Internet Journal of Food Safety, Vol.13, 2011, p.374-378

Microbiological Quality and Safety Evaluation of Fresh Juices and Edible Ice Sold in Uyo Metropolis, South-South, Nigeria

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Abstract

A study was conducted to assess the microbiological quality and safety of fresh juices and edible ice sold in Uyo Metropolis. Fresh squeezed fruit juices of lime, lemon, pineapple and orange, vegetable juices of carrot, garlic and samples of edible ice were collected. All samples were analysed for total viable count (TVC), total coliform count (TCC), faecal coliform (FC) total Staphylococcal count (TSC), total Vibro count (Tvib.C) and the presence of Salmonella. Results indicated total viable count of all fruit juices were in the range of 4.90 – 6.81 (log cfu/100ml) and vegetable juices in the range of 5.42-6.73(log cfu/100ml), with significant load of coliforms, faecal coliforms, vibro and Staphylococcal counts. Qualitative counts showed the presence of coagulese positive Staphylococcal spps in almost all the samples, while Salmonella and Vibro were detected in pineapple, orange and carrot juices. All the edible ice samples collected from vendors indicated high microbial load of coliforms and staphylococcal counts. Findings indicate a huge load of pathogenic micro-organisms a fresh vended fruit and vegetable juices as well as edible ice used by the vendors. This suggest an urgent need for government participation in developing suitable intervention measures to improve the quality of juices and implement a standard hygiene protocols that will reduce contamination of fruit and vegetable juices.

Key words: Lime, Lemon, Orange, Pineapple, Carrot and Garlic

Introduction

Fresh fruit and vegetable juices are becoming an important part of modern-day diet in many cities of the world. This is because fruit and vegetable juices serve as a veritable and affordable source of fat-free nutrients such as vitamins, minerals and other naturally occurring polynutrients which are of health and therapeutic benefits. For instance, orange juice apart from being rich in Vitamin C, is an excellent sources of bioavailable antioxidant and phyto-chemicals while carrot juice serves as a veritable source of alpha and beta carotene which is a precursor of vitamin A (Franke et al., 2005). Fruit and vegetable juices have significantly improved blood lipid profile in people affected by hyper-cholesterolemia as well as promote detoxification of human body (Deanna and Jeffrey, 2007).

Fruit and vegetable juices are simply prepared by mechanically squeezing or macerating the pulp of fresh fruits or vegetables without application of heats or solvent to give an unfermented clouded and untreated juice. Mahale et al., (2008) suggested that unpasteurized juice sold by street vendors and hawkers are preferred by consumers because of the "flesh flavour" attributes. Fresh fruit juice like pineapple, lime, orange etc and vegetable juice like carrot, spinach, garlic juices etc are sold by street vendors and hawkers in Uyo metropolis, and the consumption of fresh fruit and vegetable juices are on the increase as people from all ages and income groups consume the juice through out the year for its nutritional value and health reasons. In the same vain, commercial ice used by this food vendors should be safe to consume and be of the same quality as drinking water because it is ingested directly when added to juices and soft drinks or indirectly when used to refrigerate food items (Falcão et al., 2002).

Pathogenic micro-organisms can have access into the fruit and vegetable juice through damage surfaces, such as punctures and cuts that occur during growing and harvesting. Contamination from raw materials and equipments, improper handling, prevalence of unhygienic conditions contributes substantially to the entry of

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pathogenic micro-organisms into the juice (Titarmare et al., 2009). Other potential sources of micro-organisms into the fresh juices include, use of unhygienic water for dilution and prolonged preservation without refrigeration. Such juices have shown to be potential sources of bacteria pathogens notably E-coli 0157:H7, species of Salmonella, Shigella, Staphylococcus species etc.

Nigeria is a country where street food vending is prevalent; there is commonly lack of information on the incidence of food borne diseases related to the street vended foods. However, microbiological studies on such foods in other part of the country have revealed increased bacterial pathogens in food. There has been documented outbreak of illness in humans associated with consumption of fruit and vegetable juices.

A report published by Victoria Government Department of Human Services, Australia (2005) reported survived of E-coli 0157:H7 in apple juice for up to 24hrs at 4oC. A total of 48 cases of E-coli 0157:H7 were reported after drinking unpasteurized apple juice in Washington Dc in 1996. A cholera epidermis in pune city India was related to street vended sugar care containing ice contaminated with Vibro cholerae. (Mosupye et al., 1999). Recently, a major outbreak of hepatitis A in Lampage and Chiang Rai, Thailand, affecting about 900 people has also reported due to contaminated ice (APEC, 2005) initial investigations pointed to ice factory which draw its water from contaminated artesian wells.

In spite the increasing demand for fresh fruit and vegetable juices and the potential danger its posed to the consumers, this present study was undertaken to assess the microbiological quality of fresh juice and edible ice in Uyo metropolis. This result will provide scientific information to assess the risk posed by this juice and edible ice to the public health in developing country like Nigeria. This will help in setting guidelines for hygienic production of fruit and vegetable juices as well as edible ice as it is presently obtainable in the production of sachet water in the country.

Material and Methods

Samples Collection. Three locations in Uyo metropolis (Itam junction, Akpan-Ndem market, and Aka/Etuk Street) where fresh fruit and vegetable juices are sold were selected for this study. Based on consumers demand, the following juices were selected for microbiological analysis, lime, lemon, pineapple, orange, carrot and garlic juices. All freshly extracted juice samples were collected randomly at road side shades and hawkers at the selected locations. The juice samples collected in a sterile bottle were transported to the laboratory in a cooler for analysis within one hour of procurement. A 5ml portion of all samples were aseptically collected for pH determination. Samples of edible ice used of for cooling and dressing by the juice vendors and hawkers were also collected for microbiological analysis.

Microbiological Analysis. Microbiological analysis included identification and enumeration of potential pathogens according to standard procedures (FDA, 2001). All samples collected were serially diluted with distilled water and plated on different media for enumeration of organisms. Total viable count (TVC) on nutrient agar, total conforms using violet red bile agar, the presence of faecal coliforms using eosine methylene blue agar, and mannitol salt agar for Staphylococci count (Titarmare et al., 2009). All inoculated at the requisite time and temperature. The presence of Salmonella in the juice samples were detected using an enriched media tetrathionates broth and enumerated on xylose lysine deoxycholate agar while Vibros spps were detected using thiosulphate citrate bile Agar according to Mudgil et al., (2004).

Results

Result of this study (Table 1) indicated the presence of huge load of pathogenic micro-organisms (Total coliforms, faecal coliforms, Staphylococcal spps. Salmonella, and Vibro cholerae). Orange and pineapple juices showed higher microbial counts with the total viable counts (TVC) range of 5.91-6.81 and 6.15-6.51 (log cfu/100ml) while fruit juices extracted from lemon and lime showed much lower total viable counts (TVC) ranging from 5.24-6.05 and 5.50-6.16 (log cfu/100ml) respectively. But also indicate absence of Salmonella spps and Vibro cholerae in all the samples. The total coliform counts (TCC) ranged from 3.30-3.71 and 3.34-3.80 (log cfu/100ml) for lime and lemon juices while pineapple and orange juices indicated higher total coliform count (TCC) in the range of 3.80 -4.80 and 4.01 – 4.48 (log cfu/100ml) respectively.

Vegetable juice samples analysed (table 2) indicated a higher microbial counts compared to fresh juice. However, carrot juice was highly contaminated than garlic juice. The near neutral pH seems to favour the growth of these organisms. Samples of garlic juice analysed showed complete absence of Salmonella spp with little Vibro cholerae, while almost all the samples of carrot juice were contaminated with Vibro and Salmonella spps. The TVC of the vegetable juices ranged from 5.45-6.73 (log cfu/100ml) while total coliform count (TCC) ranged from 3.38 -4.84 (log cfu/100ml), while was TVC with a range of 5.21-6.60 (log cfu/100ml). All the ice samples indicated the presence of total coliforms; while faecal coliforms and Vibro spps were present in some edible ice samples. The presence of Salmonella spps was absent in samples analysed (Table 3). Similar studies from different countries have shown the

present of E-coli, coliforms and varieties of other micro-organisms like Streptococcus spp, Staphylococcus spp, Micrococcus Pseudomonas spp etc (Lateef et al., 2004, and Nichols et al., 2000) and thus support the findings from this study.

Table 1. Microbiological counts (log cfu/100ml) of fresh fruit juices sold in Uyo Metropolis

Sample	pH	TVC	TCC	FC	TSC	Tvibr C	Sal.
LM_1	3.3	5.88±0.51	3.50±0.91	3.30±1.56	2.11±1.33	-	-
LM_2	3.5	5.50±2.43	3.30±1.52	2.08±2.13	3.62±0.62	-	-
LM_3	3.0	5.62±0.81	3.56±2.23	2.26±1.52	2.40±0.82	-	-
LM_4	3.2	5.74±1.80	3.50±1.60	-	3.18±2.36	-	-
LM_5	3.1	6.56±2.36	3.71±0.81	2.51±1.35	2.38±1.27	-	-
LN_1	3.2	5.24±1.61	3.58±1.22	2.41±0.83	-	-	-
LN_2	3.3	5.45±1.35	3.68±0.93	2.62±1.32	-	-	-
LN_3	3.1	4.90±0.52	3.63±1.01	3.15±0.90	2.68±1.23	-	-
LN_4	3.2	5.25±0.64	3.80±1.66	-	2.38±0.53	-	-
LN_5	3.5	6.05±1.32	3.34±2.12	3.08±1.22	-	-	-
PP_1	4.6	6.81±2.33	4.20±2.13	2.50±1.90	3.41±1.33	2.30+1.22	+
PP_2	4.3	6.60±1.84	3.80±0.92	2.12±3.12	2.19±1.01	-	+
PP_3	4.0	5.91±0.92	4.53±1.16	3.40±0.91	3.30±1.52	-	-
PP_4	3.8	6.58±1.52	4.45±1.33	2.26±1.50	2.48±0.83	2.52+1.52	+
PP_5	4.5	6.74±2.33	4.80±1.02	2.11±3.19	3.51±1.26	3.10+1.36	-
OR_1	4.5	6.20±0.92	4.08±1.44	3.36±0.12	3.70±1.24	2.42±1.23	+
OR_2	3.9	6.30±2.23	4.48±0.90	3.08±1.13	3.48±0.95	-	-
OR_3	4.8	6.51±1.65	4.17±1.18	3.26±0.94	3.28±1.02	-	-
OR_4	4.5	6.26±1.48	4.01±1.52	3.20±0.86	2.15±0.62	2.32±1.14	+
OR_5	4.0	6.15±0.84	4.30±2.33	3.18±0.95	3.32±1.23	1.82±0.90	-

Data represent mean ± Standard error of 5 measurements
LM = Lime juice; LN = Lemon juice; PP = Pineapple juice, OR = Orange juice TVC = Total viable count,
TCC = Coliform count, FC = Faecal coliform TCS = Total *Staphylococcal* count, TVibr C = Total *Vibro cholerae* count
Sal = *Salmonella* on LD

Table 2. Microbiological counts (log cfu/100ml) of fresh vegetable juices sold in Uyo metropolis

Sample	pH	TVC	TCC	FC	TSC	Tvibr C	Sal.
CR_1	6.0	6.20±0.90	4.84±2.01	2.36±1.23	2.18±1.23	-	+
CR_2	6.2	5.45±1.12	3.48±1.02	-	2.32±1.44	3.47±2.02	+
CR_3	6.3	6.48±1.31	4.49±1.84	3.47±0.94	-	2.43±1.22	-
CR_4	6.1	5.55±0.93	4.62±2.16	2.18±1.15	2.42±1.87	-	-
CR_5	6.4	6.23±1.22	3.38±1.24	2.15±1.24	3.15±1.36	2.18 ±0.92	+
GA_1	6.3	6.52±1.34	4.18±1.13	3.27±0.92	2.42±0.25	-	-
GA_2	6.5	6.73±0.95	4.31±0.92	-	2.35±1.24	-	-
GA_3	6.6	5.45±0.63	3.68±1.02	2.18±1.04	2.67±0.92	2.18 ±0.84	-
GA_4	6.5	6.41±1.24	4.47±0.74	2.35±0.63	-	-	-
GA_5	6.3	5.48±1.12	4.24±1.12	3.18±1.26	-	2.0 ± 0.63	-

Data represent mean ± standard error of 5 measurements.
CR = Carrot juice; GA = Garlic juice, TVC = Total viable count, TCC = Coliform count, FC = Faecal coliform
TCS = Total *Staphylococcal* count, TVibr C = Total *Vibro cholerae* count , Sal = *Salmonella* on LD

Table 3. Microbiological counts (log cfu/100ml) of edible ice sample collected from fresh juice vendors in Uyo metropolis

Sample	pH	TVC	TCC	FC	TSC	Tvibr C	Sal.
IBK_1	6.7	5.68±1.42	3.28±1.12	-	2.43±0.54	2.0±0.62	-
IBK_2	6.8	6.41±0.62	4.18±0.83	-	3.42±0.75	-	-
IBK_3	6.8	5.75±0.94	4.32±1.65	2.47±0.32	-	-	-
IBK_4	6.6	6.60±1.23	3.43±0.36	2.25±1.25	3.38±1.20	-	-
IBK_5	6.7	5.21±0.82	4.31±1.22	3.82±0.34	2.83±1.22	1.8±0.44	-

Data represent mean ± standard error of 5 measurements
IBK = Ice Block TVC = Total viable count, TCC = Coliform count, FC = Faecal coliform TCS = Total *Staphylococcal* count,
TVibr C = Total *Vibro cholerae* count , Sal = *Salmonella* on LD

Discussion

Fresh fruit and vegetable juices are well appreciated by consumers because of their taste, low price and availability at the right time. Inspite of these potential benefits offered, concerns over their safety and quality have been raised. Freshly squeezed fruit and vegetable juices have little or no critical control points that reduce pathogen levels if contaminated. The results of this study clearly indicate the poor hygienic conditions of these juices and that the consumers are at risk of contacting food borne infections. The presence of Staphylococcus spps in almost all the juice samples can be attributed to contamination via handling. This may be due to poor personal and domestic hygiene indicating lack of knowledge of hygienic practices and safety of food products (Tambekar et al., 2009). Although the growth of Staphylococcus spps can be affected by the low pH of fruit juice samples, it is apparent that the vegetable juices having near neutral pH could be safe heaven for Staphylococcal to proliferate (Mudgil et al., 2004). All the juice samples also indicated the presence of coliforms. This shows not only poor hygienic quality of this juice but also places consumers at high risk of contacting food borne infections. The presence of Salmonella spps and Vibro cholerae in the juice is a serious cause for concern. This is similar to result obtained by Mahale et al., (2008) in his study on microbiological analysis of street vended fruit juices from Mumbai city in India. This confirms the poor hygiene conditions of street vended fresh juices and the potential danger it posed to the consumers.

Microbiological analysis of all the ice samples indicated a huge load of pathogenic microorganisms. This was earlier noted in a similar studies by Lateef et al., (2004) on microbiological safety of commercial ice used in Ogbomoso south west, Nigeria where he noted the presence of microbial load of heterotrophic bacteria of Pediococcus spps, Bacillus Streptococcus spps etc. It is therefore apparent that microbial load of ice samples in most part of the country are largely above the level recommended. It has also been noted that in Uyo Metropolis, the major source of water is from bore holes and deep wells which are prone to contamination by E-coli, coliforms and other pathogenic micro-organism. This has prompted the National Agency for food and drug administration and Control (NAFDAC) to issue guidelines listing well and deep well water as unacceptable sources of water (NAFDAC, 2004). Therefore, if water used for ice production is of poor quality, harmful microorganisms may persist in the ice, since the process of freezing cannot destroy the organisms but when the ice is thawed, the surviving micro-organisms though may be injured, tend to recover their viability (Mahale et al., 2008). Street vendors are mostly uninformed of good hygienic practices (GHP) and causes of diarrhea diseases (Mersah et al., 2002) which can increase the risk of street food contamination (Bhaski et al., 2004). They are also unaware of food regulations as well as lacking supportive services such as water supply of good and adequate quality, waste disposal systems which enhance their ability to provide safe food.

Conclusion

The study indicated that all street vended fruit and vegetable juices in Uyo metropolis are contaminated due to poor unhygienic conditions related to washing of utensils, use of contaminated water and ice, poor personal and domestic hygiene. Other sources are peeling of fruits before hand, locating shop in crowded places.

The practice of consuming fruit and vegetable juices cannot be stopped on unhygienic grounds, and street vendors cannot also be prohibited from selling such items, since it is a source of their livelihood. However, government health agencies must adopt measures to educate the vendors on food safety and hygienic practices. Regular monitoring of the quality of fruit and vegetable juices for human consumption must also be enforced.

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