the most important food staples in the tropics where it is the fourth most important source of energy (Ogunyinka and Oguntuase, 2020). Worldwide, it is the sixth most important source of calories in human diet and other regions (countries) of the tropics, where it serves as one of the basic food sources for about 200-300 million people (FAO, 2020). Over 50% of the cassava grown in Africa is used to make processed goods, accounting for the majority (88%) of cassava utilized for human consumption (Oyewole and Eforuoku, 2019). Most of the time, cassava is eaten processed, made into local dishes including pupuru, lafun, tapioca, fufu, and gari (Ogunyinka and Oguntuase, 2020).

Fufu is an acid-fermented cassava product produced through submerged fermentation of peeled cassava roots in water and consumed in Nigeria, West African Countries and other parts of the world (Chijioke et al., 2021). It is a well-known traditional fermented wet paste food product made from cassava which is typically produced in southern, western, and eastern Nigeria as well as certain other regions of West Africa. The botanical source of cassava, processing methods, and

processors all have an impact on the fufu's quality (Fayemi and Ojokoh, 2012; Bolaji et al., 2021). Prepared, packaged, and sold by street vendors in easily accessible public areas, street foods are sometimes touted as being ready to eat. There are specific health concerns associated with ready-to-eat street food, despite its accessibility and affordability (Abrahale et al., 2018). Even while the street food industry has helped the local economy flourish, food can cause illness and suffering if it is not handled properly because it can get contaminated at any point in the food chain. Vendor mishandling and disdain for hygiene precautions might raise the risk of foodborne illness by letting pathogenic bacteria to grow to a point where the consumer becomes ill (Okojie and Isah, 2019). Since street fufu is ready to eat and does not usually go through further processing, it can be a good vehicle for food borne microbial organism transmission into the body (Omorodion and Beniye, 2023). If it is not handled properly, bacterial such as *Salmonella specie, Staphylococci aureus* and *Escherichia Coli*, which can be conveyed by fufu causes food borne diseases and other food poisoning (Ewanfo et al., 2017; Omorodion and Beniye, 2023). Poor personal hygiene, and improper cooking temperatures can all be primary sources of these bacteria. Fufu is typically highly contaminated or more likely to become contaminated before consumption (Adegbehingbe et al., 2019). Sources and practices that can introduce contaminants to fufu include flies and other insect pests perching on exposed parts. These can result in changes to the product's quality, taste, form, and smell as well as a decrease in its safety and satisfaction (Ogunoye et al., 2023). A diet rich in antioxidants may lower the chance of developing a number of illnesses (Okpoghono et al., 2024a,b), such as malaria, heart disease and several types of cancer (George et al., 2013; Okom et al., 2023; Okonta et al., 2021). Antioxidants prevent or lessen oxidative damage by scavenging free radicals from bodily cells (Ejueyitsi et al., 2024; Onakurhefe et al., 2020; George et al., 2019). This research was required due to safety concerns and the high frequency of food poisoning from ready-to-eat meals. As a result, the goal of this study is to determine the bacterial load and antioxidant characteristics of the ready-to-eat fufu that is sold in Ozoro, Delta State.

2. Materials and methods

2.1. Study area

Ozoro is the headquarters of Isoko north Local Government Area, Delta State. It is situated within 532/18//N and 6º12/58//E. Ozoro is made up of five quarters: Uruto, Erovie, Etevie, Urude and Uramudu. The people of Ozoro share boundaries with Ellu, Oleh, Owhelogbo, and Akiewhe. The two distinct seasons of Ozoro's climate are the rainy and the dry seasons. Ozoro is fast developing with increasing commercial activities, exporting locally produced cash crops to nearby larger cities such as Ughelli, Warri, Sapele, Benin City, Asaba, Lagos and Abuja the capital city of Nigeria. The main economic activity is food crop farming and the staple food crops include cassava and yam. They also engage in trade off food crops for cash to meet other basic needs. Ozoro was used as a preferable study area for this research because it is predominantly a University town occupied by workers and students and they usually prefer going for ready-to-eat meals as it is quick and easily accessible thus making the demand for ready-to-eat foods high in this location.

Fig. 1: Map of Ozoro in Delta State showing sample sites

2.2. Collection of samples

The sample (fufu) was purchased at different locations in the market and campus 2 road, off kwale road Ozoro. The samples were taken to the laboratory for analysis. Ten (10 g) of fufu was homogenized in 5 mL of distilled water. Nine milliliters (9 mL) of water was pipetted into each test-tube, plugged with cotton wool and sterilized in an autoclave. On cooling, the homogenate, serial dilution was carried out on 40 samples in triplicates. The sample was added to a tube and then shaken thoroughly. Thereafter 1ml was transferred to another tube containing 9ml of sterile water. This process was continued for other tubes till the last tube in which 1ml was pipetted from and discarded.

2.3. Inoculation of test plates

Optimally, within 15 minutes after adjusting the turbidity of the inoculum suspension, a sterile cotton swab was dipped into the adjusted suspension. The swab was rotated several times and pressed firmly on the inside wall of the tube above the fluid level. This was to remove excess inoculum from the swab. The dried surface of a Müeller-Hinton agar plate was inoculated by streaking the swab over the entire sterile agar surface. This procedure was repeated by streaking two more times, rotating the plate approximately 60° each time to ensure an even distribution of inoculum. As a final step, the rim of the agar was swabbed. The lid was left for 3 to 5 minutes, but not more than 15 minutes, to allow for any excess surface moisture to be absorbed before applying the drug impregnated disks. Plate counts were carried out after 24-48 hours using the direct colony count method on the agar.

2.4 Gram staining

The microbiological analysis employed in the gram staining technique are as follows: The fixed smear is covered with crystal violet stain for 30-60 seconds. The stain was then washed off with clean water. All the water was typed off and the smear was covered with Lugoi's iodine for 30-60 seconds. Iodine was washed off with clean water. Decolonisation with acetone was done rapidly (in few seconds) and then washed off with clean water. The smear was covered with saffranin and stained for 2 minutes. The stain was then washed off with clean water. The back of the side was wiped clean and placed in a draining rack to air dry. The slide was then examined under the microscope using x 100 oil immersion objective.

2.5 Biochemical analysis

The following biochemical tests were carried out to identify the isolates in accordance with the procedure reported by Cheesebrough (2004) as follows:

Catalase test

This test detects the presence of Catalase enzyme when present in a bacterium, it catalyzes the breakdown of hydrogen peroxide with the release of oxygen as bubbles. Small inoculums were picked from the cultured plate and placed on a glass slide, then hydrogen peroxide (H_2O_2) was droped on it. Immediate production of bubbles indicates positive result.

Motility test

Motility test is use to test for the ability of the organism to move. Nutrient agars Slant were prepared in MacCartney bottles as prescribed by the manufacturer. Using a sterile straight wire, to pick a well isolated colony and stab the medium to within 1cm of the bottom of the tube and then incubate at 37°C for 24h. A positive result indicates a turbid area growing away• from the line of inoculation, a negative result is indicated by no growth along the inoculation line.

Oxidase test

This test determines the presence of oxidase enzymes in the test organism. The reagents contained tetramethyl-p-henylenediamine which served as an alternative substrate for the cytochrome oxidase reaction. A filter paper was placed into a clean petri-dish ‘and impregnate with 1% aqueous solution of nitrotetramethyl-pphenenolin-diaminedihydrochioride. Then loopful inoculums of a pure culture plate were picked up by a sterile wire loop. The inoculum was smeared over the area of the filter paper containing oxidase reagent. Organism indicates positive when it retains the purple coloration within five to ten seconds of the analysis.

Citrate test

The bacterial isolate ‘were tested for their ability to utilize citrate as the sole carbon source. Koser’s citrate medium was used, which is chemically defined for the differentiation of the family *Enterobacteriaceae* group on the basis of citrate utilization. The medium was sterilized and allowed to cool. In the Simmons citrate agar slants, bacterial isolates were inoculated by means of a stab-and-streak technique. Simmons citrate agar slant without the isolates inoculation was used as control. The inoculated tubes of Koser’s citrate medium were incubated at 37°C for 24 hours. The colour change of the slant from green to deep Prussian blue indicates positive reaction and recorded as (+) and the absence of colour change was negative for citrate utilization and recorded as (-).

Indole test

This test demonstrates the ability of certain bacteria to decompose the amino acid tryptophan to indole, which then accumulates in the medium for indole production, peptone water was prepared and sterilized, allowed to cool and was inoculated with a loopful of test organisms which was incubated at 37°C for 48hrs. At the end of incubation, 3 drops of Kovac’s reagent were added and then shaken. A red colour ring at the interface of the medium denotes a positive result.

Triple sugar iron test (TSI)

These was used for identification of enteric organisms based on their ability to liberate sulfide from ammonium sulfate or sodium thiosulde. It involved stab inoculation of the bacteria into the center of the TS1 agar and also rubbing it at the surface to determine the production and incubate at optimal temperature of 37°C for 24 hours. The presence of bubbles indicates gas production while, change of colour from light pink to black indicates hydrogen sulphide production**.**

Total flavonoid assay

Total flavonoid was determined with colourimetric aluminium chloride methods as described by Ebrahimzadeh *et al.* (2008). In a nutshell, 0.5 mL of sample was mixed with 1.5 mL of methanol, 0.1 mL of 10% aluminum chloride, 0.1 mL of 1 M potassium acetate, and 2.8 mL of distilled water, and then kept at room temperature for 30 minutes. The absorbance was measured against blank at 415 nm.

Total phenolic content

The determination of total phenolic content was carried out according to the method described by Dewanto*et al.* (2002). Zero point five millilitres (0.5 ml) of the sample was dissolved in 100 µl of Folin-Ciocalteau reagent and 6 ml of distilled water. It was vortexed for 1 minute, and 2 ml of 15% Na_2CO_3 was added and the mixture vortexed once again for thirty seconds (30 seconds). The solution was made up to 10 ml with distilled water. After 1 hour, 30 minutes, the absorbance of the samples were read at 750 nm with a UV spectrophotometer. Gallic acid solution was used for the preparation of calibration curve. Total phenolic contents of samples were expressed as milligrams of gallic acid equivalent (mg GAE)/100 g of dry weight.

2,2-diphenyl-1-picrylhydrazyl (DPPH)

The free radical scavenging ability of the sample extracts against DPPH (2,2-diphenyl-1-picrylhydrazyl) free radical was estimated using the method described by Ursini *et al*. (1994). The sample (50 µg) was diluted with 3 ml ethanol and mixed with 3 ml DPPH solution. The reaction mixture was shaken, and then incubated in dark for 30 minutes. The absorbance of the solution was measured against a blank at 517 nm.

Total antioxidant capacity (TAC)

Total antioxidant capacity in the samples were estimated by the method described by Prieto *et al*. (1999). The sample (0.1 mL) was added to 1 mL of reagent solution (28 mmol/L Na_3PO_4, 4 mmol/L ammonium molybdate and 0.6 mol/L H_2SO_4) in test tubes. The tubes were incubated in a thermal block at 95ºC for 90 min. The mixture was allowed to cool at room temperature. The absorbance was measured at 695 nm against blank. Antioxidant capacity was stated as mg gallic acid equivalent per gram dry weight (mg GAE/g DW).

3. Results

3.1. Bacterial load of ready to eat fufu

The names and total number of microorganisms isolated from ready to eat fufu are shown in Table 1. The total number of microorganisms isolated from ready to eat fufu had the occurrence of 3 to 1. Total plate count at dilution of 10^{-4} results are shown in Table 2. The ready to eat fufu obtained revealed mean bacterial count ranged between 1.4×10^5cfu/g and 4.3×10^5cfu/g. Pre-heated ready to eat fufu revealed decreased mean bacterial count ranged between 0.4×10^5cfu/g and 0.9×10^5cfu/g. Table 3 presented the various biochemical test identification of microorganisms present in ready to eat fufu sold in Ozoro. Possible microorganism found in various biochemical test identification includes: *Staphylococcus spp, Streptococcus spp, Escherichia Coli, Campylobacter jejuni, Shigella, Clostridium spp, Proteus spp* and *Enterococcus spp*.

Table 1: Names and total number of microorganisms isolated from ready to eat fufu

Organism	Number of Occurrence
Staphylococcus spp	3
Streptococcus spp.	2
Escherichia Coli	2
Campylobacter jejuni	1
Shigella	1
Clostridium spp	2
Proteus spp	3
Enterococcus spp	2

Table 2: Total plate count at dilution of 10^{-4}

Samples	Bacterial count ($X10^5$cfu/g.)	
	Ready to eat fufu not pre-heated	ready to eat fufu pre-heated at 60 °C for 30 minutes
1	2.7	0.7
3	2.5	0.7
3	2.3	0.5
4	1.6	0.6
5	2.1	0.7
6	2.6	0.6
7	1.4	0.4
8	3.3	0.9
9	2.1	0.4
10	4.3	0.8
11	2.1	0.5
12	3.1	0.8
13	2.4	0.5
14	2.6	0.7
15	1.5	0.5
16	2.2	0.6
17	2.4	0.4
18	2.6	0.8
19	1.5	0.5
20	2.2	0.9

Table 3: Various biochemical test identification of microorganisms present in ready to eat fufu sold in Ozoro market.

Samples	Gramstain	Shape	Catalase	Indole	Motility	Citrate	Oxidase	Acid	H_2S	Possible micro organism
1	-	Rod	+	+	-	+	+	+	+	*Shigella*
3	+	Rod	+	+	+	+	+	+	+	*Clostridium spp*
3	-	Rod	+	+	-	+	+	-	+	*Proteus spp*
4	+	Rod	+	+	-	+	+	-	+	*Clostridium spp*
5	-	Rod	+	+	-	-	-	-	-	*Proteus spp*
6	-	Rod	+	+	+	-	-	+	-	*Campylobacter jejuni*
7	-	Rod	+	+	-	+	-	-	-	*Escherichia Coli*
8	+	Cocci	+	+	-	+	-	-	-	*Staphylococcus spp*
9	+	Cocci	+	+	-	-	-	-	+	*Streptococcus pyogen*
10	+	Cocci	-	+	-	-	-	+	+	*Streptococcus pyogen*
11	-	Rod	-	+	-	+	-	-	+	*Escherichia Coli*
12	+	Cocci	-	+	-	+	-	-	+	*Staphylococcus spp*
13	+	Cocci	-	+	-	+	-	+	+	*Enterococcus spp*
14	-	Rod	+	+	-	+	+	-	+	*Proteus spp*
15	+	Cocci	+	+	-	-	+	-	+	*Enterococcus spp*
16	+	Rod	+	+	-	+	+	+	-	*Staphylococcus spp*
17	+	Cocci	-	+	-	+	-	+	+	*Streptococcus pyogen*
18	-	Rod	+	+	-	+	+	-	+	*Proteus spp*
19	+	Cocci	+	+	-	-	+	-	+	*Enterococcus spp*
20	+	Rod	+	+	-	+	+	+	-	*Proteus spp*

Key: present (+), Absent (-)

3.2. Antioxidant properties of ready to eat fufu

Antioxidant properties of fufu pre-heated and not pre-heated are presented in Tables 4 to 7. There were no significant differences in TPC, TFC, DPPH radical scavenging activity and TCA of ready to eat fufu not pre-heated when compared to ready to eat

fufu pre-heated at 60 °C for 30 minutes. However, as the concentration of treated samples (100-400 µg/mL**)** increase, the antioxidant content increases.

Table 4: Total phenol content (TPC) of fufu pre-heated and not pre-heated

	TPC(mg of GAE/g dw)	
Concentration (µg/mL)	fufu not pre-heated	fufu pre-heated at 60 °C for 30 minutes
100	148.65 ± 23.35 [a]	150.50 ± 21.34[a]
200	164.25 ± 34.39 [b]	165.50 ± 34.09[b]
300	176.30 ± 32.17 [c]	180.40 ± 21.12[c]
400	197.10 ± 22.25 [d]	200.00 ± 42.14[d]

Triplicate values are presented in mean ±SD. Values with different superscript differ significantly at p>0.05

Table 5: Total flavonoid content (TFC) of fufu pre-heated and not pre-heated

	TFC (mg of rutin/g dw)	
Concentration (µg/mL)	fufu not pre-heated	fufu pre-heated at 60 °C for 30 minutes
100	230.20 ± 24.90 [a]	228.30 ± 34.40 [a]
200	254.10 ± 18.05 [b]	250.60 ± 58.15 [b]
300	267.05 ± 56.40 [c]	260.50 ± 42.50 [c]
400	299.30 ± 37.07 [d]	295.40 ± 39.57 [d]

Triplicate values are presented in mean ±SD. Values with different superscript differ significantly at p>0.05

Table 6: DPPH radical scavenging assay of fufu pre-heated and not pre-heated

	DPPH radical scavenging assay (%)	
Concentration (µg/mL)	fufu not pre-heated	fufu pre-heated at 60 °C for 30 minutes
100	51.57 ± 9.23 [a]	50.52 ± 5.45[a]
200	66.20 ± 11.55 [b]	62.67 ± 21.24 [b]
300	76.50 ± 15.75 [c]	72.35 ± 21.15 [c]
400	84.19 ± 12.90 [d]	80.16 ± 22.10 [d]

Triplicate values are presented in mean ±SD. Values with different superscript differ significantly at p>0.05

Table 7: Total antioxidant Capacity (TAC) of fufu pre-heated and not pre-heated

	TAC (mg of GAE/g dw)	
Concentration (µg/mL)	fufu not pre-heated	fufu pre-heated at 60 °C for 30 minutes
100	845.86 ± 56.90 [a]	840.80 ± 103.10 [a]
200	863.51 ± 78.37 [b]	860.65 ± 88.45 [b]
300	880.44 ± 73.45 [c]	878.18 ± 59.82[c]
400	899.58 ± 107.75 [d]	894.54 ± 89.70 [d]

Triplicate values are presented in mean ±SD. Values with different superscript differ significantly at p>0.05

4. Discussion

Table 1 shows the results for microbial load ready-to-eat fufu sold in Ozoro market. From the result obtained, the following micro-organisms such as *Staphylococcus spp* with the occurrence number of three (3), *Streptococcus* with the occurrence number of two (2), *Escherichia Coli* with the occurrence number of one (1), *Clostridium spp* with occurrence number of two (2), *Proteus spp* with occurrence number of two (2) and *Enterococcus spp* with occurrence number of two (2) were present in ready to eat fufu sold in Ozoro market. Ready-to-eat foods have been known to be contaminated by foodborne bacteria, which use them as entry points into the human body (Makinde et al., 2020) and a variety of foodborne ailments, including dysentery, typhoid fever, diarrhea, and gastroenteritis, can result from coming into contact with these pathogenic germs (Makinde et al., 2023). The presence of *Staphylococcus spp* could be due to contamination from the skin, mouth or nose of the handlers or hawkers since it is a member of normal flora of the skin though the percentage of the isolate is high, this does not portray a serious concern since the temperature of most of the fufu is raised before final consumption. The presence of *Escherichia Coli* in the ready to eat fufu indicates that such fufu has been contaminated with feacal material either through water or during the production process and such fufu might not be safe for human consumption. The presence of *Proteus spp* also indicates the possibility of faecal contamination of micro-organism as previously reported (Omorodion and Beniye, 2023).

The presence of *Shigella*, *Campylobacter jejuni*, *Clostridium spp*, *Enterococcus spp* found in fufu has a potential health risk as these organisms are pathogenic and have been implicated in food-borne disease. Hence Makinde at al. (2023) suggested that it is mandatory that fufu must be free from contamination as much as possible. Previous reports with bacterial counts $>10^4$ CFU per gram in RTE fufu, which indicate dangerous food contamination levels that potentially pose serious health concerns to consumers of these items, support the findings of the current investigation (Ogunoye et al., 2023)

Phytochemicals called flavonoids can be found in a wide variety of plants, tubers, fruits, vegetables and leaves (Omoike et al., 2022; Okpoghono, 2024; Okpoghono et al..2023a; Ugwu et al., 2021). They might be employed in medicinal chemistry (Okpoghono et al., 2024a). The bioactive components of processed cassava products (fufu, lafun, and gari) have been reported to be affected differently by various processing techniques (Kareem et al., 2022). According to this study, the usage of processing methods like boiling and fermenting may be the cause of the fufu's increased levels of total phenolics and lower levels of total flavonoids. A reduction in the total amount of flavonoids upon heating at a specific temperature suggests that some flavonoids were likely eliminated. Nevertheless, there was a rise in total phenolics. Flavonoids are dimers or oligomers that include C-glycoside linkages. When they undergo industrial processing, such as boiling or heating, the hydrolysis of the C-glycoside bonds produces monomers (Sharma et al., 2015). The outcome suggests that the rise in total phenolics upon heating is caused by phenolic compounds in fufu, which are either released by the cleaving of the esterified and glycosylated bond or by the creation of Maillard reaction products (Maillard et al., 1996). On the other hand, far-infrared therapy, is said to be able to break the connection between covalently bonded phenolic compounds; the specific species of the

phenolic chemical will determine its distinct bound status (Lee et al., 2003).

The ability of fufu to scavenge 2,2-diphenyl-1-picrylhydrazyl (DPPH) when heated beforehand is an indicative of its antioxidant and free radical-scavenging potential. Similar to this, earlier research has demonstrated that cassava products (lafun, fufu, and gari) may scavenge DPPH• and ABTS•$^{+}$, suggesting that they may be able to stop the generation of free radicals in cells and absorb them when ingested (Kareem et al., 2022). The total antioxidant activity and DPPH for the fufu samples were reduced at 60°C, compared to unheated samples. The fufu that had not been heated beforehand had the least antioxidant activity in both tests. The loss of antioxidants or the emergence of substances with pro-oxidant properties may result in a decline in antioxidant activity (Ejueyitsi et al., 2022; Ejueyitsi et al., 2023; George and Okpoghono, 2017; Otuaga et al., 2020a, b). The initial antioxidant state may be improved by modifications to the structures of the known antioxidants and the synthesis of new antioxidant components (Okpoghono et al., 2018; Sharma et al., 2015). According to earlier research by Manzocco et al. (2001), heating enhances antioxidant activity due to the enhancement of the antioxidant properties of naturally occurring compounds or the formation of novel compounds like Maillard reaction products that have antioxidant activity. This suggests that heating fufu does not result in a drastic loss of antioxidant values. But according to a prior study, heating most foods to 65°C or 100°C dramatically lowers their antioxidant activity, with the exception of those containing allium species (Yin et al., 1998).

5. Conclusion

The results obtained from the microbial load of ready to eat fufu sold in Ozoro market shows the presence of microorganisms such as *Staphylococcus spp*, *Streptococcus*, *Escherichia Coli*, *Campylobacter jejuni*, *Shigella*, *Clstridium spp*, *Proteus spp* and *Enterococcus spp*. The *Staphylococcus spp* and *Proteus* had the higher number of occurrences of three (3) each. The presence of this microorganisms present in ready to eat fufu indicates the possibility of fecal contamination. It is therefore advisable that ready to eat fufu should be avoided or reheated or boiled after its normal preparation before consumption.

Authors' contributions

OBU designed the work. OJO performed the laboratory tasks and generated results. OJ analyzed the results, OJ and OBU wrote the draft manuscript, OJ, OBU and OJ critically revised and vetted the draft manuscript. All authors endorsed the manuscript for submission.

Conflict of interest

The authors declare no potential conflicts of interest.

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