



## MICROBIOLOGICAL QUALITY OF SLICED FRESH FRUITS SOLD IN BIDA, NIGERIA

DANIEL, A. A.<sup>1</sup>, DANFULANI, S<sup>2</sup>., BARNABAS, B. B<sup>3</sup>., PETER, G<sup>4</sup>. & AJEWOLE, A. E<sup>5</sup>.

Department of Science Laboratory Technology, The Federal Polytechnic, P.M.B. 55 Bida, 912002, Nigeria

<sup>1</sup>Corresponding author

### ABSTRACT

Sliced fresh fruits (pineapple, pawpaw and water-melon) packaged in polyethylene bags were bought from different locations in Bida, for microbiological analyses. The bacterial count (cfu/g) ranged from  $2.6 \times 10^3$ – $3.6 \times 10^3$  for pineapple,  $3.2 \times 10^3$ – $3.7 \times 10^3$  for pawpaw and  $4.1 \times 10^3$ – $6.3 \times 10^3$  for watermelon. There were significant differences ( $p < 0.05$ ) in bacterial count among the fresh cut fruits obtained from Poly gate, small market and modern market in all the fresh cut fruits. The fungal count of the pineapple fruit obtained from the fruit vendors at Poly small gate and Bida modern market were not significantly different ( $p > 0.05$ ); however, these differed from the pineapple purchased at Bida small market. The bacterial isolates identified were: *Staphylococcus* species, *Bacillus* species, *Escherichia coli*, *Salmonella typhi*, *Streptococcus* sp. and *Enterobacter aerogenes*. The fungal isolates identified were: *Mucor* sp., *Penicillium* spp. And *Aspergillus* spp. The results obtained in this study showed that fresh cut fruits sold in Bida are of poor microbiological quality.

**Keywords:** sliced fruits, fruit vendors, microbiological quality.

### INTRODUCTION

Fresh cut products are fruits or vegetables that have been trimmed, peeled and cut into a fully usable product, which is subsequently packaged to offer consumers high nutrition, convenience and flavour while maintaining freshness (IFPA, 2000). Consumption of sliced fruits has been on the increase because they are more convenient, easily accessible, nutritious and most especially cheaper than whole fruits or vegetables (Nwachukwu *et al.*, 2008). Fresh cut products must be safe, wholesome and nutritious (FDA/CFSAN, 2008).

The increase in consumption of sliced fruits has been linked with a parallel increase in food-borne illness. Fresh-cut fruits on the market today include water-melon, pawpaw, oranges, grape-fruit, pineapple, and salad vegetables, cucumber, carrots, cabbage and pears. Pawpaw, pineapple and watermelon are processed and sold by street vendors with poor education levels and untrained in food hygiene (Barro *et al.*, 2008; Jolaoso *et al.*, 2010). Cross-contamination of sliced fruits, unsanitary processing and preservation methods, use of dirty trays for display of fruits further increases the risk of food contamination. Another major source of contamination is the wash water; bacteria causing gastroenteritis can contaminate the sliced produce thus exposing the consumer to higher risk of food borne illness (Jolaoso *et al.*, 2010). The aim of this study is to evaluate the microbiological quality of sliced fruits sold within Bida metropolis.

### MATERIALS AND METHODS

#### Samples collection

Sliced fruits (pineapple, pawpaw and watermelon) packaged in low density polyethylene films (LDPE) were bought from various fruit vendors at modern market, small market and Federal Polytechnic school gate in Bida and the samples were immediately transported to the laboratory for analyses.

#### Microbiological analysis

Twenty gram (20g) each of the sample was weighed aseptically and transferred into 180ml of sterile diluents (0.1% peptone water) and homogenized using sterile blender (sterilized with 5% sodium metabisulphite for 5min before rinsing with sterile water); following which 1ml of the homogenate was serially diluted in a set of test tubes containing 9ml of the sterile diluents. Pour plate technique and the method of Miles and Misra described by Collins *et al.* (1989) were adopted to obtain microbial counts. Samples were cultured on the prepared media (nutrient agar and potato dextrose agar) in duplicate and incubated aerobically at 37°C for 48h for bacterial; 3-7days for fungi isolation. The colonies formed were counted and results expressed as colony forming unit per gram (cfu/g).

Bacterial isolates were identified according to the methods of Sneath *et al.* (1986) while fungi isolates were identified on the basis of standard cultural and morphological characteristics as described by Barnett and Hunter (1972).

#### Statistical analysis.

Analysis of variance (ANOVA) was carried out for microbiological counts for each of the fruit samples. The mean scores were computed and significant differences among the mean was determined (Duncan:  $P = 0.05$ ) using (2006 Statistical Packages for Social Sciences (SPSS) for Windows version 15.0 (SPSS, 2006). Percentage frequency of occurrence of each microbial isolates was computed.

## RESULTS

### Bacterial count

As shown in Table 1, the bacterial count (cfu/g) ranged from  $2.6 \times 10^3$ - $3.6 \times 10^3$  for pineapple,  $3.2 \times 10^3$ - $3.7 \times 10^3$  for pawpaw and  $4.1 \times 10^3$ - $6.3 \times 10^3$  for watermelon. There were significant differences ( $p < 0.05$ ) in bacterial count among the fresh cut fruits (pineapple, pawpaw, watermelon) obtained from Poly gate, small market and modern market (Table 1).

### Mold count

Also in Table 1, is shown the fungal count of fresh cut fruits obtained from Poly small gate, Bida small and modern markets. The fungal count (cfu/g) for pineapple fruit ranged from  $2.3 \times 10^3$ - $3.0 \times 10^3$ ; pawpaw  $2.6 \times 10^3$ - $3.8 \times 10^3$  and watermelon  $2.5 \times 10^3$ - $3.8 \times 10^3$ . The fungal count of the pineapple fruit obtained from the fruit vendors at Poly small gate and Bida modern market were not significantly different ( $p > 0.05$ ); however, these were significantly different ( $p < 0.05$ ) from the pineapple purchased at Bida small market. A similar trend was observed in the fungal count of the watermelon fruit bought from the same location (Table 1); however, the fungal count of the pawpaw fruit did not differ ( $p < 0.05$ ).

Table 1: Total microbial count of fresh cut fruits

Location	Fruit type/microbial count <sup>1,2</sup>		
	Pineapple	Pawpaw	Watermelon
	Bacterial count (cfu/g)		
Poly small gate	$3.1 \times 10^3 \pm 6.6 \times 10^{1b}$	$3.7 \times 10^3 \pm 1.3 \times 10^{2a}$	$4.1 \times 10^3 \pm 6.6 \times 10^{1c}$
Bida small market	$3.6 \times 10^3 \pm 6.6 \times 10^{1a}$	$3.2 \times 10^3 \pm 5.7 \times 10^{1c}$	$6.3 \times 10^3 \pm 1.3 \times 10^{2a}$
Bida modern market	$2.6 \times 10^3 \pm 2.0 \times 10^{2c}$	$3.3 \times 10^3 \pm 2.3 \times 10^{2b}$	$5.7 \times 10^3 \pm 6.6 \times 10^{2b}$
	Fungal count (cfu/g)		
Poly small gate	$2.4 \times 10^3 \pm 6.6 \times 10^{1b}$	$2.7 \times 10^3 \pm 3.5 \times 10^{2a}$	$2.7 \times 10^3 \pm 3.3 \times 10^{2b}$
Bida small market	$3.0 \times 10^3 \pm 6.6 \times 10^{2a}$	$3.8 \times 10^3 \pm 6.6 \times 10^{2a}$	$3.8 \times 10^3 \pm 1.7 \times 10^{2a}$
Bida modern market	$2.3 \times 10^3 \pm 6.6 \times 10^{1b}$	$2.6 \times 10^3 \pm 2.0 \times 10^{2a}$	$2.5 \times 10^3 \pm 5.0 \times 10^{2b}$

<sup>1</sup>Each data is the mean  $\pm$  standard error of triplicate determinations

<sup>2</sup>Different letters within the same column for each microbial count are significantly different ( $p < 0.05$ )

### Microorganisms isolated from fresh cut fruits.

Table 2 shows the bacterial and mold isolated from sliced fresh fruits examined in this study. The bacterial isolates identified were *Staphylococcus spp.*, *Bacillus spp.*, *Escherichia coli*, *Salmonella typhi*; *Streptococcus spp.* and *Enterobacter aerogenes* while the fungal isolates were: *Mucor spp.*, *Penicillium spp.*, *Aspergillus niger*, *Aspergillus flavus* and *Aspergillus fumigatus* (data not shown but summarised as a footnote in Table 2).

### Frequency of occurrence of the microorganisms isolated

As observed in this study, *Bacillus spp.*, *Escherichia coli* and *Mucor spp.* were isolated in all the fruit types examined (100%), while *Staphylococcus aureus*, *Salmonella spp.* and *Aspergillus niger* were isolated in two of the fruit types examined (66.7%; data not shown but summarised as a footnote in Table 2).

Table 2: Microorganisms isolated from fresh cut fruits<sup>1,2</sup>

Table 2: Microorganisms isolated from fresh cut fruits												
Fruit type	Bacterial isolate						Mold isolate					
	1	2	3	4	5	6	7	8	9	10	11	12
Pineapple	+	-	-	+	-	-	+	+	+	+	-	-
Pawpaw	+	-	+	+	+	+	-	-	+	-	-	-
Watermelon	+	+	+	+	+	+	-	+	+	-	+	+

<sup>1</sup>Isolates: 1=*Bacillus spp.*; 2=*Streptococcus spp.*; 3=*Staphylococcus spp.*; 4=*Escherichia spp.*; 5=*Salmonella typhi*; 6=*Enterobacter aerogenes*; 7=*Cephalosporium spp.*; 8=*Aspergillus niger*; 9=*Mucor spp.*; 10=*Penicillium spp.*; 11=*Aspergillus flavus*; 12=*Aspergillus fumigatus*

(+) = isolated; (-) = not isolated

<sup>2</sup>Frequency of occurrence of isolates = *Salmonella spp.* (66.7%); *Bacillus spp.* (100%); *E. coli* (100%); *Staphylococcus spp.* (66.7%).

## DISCUSSION

The bacterial count of fresh cut fruits as obtained in this study ( $10^3$ cfu/g) were generally lower than those ( $10^8$ cfu/g) reported by Daniyan and Ajibo (2011) in fresh cut fruits in Minna Nigeria. The organisms isolated in this study are of concern to the health risk by the presence of these organisms in vended fruits. The presence of *Salmonella spp.* which was isolated from pawpaw and water melon samples (66.7%) examined in this study is quite worrisome and this poses a risk to public health in vended sliced fruits. *Salmonella* is a common cause of food borne illness (salmonellosis) and is responsible for millions of cases of illness each year.

Fresh produce may become contaminated with salmonellae through contact with sewage and contaminated water or through handling by infected workers. As salmonellae do not grow in foods stored at temperatures lower than 7°C, it was observed that none of the fruit vendors in Bida uses refrigerated storage system to market their produce. *Staphylococcus aureus* are commonly found in humans and other animals and often cause food poisoning among other diseases (O'Toole, 1995). Their presence in the samples analysed was probably due to human contact. Fresh cut fruits sold in open space are prone to contamination by spores of *Bacillus species* which occur in high number (100%) in the fruits examined. It is reasonable to believe that as a result of sub-standard agricultural practices, produce may be contaminated with human pathogens such as *Escherichia coli*.

*Escherichia coli* count in fruits is widely used and accepted as indicators of faecal contamination. The 100% incidence of *Escherichia coli* in the samples examined is higher than the 70% reported in Ogun state from sliced pineapple and pawpaw (Jolaoso *et al.*, 2010). It is possible that fungal isolates might have been introduced into fruits from soil contaminated materials used in processing fruits into cut produce.

The results obtained in this study, show that hawked fresh cut fruits sold in Bida are of poor microbiological quality. This is a reflection of poor hygienic standard of fruit processing as exhibited by local fruit vendors in Bida. This invariably constitute a public health hazard among the populace.

## References

- Barnett, D. C. and Hunter, B. B. (1972). *Illustrated Genera of Imperfect Fungi*: Minneapolis, USA: Burgess Publishing Co.
- Barro, N., Iboudo, I., Traore, A. S. (2006). Hygienic status, assessment of dishwater, utensils, hands and pieces of money in street food vending sites in Ouagadougou, Burkina Faso. *Afr. Journal of Biotechnology*, 5, pp. 1107-1112.
- Collins, C. H., Lynes, P. M. and Grange, J. M. (1989). *Collins and Lyne's Microbiological Method* (6th ed): London: Butterworth
- Daniyan, S. Y. and Ajibo, C. Q. (2011). Microbiological examination of selected fruit sold in Minna metropolis. *International Research Journal of Pharmacy*, 2(7), pp 124-129.
- FDA/CFSAN (2008). Food borne pathogens associated with fruits and vegetables. Food and Drug Administration, USA, Retrieved from <http://www.cfsan.fad.gov>. Accessed 13 May 2011.
- IFPA (2000). "Fresh-cut Produce: "Get the Facts!." International Fresh –cut Produce Association. Retrieved from [www.fresh-cuts.org](http://www.fresh-cuts.org).
- Jolaoso, A. A., Kareem, S. O., Ogunmuyiwa, S. I. O., Ajayi, J. O. and Osifeso, O. O. (2010). Microbial analysis of sliced pineapple and pawpaw. *Journal of Medical and Applied Biosciences*, 2, pp 9-15.
- Nwachukwu, E., Ezeama, C. F. and Ezeanya, B. N. (2008). Microbiology of polyethylene packaged sliced watermelon (*Citrullus anatus*) sold by street vendors in Nigeria. *African Journal of Microbiology Research*, 2, pp 192-195.
- O'Toole, D. K. (1995). Technical report: Microbiological quality of pork meat from local Hong Kong markets. *World Journal of Microbiology and Biotechnology*, 11, pp 699-702.
- Sneath, P. H., Mair, N. S., Sharp, M. E. and Holt, J. G. (1986). *Bergey's Manual of Systemic Bacteriology*, Vol. 11: Baltima: William Wilkins
- SPSS (2006). *Statistical Package for Social Sciences for Windows* (version 15.0). <http://www.spss.com>