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Research Article

Bacteriological Quality Assessment of Nigerian Non Alcoholic Beverage (*Kunun-zaki*) Sold in Keffi Metropolis, Nigeria

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ABSTRACT

Twenty- five (25) samples of freshly formulated *Kunun-zaki,* a very common Nigerian non-alcoholic cereal beverage were obtained from 5 different sale locations in Keffi metropolis and analyzed using the Sandard Plate Counts (SPC), to determine their respective bacteriological quality. The results obtained showed that the total bacterial counts of *Kunun-zaki* in the 5 different locations range from $3.5x10^4$ to $8.4x10^4$ cfu/ml. The frequency of the occurrence of isolated bacteria were 72%(18) *S. aureus*, 60%(15) *E. coli*, 56%(14) *Bacillus* spp, 48%(12) *Streptococcus* spp, 36%(9) *Klebsiella* spp and 28%(7) *Salmonella* spp respectively. The percentage occurrence of isolated bacteria from High Court, Angwan Lambu, and Ungwan Waje was 43.3% while Central Market and Ungwan Mada had 60.0%, giving the total bacterial occurrence rate of 50.0%. There was no significant difference (P>0.05) in the occurrence of bacteria from samples obtained from various locations. The high bacterial load of most of the samples can be attributed to the poor hygienic practices of the handlers and possible contamination from the utensils and water that were used for processing of the beverage. The presence of these bacteria could be a matter of serious concern as these organism are involve in some health implication causing various diseases.

Keywords: Kunun-zaki, bacterial counts, beverage, contamination

INTRODUCTION

Kunun-zaki is an indigenous fermented non-alcoholic beverage. It is generally consumed on its own by adults, as a thirst quencher or serves as refreshment in some communities, used for entertainment at homes and during unique ceremonies like Christmas and Sallah, and sometimes it is used as a weaning drink for infants (Gaffa, 2000; Elmamood and Doughari, 2007; Okechukwu *et al*., 2011). The drink is produced from fermented millet, sorghum, guinea-corn and maize in decreasing order of preference. In some cultures, the grains are used in a composite form especially millet, guinea-corn and sorghum in a ratio of 1:2 w/w (Abegaz, 2007). It is sweetened with honey and sugar together with small quantities of sweet potatoes and spices (ginger, black pepper or clove).

The production methods are crude, ingredient concentrations are neither quantified nor standardized, and instead preparation is largely a matter of family tradition (Onuorah, *et al*., 1987). Significant variation exists in the production procedure depending on the cultural habits of its consumers leading to differences in quality and stability (Aboh and Oladosu, 2014). Spices are usually added in small quantities to improve taste and flavor. Because these are agricultural commodities, they may contain a high level of microbial impurities (Adeyemi and Umar, 1994; Bibek, 2001).

The high water content (about 85%) coupled with crude methods of production and packaging under inadequate sanitary conditions predisposes *Kunun-zaki* to microbial contamination (Elmahmood *et al*., 2007). The occurrence of wide genera of microorganisms could be attributed to the unhygienic conditions of preparation and the use of contaminated raw materials and utensils (*Ayo*, 2004). The microflora of finished product depends on the processing and storage conditions. High temperature and lack of refrigeration facilities in most developing countries have led to the inability to produce and store fresh *Kunun-zaki*. The pH of *Kunun-zaki* is usually too low to allow the growth of pathogenic microorganisms but the presence of *E. coli* and other coliforms such as *Salmonella* and *Citrobacter* spp could be a matter of serious concern.

A lot of food-borne diseases are caused by the ingestion of food contaminated with pathogenic bacteria (Lawal, 2012); *Kunun-zaki* is also not shelf-stable, readily undergoing microbial induced spoilage within 2-3 days . It

has immense social, economic and nutritional benefits to its numerous consumers. Non-alcoholic nature of this drink made it to be readily consumed by both Muslims and Christians alike (Okechukwu *et al*., 2011). The drink is very cheap because the cereals and additives used in its production are locally sourced as they are grown throughout the savannah belt of West Africa. Packaging materials are also cheap and easily available. *Kunun-zaki* is rich in carbohydrates, vitamins and minerals but low in proteins. Furthermore, the methods of production are simple and cheap as no elaborate equipment and expertise required (Agboola, 1987).

The high water content coupled with crude methods of production and packaging under improper sanitary conditions predisposes *Kunun-zaki* to microbial contamination. This study was designed to assess the bacterial quality of this immensely popular beverage and possibly highlight the risks involved for the consuming general public.

MATERIALS AND METHODS

Collection of Samples

Five (5) samples of freshly prepared *Kunun-zaki* were collected from each of five different locations (High court, Ungwan lambu, central market, Ungwan mada and Ungwan waje) between the months of May to September, 2013 in Keffi metropolis, Nigeria. The samples were packaged in sterile plastic bottles and immediately transported to the Microbiology Laboratory of the Nasarawa State University, Keffi for isolation and enumeration of bacteria.

Determination of Total Count of Bacteria

Bacterial total count was carried out on plates of Nutrient Agar (NA), MacConkey Agar (MCA), Mannitol Salt Agar (MSA) and *Salmonella*/*Shigella* Agar (SSA); all of Oxoid grade using pour plate method. The samples were serially diluted and 1ml of appropriate dilution was used to inoculate each of the plates in triplicates. The culture plates were then incubated at 37^0C for 24-48h and colonies counted. The mean of triplicate results were then recorded as the colony count (Lateef *et al*., 2004).

Isolation and Identification

Discrete colonies of bacteria were selected and sub cultured from mixed cultures of the plates to respective NA plates and incubated at 37^0C for 24h. The bacterial isolates were then identified following standard microbiological procedures based on cultural, morphological and biochemical characteristics as described by Buchanan and Gibbons (1974), Cowan and Steel (1985) and Cheesbrough (2002).

RESULTS

The mean total viable count, coliform, staphylococci, *Salmonella*/*Shigella* counts (cfu/ml) for fresh *Kunun-zaki* beverage at different locations in Keffi metropolis are shown in Table 1.The mean total viable counts of *Kunun-zaki* range from $3.5x10^4$ to $8.4x10^4$ cfu/ml in High Court and Central Market. The mean coliform counts range from $2.5x10^4$ to $5.1x10^4$ cfu/ml in High Court and Ungwan Mada. The mean staphylococci counts in the samples range from $1.6x10^4$ to $2.9x10^4$ cfu/ml in Ungwan Mada and Ungwan Waje, while the mean *Salmonella*/*Shigella* counts range from $1.5x10^4$ to $2.5x10^4$ cfu/ml in High court and Central Market (Table 1). The bacterial isolates and their percentage frequency of occurrence is presented in Table 2. The percentage occurrence of bacteria from *Kunun-zaki* as recorded in this study are 72%(18) *S. aureus*, 60%(15) *E. coli*, 56%(14) *Bacillus* spp, 48%(12) *Streptococcus* spp, 36%(9) *Klebsiella* spp and 28%(7) *Salmonella* spp (Table2). The percentage occurrence of isolated bacteria from the High Court, Angwan Lambu, and Ungwan Waje is 43.3% while Central Market and Ungwan Mada had 60.0%, giving the total bacterial occurrence rate of 50.0% (Table 2). There was no significant difference ($P>0.05$) in the occurrence of bacteria from samples obtained from various locations.

Table 1: Mean Bacterial Counts (cfu/ml) of *kunun-zaki* Sold in Different Location in Keffi Metropolis, Nigeria.

Location	Mean total viable count (cfu/ml)	Mean Coliform count (cfu/ml)	Mean Staphylococcal count (cfu/ml)	Mean *Salmonella*/ *Shigella* count (cfu/ml)
High Court	$3.5x10^4$	$2.5x10^4$	$1.7x10^4$	$1.5x10^4$
Ungwan Lambu	$6.0x10^4$	$5.0x10^4$	$2.9x10^4$	$1.9x10^4$
Central Market	$8.4x10^4$	$4.1x10^4$	$2.5x10^4$	$2.5x10^4$
Ungwan Mada	$4.8x10^4$	$5.1x10^4$	$1.6x10^4$	$2.2x10^4$
Ungwan Waje	$5.0x10^4$	$3.5x10^4$	$3.1x10^4$	$1.6x10^4$

Table 2: Percentage Occurrence of Bacteria from *Kunun-zaki* Sold in Keffi Metropolis, Nigeria.

Location	No. Examined	Occurrence (%) of bacterial isolates						Total %
		S. aureus	*E. coli*	*Bacillus* spp	*Streptococcus* spp	*Klebsiella* spp	*Salmonella* spp	
High court	5	2(40)	2(40)	3(60)	3(60)	2(40)	1(20)	43.3
Ungwan lambu	5	4(80)	3(60)	3(60)	1(20)	1(20)	1(20)	43.3
Central Market	5	5(100)	3(60)	4(80)	3(60)	2(40)	1(40)	60.0
Ungwan Mada	5	4(80)	4(80)	2(40)	2(40)	3(60)	3(60)	60.0
Ungwan Waje	5	3(60)	3(60)	2(40)	3(60)	1(20)	1(20)	43.3
Total	**25**	**18(72)**	**15(60%)**	**14(56%)**	**12(48%)**	**9(36%)**	**7(28%)**	**50.0**

DISCUSSION

From this study, the total bacterial count falls within the range $3.5x10^4$ to $8.4x10^4$ cfu/ml. This is in agreement with the findings of Hatcher *et al*. (1992), Elmamood *et al*. (2007), Lawal (2012), and Aboh and Oladosu (2014) who reported a total bacterial count of $5.0x10^4$ to $2.0x\ 10^6$, $1.0\ x\ 10^2$ to $8.9\ x\ 10^4$ cfu/ml, $5.0x\ 10^4$ to $1.79x\ 10^5$ cfu/ml and $5.1\ x\ 10^2$ to $2.0x\ 10^8$ cfu/ml respectively. The high bacteria count observed in this study might be attributed to factors such as the environment, which include exposure of the foods (*kunun-zaki*) to air, soil; type of water used in processing; post production operations and personal hygiene of the handlers (Kawo and Abdulmumin, 2009; Aboloma, 2008). Exposure of the foods to air or dust at the point of sale is likely to increase the counts of the bacteria as virtually most of the bacteria are carried in aerosols by dust and air (FDA, 2009). Also, during production, most handlers sometime dip their hands into the containers while making *kunun-zaki*.

Out of the 25 *kunun-zaki* samples examined, 18(72%), 15(60%), 14(56%), 12(48%), 9(36%), and 7(28%) were contaminated with *S. aureus*, *E. coli*, *Bacillus* spp, *Streptococcus* spp, *Klebsiella* spp and *Salmonella* spp. The cumulative occurrence of bacteria from *kunun-zaki* samples examined was 50%. The most occurring bacterial as indicated from this study was *S. aureus* with the occurrence rate of 72% (18) while *Salmonella* spp had the least occurrence rate of 28% (7).

The presence of *S. aureus*, *E. coli*, *Bacillus* spp, *Streptococcus* spp, *Klebsiella* spp and *Salmonella* spp in relatively high rates could be a matter of serious concern, since these organisms are involve in health implications. The pH of *Kunun-zaki* is usually too low to allow the growth of pathogenic microorganisms, but the presence of *E. coli, S. aureus* and *Streptococcus* spp. could be a matter of serious concern.

S. aureus is a normal flora of the skin, nose, throat, palms, hairs and mucus membrane and a common etiological agent of septic arthritis. It is an ubiquitous microorganism that can enter foods from many sources such as handlers with pyogenic infections or healthy carriers who habour the organism in their nose or throat. It is commonly implicated in water and food contamination. The high occurrence of *S. aureus* (72%) is of serious public health importance because of its ability to cause a wide range of infections especially food-borne intoxication. This organism was equally isolated by Aboh and Oladosu (2014) from *kunun-zaki*.

E. coli is an important member of the coliform group isolated from this study. It is part of the normal flora of the human intestine. Some strains can cause gastroenteritis, diarrhoea and urinary tract infection. The high occurrence (60%) of this organism in *kunun-zaki* is an indicator of faecal contamination. This percentage could easily cross-contaminate a whole production batch unnoticed. Ironically, most food handlers do not practice good personal hygiene and do not follow good manufacturing practices, which could reduce the occurrence of such bacteria in foods (Bukar *et al*., 2009; Kawo and Abdulmumin, 2009).

Salmonella spp an enteric bacteria is the causative agent of typhoid fever. The increased frequency of food-borne *Salmonella* has been causing recurring outbreaks, sometime with fatal infections which has been linked to the unsanitary practices of food and beverages processes leading to contamination of foods by *Salmonella*. The detection of *Salmonella* in the environment including in foods and beverages is a necessary component of public health program.

The presence of *Klebsiella* spp as recorded in this study is usually associated with faecal contamination. Being an enteric bacterium its presence indicates poor practices among handlers. Due to the significance of the faecal-oral route transmission for many bacterial food-borne diseases, basic hygiene measures assume a decisive importance in food safety management (Uzeh *et al*., 2006).

The presence of *Streptococcus* and *Bacillus* spp as indicated in this study is in consonance with the report of Ayo (2004), who isolated these organisms from *kunun-zaki*. *Bacillus* spp is widely distributed bacteria that is commonly found in soils and have been isolated in various countries from a variety of foods (Okechukwu *et al*., 2011). The presence of these pathogens even in small numbers could render a beverage unsuitable for human consumption (PHLS, 2000). It is possible that contamination by these pathogens could have occurred during sieving and packaging, as most of the people involved in the production, packaging and hawking do not take necessary precautions, and as such contamination could be very prominent (Elmamood *et al*., 2007).

Many native African beverages are little known outside the parent continent. A concerted effort should therefore be made to improve in the quality and production techniques of these indigenous exotic beverages so that large- scale production for export outside the continent can be carried out. Many people now prefer imported and exotic beverages because of their attractive forms, long shelf life, ease of transportation and other forms of utility which consumers associate with them (Achi, 2005). As of now, there are no industries involved in production of *Kunun-zaki*. Kunun-zaki is widely believed to be of immense social, economic and medicinal importance to its numerous consumers (Akoma *et al*., 2006).

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