



Bacteriological Assessment of Sliced Fruits Vended In Sabon Gari, Zaria, Kaduna State, Nigeria

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ABSTRACT

A study was conducted to assess the bacteriological quality of sliced fruits vended in three markets within Sabon Gari local government area. Zaria, Kaduna state. A total of forty five fresh sliced vended fruits were randomly procured comprising of pawpaw, pineapple and water melon. Samples were taken from the fruits, inoculated on nutrients agar, mannitol salt agar and macConkey agar and incubated for 24 hours. Serial dilution technique was used for isolation and enumeration of the bacterial species present in the fruits. Data obtained analyzed using analysis of variance with Duncan's new multiple range test used to separate significant means at 5% level. Five bacterial species: *Escherichia coli*, *Bacillus subtilis*, *Citrobacter freundii*, *Staphylococcus aureus* and *Providencia sp* were found to be associated with the fruits with *E. coli* having the highest prevalence. The result obtained revealed significant difference ($P \leq 0.05$) in bacterial loads among the sliced fruits. Highest bacterial load is found in pawpaw. Therefore, hygienic practices should be ensured for the safety of consumers as well as to prevent food borne illnesses.

Keywords: MacConkey agar; Nutrients agar; Pawpaw; Pineapple; Watermelon

INTRODUCTION

Fruits are an extraordinary dietary source of nutrients, micronutrients, vitamins and fiber for humans and are also vital for health and well-being. Well balanced diets, rich in fruits have been reported to help to prevent vitamin C and vitamin A deficiencies and to reduce the risk of several diseases. Sliced fruits refer to fruits that have been cut open, sliced into bits, but remain in the fresh state and displayed for sale in retail outlet for consumption. These sliced fruits are bought directly from the street vendors or hawkers or at local market without necessarily having to undergo any further treatment before consumption. They are usually packaged in small polyethene bags for sale. Over the last few years, there has been a significant increase in the consumption of vended fruits in Nigeria. This is because they are easily accessible, conveniently, and most importantly, they are cheaper than the whole fruits. Other reasons include modern lifestyle, industrialization, economic downturn, materialism and lack of time to prepare proper meal [1,2].

Fruits are widely exposed to microbial contamination through contact with soil, dust and water and also by mishandling during harvest or post-harvest processing. They therefore harbor a diverse range of micro-organisms including pathogens. This therefore increases the risk of food-borne diseases caused by a wide range of pathogens such as bacteria (*Salmonella sp*, *Staphylococcus aureus*, *Enterobacteriaceae*), fungi, viruses and parasites. These pathogens could invade these fruits during washing, peeling, and slicing, trimming, packaging, handling and marketing. The use of dirty utensils encourages rare visits of cockroaches, flies and rats [3-5].

Vended sliced fruits have been on the increase in many developing countries due to lack of formal jobs for the working age groups. Sales of sliced fruits can contribute significant income for households and at the same time providing a source of inexpensive nutritious meal. Outbreak of illness caused by consumption of fruits had been reported. The increase in consumption of sliced fruits has been linked with a parallel increase in food borne illness. Fruit produce is known to carry a

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natural nonpathogenic micro flora, and have an epidermal layer of cells which provides a barrier for penetration of microorganisms. Cutting and slicing can eliminate the protections and microbes can invade the internal tissue. Unsanitary processing and preservative methods could increase the possibilities of contamination. Open display of street food produce encourages sporadic visits by flies, cockroaches, rodents and dust in Nigeria where street food vending is very common. This study therefore aimed at assessing the bacteriological quality of sliced fruits vended in Sabon gari Zaria, Kaduna state [6-10].

MATERIALS AND METHODS

Collection of samples

A total of forty five (45) fresh sliced vended fruits were randomly procured from three (3) different locations (Samaru market, Sabon Gari market and Ahmadu Bello University Campus market) in Zaria comprising of fifteen fruits from each market. The sliced fruits used were: Pineapple (*Ananas comosus*), pawpaw (*Carica papaya*) and watermelon (*Citrullus lanatus*). The samples were collected in clean polythene bags and labelled respectively. The samples were kept in the refrigerator at 4°C for later use [11-15].

Enumeration and isolation of bacteria isolates

For enumeration and isolation of bacterial flora from the samples, the method of Dashwood, et al. was used. About 10 grams of each cut fruits sample was placed in 90 ml of sterile distilled water and then blended in a sterile blender after which 1 ml of the homogenate was then constituted in 9 ml of sterile peptone water. From there, 10 fold serial dilutions was performed and 0.1 ml of 10^{-3} was inoculated in triplicate on freshly prepared nutrients agar plates using pour plate technique

Table 1: Mean bacterial loads in sliced fruits vended in Sabon Gari Zaria.

| Fruits | Bacterial loads (CFU/ml) |
|------------|--------------------------|
| Pawpaw | 4.14×10^{6a} |
| Pineapple | 3.92×10^{6b} |
| Watermelon | 2.55×10^{6c} |

Key: Value with the same letters down a column are not significantly different (P=0.05)

Characterization of bacterial isolates

The result for bacterial characterization in sliced fruits is shown in obtained from Sabon gari Zaria is shown in Table 2. The result indicated the presence of five (5) different bacterial species

Table 2: Characterization of bacterial species from sliced fruits.

| Fruit | Cell morphology | Color | Gram's reaction | IND | MR | VP | CIT | Genus |
|-----------|-----------------|---------------|-----------------|-----|----|----|-----|--------------------------|
| Pineapple | Short rod | Whitish green | - | + | + | - | - | <i>Escherichia coli</i> |
| | Irregular | Creamy | - | + | + | - | + | <i>Bacillus subtilis</i> |

for bacterial enumeration [16-20]. The plates were then incubated at 37°C for 24 hours and examined for the presence of discrete colonies. Colonies were counted using the colony counter and expressed as colony forming unit per milliliter (CFU/ml) of sample homogenate. Characteristic discrete colonies on the different media were isolated and purified by repeated sub culturing on the same media. Pure colonies were stored on agar slants at 4°C for further characterization [21-25].

Characterization of bacterial isolates

Various colonies observed in the plates were distinguished on the basis of their cultural characteristics such as shape, colour and elevation as described by Fawole and Oso. The pure colonies were characterized based on gram staining as described by Cheesbrough and using biochemical test such as Indole, methyl red, Voges Proskauer and citrate utilization tests [26-30].

Data analysis

Data obtained for the prevalence was analysed in frequency and percentages while that from enumeration was analyzed using analysis of variance with Duncan's new multiple range test used to separate significant means at 5% level.

RESULTS

Enumeration and isolation of bacteria isolates

The result for bacterial enumeration in the sliced fruits is presented in Table 1. The result revealed that pawpaw had the highest bacterial load of 4.14×10^6 CFU/ml while water melon had the least value of 2.55×10^6 CFU/ml.

in the fruits: *Escherichia coli*, *Bacillus subtilis*, *Citrobacter freundii*, *Providencia sp* and *Staphylococcus aureus* [31].

| | | | | | | | | |
|------------|------------------------|---------------|---|---|---|---|---|-------------------------------|
| | Irregular | White | + | + | + | - | + | <i>Staphylococcus aureus</i> |
| Pawpaw | Swarming and Irregular | Creamy | - | + | + | - | + | <i>Providencia sp.</i> |
| | Short rod | Whitish green | - | + | + | - | - | <i>Escherichia coli</i> |
| | Irregular | Creamy | - | + | + | - | + | <i>Bacillus subtilis.</i> |
| | Irregular | White | + | + | + | - | + | <i>Staphylococcus aureus.</i> |
| | Convex | Whitish | - | - | + | - | + | <i>Citrobacter freundii.</i> |
| Watermelon | Short rod | Whitish green | - | + | + | - | - | <i>Escherichia coli</i> |
| | Irregular | Creamy | - | + | + | - | + | <i>Bacillus subtilis.</i> |
| | Irregular rod | | - | + | + | - | + | <i>Providencia sp.</i> |

Key: Ind: Indole; MR: Methyl red; Vp: Vogues Proskaver; +: Positive reaction; -: Negative reaction; Cit: Citrate

Prevalence of bacterial species

The result for the prevalence of bacterial species in the sliced fruits vended in Sabon gari local government area is presented in Table 3. The result showed that, pawpaw had the highest number of bacterial species with *E. coli* as the most prevalent in

all the fruits with 33.33%, 50.00% and 60.00% in pawpaw, pineapple and water melon respectively.

Table 3: Prevalence of bacterial species in sliced fruits vended in Sabon Gari, Zaria.

| Fruits | Bacteria spp. | Frequency | Percentage (%) |
|------------|-------------------------------|-----------|----------------|
| Pawpaw | <i>Escherichia coli</i> | 8 | 33.33 |
| | <i>Bacillus subtilis.</i> | 3 | 12.5 |
| | <i>Citrobacter freundii.</i> | 5 | 20.83 |
| | <i>Staphylococcus aureus.</i> | 2 | 8.33 |
| | <i>Providencia sp</i> | 6 | 25 |
| | Total | 24 | 100 |
| Pineapple | <i>Escherichia coli</i> | 7 | 50 |
| | <i>Bacillus subtilis</i> | 4 | 28.57 |
| | <i>Staphylococcus aureus</i> | 3 | 21.43 |
| | Total | 14 | 100 |
| Watermelon | <i>Escherichia coli</i> | 6 | 60 |
| | <i>Bacillus subtilis.</i> | 2 | 20 |
| | <i>Providencia sp.</i> | 2 | 20 |
| | Total | 10 | 100 |

DISCUSSION

The presence of different genera of bacteria in sliced fruits vended in Sabon gari Zaria had proved the fact that fruits are extraordinary dietary source of nutrients, micronutrients and vitamins on which bacteria and man compete. The findings from the present study showed that sliced vended fruits are contaminated with microbes and the contamination might be due to improper washing of fruits, utensils and personal hygiene of the vendors as reported by Tambekar, et al. The values of bacterial loads reported by this study agrees with that of Nwachukwu and Chukwu who reported total bacterial counts in pineapple as 3.5×10^6 cfu/g. However, it contradicts the work of Eni, et al. who reported low bacterial counts in pineapple. Another study by Oranusi and Olorunfemi showed total bacterial count of 2.0×10^6 in pineapple. In this study, it is obvious that most of the fresh fruits and vegetables frequently eaten raw in Zaria, Nigeria were contaminated with different bacterial species. The significant difference observed in levels of contamination of products from the sampling location compared to the other location could probably be a reflection of the level of exposure and the handling process as stressed by Oranusi, et al. The dusty, unhygienic market environments coupled with the poor handling by the vendor can be the factors contributing to the high microbial loads in these fruits. The common practice of using bucket of water to wash the fruits and the used of some utensils for cutting across could also be the potential sources of contamination.

The high prevalence of *E. coli* shows faecal and non-faecal indicators of fruits contamination. *Escherichia coli* are regarded as primary indicator for microbiological quality of food and water and this shows that these fruits are not safe for human consumption. The main transmission of *Escherichia coli* was through fiscally contaminated food or water. The presence of *Staphylococcus* may be explained by the fact that human beings, that is, processors or vendors, carry these organisms on/in several parts of their bodies as reported by Nester, et al. This can be introduced into the fresh sliced watermelon during handling, processing or vending. Staphylococci grow readily on many types of media and active metabolically, fermenting carbohydrates and producing pigments that vary from white to yellow; colonies on solid media are round, smooth, raised and glistening. Shima, et al. Reported the presence of *Providencia spp* among vended meat in Thailand.

Staphylococcus spp. is commonly found in humans and other animals and often cause food poisoning among other diseases. Their presence in the samples analysed was probably due to

human contact. Jolaoso, et al. isolated *Staphylococcus aureus*, and *Escherichia coli* from sliced pineapple and pawpaw. This is further supported by the work of Oranusi and Olorunfemi, that isolated *Staphylococcus aureus*, and *Escherichia coli* from ready to eat fruits sold in Otta, Ogun state; Tambekar, et al. also isolated *Staphylococcus spp* and *Escherichia coli* from street vended fruits juices in Amravati, India. Moreover, the result of this study is in line with the report of Fowoyo, from air contaminated vended foods sold in Lokoja, Kogi state.

Aboloma and Wada Kura, et al. has also reported that the incidence of *Staphylococcus aureus* in food is an indication of environmental and human contamination. This high incidence may have occurred due to the use of polyethene bags for the packaging of these fruits after slicing or cutting them. Adegun, et al. isolated *Citrobacter freundii* from fruits and vegetables sold for consumption in Ile-Ife, Nigeria. Occurrence of *Citrobacter spp* in fruits and vegetables depends on several factors such as: type of fruit, contact with the soil and season. The high occurrence may have occurred in the contact of contaminated water with the fruits during washing of the fruits and also the inadequate washing of hands by the fruit vendors.

CONCLUSION

Five bacteria species were isolated from sliced fruits vended in Sabon gari, Zaria. These isolates were: *E. coli*, *Bacillus subtilis*, *Staphylococcus aureus*, *Providencia sp* and *Citrobacter freundii*. *E. coli* had the highest prevalence of 60.00%. Among the sliced fruits pawpaw harbors the highest bacterial loads. Thus, the study recommends that, all sliced fruits vended in Zaria markets should be washed with clean water before consumption. Retailers of sliced fruits should be enlightened on personal hygiene to reduce rate of contamination.

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