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# BACTERIOLOGICAL QUALITY OF SLICED FRUITS SOLD AT ROAD SITE IN MAIDUGURI, BORNO STATE

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**Abstract**

The study was conducted to assess the bacteriological quality of sliced fruits, Fresh cut fruits collected from different stationary vendors in Maiduguri metropolis and were analysed to determine their bacteriological quality. All samples examined were contaminated with bacteria load. The Total aerobic plate count (TAPC) range from $1.8x10^5$ – $3.4x10^5$ for pawpaw, $1.9x10^5$- $6.8x10^5$ for pineapple and $1.5x10^5$- $5.1x10^5$ for watermelon, Likewise Total coliforms count range from $1.0x10^4$ – $2.0x10^4$ for pawpaw, $1.0x10^4$- $3.8x10^4$ for pineapple and $1.0x10^5$- $4.6x10^4$ for watermelon. The bacterial isolate were identified as *Staphylococcus aureus*, *E.coli*, *Pseudomonas*, *Shigella sp.* and *Salmonella sp*. The results obtained shows that sliced fruits sold in Maiduguri metropolis are habited by pathogenic bacteria. Therefore educating our fruit vendors on food hygiene, adequate packaging/covering of fruits on display for sale and washing of fruits before consumption is recommended.

Keywords: Bacteriological, Quality, Sliced fruit, and Maiduguri.

## Introduction

Fruits are an extraordinary dietary source of nutrients, micronutrients, vitamins and fiber for humans and are thus vital for health and wellbeing. Well balanced diets, rich in fruits and vegetables, are especially valuable for their ability to prevent vitamin C and A deficiencies and are also reported to reduce the risk of several diseases. Fruits product are known to carry natural nonpathogenic micro flora; however, contamination with pathogens from humans or animals source can also occurs sporadically at various stages along the production. Globalization of fresh fruits potentially increase human exposure to a wider variety of food-borne pathogens and has resulted in a potential increased risk of food-borne illness outbreak associated with the consumption of these raw commodities. These pathogens may invade the inner surface of the fruits during slicing or peeling. Studies have already confirmed that pre-cut fruits might be contaminated with *Salmonella, Listeria monocytogens* and high count of *Stapyylococcus aureus* (Eni *et al*., 2010). Consumption of sliced products has been on the increase locally and globally. This is so because they are more convenient, easily accessible, and most especially cheaper than the whole fruits (Nwanchukwu *et al.*, 2008). The increase in the consumption of sliced fruits has been linked with parallel increase in food-borne illnesses (Mensah *et al.*, 1999; Estrada-Garcia *et al*., 2004; Eni, *et al*., 2010). Sliced fruits commonly consumed in Borno state include pawpaw pineapple and watermelon. Pawpaw pineapple and watermelon are process and sold by street vendors with poor education levels and untrained in food hygiene (Barro *et al*., 2006). The consumption of sliced pawpaw and watermelon may have potentially increase the risk of food-born disease caused by variety of pathogens, cross contamination of fruits, unsanitary processing and use of dirty trays for display of fruits further increases the risk of contamination. Another major source is the water used in washing those cut fruits (Khali *et al*., 1994). Bacteria causing gastrointestinal infection can contaminate the sliced fruits thus exposing the consumer to greater risk.

In Nigeria, fruits are popularly displayed completely exposed for sales in shopping malls, along busy and major streets and hawked by street food vendors in motor parks and on busy roads with heavy traffic, security check points or at bad spots on the highways where motorists are forced to slow down. Fruits are often purchased as ready to eat and thus usually consumed without washing. The sliced fruits such as pawpaw, pineapple and watermelon could become contaminated with foodborne bacteria in the process such as processing utensils in adequate hygienic conditions, as they are left uncovered, trays left open in unsuitable places for buyers and irregular hand-washing by the vendors. The consumption of sliced pawpaw pineapple and watermelon may have potentially increased the risk of food-borne disease caused by variety of pathogens. To investigate the quality of those consume fruits sold at road side is of great concern.

## Material and Method

### Study Area

The study area Maiduguri is located in the arid zone of Borno state, with an area of about 69,436km$^2$ and lies within latitude 11$^o$ 50$^o$ 46 N and longitude 13$^o$ 08$^o$ 29 E. Borno state has an estimated population of about 4,151,193.

### Sample Collection

One hundred and fifty apparently fresh and healthy sliced pawpaw, watermelon, and pineapple fruits were purchased comprising of five pawpaw, five watermelon and five pineapples from each of the ten locations. Sampling sites were visited twice in two weeks within the months of June to July 2014, during which samples were obtained from the street vendors. Each sample was placed separately in sterile plastic bags and transported to the laboratory for processing within 1 h of collection.

### Bacteriological analysis

Determination of bacterial load: Each sliced fruit sample was rinsed out in 10 mL sterile peptone water (Fluka, Germany). The resultant homogenate was diluted $10^{-2}$, $10^{-3}$, $10^{-4}$, $10^{-5}$ and $10^{-6}$. The pour plate technique was adopted in plating aliquots of 0.2 mL of the dilutions in duplicate onto different media plates; Nutrient agar and plate count agar (Oxoid, England) for total aerobic plate count, Eosin Methylene Blue (EMB) agar (Oxoid) and MacConkey agar (Fluka) for coliform counts. All the media were prepared according to the manufacturer's instruction. Plates were incubated for 24 h at 37ºC for colony formation. Each colony was isolated in a pure form by sub- culturing for further studies and identification. Distinctive morphological properties of each pure culture such as colony form, elevation of colony and colony margin were observed. Further microbial identification was based on the methods of Eni, *et al*. (2010).

For enumeration of bacteria present in each sample, 10-fold serial dilutions of each were made and 1 ml of $10^{-2}$, $10^{-4}$, $10^{-5}$ dilutions were pipette into sterile Petri-dishes and molten nutrient agar (45$^o$C) was added and swirled thoroughly to allow even distribution. The colonies were counted using a colony counter (Stuart Scientific, UK) after 24 h incubation at 37ºC.

## Results and Discussion

Total aerobic plate count, and coliform count are shown in Table 1. Aerobic plate count in most of the samples was high ranging from $1.8x10^5$ to $3.4x10^5$ for pawpaw, $1.9x10^5$ to $1.9x10^5$ to $6.8x10^5$ for pineapple and $1.5x10^5$ to $5.1x10^5$ likewise Total aerobic plate counts in pawpaw was high at Monday market with $3.4x10^5$ and with least counts at Gidan madara $1.8x10^5$ while for pineapple high counts was recorded Monday market with $6.0x10^5$ counts and with least counts at Unimaid park with $1.9x10^5$ and watermelon with higher counts at Monday market with $5.1x10^5$ and least counts at Kostin with $1.5x10^5$ counts.

Total coliform counts in the sampled fruits range from $1.0x10^4$ to $2.0x10^4$ for pawpaw, $1.0x10^4$ to $3.8x10^4$ for pineapple, and $1.0x10^4$ to $4.6x10^4$ similarly, total coliform counts in pawpaw at Monday market with $2.9x10^4$ and with least counts at Gidan madara and Tashan

Bama with $1.0x10^4$ while for pineapple high counts was also recorded at Monday market with $3.8x10^4$ and least counts was recorded at Gidan madara and Unimaid park, and watermelon records high counts of $4.6x10^4$ at Monday market and least counts at Gidan madara with $1.0x10^5$ (Table 1).

The bacterial isolate were identified as *Staphylococcus aureus*, *E.coli*, *Pseudomonas*, *Shigella sp.* and *Salmonella sp*. Table 2 shows that S. aureus was isolated from samples in all the locations. *Pseudomonas, Shigella spp, Samonella spp, E. coli* was detected in some samples.

**Table 1. Distribution of mean bacterial load of sliced fruits sold at road site in Maiduguri**

| | **Bacterial load** | | | **cfu/ml** | | |
|---|---|---|---|---|---|---|
| **Samples sites** | TAPC | | | TCC | | |
| | Pawpaw | Pineapple | Watermelon | Pawpaw | Pineapple | Watermelon |
| **Unimaid Park** | $2.5x10^5$ | $1.9x10^5$ | $2.6x10^5$ | $1.5x10^4$ | $1.0x10^4$ | $1.1x10^4$ |
| **Kostin** | $2.9x10^5$ | $2.8x10^5$ | $1.5x10^5$ | $1.4x10^4$ | $1.4x10^4$ | $1.1x10^4$ |
| **Unimaid Commercial** | $2.7x10^5$ | $2.0x10^6$ | $2.7x10^5$ | $1.3x10^4$ | $1.4x10^4$ | $2.2x10^5$ |
| **Tashan Bama** | $2.4x10^5$ | $3.3x10^5$ | $3.4x10^5$ | $1.0x10^4$ | $1.9x10^4$ | $2.6x10^4$ |
| **Monday market** | $3.4x10^5$ | $6.8x10^5$ | $5.1x10^5$ | $2.9x10^4$ | $3.8x10^4$ | $4.6x10^4$ |
| **Borno express** | $2.6x10^5$ | $4.4x10^5$ | $3.2x10^5$ | $1.1x10^4$ | $3.1x10^4$ | $2.5x10^4$ |
| **Post office** | $2.2x10^5$ | $2.5x10^6$ | $2.3x10^5$ | $2.0x10^4$ | $1.6x10^4$ | $4.0x10^4$ |
| **Gidan madara** | $1.8x10^5$ | $2.2x10^5$ | $3.3x10^6$ | $1.0x10^4$ | $1.0x10^4$ | $1.0x10^5$ |
| **Custom** | $2.7x10^5$ | $6.0x10^5$ | $3.2x10^5$ | $1.9x10^4$ | $2.0x10^4$ | $4.1x10^4$ |
| **West end** | $2.5x10^5$ | $3.0x10^5$ | $3.5x10^5$ | $2.0x10^4$ | $1.8x10^4$ | $2.4x10^4$ |

TAPC: Total aerobic plate counts, TCC: Total coliform counts

**Table 2. Occurrence of bacterial isolates in fruits samples**

| Sample sites | *E.coli* | *Pseudomonas* | *Salmonella* | *Shigella sp.* | *S.aureus* |
|---|---|---|---|---|---|
| Unimaid Pack | - | + | + | + | + |
| Kostin | - | + | + | + | + |
| University commercial | - | + | - | - | + |
| Tashan Bama | + | + | + | + | + |
| Monday market | + | - | + | + | + |
| Borno express | + | - | - | + | + |
| Post office | - | + | + | + | + |
| Gidan Madara | - | + | - | - | + |
| Custom | - | + | - | - | + |
| West end | - | + | - | + | + |

+= present, - =absent

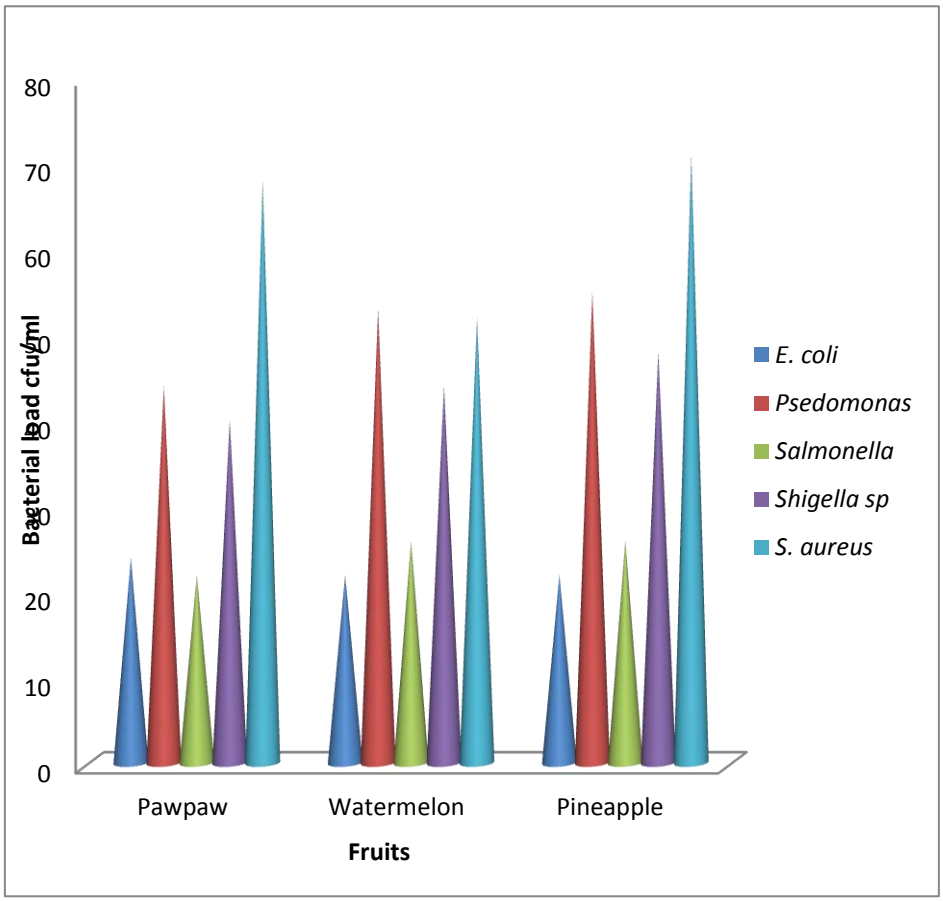


**Figure 1. Distribution of bacterial load on fruits sample**

The bacterial loads present in fruits are a direct reflection of the sanitary quality of the cultivation water, harvesting, transportation, storage, and processing of the produce (Eni, *et al*., 2010). All the bacteria isolated in this study have previously been isolated from fruits and vegetables in other studies, both in Nigeria and elsewhere (Eni, *et al*., 2010).The high bacteria counts observed in the fruits are similar to those obtained in other studies in Nigeria (Bukar *et al*., 2010). The high bacterial contamination observed in the fruits may be a reflection of storage conditions and how long these fruits were kept before they were obtained for sampling. More importantly, bacteria on the fruits may multiply over time depending on the storage conditions especially those that are psychrophilic (Abadias *et al*., 2008). Some of the bacteria isolated in this study may be part of the natural flora of the fruits and vegetables or contaminants from soil, irrigation water, and the environment during transportation, washing/rinsing water or handling by processors (Eni, *et al*., 2010). *Pseudomonas* part of the natural flora and are among the most common vegetable spoilage bacteria (Eni, *et al*., 2010). The presence of *S. aureus*, a pathogenic organism of public health concern, in most of the samples and the presence of other pathogenic and opportunistic bacteria like *Shigella spp*, and *Salmonella spp*., in some of the fruits, further highlights the need to safeguard the health of the consumers by proper washing and decontamination of these fruits which are consumed without heat treatment. *E. coli* been an indicator of faecal contamination is of great concern.

**Conclusion**

The present study reveals that fresh cut fruits sold in Maiduguri metropolis are not free from bacterial contamination. Among the isolate are *Staphylococcus aureus*, *E.coli*, *Pseudomonas*, *Salmonella* and *Shigella sp*. which causes food poisoning or intoxication. This agrees with previous work by Eni *et al*., 2010 and Bukar *et al*., 2010 which shows that *Staphylococcus aureus* isolated from fruits caused poisoning and that profileration of the organisms could lead to food intoxication. *E.coli* and *Salmonella* revealed that the water used in processing (e.g washing knives and utensils) are faecally polluted and these organisms can cause diarrhoea.

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