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# Microbiological and Proximate Analysis of a Local Food Beverage - Kunu Zaki, Sold in Owerri Municipal

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**Abstract**

Kunu zaki is a popular food beverage usually made from grains such as millet or sorghum as well as maize. It is consumed by both young and old, probably due to its ability to nourish the body as well serve as an alternative to other costly conventional beverage drinks. Thirty (30). Kunu- zaki samples were obtained as freshly formulated beverages from three (3) different densely populated locations in Owerri metropolis, Imo State, Nigeria, and screened for microbial presence. The pH of the samples ranged between 3.38 - 3.65. Mean total heterotrophic bacteria count ranged from 2.6 - 6.6 x $10^4$ cfu/ml, mean total coliform count ranged from 1.0 - 2.5 x $10^3$ cfu/ml and the mean fungal count ranged from 5.2 - 9.0 x $10^4$ cfu/ml. The high microbial loads of these samples were an indication of poor hygiene during the preparation of the drink. *Escherichia coli*, *Staphylococcus aureus*, *Klebsiella* sp, *Aspergillus* sp., *Bacillus* sp and *Lactobacillus* sp were the microorganisms recovered. The proximate analysis reveals that the beverage can supply significant quantities of ash, carbohydrates, fats, proteins and fibre. The types and density of microorganisms isolated makes it very important for adequate hygiene methods to be observed while preparing distributing already prepared Kunu zaki.

**Keywords**: Kunu zaki, heterotrophic bacteria count, mean total coliform count, proximate analysis

## 1. Introduction

Local food beverages usually consumed by people in different parts of the world are rich in essential nutrients. Kunu zaki also known as 'kunu' a popular drink in Nigeria, mostly in the north, is among these local food beverages. It nourishes the body, offers improved taste and flavour, digestibility and reduction of antinutritional qualities (Nwogwugwu *et al*., 2012). It is greatly consumed by large number of men and women including the young and the old. Kunu is taken after meal as a supplement or to quench thirst. The quality and quantity of the products depends largely on the quality of the ingredients and its proper handling in the course of production by the producer (Adeyemi & Umar, 2010). It is usually made from grains such as millet, sorghum or maize. These products can supply significant quantities of

carbohydrates, fat, protein and minerals, although, its protein is low in methionine (Oranusi & Umoh 2003).The variety of the drink made from sorghum is a milky light-brown colour, whilst that which is made from millet and maize is whitish in colour. During the preparation of Kunu, the ingredients needed are grains such as millet or sorghum, ginger *(Gingier officials), alligator pepper (Aframomum melegueta),* red pepper (*Capsicum species*), black pepper (*Piper guineense*) and Kakandoru or eru. All these ingredients perform one function or the other in the course of preparation. Kunu is made up of about 95% water, sugar, flavoring agents and sometimes preservatives (Osuntogun &Aboaba, 2004). Unfortunately, it has a relatively short shelf-life of 24 hours at ambient temperature, which can be extended for another 3 days when refrigerated (Ugbonna *et al*., 2011) and to 8 days by pasteurization at $60^0$C for 1 hour and storage under refrigeration conditions (Adeyemi and Umar 2010). However, drink becomes more acidic as the hours of storage increased, with the most significant changes occurring in samples kept at 25$^o$C. It has been reported that, if Kunu zaki is kept overnight during the hot season without being refrigerated, its quality begins to deteriorate and this may lead to spoilage which when consumed could constitute danger to health (Adebayo *et al.,* 2010). A large number of lactic acid bacteria, coliforms such as *Escherichia coli*, molds and yeasts can cause spoilage of the drink by producing undesirable changes. Apart from serving as a food drink, Kunu also provides a source of income, a means of poverty alleviation and contributes to food security. Small-scales food industry also provides linkage to local suppliers of agricultural raw materials and incomes generating activities such as the manufacture of processing machinery for packaging. (Braide *et al.,* 2018).

Therefore, considering the high cost of conventional food drinks, this study is aimed at analyzing the microbiological quality of Kunu which can serve as an affordable and nutritious alternative to beverages and carbonated drinks in Nigeria and other African countries with a view to encouraging local producers to step up in their level of hygiene during production.

## 2. Materials & Methods

### 2.1. Collection of materials

Samples of Kunu drink were aseptically obtained from three open markets in Owerri Metropolis (Shell camp 1, Shell camp 2 and Ama hausa ) using sterile containers and taken to the laboratory for analysis.

### 2.2. Microbiological analysis

Nutrient Agar, MacConkey Agar, Sabouraud Dextrose Agar (SDA), Eosin Methylene Blue Agar, Salmonella-Shigella Agar and Lactobacillus MRS Agar were used as appropriate for the isolation and enumeration of bacteria and fungi (yeast and mould). Microbial analyses of samples of the Kunu zaki drink were performed using the pour plating and streaking techniques. One milliliter of each sample was inoculated into 9m1 each of tryptone soy Broth (TSB) for enrichment in test tubes. The test tubes were then incubated at $37^0$C for 24hours. The inoculated broth was placed on Sabouraud Dextrose Agar for the isolation of yeast for 3-4 days at 28$^o$C. The other plates were incubated overnight at $37^0$C for 24 hours. Isolates showing growth were identified using Gram staining and other biochemical test such as catalase, coagulase, motility, and indole as applied by Cheesbrough (2006).

### 2.3. Proximate analysis of Kunu sample

The Kunu samples were analyzed for the following properties; ash, crude protein, crude fibre, crude fat, carbohydrate and moisture content. The analysis were carried out according to the method described by James (2005).

## 3. Results

The mean pH values and the extent of microbial contamination in colony forming units per milliliter of the fresh Kunu beverage from the three locations in Owerri municipal are shown in Table 1. Results of pH determination showed that all Kunu samples are acidic in nature; their pH ranged from 3.38 - 3.65. The mean counts of microorganism for fresh Kunu beverage were presented in Table 2. Total heterotrophic bacteria ranged from 2.6 - 6.6 $x10^4$ cfu/ml, total coliform ranged from 1.0 - 2.5$x10^3$ cfu/ml and the average number of colonies for fungi ranged from 5.2 - 9.0$x10^4$ cfu/ml.

Proximate compositions of samples reveal that Kunu is proteinous and contains a lot of carbohydrates. The results are shown in table 3.

Table 1: Percentage Distribution of Bacteria and Fungi isolates.

| Bacterial isolates | % occurrence | Fungal isolates | % occurrence |
|---|---|---|---|
| *Bacillus* sp | 6.8 | *Saccharomyces* sp | 8.2 |
| *E. coli* | 9.4 | *Aspergillus* sp | 10.4 |
| *Lactobacillus* sp | 22.4 | | |
| *Staphylococcus aureus* | 11.8 | | |
| *Klebsiella* sp | 6.8 | | |
| *Pseudomonas* sp | 7.1 | | |
| *Streptococci* sp | 3.5 | | |

Table 2: Mean values of total bacterial, total coliform, fungal count and pH values of fresh "kunu" samples sold in Owerri Metropolis.

| Location | Sample size | MTHBC (Cfu/ml) | MCC (Cfu/ml) | MFC (Cfu/ml) | MpH |
|---|---|---|---|---|---|
| Ama hausa | 10 | $6.4x10^4$ | $2.0x10^3$ | $8.2x10^4$ | 3.65 |
| Shell camp[1] | 10 | $6.6x10^3$ | $2.5x10^3$ | $9.1x10^4$ | 3.47 |
| Shell camp[2] | 10 | $2.6x10^4$ | $1.0x10^4$ | $5.2x10^4$ | 3.38 |

Key: MTHBC Mean Total Heterotrophic Bacterial Count, MCC: Mean Coliform Count
MFC: Mean Fungal Count, MpH: Mean pH

Table 3: Proximate analysis of the kunu samples (mean values for 10 samples)

| Parameters (%) | Ama Hausa Samples | Shell camp[1] Samples | Shell camp[2] Samples |
|---|---|---|---|
| Ash Content | 0.09±0.01 | 0.15±0.03 | 0.18±0.01 |
| Crude Fiber | 0.23±0.01 | 0.17±0.02 | 0.10±0.01 |
| Crude Protein | 2.99±0.13 | 2.57±0.04 | 2.38±0.03 |
| Crude Fat | 1.29±0.07 | 1.21±0.02 | 1.34±0.02 |
| Carbohydrates | 12.30±0.06 | 12.78±0.22 | 13.00±0.11 |
| Moisture Content | 72.77±0.20 | 72.29±0.09 | 73.58±0.11 |

## 4. Discussion & Conclusion

### 4.1. Discussion

Kunu is a well-known cereal-based, non-alcoholic beverage produced and consumed throughout Nigeria, mostly in the Northern part for its thirst quenching properties. It is relatively cheap and nutritious when compared to carbonated drinks. Since the method of preparation of the beverage is still at village technology level, the risk of contamination is very high and could come from different sources.

From the three areas that Kunu samples were collected Shellcamp1 had the highest mean total count of $6.6x10^4$ cfu/ml, $2.5x10^3$ cfu/ml and $9.0x10^4$ cfu/ml on Nutrient Agar, MacConkey Agar and Sabouraud Dextrose Agar respectively. This study indicates that high populations of microorganisms were present in the different Kunu samples collected from Owerri metropolis, to attract food safety attention. *Klebsiella* sp, *Escherichia coli* and *Staphylococcus aureus* were isolated in varying levels from the samples.

The presence of these organisms in Kunu, suggests that it must have been contaminated after the cooking and cooling process of the drink. Also, some sources of contamination could be as a result of fermentation vessels, storage containers, sieves used for filtration, hands of the handlers and even the polythene bags/plastic bottles used for packaging before sales. Therefore, there is need for high degree of sanitation during the preparation of Kunu drink (Elmahmood *et al*., 2007; Oshoman *et al*., 2009; *Braide et al*., 2018)

The presence of *Escherichia coli* indicates faecal contamination which may have serious health implications. *Lactobacillus* sp is non-pathogenic and has been known to aid fermentation of Kunu samples investigated. *Lactobacillus* sp is known to produce lactic acid which can increase acidity of the drink thereby reducing the chances of pathogenic organisms and microbial safety of the Kunu (Abulude *et al.,*2006). The percentage occurrence of the bacteria isolated showed that *Lactobacillus* sp had the highest percentage occurrence followed by *Staphylococcus aureus*. *Staphylococcus aureus* is enterotoxigenic but enterotoxin production by this bacterium may not have occurred in view of the pH of the drink. This is because it has been reported that enterotoxin production by *Staphylococcus aureus* does not occur at pH below 5 (Ashiru *et al.,* 2003). *Bacillus* also has been implicated in food poisoning especially in cereals that have been cooked and stored at warm temperatures. Reports indicate that toxins produced by *Bacillus* sp cause pneumonia and

broncho-pneumonia (Chessbrough, 2006). Its occurrence in Kunu also suggests that Kunu can constitute health hazards to the consumers if not handled under hygienic conditions. In addition, the organism is also known to produce heat-resistant spores that cannot be eliminated by boiling. *Streptococci*, *Pseudomonas* and *Klebsiella* spp have been implicated in the spoilage of food and beverages (Adebayo *et al.,* 2010). Kunu also stands the risk of being deteriorated by these organisms. The isolation of *Aspergillus* is an evidence of food intoxication since it is capable of producing mycotoxins.

The pH obtained from the kunu samples ranged from 3.38-3.65.These values were lower than has been obtained by other researchers (Akoma *et al.,* 2006; Adejuyitan, 2008 and Adebayo *et al.*, 2010; Braide *et al*., 2018). The acidity of Kunu beverage has been noted to be a result of lactic acid production by Lactic acid bacteria during fermentation (Ashiru *et al.,* 2003) and thus, the drink becomes sour to taste and organoleptically unacceptable with time. Moisture contents contribute greatly to the microbial flora of food sample. Kunu has a high percentage of water content which supports microbial growth.

The Standards Organization of Nigeria (SON) had stated that coliform bacteria and pathogenic microorganisms should not be present in beverages, and this applies also to other food products and it has also been reported that counts of $10^4$ cells/ml for *Bacillus cereus* and $10^6$ cells/ml for enterotoxigenic *Staphylococcus aureus* are required to present a risk of intoxication (Ashiru *et al.,* 2003).

### 4.2. Conclusion

This study reveals a high occurrence of these contaminants which could be an indication that the Kunu samples sold in Owerri Metropolis may not be of standard required by Standard Organization of Nigeria, SON. Therefore, care should be taken while preparing or purchasing already prepared samples of Kunu. Besides sanitary measures, there is also need for effective monitoring of the microbial standard of the local beverages “Kunu” sold to the public by both the State and Federal Ministry of Health as a way of fighting the health hazard that its consumption may cause.

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