

Full Length Research Paper

Microbiological quality of pre-cut fruits on sale in retail outlets in Nigeria

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Microbiological quality of pre-cut fruits sold in retail outlets in Kano metropolis in Nigeria was evaluated. One hundred and fifty pre-cut fruit samples comprising pineapples (50), paw-paw (50) and watermelon (50) at the point of stand retail outlets were tested by standard microbiological methods to determine bacterial and parasite contamination. Out of these, 136 (90.67%) were contaminated with bacteria. Parasites were absent in all samples. The general distribution of the bacterial contaminations were; *Escherichia coli* 69 (46.00%), *Staphylococcus aureus* 29 (19.33%), *Salmonella* species 13 (8.67%), *Proteus* species 18 (12.00%), *Enterobacter aerogenes* 3 (2.00%), *Klebsiella pneumoniae* 2 (1.33%) and *Pseudomonas aeruginosa* 2 (1.33%). Among the 50 pineapple cuts - *E. coli* 26, *S. aureus* 6, *Salmonella* species 7, *Proteus* species 9, *P. aeruginosa* 2; the 50 watermelon had *E. coli* 22, *S. aureus* 13, *Salmonella* species 3, *Proteus* species 5, *E. aerogenes* 2 and *K. species* 2. From 50 paw-paw cuts *E. coli* 21, *S. aureus* 10, *Salmonella* species 3, *Proteus* species 4 and *E. aerogenes* 1 were isolated. These findings demonstrate that microbiological quality of pre-cut fruits sampled, suggest that the risk of foodborne illness from pre-cut fruits is high. There is a need to enforce good food hygiene practices to avoid contamination of pre-cut fruits.

Key words: Fruit vendors, pre-cut fruits, microbial contamination, hygiene.

INTRODUCTION

Consumption of fruits and vegetables has increased significantly in many countries during the past decade. Vegetables and fruits have been associated with outbreaks of food-borne disease in many countries. Organisms involved include bacteria, fungi, viruses and parasites (Jay, 1996; De Roever, 1998). Pre-cut fruits (pineapple, strawberries, cantaloupes, watermelon and grapes) suspected to be contaminated with *Norovirus* has been reported. Kaplan and Campbell (1982) implicated *Norovirus* in fruit salad. Outbreaks of salmonellosis have been associated with the consumption of cut watermelon and cantaloupe (CDC, 1979; Reis et al., 1990; CDC, 1991; Blostein, 1993; CDC, 2009) in the United States of America. Fruits may be fresh, canned and may be whole,

pre directly after peelin-cut or pureed. Fruits may be eaten g, pre-cut or sliced into pieces. Pre-cut fruits refer to fruits that have been cut open, sliced into pieces but remain in the fresh state and are stored or displayed for sale or for serving in retail outlets (fresh fruit packs in supermarkets, cut fruits in buffets) assorted fruits offered by restaurants and vendors (Kaplan and Campbell, 1982; Lund, 1992; De Roever, 1998). Epidemiological data have shown that food cross-contamination during preparation contributes remarkably to the occurrence of food-borne diseases (Gilling et al., 2001; Kusumaningrum et al., 2004; CDC, 2009).

Commercial pre-cut fruit vending in Nigeria consists of a small number of operations in most cities. However, this sector has not been considered by agencies responsible for food services as having a role in the introduction of potential foodborne bacteria or parasites. Fruits are known to carry natural non-pathogenic

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Table 1. General distribution of bacterial organisms isolated from pre-cut fruits samples investigated.

| Bacterial organism | Pineapple (50) | Watermelon (50) | Paw-paw (50) | Total fruits (150) (%) |
|-------------------------------|----------------|-----------------|--------------|------------------------|
| <i>Escherichia coli</i> | 26 | 22 | 21 | 69 (46.00) |
| <i>Staphylococcus aureus</i> | 6 | 13 | 10 | 29 (19.33) |
| <i>Salmonella</i> species | 7 | 3 | 3 | 13 (8.67) |
| <i>Proteus</i> species | 9 | 5 | 4 | 18 (12.00) |
| <i>Enterbacter aerogenes</i> | 0 | 2 | 1 | 3 (2.00) |
| <i>Klebsiella pneumonia</i> | 0 | 2 | 0 | 2 (1.33) |
| <i>Pseudomonas aeruginosa</i> | 2 | 0 | 0 | 2 (1.33) |
| Total | 50/50 | 47/50 | 39/50 | 136/150 (90.67) |

microflora; but contamination with pathogens from human, animal and environmental sources can sporadically occur at various stages of preparation before consumption. The aim of this study was to determine microbiological quality of pre-cut fruits in various retail outlets.

MATERIALS AND METHODS

Survey and sample collection

Between April and August, 2008 a total of 150 pre-cut fruits comprising 50 pineapples, 50 paw-paw and 50 watermelon from 10 point retail outlets were analyzed for presence of food-borne bacterial pathogens. Sampling sites were randomly determined, based on the places where pre-cut fruits were sold by street and market vendors within Kano metropolis. At each point of sale, a sample of each pre-cut fruit was taken into sterile polythene bags, placed in a cold box and transported to the laboratory for bacteriological analysis.

Bacteriological processing of samples

Bacteriological analysis included isolation of potential pathogens according to standard procedures of American Public Health Association (APHA) (1992). The entire surface of each pre-cut fruit was swabbed with a sterile swab and inoculated into Brain Heart infusion broth (pH: 7.2±0.2). Bacteria were mechanically removed by shaking the broth. The swab in the broth was incubated at 37°C for 24 – 48 h. This was followed by streaking onto blood agar (BA), Macconkey agar (MCA) and deoxycholate citrate agar (DCA) (OXOID) and incubated at 37°C for 24 – 48 h.

Identification

The colonial morphology characteristics of the bacterial organisms on the different solid media agar plates were observed. The suspect organisms were further identified and characterized based on their microscopic, physiological and biochemical characteristics according to Barrow et al. (1993). The presence or absence of *Salmonella* species was determined using APHA (1992). The swab cultures of pre-cut fruits in BHI were transferred to Rappaport-Vassiliadis broth and incubated at 42°C for 24 h. A loopful of each suspension was streaked on DCA and MCA and incubated at 37°C for 24 h. Suspect colonies were identified using standard

biochemical tests according to Barrow et al. (1993).

Parasitological analysis

The concentration method using swab of pre-cut fruits in 10 ml of sterile phosphate buffered saline (pH: 7.2±0.2) was used to detect parasite cysts, ova, and larvae according to Hoffmann et al. (1934). The entire surface of each pre-cut fruit was swabbed with a sterile swab and inoculated into phosphate buffered saline. Parasites, cysts, eggs, and larvae were mechanically removed by shaking the swab in phosphate buffered saline. This was then centrifuged at 3,000 rpm for 10 min. The supernatant was discarded and the sediments examined under the microscope using ×10 and ×40, respectively.

RESULTS

The results show that 136 (90.67%) of the 150 samples of pre-cut fruits investigated were contaminated with potential bacterial pathogens. Parasite or cysts, ova and larvae were not detected from any of the pre-cut fruits sampled. The general distribution of the bacterial contamination of the pre-cut fruits sampled were; *Escherichia coli* 69 (46.00%), *Staphylococcus aureus* 29 (19.33%), *Salmonella* species 13 (8.67%), *Proteus* species 18 (12.00%), *Enterobacter aerogenes* 3 (2.00%), *Klebsiella pneumoniae* 2 (11.33%) and *Pseudomonas aeruginosa* 2 (1.33%) (Table 1).

DISCUSSION

The results obtained from this study show that the samples were not wholesome despite their aesthetics, as 90.67% of the pre-cut fruits were contaminated with bacteria. This contamination may have been introduced at the point of processing and distribution. The 69 (46.00%) presence of thermo-tolerant (44°C) *E. coli* and other coliform bacteria is generally an indication of faecal contamination of the water often used by vendors for washing their utensils and hands before cutting the fruits. A study on the quality of sugarcane juice showed similar results of high occurrence of thermo-tolerant coliforms in 25% of samples (Oliveira et al., 2006).

The parasitological analysis in this study showed negative results for mature worms, ova, and larvae in all the samples. This is in correlation with the findings of Oliveira et al. (2006) who reported the presence of some foodborne bacteria with the exception of *Salmonella* species as recorded in this study and absence of worms and protozoa from sugarcane juice in Brazil.

The data presented here suggest that pre-cut fruits of paw-paw, pineapple and watermelon could become contaminated with foodborne bacteria by factors such as processing utensils in inadequate hygienic conditions as they are left uncovered, trays left open in unsuitable places for buyers and irregular hand-washing by the vendors. Cross-contamination of food during preparation has been identified as an important factor associated with food-borne illness (Wanyenya et al., 2004). In this survey, the utensils used for cutting the fruits were not investigated. However, pre-cut fruit vendors used plain water to wash their hands and knives used for cutting the sampled fruits.

Results from this study are similar to those of Blostein (1993), Wang (1996), CDC (1979, 2002, 2009a) and Kumar and Ganguli (2006) which reported *E. coli* and *Salmonella* species as being responsible for outbreaks involving pre-cut fruits. *Salmonella* species isolated could have been contaminated by water during washing such that the edible surfaces became contaminated during cutting.

Humans are the primary reservoirs of *S. aureus* in their nasal passage, hands and skins of healthy individuals. As the fruits are being cut and handled with bare hands by the vendors, *S. aureus* may be introduced into the pre-cut fruits during peeling or slicing of the fruits. The high rate of *S. aureus* as shown in this study is similar to the report of Kumar and Ganguli (2006), where they reported high occurrence rate of *S. aureus* in food.

S. aureus, *E. coli*, *Salmonella* species and other bacteria isolated in this study could be associated with the general poor sanitary environmental conditions under which the fruits were handled (Little and Mitchell, 2004). The microbial quality of the fruits in their raw state, contaminated water or inadequate hand-washing by fruit vendors and the absence of individual sanitary practices are similar to the reports of Kuminos and Copeland (1972) who reported *P. aeruginosa* infection in a hospital via vegetables. In a related survey of retail establishment, Allwood et al. (2004) reported that only 52% of the food handlers knew how to wash their hands. In this study, about 100% of these pre-cut fruit vendors were unfamiliar with the importance of maintaining personal and utensil hygienic standards. Similarly Okonko et al. (2009) reported high contamination of sea food processors and water used by pathogenic bacteria in Nigeria. In conclusion, inadequate hygiene among vendors may be mainly due to lack of knowledge rather than negligence with proper precautions. Among pre-cut fruits sampled, the most contaminated was pineapple (100%), followed

by watermelon (94%), while the least contaminated was pawpaw which had (78%). This calls for improved surveillance system on fruits products and public health education and enlightenment of retailers and consumers.

As a result of the occurrence of potential foodborne pathogens contamination of these pre-cut fruits studied before their purchase for consumption and the possible outbreaks of food poisoning, retailers and consumers are advised to wash fresh fruits properly before peeling, slicing or cutting. Also to handle and cut fruits with clean and sanitized utensils, surfaces and to store cut fruits at 4°C or below until sold or consumed.

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