Evaluation of microbial quality of conventionally and mechanically processed fufu in Kumasi Metropolis

Abstract

Aim: The studyaimed at the evaluation of microbial quality of conventionally (CV) and mechanically (MC) processedfufu samples in Kumasi Metropolis in Ghana.

Study design: The study used 2 x 2 x 5 experimental design

Materials and Methods: Ten (10) samples of fufu and water used during processing were collected and analyzed.

Place and Duration of study: The study was carried out in in Kumasi Metropolis in Ghana, betweenMarch 2021 to April 2024

Results: The total mesophilic/aerobic bacteria in conventional and mechanical ranged from 5. 2×10^7cfu/g to 4.5×10^8cfu/g and 5. 4×10^7cfu/g to 1.35×10^8cfu/g respectively. The total mesophilic/aerobic of water was 9.7×10^6cfu/ml – 1.35×10^9cfu/ml (CV) and 1.53×10^6cfu/ml – 6.3×10^8cfu/ml (MC).The total coliform counts ranged from 6.1×10^6 cfu/g to 3.7×10^7cfu/g for conventionally produced fufu and from 6.5×10^6 cfu/g to 5.6×10^7cfu/g for mechanically produced fufu.The total coliform in water were 5.3×10^6cfu/ml – 1.28×108cfu/ml (CV) and 6.9×10^6cfu/ml – 3.5×10^7cfu/ml (MC).The faecal coliform in fufu were4.5×10^4 to 5.8×10^6 cfu/g (CV)and 9. 4×10^4 to 4.7×10^6 cfu/g (MC).The faecal coliforms in the water ranged from 4.1×105cfu/g – 8.4×106cfu/g (CV)and 6.3×10^4 cfu/g and 7.5×10^6 cfu/g (MC).Staphylococcus aureus count ranged from 5.7 x 10^4 -5.5 x 10^5 cfu/g for conventional and 9.5x 10^3 -5.9x10^5 cfu/g for mechanically processed fufu.The *Staphylococcus aureus*count in water used for conventional and mechanical processing ranged from 3.8×10^3cfu/g to 3.2×10^5cfu/g and 3. 4×10^3cfu/g to 6.4×10^4cfu/g respectively. The yeast counts for conventional and mechanicalwere 8.1×10^5cfu/g-8.3×10^6cfu/g, and 1.3×10^3cfu/g-5.8×10^6cfu/g respectively. The yeast count of water samples were 8.5×10^6cfu/g-4.6×10^7cfu/g (conventional) and 9.4×10^2cfu/g-6.5×10^6cfu/g (mechanical).

Conclusion: The research has demonstrated that fufu prepared by both conventional and mechanized process within Kumasi metropolis contain high microbial load are unsafe for human consumption. As a result, when processing fufu, appropriate hygienic conditions are required.

Keywords: microbial quality, fufu, Kumasi , cassava, food safety

Introduction

Fufu is a staple dish in western and central Africa that is thought to have generated from Akan people in Ghana[1].The majority of Ghanaians eat fufu" as a staple food especially the Akans. Fufu is typically processed in Ghana using two primary techniques, mechanical and convectional. Fufu is traditionally made by boiling unripe mature plantains, cassava,

cocoyams or yamsuntil they are tender[2][3].After thetubers or plantains are cooked, they are crushed with a pestle and mortar, turning them over and over with wet hands until the mixture forms a dough [2].Ordinarily, one person stands and mechanically uses the pestle to pound the cooked ingredients in the mortar in rhythmic strokes, while the other person turns the ingredients in the mortar, with wet hands and intermittently adds water to form the "fufu" dough[4][1]. This is a time-consuming and hard operation, particularly if it needs to be prepared commercially or in large quantities. This resulted in the creation of the automated fufu processing method (using fufu machine), which requires less labour than the conventional approach[5].The components of the fufu machine include the electric motor, shaft, trough, pulleys, propellers (yam beater), and a frame with vents to allow for proper cooling of the machine while it is in use.The fufu milling machine receives the cooked roots or tubers through an automated process. The fufu is subsequently mechanically processed by the mill and extruded as a dough. The extruded dough is briefly pounded and formed into balls for eating [2]. The prepared fufu is typically served with the soup of choice and the safety and quality of fufu is largely dependent on the hygienic practices of the producers. It is particularly perishable because it is often offered in the wet form (moisture content of roughly 50%)[6]. Studies on the microbiological quality of different street foods have been conducted in Ghana. The use of hands, utensils, and the environment or the water used to moisten hands when processing fufu can be a source of contamination for ‘fufu’[7]. These could inevitably lead to modifications in the food product's texture, taste, look, and fragrance, as well as a decline in its acceptability and safety[6].Mechanized fufu processing has become common in Ghana's cities, and most people choose to use it instead of the more antiquated pestle and mortar approach [1].A comparative to evaluate whether the mechanized processing of fufu will improve microbial load is therefore very essential. This study therefore aimed at the evaluation of the microbial quality of fufu samples from conventionally and mechanically prepared in Kumasi Metropolis in Ghana.

Materials and Methods

Study Area

The study was carried out in the Kumasi Metropolis (Kejetia) of the Ashanti region of Ghana, West Africa

Sampling and Preparation

Ten (10) samplesof fufu and water used during processing were obtained from ten different fufu sellers (5 conventional & 5 mechanical) within the Kumasi Metropolis (Kejetia) of the Ashanti region.The fufu samples were collected into sterile Zip-lock bags using a sterile spatula which was sterilized with 70% ethanol prior to sampling. The water samples were collected into sterile sampling bottles, sealed and labelled accordingly. The fufu and water samples were transported with ice to the Microbial Biotechnology laboratory of the Department of Biochemistry, KNUST.

Microbial Analysis

Serial dilution

For all the samples, 5 grams were added to 45ml sterile peptone water and homogenized in a stomacher (Lad Blender, Model 4001, Seward Medical, England), for 30 s at normal speed. One millilitre aliquot of each dilution, prepared using suitable ten-fold dilutions, was directly inoculated into sterile Petri dish containing Mannitol Salt Agar, MacConkey agar, Plate Count agar and Potato Dextrose Agar and spread.

Enumeration of Total Aerobic Count (TAC), Total Coliform Count (TCC), *Staphylococcus aureus* and Yeast and Mould Count

Aerobic bacteria were enumerated by the spread plate method on Plate count agar (PCA)(Oxoid CM325; Oxoid Ltd., Basingstoke, Hampshire, UK). The plates were incubated at 37 ºC for 48 hrs.Total coliforms and E. coli were determined using the spread plate technique on MacConkey agar. The plates were incubated at 37 ºC for 48 hrs. The appearance and color of coliforms were used to differentiate lactose fermenters from non lactose fermentors. The red colonies, which are lactose fermenters, were counted as suspected Escherichia coli. Klebsiella pneumoniae and Enterobacter species were eliminated by looking for colonies with a smooth texture. *Staphylococcus aureus* was determined by spread plate method on Mannitol Salt Agar (Oxoid Ltd, Hampshire, England). The plates incubated at 37 ºC for 24 hours. The number of yellow colonies wereenumerated as *Staphylococcus aureus* and pink colonies were enumerated as *Staphylococcus epidermidis*. Yeasts and moulds were enumerated by the spread plate technique on a fresh potato dextrose agar plate. The plates were incubated at 25 °C for a week. The yeast cells were separated from moulds by looking at their unique shapes on a flat dish called an agar plate. The number of yeast and moulds found on the plates were counted and the CFU (colony forming units) were calculated.

Characterization and Identification of Bacteria Isolates from Fufu

The isolates were identified by looking at their tiny features under a microscope and also by testing some of their chemical traits. The bacteria were isolated and identified using standard microbiological methods such as the catalase test,potassium hydroxide test, and Gram stain [8]. All of the isolated fungus were identified using standard methods.

Statistical Analysis

The mean and standard deviation of the microbial count were subjected to analysis using SPSS version 23 and Microsoft Excel.

Results

Microbial Quality and Safety of Fufu Samples

Total Mesophilic/Aerobic Bacteria Contamination of Fufu Samples

The amount of total mesophilic/aerobic bacteria in conventional and mechanical ranged from 5. 2×10^7cfu/g to 4.5×10^8cfu/g and 5. 4×10^7cfu/g to 1.35×10^8cfu/g respectively (Table 1.0). This results is in agreement with that reported byAdegbehingbe [6] who reported a total bacterial count (3.43 x 10^6 to 5.3x10^6 cfu/g) of fufu which exceeded the acceptable limit of 1.0×10^5cfu/g for ready to eat food [9][10].There was no significant difference (*P=.05*) in the bacterial load of both conventional and mechanically processed food. This study indicates that the bacterial load of both conventional and mechanically processed fufu were above the required standards. Annan et al. (2018) also reported an unsatisfactory bacterial load (6.8 x 10^5-2.2 x 10^6) in conventionally processed fufu and a borderline bacterial load(3.4 x 10^3-4.3 x 10^4 cfu/g) for mechanically processed fufu.The processing technique, the quality of the water

utilized in the production process, and the duration of exposure during sale could all be contributing factors to the discrepancy in the microbial count between these investigations. The findings of the study indicated high levels of mesophilic bacterial contamination in the water samples used by both conventional and mechanical fufu service providers. The detected levels of contamination 9.7×10^{6}cfu/ml – 1.35×10^{9}cfu/ml and 1.53×10^{6}cfu/ml – 6.3×10^{8}cfu/ml for the conventional and mechanical processing respectivelyexceed the safe and acceptable limits for mesophilic bacteria (5.0×102cfu/ml) in portable water .This confirms that the quality of water used during the preparation of fufu was a source of contamination. There was no statistically significant difference (*P=.05*) in the bacterial load of water used for both conventional and mechanically processed fufu, although the bacterial load in the water used by the conventional method was higher than that of the mechanical process (Table 1.0).

Table 1.0Total aerobic/mesophilic count of fufu and water samples from conventional and mechanical processing

Vendors	Fufu samples(cfu/g)		Water Samples(cfu/g)	
	Conventional	Mechanical	Conventional	Mechanical
1	$9.4\text{x } 10^{7}\pm0.8^{a}$	$1.3\text{x } 10^{8}\pm0.1^{d}$	$1.0\text{x } 10^{9}\pm0.2^{c}$	$1.5\text{x } 10^{6}\pm0.3^{a}$
2	$5.2\text{x } 10^{7}\pm0.3^{a}$	$1.1\text{x } 10^{8}\pm0.3^{c}$	$9.4\text{x } 10^{7}\pm0.5^{ab}$	$7.0\text{x } 10^{7}\pm0.2^{b}$
3	$8.2\text{x } 10^{7}\pm0.1^{a}$	$7.8\text{x } 10^{7}\pm0.2^{b}$	$1.3\text{x } 10^{8}\pm0.1^{b}$	$6.3\text{x } 10^{8}\pm0.5^{c}$
4	$4.5\text{x } 10^{8}\pm0.3^{c}$	$6.3\text{x } 10^{7}\pm0.1^{a}$	$4.3\text{x } 10^{7}\pm0.2^{a}$	$9.3\text{x } 10^{7}\pm0.1^{b}$
5	$3.7\text{x } 10^{8}\pm0.4^{b}$	$5.4\text{x } 10^{7}\pm0.3^{a}$	$5.2\text{x } 10^{7}\pm0.4^{a}$	$1.1\text{x } 10^{7}\pm0.2^{a}$

Data expressed as mean ±SD.
Means bearing different superscripts in the same column are significantly different (*P=.05*).

Total Coliform Contamination Levels of Fufu

The total coliform counts of the fufu samples ranged from 6.1×10^{6} cfu/g to 3.7×10^{7}cfu/g for conventionally produced fufu and from 6.5×106 cfu/g to 5.6×10^{7}cfu/g (Table 2) for mechanically produced fufu which was hugher than the required amount of 1.0×10^{2}cfu/g [9].There was a statistically significant difference between total coliform counts of the fufu samples produced conventionally and those produced mechanically(*P=.05*) This results was similar to work done by Annan [2], who reported the total coliform range of 1.4×10^{3}-3.1×10^{4} cfu/gand 9.7×10^{1}-4.1×10^{2} cfu/g for conventional and mechanically produced fufu respectively which was above the required limit. Akoma [11] also reported the presence of *Klebsiella sp.* and *Pseudomonas sp.* in fufu samples. Coliform is employed as a hygiene indication; if it is found in food or water, it means that hygiene standards were not met during preparation[12].This designates as hazardous and unsanitary for human consumption all of the fufu samples collected during the study. Since the majority of these coliforms are known to be pathogenic, levels of coliform contamination far above the acceptable limit and should be taken seriously as a health hazard. The detected coliform contamination levels were 5.3×10^{6}cfu/ml – 1.28×10^{8}cfu/ml for the water from conventional fufu and 6.9×10^{6}cfu/ml – 3.5×10^{7}cfu/ml for the water used for mechanical fufu production. Although the coliform load in the water used for the mechanical fufu were lower than that of the conventional, there were no statistically significant difference between them (*P=.05*).

Table 2. Total Coliform levels of fufu and water samples from conventional and mechanical processing

Vendors	Fufu samples (cfu/g)		Water Samples(cfu/g)	
	Conventional	Mechanical	Conventional	Mechanical
1	$9.5x\ 10^5 \pm 0.1^a$	$3.5x\ 10^7 \pm 0.6^a$	$5.3x\ 10^6 \pm 0.3^a$	$6.9x\ 10^6 \pm 0.5^a$
2	$6.3x\ 10^6 \pm 0.4^a$	$5.6x\ 10^7 \pm 0.2^b$	$1.2x\ 10^8 \pm 0.2^b$	$3.6x\ 10^7 \pm 0.3^d$
3	$3.7x\ 10^7 \pm 0.5^b$	$4.7x\ 10^7 \pm 0.4^c$	$4.5x\ 10^7 \pm 0.5^c$	$1.0x\ 10^7 \pm 0.2^{bc}$
4	$8.4x\ 10^6 \pm 0.2^a$	$6.5x\ 10^7 \pm 0.3^d$	$3.9x\ 10^7 \pm 0.3^c$	$1.1x\ 10^7 \pm 0.1^c$
5	$6.0x\ 10^6 \pm 0.4^a$	$6.6x\ 10^6 \pm 0.1^e$	$1.2x\ 10^7 \pm 0.4^d$	$8.7x\ 10^6 \pm 0.3^{ab}$

Data expressed as mean ±SD.
Means bearing different superscripts in the same column are significantly different (*P=.05*).

Faecal *Coliform* Contamination of Fufu

The faecal coliform in the conventionally pounded fufu(4.5×10^4 to 5.8×10^6cfu/g) were higher than that of the mechanically milled fufu(9. 4×10^4 to 4.7×10^6cfu/g).There was no statistically significant difference between the faecal coliform of both conventioanlly processed fufu and mecchanically processed ones(*P=.05*).The findings of this study was similar to work done by Annan [2], who also reported the sameto machine-processed fufu (0-1.6. 4×10^1cfu/g) traditional fufu typically showed higher rates (1. 4×10^2 cfu/g-8. 3×10^3) of faecal coliforms.The detected levels of faecal coliforms in the fufu samples from both conventional and mechanical processing were significantly high and exceeded the safe and acceptable limit of 20 - <100cfu/g [10]. The findings of the study also indicated the presence of some faecal coliforms in the water used by both methods (conventional; 4.1×10^5cfu/g – 8.4×10^6cfu/g and mechanical 6.3×10^4cfu/g and 7.5×10^6cfu/g). However, some fufu milling machine operators recorded nofaecal coliform contamination in both fufu and water samples which is indicative of relatively better hygienic conditions and relatively better water microbial quality at those facilities(Table 3).

Table 3: Feacal Coliforms levels in fufu and water samples

Vendors	Fufu samples (cfu/g)		Water Samples (cfu/g)	
	Conventional	Mechanical	Conventional	Mechanical
1	$4.4x\ 10^5 \pm 0.5^a$	0.0	$4.4x\ 10^5 \pm 0.6^a$	0.0
2	$5.8x\ 10^6 \pm 0.3^b$	0.0	$8.4x\ 10^6 \pm 0.5^b$	$6.8x\ 10^6 \pm 0.4^b$
3	$5.3x\ 10^6 \pm 0.2^b$	$9.4x\ 10^4 \pm 0.2^a$	0.0	0.0
4	$4.5x\ 10^4 \pm 0.6^a$	$4.7x\ 10^6 \pm 0.4^b$	0.0	$7.6x\ 10^6 \pm 0.2^c$
5	$2.0x\ 10^5 \pm 0.5^a$	$4.4x\ 10^6 \pm 0.5^b$	$4.1x\ 10^5 \pm 0.4^a$	$6.3x\ 10^4 \pm 0.3^a$

Data expressed as mean ±SD.
Means bearing different superscripts in the same column are significantly different (*P=.05*)

Contamination of Fufu and Water by *Salmonella typhi*
The results of the *Salmonella* test in this study showed that there were no Salmonella bacteria found in any of the fufu and water samples. This research shows that the machines, tools, and water used in making fufu are safe and do not contain *Salmonella* bacteria.

Contamination levels of *Staphylococcus aureus* fufu and water
Conventionally processed fufu recorded *Staphylococcusaureus* count ranging from 5.7×10^4 -5.5×10^5 cfu/g and mechanically processed fufu recorded *Staphylococcus aureus*count from $9.5x\ 10^3$ -$5.9x10^5$ cfu/g. There was no statistically significant difference in the *Staphylococcus aureus*

count of between the conventionally and mechanically processed fufu(*P=.05*).This differs from work done by Annan [2] who describe the *S. aures* count of traditionally processed fufu ($1.5x10^2$-2.0 $x10^3$cfu/g) and mechanically processed ones (0-8.9 $x10^2$cfu/g) as borderline (20-$\leq 10^4$) .Another study by Akoma [11]and Ewanfo [13]reported the presence of *Staphylococcus aureus* in fufu samples in Lokoja and Benin market respectively.Food poisoning can occur when a food handler contaminates food or from surfaces and equipment that the food comes into contact with. Staphylococcus aureus is a common bacteria that can be found on the skin, hair, noses, and throats of people and animals [2].Furthermore, because fufu is typically stored at room temperature, these bacteria multiply quickly and may produce toxins at concentrations of $>10^5$ cfu/g, which can cause foodborne disease [14]. *Staphylococcus aureus* in both conventional and mechanical fufu are classified as unsatisfactory ($>10^4$cfu/g), however, fufu that was mechanically processed had a higher microbiological quality than fufu that was made the conventional one.The amount of *Staphylococcus aureus* in water used for conventional and mechanical processing ranged from 3.8×10^3cfu/g to 3.2×10^5cfu/g and 3. 4×10^3cfu/g to 6.4×10^4cfu/g respectively. *Staphylococcus aureus* in the water used for conventional processed fufu are classified as unsatisfactory ($>10^4$cfu/g) whereas the *Staphylococcus aureus*count in mechanically processed fufu are classified as borderline (20-$\leq10^4$ cfu/g)[10]. There was no statistically significant difference in the *Staphylococcus aureus* count of water used for conventionally and mechanically processed fufu.(*P=.05*).

Table 4. Levels of *Staphylococcus aureus* fufu and water samples

Vendors	Fufu samples (cfu/g)		Water Samples (cfu/g)	
	Conventional	Mechanical	Conventional	Mechanical
1	$3.2x\ 10^5\pm0.4^{ab}$	$1.1x\ 10^5\pm0.1^{c}$	$9.3x\ 10^4\pm0.2^{b}$	$3.5x\ 10^4\pm0.5^{ab}$
2	$5.7x\ 10^4\ \pm0.2^{a}$	$5.9x\ 10^5\pm0.3^{d}$	$3.2x\ 10^4\pm0.5^{a}$	$6.9x\ 10^4\pm0.2^{b}$
3	$1.1x\ 10^5\pm0.3^{a}$	$1.2x\ 10^5\pm0.2^{c}$	$3.2x\ 10^5\pm0.1^{c}$	$3.4x\ 10^3\pm0.3^{a}$
4	$5.5x\ 10^6\pm0.2^{c}$	$7.0x\ 10^4\pm0.1^{b}$	$3.3x\ 10^4\pm0.2^{a}$	$4.1x\ 10^5\pm0.1^{c}$
5	$4.6x\ 10^5\pm0.3^{b}$	$9.5x\ 10^3\pm0.3^{a}$	$3.8x\ 10^3\pm0.4^{a}$	$6.3x\ 10^4\pm0.2^{b}$

Data expressed as mean ±SD.
Means bearing different superscripts in the same column are significantly different (*P=.05*)

Contamination levels of Yeast and Moulds in fufu and water

The recorded yeast counts exceeded the acceptable limit 1.0×10^3cfu/g in both fufu (Conventional:8.1×10^5cfu/g-8.3×10^6cfu/g, mechanical 1.3×10^3cfu/g-5.8×10^6cfu/g) and water samples (Conventional: 8.5×10^6cfu/g-4.6×10^7cfu/g, mechanical 9.4×10^2cfu/g-6.5×10^6cfu/g) obtained from the vendors using both conventional pounding and mechanized milling (Tabel 5 and 6). There was no statistically significant difference in the yeast count of the fufu from the traditional and mechanized methods(*P=.05*) however, there was a statistically significant difference in the yeast count of the water from the traditional and mechanized methods(*P=.05*).The outcome of the assay indicated only 1(10%) of the fufu samples recorded mould colonization with mean count of 7.0×10^1cfu/g which came from a sample from the mechanized mills. There was no statistically significant difference in the mould count of the fufu from the traditional and machine methods, however, there was a statistically significant difference in the mould count of the water from the traditional and machine methods. The amount of moulds found in the fufu and water used for processing was lower than the safe limit of 1. 0×10^3cfu/g. *Aspergillus niger* was themouldisolated and is not harmful to consumers.The ability of moulds to generate spores makes them ubiquitous environmental pollutants. Their appearance in the fufu samples utilized in this investigation may have been due to this [6].

Table 5. Contamination levels of yeast in fufu and water from conventional and mechanized processing

Vendors	Fufu samples (cfu/g)		Water Samples (cfu/g)	
	Conventional	Mechanical	Conventional	Mechanical
1	$1.0x\ 10^{6}\pm0.5^{a}$	$5.8x\ 10^{6}\pm0.1^{d}$	$3.4x\ 10^{7}\pm0.3^{b}$	$9.4x\ 10^{1}\pm0.3^{a}$
2	$1.1x\ 10^{6}\pm0.2^{a}$	$4.5x\ 10^{4}\pm0.3^{a}$	$4.6x\ 10^{7}\pm0.5^{c}$	$3.6x\ 10^{5}\pm0.2^{b}$
3	$4.4x\ 10^{6}\pm0.1^{b}$	$1.3x\ 10^{3}\pm0.2^{a}$	$3.9x\ 10^{7}\pm0.1^{bc}$	$5.3x\ 10^{5}\pm0.5^{b}$
4	$8.3x\ 10^{6}\pm0.3^{c}$	$9.5x\ 10^{5}\pm0.1^{b}$	$1.1x\ 10^{7}\pm0.2^{a}$	$6.5x\ 10^{6}\pm0.1^{c}$
5	$8.1x\ 10^{5}\pm0.3^{a}$	$4.8x\ 10^{6}\pm0.3^{c}$	$8.4x\ 10^{6}\pm0.4^{a}$	$1.1x\ 10^{6}\pm0.3^{d}$

Data expressed as mean ±SD.
Means bearing different superscripts in the same column are significantly different (*P=.05*)

Table 6. Contamination levels of mould in fufu and water from conventional and mechanized processing

Vendors	Fufu samples (cfu/g)		Water Samples (cfu/g)	
	Conventional	Mechanical	Conventional	Mechanical
1	0.0	0.0	0.0	$9.3x\ 10^{1}\pm0.3^{a}$
2	0.0	0.0	$2.8x\ 10^{1}\pm0.3^{c}$	$3.1x\ 10^{1}\pm0.2^{b}$
3	0.0	0.0	0.0	$3.5x\ 10^{2}\pm0.5^{c}$
4	0.0	0.0	$2.3x\ 10^{1}\pm0.2^{a}$	$4.7x\ 10^{2}\pm0.1^{d}$
5	0.0	$7.0x\ 10^{1}\pm0.2$	$6.0x\ 10^{1}\pm0.3^{b}$	$1.5x\ 10^{2}\pm0.3^{e}$

Data expressed as mean ±SD.
Means bearing different superscripts in the same column are significantly different (*P=.05*)

. Conclusion

The research has demonstrated that fufu prepared by both conventional and mechanized process within Kumasi metropolis contain high microbial load which exceeds safe and acceptable standards and are classified as unsafe and unwholesome for human consumption. *Escherichia coli*, *Staphylococcus aureus*, *Saccharomyces cerevisiae*, *Rhodotorula* and *Aspergillus niger* were detected in the fufu samples. The water used in the preparation of the fufu also failed the microbial tests and were classified as unsafe with total aerobic and coliform counts exceeding the acceptable limits. The water samples were also contaminated with *Escherichia coli* and *Staphylococcus aureus* with counts exceeding the safe and acceptable limit. Although both the conventional and mechanized processing had high microbial load, the microbial count in the mechanized processing were lower than the conventional processing method.As a result, when processing fufu, appropriate hygienic conditions are required.

Conflicts of Interest

The authors declare there are no conflicts of interest.

Authors' contributions

'Francis Xavier Tebri' designed the study, performed the statistical analysis, wrote the protocol, and wrote the first draft of the manuscript. 'Doreen Dedo Adi[1]'supervision, drafting

of manuscript, editing, analysis. 'Yaa Mawufemor Akubia , and Abena Sekyere' managed the literature searches. All authors read and approved the final manuscript.

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