POST-HARVEST STORAGE AND SPOILAGE OF CASSAVA TUBERS (MANIHOT SPP) IN IKOT EKPENE, AKWA IBOM STATE, NIGERIA

Udoudoh, P. J.
Department of Hotel and Catering Management
Akwa Ibom State Polytechnic, Ikot Osuru - Ikot Ekpene, Nigeria
E-mail- pjudoudoh@yahoo.com

ABSTRACT
Cassava (Manihot spp.) tubers form a major food source of carbohydrates and other food nutrients for tropical dwellers. The tubers also are sources of industrial products such as dextrins, glues, ethyl alcohol, acetone and glucose etc. Post - harvest losses on storage of cassava root tubers are large because of their poor storage qualities. In this study, wholesome cassava tubers were washed and disinfected for used to study the storage and spoilage of cassava tubers using moist saw dust in sealed boxes and some exposed as control. Profuse microbial growths occurred on the surface of tubers exposed on the 4th day and were completely soften due to fermentation of the tissues on the 7th day. Bacteria isolated from the tubers were species of Staphylococcus, Bacillus and Diplococcus. Fungal species isolated using cultural characteristics were Candida and Aspergillus. Tubers on moist sawdust had no microbial growth but developed secondary roots on the 3rd day of storage. They could be stored up to 3 weeks. The sawdust acted as soil for the tubers while the different gases and heat evolved by the tubers in the sealed boxes had a curing effect on the tubers. The study hence recommends that storage of cassava tubers in moist saw-dust would provide effective preservative method against post-harvest losses.

Keywords: Post-Harvest losses, cassava storage, curing, microbial growth.

INTRODUCTION
Cassava (manihot esculenta crantz) is a major root crop eaten in the tropics and subtropics. It is estimated that some 700 million people receive from 200-1000 calories a day from cassava (IITA, 1990). Cassava is well supplied with other nutrients aside from the carbohydrate. There are two main varieties of cassava divided into the bitter and sweet varieties because of the cyanogenic glycoside content (Asiedu, 1989). The bitter varieties have high cyanogenic glycoside which is distributed throughout the tuber while the sweet varieties have low cyanogenic glycoside confined mostly in the peel (Bradbury and Holloway, 1988). The bitter varieties are poisonous but are detoxified during processing. The cyanogenic glycosides (Linamarin and Lotaustral in) are hydrolyzed by enzyme into hydrogen cyanide which is volatilized (Cereda and Mattos, 1996). The edible flesh of cassava makes up 80-90% of the root (Asiedu, 1989). The composition of cassava is influenced by the variety and environment. Cassava roots contain 30-40% dry matter of which starch and sugar are the predominant components (Bradbury and Holloway, 1988). According to Onwueme (1978), Odigboh (1983) and Asiedu (1989) fresh cassava roots contain about 30-35% starch, less than 1% protein, about 15mg/100g Vit. C and 20mg Calcium. It is
high in fibre. Mg, Na, Vit. A compared with other root crops. Cassava peels are richer in proteins, ether extract (fat) and ash than the edible portion (Cooke and Coursey, 1981). Cassava contains Cyanogenic glycosides, which must be detoxified before consumption. According to Ihekoronye and Ngoddy (1985), cassava can be roasted, boiled or made into fufu. Cooked peeled cassava roots are also sliced and partially fermented which are eaten as snack food. The main form in which cassava is eaten in West Africa is garri, a peeled grated, fermented and fried product.

Asiedu (1989) has described how Chickwangue is prepared by soaking the cassava in water for 2-7 days until it softens after which the root is mashed. The resulting paste is wrapped in banana leaves, boiled and pounded into fufu. Cassava is equally processed into flour for composite bread and confectioneries. However, cassava starch has higher thickening power consequently minimum quantity of starch could be used for food product (Udoudoh, 2005). Industrial products from cassava are adhesives from low amylose, high amylopectin variety, starch for dextrin's and in glues, ethyl alcohol and acetone, glucose. All these benefits from cassava notwithstanding, the post-harvest and storage of the product constitute concern in Nigeria hence this study was carried out to look into storage methods of fresh cassava tubers and the microorganism associated with their spoilage.

Cassava roots are harvested when needed because of their poor storage qualities. They are highly perishable and begin to spoil 2 or 3 days after harvest (CIAT, 1984). The primary deterioration is an endogenous physiological process called vascular streaking which results in a fine blue-black or brown discoloration. It is followed by secondary deterioration which involves microbial rotting or softening or fermentation of the tissue (Rickard and Coursey, 1981; Uritani, Data and Tanaka, 1984). Rickard (1985) and Sakai et al (1986) studied the physiology and biochemistry of primary deterioration and observed that deterioration involved increased activity of various enzymes, production of catechin and coumarin components including scopoletin, scopolin, esculin and other metabolites. Primary deterioration may however be accelerated by mechanical damage to roots during harvesting.

Pillai, Steemulanathan and Chettiar (1970) observed an increase in sugar and decrease in starch on storage of tubers in soil. Kawabata et al (1984) found an increase in the amount of glucose and fructose and a decrease in the amount of sucrose during storage at ambient temperature. In a study by the International Tropical Agriculture Center, Colombia (CIAT, 1984) cassava roots have being stored for two weeks by treating the roots with a thiabendazole based fungicide, then packing them in polyethylene bags. The storage in bags resulted in high temperatures and relative humidity for curing to take place while the fungicide controlled microbial growth. Bradbury and Holloway (1988) recommend use of curing which involved exposure of the tubers to about 35°C at 80-85 relative humidity (RH). The use of microbial agents in the control of plant pathogens has been investigated (Podile and Prakash, 1996; Brandon, 1996; Okigbo, 2002). Ojimelukwe, Ukachukwu and Elijah (2006) have studied the potentials of using Lactococcus lactis, Lactobacillus bulgaricus.
and *Lactobacillus acidophilus* in the control of post harvest roots of yam tubers caused by Fusarium species. Cold storage at 30°C is optimal while sample could be stored at 20°C (Bradbury and Holloway, 1988). Traditionally, burning or trimming off the branches three weeks before harvesting results in improved storage of tubers (Rickard and Coursey, 1981; Odigbo, 1983). There is need to search for main microbial agents responsible for spoilage for improved and effective control of post-harvest losses of cassava tubers.

**MATERIALS AND METHODS**

The design adopted for this study was experimentation. Wholesome, uninjured freshly harvested tubers were purchased from Ikot Osurua market in Ikot Ekpene Local Government Area of Akwa Ibom State. All the materials and samples were routinely washed and sterilized with disinfectant. Aseptic techniques were used throughout the experiment to avoid negative results. Twenty five cassava tubers were washed under flowing tap water, and rinsed using water containing potassium metabisulphite (KSM) then allowed to dry. Some of the cassava lots were used for moisture determination while experimental units each 10 tubers were set up. One of the units was exposed in the laboratory environment for observations. The other unit was placed in a box containing wet or moist saw dust and kept in the laboratory for daily observations. Spore and Gram staining of bacterial isolates were done to detect the shape and morphology of the organisms found in the cassava samples. Bourand Dextrose agar and Nutrient agar were used for culturing the microorganisms. The inoculated samples were subcultured using a sterile wire loop. Biochemical tests carried out were coagulase, catalase oxidase, while motility test was also done to identify the microorganisms.

**RESULTS AND DISCUSSION**

**Table 1:** Morphological, Cultural and Biochemical Characteristics of Bacteria Isolated from Cassava Tubers

<table>
<thead>
<tr>
<th>Isolate</th>
<th>Colony characteristics</th>
<th>Cell gram reaction</th>
<th>Spore staining</th>
<th>Coagulase test</th>
<th>Catalase test</th>
<th>Oxidase test</th>
<th>Motility test</th>
<th>Probable identification</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Creamy white colonies</td>
<td>+</td>
<td>Cocci</td>
<td>-</td>
<td>+</td>
<td>+</td>
<td>-</td>
<td>Staphylococci sp</td>
</tr>
<tr>
<td>2</td>
<td>Small colonies with milky colour rods in singles</td>
<td>+</td>
<td>-</td>
<td>+</td>
<td>-</td>
<td>-</td>
<td>Bacillus sp</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Small colonies with dirty white colour Cocci in pairs</td>
<td>-</td>
<td>NT</td>
<td>NT</td>
<td>-</td>
<td>-</td>
<td>Diplpccus sp</td>
<td></td>
</tr>
</tbody>
</table>

(+) = positive, (-) = Negative; (NT) = Not tested. *Source:* Experimentation, 2011

**Table 2:** Cultural Characteristics of Fungi Isolated From Cassava Tubers

<table>
<thead>
<tr>
<th>Isolates</th>
<th>Colony characteristics</th>
<th>Microscopic Examination</th>
<th>Probable identification</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Colonies fluffy cordial yellowish to blackish with white periphery</td>
<td>Cordial; head black and radiate non septate conidiophores</td>
<td>Aspergillus sp.</td>
</tr>
<tr>
<td>2</td>
<td>Colonies fluffy white with mycelium</td>
<td>Cell from budding roundish with chlamydospores</td>
<td>Candida sp.</td>
</tr>
</tbody>
</table>

*Source:* Experimentation, 2011

Cassava tubers were found to posses an average moisture of 27.67%. The
presence of high moisture encourages growth of microorganisms, hence low storage stability of cassava tuber. There was no observable deterioration of the cassava tubers exposed in the laboratory environment in the first three days; however deterioration occurred mildly on the fourth and fifth day. Complete deterioration occurred from the sixth day to the seventh day with profuse microbial growth on the surface of the tubers. The tubers became rotten and softened with fermentation of the tissues occurring (CIAT, 1984). Bradbury and Holloway (1988) observe that cassava roots deteriorate after one to three days exposure to air in the tropics. For the tubers on moist saw-dust there was no microbial growth.

Secondary roots were found on the body of the cassava on the third day of storage. The observation was made for three weeks and no observable changes occurred. The tubers absorbed water from the moist sawdust, which helped to keep the tubers fresh. According to Booth et al (1976) and Sivan (1979), longer periods of storage up to 2 months may be obtained by reducing moisture loss by packing the tubers in moist saw-dust in boxes or inter layered between cassava leaves. The morphological, cultural and biochemical characteristics of bacteria isolated from cassava are shown on table 1 while the fungi isolated are shown on table 2. Species of bacteria isolated were identified as Staphylococcus, Bacillus and Diplococcus (Table 1). Deterioration of the tubers was encouraged by the high moisture content (27.67%) of the cassava tubers and the exposure without any additional protection. Mesophilic bacteria would therefore easily grow on the tubers since it is high in moisture in free form (Okaka J. and Okaka A., 2001).

Fungi species isolated using cultural characteristics were Candida and Aspergillus. Aspergillus species cause decay of materials while Candida species have a particular predilection for acids foods that contain sugar from which they produce ethyl alcohol and a large quantity of gas (Okaka J. and Okaka A., 2001). Fungi are aerobic organisms and can tolerate a wide range of pH (2.2-9.6) but most fungi grow at temperature between 20° and 35°C (Okaka J. and Okaka A., 2001). The environmental temperature of the exposed tubers favours the growth of fungi. Storage of food in airtight containers controlled atmospheres will prevent growth of moulds and bacteria. The saw-dust acted as soil to the cassava tubers while the roots were absorbing moisture from the saw-dust. The different gases in the sealed box are kept under control under the storage atmosphere. Curing was thus effected and shelf-life prolonged (Sivan, 1979; Bradbury and Holloway, 1988).

CONCLUSION

Cassava (Manihot spp.) tubers form a major food source of carbohydrates and other food nutrients for tropical dwellers. The tubers also are sources of industrial products such as dextrins, glues, ethyl alcohol, acetone and glucose etc. Post -harvest losses on storage of cassava root tubers are large because of their poor storage qualities. Storage of cassava tubers on moist saw-dust in a controlled environment would enhance extension of shelf-life of cassava tubers. Most farmers usually leave their
tubers in soil until needed. With the abundance of saw-dust, its utilization in cassava storage and preservation would seriously help in the current massive drive towards increased cultivation and utilization of cassava. It is therefore recommended that storage of cassava tubers in moist saw-dust would provide effective preservative method against post harvest losses.

REFERENCES


