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Effect of Different Packaging Materials on Microbiological Quality of Baobab Fruit Pulp

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ABSTRACT: Today, dried fruit consumption is widespread in developing countries such as Sudan. Traditional retain most of the nutritional benefits of fresh fruit, and gain others. Dried fruit contains a large amount of fiber, and it is widely accepted that eating a very high fiber meal, such as a large amount of dried fruit, can cause increased gas production and a shortened transit time of food through the intestines. This experiment was designed to try to determine if dried fruits contain heavy loads of bacteria or mold since these microorganisms might contribute to foodborne diseases sometimes experienced after ingestion. This study was conducted during March 2006 and March 2007 to understand the relationship between different packaging materials and loads of microorganisms. Different packaging materials namely jute, basket and polyethylene were used in this study. The sample of baobab fruit divided into two portions. In the first portion shells were removed while in the second portion shells were not removed. All samples were stored at ambient temperature (35C°±5) sample from market was evaluated for comparison. The total bacterial load was determined by employing total plate count (TPC), pour plate (PP) and spread plate (SP). The highest load of bacteria was found in market sample. The predominant bacteria isolated from the samples were species of Staphylococcus, Bacillus, Listeria, *E. coli*, Vibrio and Salmonella. The fungus (Asperigillus) also isolated from samples and samples collected from market for comparison. The study revealed that contamination of shelling sample was shown in basket samples only. In sample that was stored without shell polyethylene sample was showed the highest TPC followed by jute and basket.
Keywords: Baobab Fruit, Polyethylene, Predominant Bacteria

ORIGINAL ARTICLE

INTRODUCTION

The baobab is a deciduous tree with a thick trunk; diameter may reach 8m, girth 20m and height 25m. Bare for up to 9 months, the stiff bare branches resemble roots (hence the name 'up-side-down tree'). The bark is smooth, grey and up to 10cm thick, young Spongy wood can hold much water. Baobab seedlings have simple leaves; mature leaves have up to 9 leaflets. The flowers are large and white in color, opening at night. The unpleasant smelling nectar attracts pollinating fruit bats. The fruits are very big (15 –22cm), hairy, yellow-brown capsules, hanging on long stalks on the bare tree (Famine Food Guide website, 2009). There are many seeds in the fruit, within white-pink, dry pulp (Andrew, 2004). In Sudan these dried fruits are usually sold everywhere, by street vendors in raw form, these street foods are exposed to abundant sources of contamination. All the vendors who are selling these dried snacks food are used to place the fruits on a piece of cloth or directly on the ground without any health precautions. They distribute the fruits into small heaps; these heaps are kept in small polyethylene bags or folded in a piece of paper and displayed. Selling these fruits under such conditions will expose them to contamination from the environment. Handling and preparation of these dried fruits without care and without any control measures of sanitation, hygiene or any treatment to public may cause some health hazards (Bryan, 1992). Microorganisms can gain entry into food chain from various sources during different stages of their processing, storage and serving may contaminate and grow in many food products (WHO, 1996). The possible sources of contamination of foods include environmental sources such as soil, dust and air (Jay, 1996), biotic sources such as food handlers having illness or unhygienic practices (Jay, 1996; FDA, 2002) also animals (Bryan, 1992); other miscellaneous that include laundering facilities used by food handlers and the utensils and other articles used during collection and serving of food (Solberg et al., 1976).

METHODS AND MATERIALS

Dry Gongolase fruits *Adansonia digitata* were purchased from the local market of Nyala in Western Sudan during March 2006 and March 2007 with shell. The bulk of samples were divided into two portions with and without shell. Both, samples with/without shell were

stored for one year at room temperature (35C°±5) in three different packaging materials namely plastic Jutes, polyethylene sacks and palm leave Baskets. All the microbiological examinations for sample were held in the laboratory of microbiology, Faculty of Veterinary, University of Khartoum over a period of one year. The isolations were identified according to (Jay, 1996). Identification was based on morphological characteristics, Gram – staining, motility and biochemical reactions as shown in Tables 1and 2, were followed to identify bacterial groups as reported by (Jay, 1996). Ten grams of samples were transferred aseptically to a sterile pestle and mortar. The samples were macerated with 90ml distill water for 3min. Appropriate replications were made from the sample and plated. The plates were incubated at 35C°± 5.The total bacterial load was determined by employing total plate count (TPC), pour plate (PP) and spread plate (SP). The samples were plated on Nutrient agar (NA), MacConkey agar (MA) and Xylose Lysine Deoxycholate Agar (XLDA) media (Barrow et al., 1993).Acidified Potato Dextrose Agar (APDA) for yeasts and moulds was used and incubated at 22C° for 4-8days, morphological and microscopic tests were carried, according to (Lennette et al., 1980).

RESULTS

Observations were recorded regarding the handlers of these dry Fruits in Khartoum markets (Sudan). They were not carrying medical examination cards from the health authorities. Most of these were vended in markets, streets, and at the gates of the schools with no licenses, some of them wearing dirty clothes and poor personal hygiene. The dry fruits were displayed covered on the ground and sometimes packaged in different local materials. Some of these packaging materials were reused as shown in Figure 1 (A,B,C). Quantitative bacteriological examinations were carried out for these fruits. Results are presented in Tables 1 and 2 as shown below.

A **B** **C**

Figure 1. The fruits of Gongolase.
A) The fruits of Gongolase subjected directly to the sun (Source photo taken from Elsoug Elshaabi Omdurman April 2007);
B) The fruits of Gongolase purchased under polluted condition (Source photo taken from Soug Omdurman April 2007);
C) The fruits of Gongolase distributed on the ground and near the horses station (Source photo taken from Soug Omdurman April 2007).

Table 1. Changes in Total plate count of Baobab fruits during storage period as affected by wrapping with\without shell and type of packaging materials

Status / Time	Jute		Polyethylene		Basket		Market
	W.	W.o	W.	W.o	W.	W.o	W.o
0	Zero	2.2×10^3	Zero	1.6×10^3	0.2×10^3	2.7×10^3	7.9×10^4
3	Zero	3.210^3	zero	Uncountable	zero	2.7×10^3	Uncountable
6	Zero	Uncountable	zero	Uncountable	Zero	1.9×10^3	Uncountable
9	Zero	Uncountable	zero	Uncountable	Zero	1.6×10^3	Uncountable
12	Zero	Uncountable	zero	Uncountable	Zero	1.2×10^3	Uncountable

W: with shell; W.O: without shell

Table 2. Type of micro-organisms isolated from Gongolase fruit samples

Status / Time	Jute		Polyethylene		Basket		Market
	w.	w.o	w.	w.o	w.	w.o	w.o
0	----	***B.*** *Cereus* ***S.****aureus*	----	***B.*** *Cereus* ***A.****flavus*	***B.*** *Cereus*	***B.*** *Cereus* ***L.****monocytogenes*	***B.*** *Cereus* ***S.****aureus* ***L.****monocytogenes*
3	----	***B.*** *Cereus* ***S.****aureus*	----	***B.*** *Cereus* ***E.*** *coli*	----	***B.*** *Cereus* ***L.****monocytogenes*	***B.*** *Cereus* ***S.****aureus* *V.cholera* ***A.****flauvus*
6	----	***B.*** *Cereus* ***S.****aureus*	----	***B.*** *Cereus* ***L.****monocytogenes*	----	***B.*** *Cereus* ***S.****aureus*	***B.*** *Cereus* ***S.****aureus* ***L.****monocytogenes* ***A.****flavus*
9	----	***B.*** *Cereus* ***A.****flavus*	----	***B.*** *Cereus* ***A.****flavus*	----	***B.*** *Cereus* ***S.****aureus* ***A.****flavus* ***A.****niger*	***B.*** *Cereus* ***S.****aureus* Salmonella spp ***A.****niger* ***E.*** *coli*
12	----	***B.*** *Cereus* ***A.****flavus*	----	***B.*** *Cereus* ***L.****monocytogenes*	----	***B.*** *Cereus* ***S.****aureus* ***L.****monocytogenes* ***A.****flavus*	***B.*** *Cereus* ***S.****aureus* ***L.****monocytogenes* ***E.*** *coli* ***A.****flavus* ***A.****niger*

W: with shell; W.O: without shell

The results revealed many bacterial colonies, were seen on the plates. This indicates to fecal contamination. Many of the plates, especially those from market samples exhibited a large amount of mold growth and probably some yeasts.

DISCUSSION

The total plate count (TPC) in fresh dry Gongolase fruits was initially zero in all samples in different packaging materials used in this study stored with shell (Table 1) and increased from 1.6×103 to uncountable in samples without shell. This may be contaminated during handling and packaging from utensils, equipment and surrounding environment. The TPC increased continuously during storage period. The maximum increase in log10 cfu/g of sample was observed in market samples. This might be due to so many reasons those samples maybe exposed to unhygienic conditions as shown in (Photos A,B,C). In sample that was stored without shell polyethylene sample was showed the lowest TPC followed by jute and basket, due to fact that polyethylene is impermeability and not allowing direct air contact and free movement of air thereby changed the redox potential by decreasing air movement which is not favoring the growth of aerobic microorganisms. Contamination of shelling sample was shown in basket samples only.

This may be the basket open and permit movement of air throughout it and then the shell shrunk, this may lead to crack or pores where it permit microbial contamination.

Pathogenic Bacteria: Even though dried fruits are a very low moisture food, they did appear to harbor bacteria and other microorganisms. B. Cereus was found in several of the dried fruits tested and even E. coli in organic raisin samples. However, the confirmation of the presence of bacteria and mold growth from the dried gongolase fruits tested in this study does not necessarily prove that the bacteria and mold on dried fruit are the cause of the intestinal upset that sometimes occurs when a large amount of dried fruit is ingested. Low moisture foods may be heavily contaminated with bacteria, including *B. Cereus* and others. Open food are exposed to environmental contamination. According to (Jay, 1996) the nutrients of fruit are capable of supporting the growth of bacteria and fungi (yeasts and moulds). This may leave the consumers with no choice for quality. As such, no standards have been laid down for dry fruits, in this study some of pathogenic bacteria were isolated such as *Staphylococcus aureus* the presence of high numbers of coagulase positive S.aureus in samples of concern as *S.aureus* is an important food-borne pathogen and staphylococcal food poisoning ranks as one of the most prevalent causes of gastroenteritis worldwide. *Bacillus cereus*, *Listeria monocytogenes*, *E. coli*, Salmonella, *Vibrio cholerae*, The presence of faecal coliforms and Salmonella enteridis in the samples further confirms the

poor microbiological qualities of these products, market samples showed the highest number of pathogens. This contamination may be due to post-harvest from many sources such as contaminated environment, cross contamination during processing, handling and improper are display in shops and during storage (Kapdia, 1984). Therefore if the consumer is to get the full benefit of street vended foods (dry fruits) with minimal risks of diseases, government intervention is required to ensure that the standard of safety of such foods is attainable.

Yeasts and Moulds: The results of yeasts and moulds as shown in (Table 2). Samples packaged in basket showed the highest number of yeasts and moulds. This might be due to external contamination as the basket provided poor protection to external contamination as well as availability of air this is in agree with reported by (Jay, 1996). Pathogenic moulds isolated from this dry fruit were *Asperigillus flavus* and *Asperigillus Niger*. (FAO, 1996) disregarded environmental conservation and use of force and even violence among the sector practitioners. The disadvantages described were the unstable and illegal state living due to the failure of authorities concerned to carry out their regulatory and educative responsibilities (WHO, 1996).

Packaging materials of dry Gongolase fruits were affected by storage conditions in addition to that, only few species of pathogenic bacteria have the ability to grow and multiply. Market samples showed the highest levels of contamination with pathogenic organisms that may cause health hazards to consumer this is mainly due to the fact that all the vendors who are selling these dried fruits are used to place the fruits on a piece of cloth or directly on the ground in form of heaps without any health precautions as shown in photos A and B. Selling these fruits under such conditions expose them to contamination from the surrounding environment. Handling and preparation of these dried fruits without care and without any control measures of sanitation, hygiene or any treatment may cause some health hazards to consumers.

Recommendations: The topic of street-vended food should receive much attention of the public health authorities in Sudan especially of those fruits as used directly by consumer such as baobab fruits. It is suggested that the fruits should be collected and sold with shell or packed in polyethylene and stored in a dry and cold place. The following aspects require prompt action: Health education for all handlers of dry fruits especially Gongolase fruits should meet licensing requirements of street-vending centers. Hygiene code of practice concerning fruits hygiene and safety should be applied as well as regulatory and sanitary measures concerning fruits quality. Further microbiological and epidemiological studies to be carried out to cover most of other dry fruits.

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