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Determination of microbial characteristics of selected fruits sold in major markets in Ilorin metropolis

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ABSTRACT: The presence of microorganisms on five fruits: cashew (*Anacardium occidentale*); kola nut (*Cola nitida*); star apple (*Chrysophyllum cainato*); sweet orange (, *Citrus sinensis* and pawpaw, *Carica papaya* obtained from four major markets in Ilorin township were examined for their microbial quality. Five genera of pathogenic bacteria: Escherichia coli, Staphylococcus, Salmonella and Bacillus and two fungi: Aspergillus niger and Rhizopus stolonifer were successfully isolated from these fruits. The fruits from Baboko/new market carried the least microbial load while coliform popularly high on fruits obtained from Sango market, which has a nearby cattle ranch. The inherent hazards associated with the consumption of fruits on display at these markets are discussed and suggestions on how to prevent the likelihood of fruit-borne infections, including improved sanitary conditions in the markets are provided.

Key Words: Microbial quality, Fruits; Vegetables; Preservation.

Introduction

Cashew, cola nut, star apple, sweet orange and pawpaw are some of the fruits that are normally consumed raw in order to obtain their valuable nutrients in the best form. Fruits are good sources of nutrients for growth, repair and control of body processes as most of them contain sugar, vitamins, mineral elements and small quantities of protein and oil (Duckworth,1996).For their nutritional values, man has been utilizing fresh fruits for the production varieties of consumable items like jam, juices, flavoring agents, marmalade, beverages and production of wine (Hobbs, 1998).

Due to their high nutritional contents, particularly sugar, and low pH, fruits and their products serve as breeding substrates for microorganisms whose activities constitute the most important causes of spoilage. Microorganisms from many sources such as agricultural environment, the vegetation as well as dead decaying materials, can contaminate fruits. Michael *et al* (1958) and Duckworth (1966) reported that tree-borne fruits like orange and pawpaw are contaminated more readily with spores from the infections on surrounding vegetation.

It has been reported (Anon 1975) that the pathogens of main concern on fresh fruits are *Salmonella, Shigella* and gastro-intestinal viruses; and that man is the main source of *Shigella, Escherichia coli Streptococcus* while contamination from the environment includes Staphylococcus, Clostridium, Bacillus and yeasts. Up to 80 percent and 40 percent of food poisoning cases were due to Salmonella in England and the United States respectively.

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Beuchat *et al* (2001) showed that enterotoxin produced by Bacillus cereus was necrotic to the intestinal mucosa and sub-mucosa. Bilgrami and Dube (1979) listed *Aspergillus niger* as a soft rot fungus of mango and banana and, *Rhizopus nigricans* as an agent of watery rot of papaya fruits. The latter also involves reduction in sugar, amino acids and ascorbic acid contents (Tendor, 1967). Staphylococcus is one of the most commonly reported causes of food-borne illnesses in the United States of America while species of this bacterium are causes of abscesses, osteolmyelitis, enterointoxication and pneumonia in man and animals.

Due to these serious implications from the consumption of contaminated fruits as highlighted above, this work aims at conducting market survey of fruits sold in four major markets in Ilorin metropolis with the view to identifying the associated microorganisms and then make useful suggestions on how the sale of contaminated fruits and their consumption would be minimized.

Materials and Methods

Collection of Samples

Four markets were visited in Ilorin metropolis in order to find out the fruits that were being sold therein; observe the market hygiene condition and also the methods in which the fruits are displayed. Thereafter samples of five selected types of fruits were bought and subjected to laboratory analysis within 24 hours of collection. The markets visited were at Baboko, Ipata, Oja-Oba and Sango,; while the sampled fruits were cashew, *Anacardium occidentale*; kola nut, *Cola nitida*; star apple, *Chrysophyllum cainato*; sweet orange, *Citrus sinensis* and pawpaw, *Carica papaya*.

Determination of Viable Counts of Microorganisms

Aqueous suspensions were obtained by washing the surface of each fruit with sterile distilled water. The suspension was then diluted four times and 1 cc of last dilution was spread over solid nutrient agar and incubated at 37 ^{0}C for 24 hours for bacterial isolation or malt agar incubated at 38 ^{0}C for 48 hours for fungal isolation, the malt agar having been fortified with penicillin and streptomycin antibiotics and adjusted to about pH6. Inoculation was in six replicates while the colonies were counted by means of Gallenhamp colony counter.

Coliform Estimation

A set of five bottles containing 10 cc double strength MacConkey broth was inoculated with 10 cc of inoculum while two other sets of five bottles each containing 5 cc of single strength broth were inoculated with 1 cc and 0.1 cc of inoculum respectively. Bottles were then incubated for 24 - 48 hours at 37 ^{0}C.

Results and Discussion

Market Survey

Visits to the markets revealed that the fruits were displayed on open stalls and counters or even on bear grounds close to the open gutters. This sordid situation was pronounced in Ipata and Sango markets. The environments in the markets were generally unhygienic with open clogged gutters, and refuse dumps with pieces of dirts littering virtually every available space. Most fruit sellers had no specific places allocated for the display of their goods rather they squeezed themselves together in available spaces and extending to roadsides at the edges of dirty drainages. At Ipata and Sango markets, fruits were seen on display in close proximity to the abattoir and cattle ranch with flies swarming all over the places. Water pools and pieces of rotten matters like fruits and meat dotted the open gutters and every other space. This filthy and unhealthy scenario at the markets provides an adequate environment for breeding of dangerous microorganisms that are easily transmitted by vectors like flies thereby contaminating fruits and other items that are exposed in the markets.

Table 1: Viable Bacterial Counts / cc of Fruits x 10^4

	Mean Bacterial Counts (x ± SD, n = 6)				
Market	Cashew	Orange	Pawpaw	Star apple	Kola nut
Sango	14.17±5.80	13.17±4.58	22.83±8.01	11.33±3.08	9.50±1.14
Ipata	12.50±5.79	12.83±4.83	19.00±2.10	11.83±3.08	10.17±0.41
Oja-Oba	12.67±6.44	17.17±5.53	16.67±8.91	11.00±2.00	10.50±1.05
Baboko	7.83±2.14	9.83±0.75	13.33±4.80	9.17±1.30	38.33±2.25

Table 2 The Most Probable Number of Coloiform on Fruits in Ilorin Markets

	Most Probable Coliform Number per 100 cc					
Market	Cashew	Orange	Pawpaw	Star apple	Kola nut	Mean MPN
Sango	95	55	60	55	45	62±19.23
Ipata	70	25	50	50	35	46±17.10
Oja-Oba	65	50	45	35	25	44±15.18
Baboko	55	35	35	40	20	37±12.95
Fruit Mean MPN	71.25	41.25	47.50	45.00	31.25	

Table 3: Occurrence of Microorganisms on Fruits in Ilorin markets

	Fruits in Ilorin Markets				
Market	Cashew	Orange	Pawpaw	Star apple	Kola nut
Sango	*Escherichia sp* *Rhizopus sp*	*Bacillus sp* *Staphyloccocus sp* *Aspergillus sp* *Rhizopus sp*	*Staphyloccocus sp* *Aspergillus sp* *Rhizopus sp*	*Bacillus sp*	*Staphyloccocus sp* *Aspergillus sp* *Rhizopus sp*
Ipata	*Salmonella sp* *Rhizopus sp* *Rhizopus sp*	*Escherichia sp* *Aspergillus sp* *Rhizopus sp*	*Salmonella sp* *Aspergillus sp* *Rhizopus sp*	*Staphyloccocus sp*	*Staphyloccocus sp* *Aspergillus sp*
Oja-Oba	*Staphyloccocus sp* *Rhizopus sp* *Rhizopus sp*	*Escherichia sp* *Aspergillus sp* *Rhizopus sp*	*Salmonella sp* *Aspergillus sp* *Rhizopus sp*	*Staphyloccocus sp*	*Escherichia sp* *Aspergillus sp*
Baboko	*Staphyloccocus sp* *Rhizopus sp*	*Bacillus sp* *Shigella sp* *Aspergillus sp* *Rhizopus sp*	*Salmonella sp* *Aspergillus sp* *Rhizopus sp*	*Bacillus sp*	*Staphyloccocus sp* *Aspergillus sp* *Rhizopus sp*

Viable Bacterial Counts

The lowest bacterial counts obtained on all fruits at Baboko market was due due to the relatively better sanitary condition observed there than in other markets. The market is the most recently constructed with tarred road network; more neatly arranged stalls and better spaces in between shops for freer movements. In virtually all the markets, kola nut carried the lowest and most stable bacterial

load just ranging from 8.25 – 10.50 x 10^4 as against 7.83 – 14.17 x 10^4 for cashew and 13.33 t0 22.83 x10^4 for pawpaw. This observation could be attributed to the facts that the retailed kola nut is actually the seed which was protected in the pod before harvesting and processing and that, the seeds were usually treated with certain dilute antiseptic solution immediately after harvesting. Consequently, the other fruits that were exposed to the atmosphere from the onset bear heavier microbial loads with the highest (22.33 x 10^4) recorded for pawpaw from Sango and the lowest for cashew from Baboko market (Table 1).

Most Probable Coliform Number (MPN)

Table 2 shows that MPN was lowest (3.35) in kola nut and highest (71.25) in cashew, while it is lowest at Baboko but highest at Sango. Generally, cashew fruits collected from Sango contained the highest coliform load of 95 while the lowest (20) was recorded on kola nut at Baboko market. The relatively higher MPN for coliform obtained on fruits from Sango and Ipata confirms the significance of the presence of abattoir in Ipata and cattle ranch in Sango in the spread of faecal coliform particularly *Escherichia coli.* Baboko market is quite a distance from these sources of pollutants and it is a relatively new market hence, the substantially low MPN of 33 as against 62 for Sango.

Occurrence of Microorganisms on Fruits in Ilorin Markets

The frequency of the associated microorganisms on fruits as shown in Table 3 varies. *Rhizopus* occurred on all fruits in all markets i.e. 100 % occurrence, followed by *Aspergillus*, 60 %; *Staphylococcus*, 45 %; *Escherichia coli*, 20 %; *Salmonella* and *Bacillus*, 15 % and; *Shigella*, 10 %. The spores of *Rhizopus* and *Aspergillus* are quite abundant in air irrespective of the atmospheric humidity (Bilgrami and Dube, 1979), but bacteria require higher moisture availability to stay viable. This could be accountable for the observed variability of occurrence between fungal and bacterial genera in this study. Fagbohun and Anibijuwon (2006) recorded the occurrence of Aspergillus and Rhizopus on fruits including Cola species.

Conclusion and Recommendations

All fruits in the four markets selected at Ilorin metropolis are quite rich in microorganisms, most of which are dangerous to human health. These microbes become even more dangerous because the fruits concerned are normally consumed raw without any conscious attempts made at sterilizing them before consumption.

It therefore, becomes imperative to find solution to the problems of consuming unwholesome fruits. The Local Government Authorities should provide modern infrastructural facilities in the markets including allocation of specific stalls or shops for fruit sellers and banning hawkers within or in the market vicinity. Furthermore, the dusty roads should be tarred, adequate and efficient water system as well as toilet facilities be made available while health officers should ensure compliance with sanitary regulations.

On the part of the farmers, they should adopt modern methods of harvesting the fruits; package them in well ventilated wooden boxes for eventual transportation to the markets. The marketers could then display the fruits in transparent polythene bags or in glass counters. The fruits should be handled with great care at all points of contact with man in order to avoid injuries that would serve as primary points of attack by microorganisms.

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