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BACTERIOLOGICAL QUALITY OF WATER USED FOR ICE MAKING IN SOME PARTS OF KANO METROPOLIS, NIGERIA

***[1]Shamsuddeen, U., [1]Bukar, A., [1]Usman A. D., [1]Kabir M. H. and [2] Abdulmalik, S. A.**
[1]Department of Biological sciences, Bayero University, Kano, Nigeria
[2]Department of Laboratory Technology, School of Technology, Kano, Nigeria
*Correspondence author

ABSTRACT
A study was carried out on the bacterial counts of water used for commercial production of ice. Total of twenty samples (ten raw water samples and ten ice samples) were collected at random from ten different locations, and subjected to aerobic mesophilic bacterial and coliform counts according to FAO/WHO standard methods for the examination of water and wastewater. The results showed that the raw water had mean aerobic plate count of 2.05 x 10^3 cfu/ml, coliform MPN ranged from <2 to 110coliforms/ml and two samples yielded E. coli. The ice had mean aerobic plate count of 7.90 x 10^3cfu/ml and coliform MPN ranged from <2 to 130 coliforms/ml and four samples yielded E. coli. It is recommended based on the findings that the commercial ice makers should observe hygienic practices in all their operations, so as to reduce the chances of contamination and possible infection by the microbial contaminants.

Key words: Bacteriology, quality, water, ice, Kano.

INTRODUCTION

Commercial production of ice is a common business in Kano city. The ways and manners in which the ice is produced is a great point of concern from the public health view point. There are many producers of this ice and thousands of urban dwellers consume or use the ice daily either by taking it directly in drinking water or other homemade drinks or indirectly to make bottled or canned drinks cold. There seem to be no standardization and quality control in both processing and delivery of the ice. This apparent lack of quality control predisposes the consumers to serious health risk. Many of the ice makers get their water from vendors who use carts with multiple jerry cans. The proliferation of water vendors using carts with multiple jerry cans is an issue of concern in the public health sectors especially with the common incidence of enteric diseases like typhoid fever, cholera and dysentery. According to Idakwo and Abu (2004) a wide variety of micro organisms pathogenic to human beings are transmitted through contaminated water. Also the world health organization (WHO, 1982), reported that some 300,000 people die every day from water related diseases like typhoid and para typhoid fevers, cholera bacillary dysentery and gastroenteritis.

Water borne or related pathogens including bacteria are spread in water either through human ingestion of contaminated water or because water provides the habitat for intermediate host. The most common and wide spread problem is pathogens from human excreta which contaminate water supplies. Typhoid fever diarrhoeal diseases and cholera are among the diseases spread in this way (Jorge *et. al.,* 1997).

So, in order to supplement the nation's effort to provide safe drinking water, this study was set with the aim of ascertaining the bacteriological quality of water and ice from ice makers in some parts of Kano. This is with a view to ascertain their status from public health perspective so that appropriate recommendations can be made.

MATERIALS AND METHOD

Sample Collection

Samples of water (10) before ice making (raw water) were collected in a sterile, 250ml dark-brown glass sampling bottles on different occasions. Ice samples (10) were also collected in the nylon bags used for the ice making. Each time a sample of water was collected, ice produced from the same sample was also collected and both were taken immediately to the laboratory for analysis.

Aerobic Mesophilic Bacterial Count

This was carried out according to Refai (1979). One milliliter (1ml) of sample was transferred in to a test tube containing 9.0ml of sterile distilled water and the tube labeled 1:10. From this tube, 1.0ml was transferred after agitation into another tube containing 9.0ml of sterile distilled water and labeled 1:100. This was agitated and from it 1.0ml was transferred into another tube containing 9.0ml of sterile distilled water and labeled 1:1000 and the procedure was repeated up to $1:10^6$. Using sterile pipette 1.0ml of inoculum was transferred from dilution tubes into duplicate Petri dishes. This was followed pouring of a cooled molten nutrient agar (Oxoid). The dishes were gently rocked allowed to solidify and finally incubated at 37ºC for 24 hours. Following 24hours incubation, plates containing 30-300 colonies were counted and the number obtained multiplied by the inverse of the dilution factor to get the number of colony forming unit per ml (cfu/ml).

Enumeration of Coliforms

This was carried out according to the method described by Refai (1979) using multiple tube fermentation technique. Each sample was inoculated in to 3 sets of tubes as follows: First, 10ml into each of five tubes containing 10ml of sterile double strength lactose broth with Durham tubes. Then, one ml of each sample inoculated into five tubes each containing 5ml of sterile single strength lactose broth with Durham tubes. Then 0.1ml inoculated into five tubes each containing 5ml of sterile single strength lactose broth with Durham tubes. The tubes were incubated at 37°C for 24hours. Following incubation tubes showing gas production were counted and compared to MPN table adapted from WHO, (1982) for the determination of most probable number (MPN) of coliforms. A loopful of broth from gas positive tube was streaked onto eosin methylene blue (EMB Antec UK) agar plate and incubated at 37°C for 24hours. The plates were observed after 24 hours for the presence of bluish black colonies with green metallic sheen which confirms the presence of coliform bacteria. Colonies that formed green metallic sheen on EMB were biochmically characterized to be *E. coli* using indole, methyl red, Voges Proskeuer and citrate tests.

RESULTS

The results of mesophilic bacterial count, coliform bacterial as well as occurrence of *Escherichia coli* for both raw and ice water samples are presented in Tables 1 and 2. The mean APC of raw water was found to be 2.05 x 10^3 cfu/ml, Coliform counts ranged from <2 to 110 MPN/ml and two samples yielded *E. coli*(Table 1). The mean APC of ice water was found to be 7.90 x 10^3 (cfu/ml), Coliforms count ranged from <2 to 130 and four samples yielded *E. coli* (Table 2).

Table 1: The Bacterial and coliform counts of the water samples.

S/N	Aerobic mesophilic bacterial Count (cfu/ml)	Coliform count MPN/ml	*E. coli*
1	1.40 x 10^3	9	-
2	5.70 x 10^2	9	-
3	3.00 x 10^1	< 2	-
4	4.60 x 10^3	21	-
5	6.70 x 10^3	110	+
6	1.13 x 10^3	6	-
7	7.00 x 10^1	< 2	-
8	2.80 x 10^2	9	+
9	5.40 x 10^3	< 2	-
10	3.40 x 10^2	4	-

Mean APC =2.05 x 10^3 cfu/ml

Table 2: Bacterial and coliform counts of the water samples (ice).

S/N	Aerobic mesophilic bacterial Count (cfu/ml)	Coliform count MPN/ml	*E. coli*
1	2.70 x 10^3	17	-
2	9.40 x 10^3	110	+
3	3.00 x 10^1	< 2	-
4	2.60 x 10^3	17	-
5	4.50 x 10^4	130	+
6	8.20 x 10^3	5	+
7	5.80 x 10^3	< 2	-
8	3.60 x 10^3	2	-
9	1.50 x 10^3	2	-
10	6.10 x 10^2	4	+

Mean APC=7.90 x 10^3 cfu/ml

DISCUSSION

Even though the decrease in temperature reduces the metabolic activities of some bacteria, it should always be borne in mind that low temperature is not a sterilization process rather a set of conditions that may stop the multiplication of microorganisms (Refai, 1979). So, microbial load of water may be increased before, during or after refrigeration. Additionally, environment, handlers and unclean containers may be the source of contamination.

The results obtained showed that the aerobic mesophilic bacterial counts ranged from 10^1 to 10^3cfu/ml in raw water and 10^1 to 10^4cfu/ml for the Abdullahi and Indabawa (2004) also reported that water sold in unsealed (bread type) cellophane bags had fecal coliform count of 100MPN/100ml. With bottled water however, the MPN index of less than ice. The higher value of APC from the ice is an indication of contamination, which might be as a result of handling and use of unclean containers. The high coliform count from both the raw and ice samples is also a point of concern since some of the samples had coliform counts that are higher than the values acceptable by FAO according to which the coliform MPN index of untreated water should not exceed 20 (Refai, 1979). Mukhtar and Oyeyi (2005) also reported high coliform counts in raw water from some open wells in Kano, which had coliforms of up to 15MPN/100ml.

five per ml was independently reported by Halliru (1998) and Bashir (2006).

E. coli, which is the most important indicator organism, whose presence in water indicates fecal contamination from warm blooded animals, was detected from both the raw and the ice water samples (Table 2). This is another point of deviation from the FAO standards according to which in all samples of water analyzed *E. coli* should not be found (Refai, 1979). The presence of *E. coli* in both the raw and the ice water samples is really hazardous and an indication of improper and unhygienic handling. Shamsuddeen *et. al.,* (2007) also reported the presence of *E. coli* in water hawked in jerry cans from some parts of Kano.

Conclusion and Recommendations

the consumers of ice water in some parts of Kano metropolis are at risk since there was evidence of contamination of both the raw water and the ice. The following recommendations are therefore made.

- Water intended for use in making ice should be treated to reduce its microbial load.
- All the operators should exercise strict personal and environmental hygiene in all operations.
- There should be regular microbiological investigation of both the ice and the water so as to ensure their safety for human and animal use.

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