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Microbiological Safety: Evaluation of some Street Vended Ready-to-Eat Fruits Sold in Yenagoa Metropolis, Bayelsa State, Nigeria

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Abstract:

Street vended fruits cause food borne illnesses in developing countries. This study was carried out to determine the microbiological safety of some street vended fruits sold in Yenagoa metropolis of Bayelsa State, Nigeria. Freshly cut ready-to-eat vended pawpaw, watermelon and pineapple were analysed for possible contamination with bacteria and fungi using standard microbiological techniques. A total of (17) samples: (5) Pawpaw, (6) Watermelon and (6) Pineapple were obtained from three (3) different local markets in Yenagoa metropolis, namely; Tombia, Opolo and Swali markets. Bacterial count ranged from 1.3x105 to 2.4x106cfu/ml for pineapple; 1.9x105 to 8.1x106cfu/ml for watermelon and 3.7x106 to 7.6x106cfu/ml for pawpaw samples. The highest bacterial count was obtained in watermelon from Opolo market, while the highest fungal count was recorded in pawpaw retailed at Opolo market. Microbial isolates were Bacillus sp, Escherichia coli, Salmonella sp, Staphylococcus sp, Klebsiella spp, Citrobacter spp, Proteus spp, Enterobacter spp, Mucor spp and Saccharomyces cerevisiae. There were 58.8% occurrence of Escherichia coli and Staphylococcus spp and occurred most. Bacillus spp and Klebsiella spp had 47.1% occurrence and closely followed by Staphylococcus aureus 41.2%, while Proteus spp had the least 5.9% occurrence. The result obtained may be responsible for the prevalence of Escherichia coli and Staphylococcus spp in Yenagoa metropolis. The presence of these organisms in these ready-to-eat retailed fruits analysed is a reflection of unwholesomeness and gross contamination of the fruits and therefore make the fruits unsafe for human consumption; hence the need for proper microbiological safety analysis of fruits for human consumption.

Keywords:
fruits; market; hygiene; contamination; health and welbeing

I. Introduction

Botanically, fruit means the fleshy seed associated structures of a plant that are sweet or sour and edible in the raw state, such as apples, orange, grape, strawberries, and lemons (Schlegel, 2003). Fruits are rich in vitamins, minerals, fibers, antioxidants and many phyto-nutrients; hence they are very essential for overall wellbeing of man (Adedeji and Oluwalana, 2013). Some of these fruits are produced by ornamental trees cultivated around houses or natural grown in the wild (Ajay et al., 2020). The fruits contains essential metabolites (Bawo et al., 2020) useful to the body system. Balance diet, rich in fruits is especially valuable for their ability to pervert vitamin C and vitamin A deficiencies and also reported to reduce risk of several diseases. (Kalia and Gupta, 2006).

Ready-to-eat fruits imply freshly sliced fruits that can be purchased directly from street vendors, hawkers or at local markets for immediate consumption, without necessarily having to rinse again before consumption as they have already been prepared by the vendors (FAO, 1989). Over the years, there has been a significant increase in consumption of sliced / ready-to-eat fruits in Yenagoa, particularly at the local markets, because they are easily accessible,

convenient, nutritious and most especially cheaper than whole fruits (Nwachukwu et al., 2008). The recent global economic recession has also increased the patronages for sliced fruits.

Fruit produces is known to carry a natural non-pathogenic micro flora and have an epidermal layer of cells which provide barrier for penetration by microorganisms. However, fruits are widely exposed to microbial contamination through contact with soil, dust, water and handling at harvest or during postharvest processing, transportation and marketing. These fruits therefore harbor a diverse range of microorganisms including pathogens (Dunn et al., 1995; Ray and Bhunia, 2007, Ofor et al., 2009). There are different sources of microbial invasion of sliced fruit produces; pathogens may invade the interior surface of the fruits during washing, peeling, slicing, trimming, packaging, handling and marketing (Khali et al., 1994; Barron et al., 2005).

Raw foods especially ready-to-eat sliced fruits such as pawpaw, watermelon, pineapple, cucumber, carrot, pear, among others have been implicated in outbreak of food borne diseases in both developed and developing countries (WHO, 2002). Microbial organisms present in ready-to-eat fruits include bacteria, fungi, viruses and parasite, (Jay, 1996; De Rover, 1998). The use of dirty utensil, as well as the open display of street food produce encourages sporadic visits by flies, cockroaches, other insects and dust (Bryan et al., 1992). It is difficult for one to attest to the hygiene of the processors or sanitary conditions during preparations. It is therefore imperative to evaluate microbiological safety of ready-to-eat fruits among the consumers, retailers and the general public for a healthy living.

II. Materials and Methods

2.1 Source of Samples

Three different markets were sampled within Yenagoa metropolis namely; Tombia, Opolo and Swali markets.

2.2 Collection of Samples

A total of seventeen (17) ready-to-eat sliced fruit samples were collected to include two (2) each from the various sampled stations. The samples included pineapple, pawpaw and watermelon. These were purchased and put into sterile cellophane bags. These samples were transported and immediately processed at the Microbiology and Parasitology Laboratory, College of Health Sciences, Niger Delta University.

2.3 Media Preparation

Six (6) different culture media were used in the study. They include Salmonella Shigellaagar, Nutrient Agar, Mannitol Salt Agar, Blood Agar, Mackonkey Agar and Saborauds Dextrose Agar. All media were prepared according to manufacturer's instruction.

2.4 Microbiological Analysis

Twenty five grams (25 g) of each sampled fruit was weighed and soaked in 100 ml distilled water for about 20 minutes and a 10-fold serial dilution was made using 9 ml sterile peptone water. 1 ml was then plated into the different culture media using pour plate technique. Blood Agar, Mannitol Salt Agar, Nutrient Agar and Mackonkey Agar were used for the isolation and identification of the bacterial isolates, while Sabouraud Dextrose Agar was used for the isolation and identification of fungal isolates. The plates were then incubated at 37oC for 12-18 hour and 25oC for 72 hours for the bacterial and fungal organisms

respectively. Plates were thereafter assessed for colonial characteristics, colony counted and reported as CFU/ML.

2.5 Identification of Bacterial and Fungal Isolates

The gram staining reactions were used to help identify pathogens in specimens and cultures by their gram reaction (Gram positive or Gram negative) and morphology. The isolates were Gram stained and specific biochemical tests performed to include catalase activity, sugar utilization, oxidase test, indole test, urease test, methyl red and vogesproskauer test, coagulase activity, citrate utilization and motility test. Fungal isolates were identified based on their macroscopic and microscopic characteristics.

III. Result and Discussion

3.1 Result

All ready-to-eat fruit samples namely; pineapple, watermelon and pawpaw retailed in the local markets within the study area were contaminated. However, the microbial load of the fruits varies with type and vendor (Table 1). The microbial load for station A (Tombia) ranged between 1.9x105 - 4.6x106cfu/ml; 1.3x105 - 8.1x106 for station B (Swali) and 5.2x105 - 7.6x106 cfu/ml for Station C (Opolo) market for bacterial organisms.

Table 1. Total viable microbial counts from the sliced ready-to-eat fruit samples in Yenagoa metropolis, Nigeria

	Microbial Load (cfu/ml)					
	Station A (Tombia)		**Station B (Swali)**		**Station C(Opolo)**	
	Bacteria	**Fungi**	**Bacteria**	**Fungi**	**Bacteria**	**Fungi**
Pineapple	$2.4x10^6$	Nil	$1.3x10^5$	$1.2x10^6$	$1.5x10^6$	$2.1x10^6$
Watermelon	$1.9x10^4$	$1.7x10^6$	$8.1x10^6$	$2.7x10^6$	$5.2x10^5$	$2.6x10^6$
Pawpaw	$4.6x10^6$	$1.2x10^6$	$3.7x10^6$	$4.2x10^6$	$7.6x10^6$	*NT

*NT: No test

The bacterial and fungal isolates present in the fruit samples were determined based on cultural, morphological and biochemical characteristics of the organisms. A total of nine (9) bacterial and two (2) fungal isolates identified (Table 2). However, the number of the different bacteria isolated from each of the samples varied.

Table 2. Bacterial and fungal isolates from sliced ready-to-eat fruit sampled in Yenagoa metropolis, Nigeria

Bacterial isolates	**Fungal isolates**
Bacillus app	*Mucor* spp
Escherichia coli	*Saccharomyces cerevisiae*
Salmonella spp	
Staphylococcus spp	
Staphylococcus aureus	
Klebsiella spp	
Citrobacter spp	
Proteus spp	
Enterobacter spp	

The percentage occurrence of the bacterial isolates was shown in Table 3. Escherichia coli and Staphylococcus spp had 58.8% distribution in the study area and occurred most.

Bacillus spp and Klebsiella spp had 47.1% occurrence and closely followed by Staphylococcus aureus 41.2%, while Proteus spp had the least 5.9% occurrence. The result obtained may be responsible for the prevalence of Escherichia coli and Staphylococcus spp in Yenagoa metropolis.

Table 3. Percentage occurrence and distribution of bacterial isolates in selected sliced ready-to-eat fruits in Yenagoa metropolis, Nigeria

	Fruit samples				
Bacterial isolates	**Pawpaw (5)**	**Pineapple (6)**	**Watermelon (6)**	**Number of fruits with isolates (17)**	**Frequency occurrence (%)**
Bacillus spp	2	2	4	8	47.1
Escherichia coli	4	1	5	10	58.8
Salmonella spp	1	0	2	3	17.6
Staphylococcus spp	5	1	4	10	58.8
Staphylococcus aureus	2	1	4	7	41.2
Klebsiella spp	3	2	3	8	47.1
Citrobacter spp	2	1	1	4	23.5
Proteus spp	0	0	1	1	5.9
Enterobacter spp	1	2	0	3	17.6
Total	20	10	24	54	

3.2 Discussion

The presence of microorganisms in the fruit samples obtained from the local markets reflects the rate of contamination of sliced ready-to-eat fruits with bacteria and fungi. Presence of these organisms in fruits can be due to the nutritional composition and available water in fruit, which are very beneficial for the growth and survival of these microorganisms. Most of the organisms isolated might have been introduced due to failure of food handlers to observe basic safety rules, packaging materials, use of sample facilities like wheelbarrows, trays to hawk the fruits or display on tables as possible source of fruit contamination. International commission on Microbiological specification for food (ICMSF, 1996) recognized that there could be some level of contamination in foods, but stated that ready-to-eat foods with plate counts between 0 - 103 is acceptable, within 104 – 105 is tolerable and 108 and above is unacceptable, from the results obtained, the level of contamination can be tolerable based on the recommended standards.

The level of contamination of the products could be a reflection of the level of exposure and the handling process in the vending markets. It is observed that majority of these vendor stores were located very close to the main road exposing the fruit to dust and other contaminants (Chukwu et al., 2010). The unhygienic market environments coupled with the poor handling by vendors are factors contributing to the high microbial load in the ready-to-eat fruits (Muinde and Kuria, 2005; Quattro et al., 2007). The common practice of using same bucket of water to wash all the fruits if it is ever washed at all and the use of same utensils such as knife for cutting may be responsible for increased microbial load (Khali et al., 1994). Pathogens may invade the interior surfaces of the product during peeling, slicing, trimming, and marketing (Barro et al., 2007). The chances of contamination is heightened by the fact that street vended ready-to-eat sliced fruit vending is done without adequate storage conditions, thereby exposing the sliced fruits to flies and maintains the produce at optimum temperature for invasion and proliferation of contaminants.

IV. Conclusion

The organisms isolated in this study are involved in different infections. Escherichia coli, Klebsiella spp, Salmonella Spp, Proteus and Enterobacter Spp are environmental contaminants; which have been isolated from plants, human skin, animal and dairy products. Their presence in the ready-to-eat fruits could be through unclean hands of the vendor, contact with sewage contaminated water (Chukwu et al., 2010). The presence of Salmonella spp, Escherichia coli, Klebsiella and Enterobacter spp called for concern as these organisms are frequently associated with poor sanitary practices and could be a pointer to danger of possible food borne infection. Escherichia coli and Salmonella spp are especially of facial origin and have been implicated in numerous food borne diseases (Oranusi et al., 2007; Eni et al., 2009). Staphylococcus aureus is a normal flora of the skin and could have been introduced through unclean hands of the vendor and customers. It can also cause staphylococcal intoxication when enterotoxin produced in consumed. Bacillus spp is indicative of contamination from environmental sources either soil or air (Willey et al., 2010).

The presence of saccharomyces cerevisiae is in agreement with report of Splittstroesser (1987) who implicated fungi as contaminants of fresh fruits especially in the presence of the injuries like slicing. Water and the environment may have played major roles in fungal contamination of the samples especially during washing of the fruits (Al-Hindi et al., 2011). Mucor spp. in fruits may be due to the fact that they are spore formers and are common environmental contaminants. Low occurrence of Mucor may be due to the fact that the species require organic matter for growth (Nwachukwu et al., 2008). Vendors and consumers are advised to wash fresh fruits properly before peeling, slicing or cutting. Fruits should be refrigerated if there is any delay in consumption. Adequate sanitary measures should be employed in handling ready-to-eat fruits in Yenagoa metropolis and globally.

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