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Potential use of shea nut (*Vitteleria paradoxom*) butter as skin coat for ripening and improved storage of banana

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Abstract

The study was designed to assess the effect of locally produced butter from nuts of shea butter trees (*Vitteleria paradoxom*) on the ripening and storage of banana. A simple complete randomized experimental design was used to test the effect of coating matured banana fingers with shea butter oil before storage under three temperature conditions *viz*., 35, 25 and 10 °C. Each treatment was replicated three times. Results showed a significant effect of different storage temperatures. Days to ripening between coated and uncoated bananas, and the interaction with storage temperatures were not statistically different. A taste panel's results of assessing the effect of coating treatment on the textual quality of ripe bananas did not show any significant difference neither was there an effect on the appeal of ripened bananas. The result showed that banana fingers stored in the refrigerator at 10°C lasted beyond 53 days of storage irrespective of the treatment. At 25 °C, the coated fingers took 15.7 days to ripen while the uncoated lasted 8 days. Coated banana fingers stored at 35 °C took 11.3 days to ripen but the uncoated ripened after 6 days. The use of shea butter for shelf life prolongation is discussed while the test is continuing.

Key words: Shea butter tree (*Vitellaria paradoxa*), banana, ripening, storage, wax coating

Introduction

The shea butter tree (*Vitellaria paradoxa* C. F. Gaertn.) is a very important tree in West Africa especially in central Nigeria because of its high prospective contribution to the reduction of poverty, hunger and disease among rural people. It serves as efficient fuel wood. Its fruit pulp has excellent nutritional content (Ugese *et al.*, 2008) and is widely consumed among indigenous peoples of central Nigeria (Maranz *et al.*, 2004). In Nigeria, its oil is used as a cooking fat and in chocolate manufacturing elsewhere (Umali and Nikiema, 2002). Caterpillars of *Cirina butyrospermi*, associated with the trees are a good source of protein for some ethnic tribes such as the Yoruba, Nupe and Tiv who inhabit the central states of Nigeria (Ande, 2004). Although trade in shea tree products has been reported to improve the incomes and living standards of rural farm families and the economies of exporting countries (Popoola and Tee, 2001), its use as a natural wax in storage has not been sufficiently reported.

Bananas (*Musa* sp.), like many other fruits and vegetables, are classified as perishable crops. In Nigeria, this crop is abundant and cheap only at certain times of the year and become quite expensive during some parts of the year. The exact figure for estimating post-harvest loses in bananas is difficult to get due to the non-availability of the actual land area under the production of the fruit crop and logistic reasons.

Post-harvest losses in banana results from three main sources: mechanical injury, activity of micro-organisms and physiological changes (Liu and Ma, 1985; Lyman, 2000). Because fruits are still living entities after harvest and detachment from the mother sucker, it seems proper to try to slow down the metabolic/ physiological changes that lead to loss of the fruits thus extending the shelf life of such fruits.

Waxing, especially for fruits, plays at least two important roles: (i) it provides repellency for water and other solutions from fruit surfaces and (ii) it reduces the permeability of these solutions through the skin. Water repellency affects the deposition, distribution and retention of chemicals applied to foliage or fruits as solutions or emulsions.

Permeability is a major problem when water soluble materials such as calcium need to be introduced into the fruits for desirable effects such as maintenance of firmness. Waxes prevent moisture loss during fruit storage. Although natural waxes on fruits are effective in preventing water loss, the application of commercial wax can further decrease water loss during prolonged storage.

A lot of work has been carried out on delaying ripening of bananas and plantains. Some of these have included the use of fungicides and other chemicals to arrest metabolic activity of micro-organisms and control diseases (Opadokun and Onwugulu, 1984) and the use of waxes of various compositions (Kolekar, 1988; Marchal, 1990 and Kolattukudy, 2003). The results from these works have been impressive; however, due to non-availability of some of the chemicals and cost, farmers in developing countries may not be able to afford them. The possibility of a residual effect of the chemicals and the safety of their use has necessitated this study to test the effect of locally available and inexpensive coating material (Shea butter oil), that can be used in prolonging the shelf life, ripening and storage of bananas fruits.

Materials and methods

A bunch of banana of Gross Michel cultivar was harvested from a local banana plantation in Minna, Niger State, Nigeria. The bunch was brought into the laboratory of the Department of Crop Production where it was de-fingered. These fingers were washed first in water to remove latex from the cut ends and other dirt

particles on the fruits, then washed in a 5% solution of sodium hypochlorite (Parazon - bleach) to disinfect the banana fingers. The fingers were allowed to air-dry for a minimum of eight hours before a few of the fingers were treated with shea butter and then stored. A few uncoated fingers were also stored as control.

The butter, derived from nuts of the shea butter tree (*V. paradoxom*) was purchased from the local Minna market and melted over an open flame. Banana fingers were coated by swapping the fingers with cool melted butter. To prevent the transmission of germs from the hands onto the treated banana fingers, the operator wore rubberized gloves.

The banana fingers were first wrapped in paper bags and then placed in polythene bags and stored at 35, 25 and 10 °C. Thermometer probes were inserted in all the storage chambers to monitor storage temperatures. Each treatment was replicated three times. Parameters monitored included days to fruit ripening, fruit colour change as affected by storage temperatures, rate and type of fungus associated with deterioration and palatability (sweetness) of the banana.

Statistical Analysis: Data were analyzed using the MINITAB release 14, computer software for Statistics. Analysis of variance (ANOVA) was performed on results for each quality variable to determine the significant storage method(s) while means were separated using the least significance difference – LSD test (Gomez and Gomez, 1983).

Results and discussion

Number of days to fruit ripening: Number of days to ripening for both treated and untreated bananas is presented as Table 1. A statistically significant difference ($P< 0.05$) was observed between the storage temperatures. Coating treatments and the interaction between storage temperatures and coating was however not significant.

Banana fingers stored in the refrigerator at 10°C did not ripen after 53 days of storage irrespective of the treatment. When removed from this environment though, uncoated banana fingers ripened 5 days later, while the coated fingers remained unripe for 8 days. At 25°C, the coated fingers took 15.7 days to ripen. This was 7 days more than the uncoated fingers that ripened by 8.7 days. Treated banana fingers stored at 35°C took 11.3 days to ripen; this was 6 days more than the untreated fingers stored at the same temperature.

Effect of storage temperature on colour of the banana peel: As has been reported ripening was fastest at high temperatures but delayed at low temperature. This also affected the colour of the fruit peel. The development of yellow colour of fingers, indicating ripeness and closely associated with softening of the skin tissue was observed to be earliest at high temperatures. Banana finger stored at 10 °C was green for about 26 days after which fingers started losing chlorophyll and turning brownish green (but still firm). Storage at 10 °C was not too different from that of 25 °C.

Table 1. Effect of wax treatment on number of days to fruit ripening

Treatment	Storage temperature		
	10 °C	25 °C	35 °C
Coated banana	53	15	11
Uncoated banana	53	8	6

Deterioration after ripening: Deterioration of the uncoated fingers started after 3 days from when banana fingers were judged to be 100% ripe. Coated fingers lasted an average of 7 days; 4 days more than the uncoated fingers. The deterioration in the treated fingers began first from the point of attachment to the bunch. This point was observed to have gone yellowish, a sign of ripening much earlier than the pulp of the banana. At the end of 3 days for the untreated and 7 days for the treated fingers, fungal attack was observed. Investigation revealed the presence of strains of *Aspergillus flavus, A. niger* and *Rhizoctonia* sp.

Palatability test: When ripe, bananas were subjected to a palatability test to assess sweetness and texture (softness). A Likert scale of 1-5 was used where 1 represented very poor quality and 5 represented best quality. The result showed that the untreated fingers were rated an average score of 5, while treated fingers were rated an average score of 3, inferring fairness. This was because the "placenta" of the banana fingers had not softened enough to be noticed at this time.

The delay in the number of days to ripining of coated banana fingers was significant ($P< 0.05$), inferring sufficient delay in ripening compared to untreated fingers. The coating of the fingers with shea butter had caused a reduction in the physico-biochemical processes in the fingers. This result is in agreement with Kolekar *et al.* (1988) who reported that shelf-life of bananas could be extended by coating them with 0.5-2.0% sucrose ester emulsion. Coating of the bananas fingers impaired rate of respiration as the rubbing of the butter has sealed the lenticels.

The results of the taste panel on texture and sweetness is not different from the findings of Marchal (1990), who reported similar findings. Esquerra *et al.* (1993) reported that respiration rate of bananas was high at 35 and 30 °C while it was low at 15 °C. This explains why fingers at 10 °C in the current work did not ripen after the 53 days of storage. Porritt (1974) had opined that the temperature of storage was the one most important external factor that affects the post-harvest shelf life of most perishables. The rate of microbial activity is also enhanced at high temperatures hence the quick deterioration of the banana fingers occurred under high temperature storage. Banana itself is a good base for culturing microbes. This explains the type of fungi found on the fruits. It is however not clear if the fungus observed were present on the banana skin before the coating; introduced from the butter or in the immediate environment or air surrounding the stored fruits. The treatment with sodium hypochloride might have killed only the bacteria and not fungi.

The conclusion from this study is that fruit ripening can be delayed when banana fingers are coated with shea butter. The use of this butter could have a good potential for fruit coating. Although low storage temperature environments may not be available for use by farmers in the rural developing nations, retailers in urban

Table 2. Effect of storage environment on taste, aroma and textural quality of banana fingers

Storage temperature	Taste	Aroma	Texture
10 °C (Refrigerator)	1.6c*	1.6c	1.4c
20 °C	2.8b	2.6b	2.6
35 °C	3.6a	3.6a	3.6a

* Likert scale 1-4; where 1 is excellent and 4 is poor.

centers may be able to delay ripening in bananas for more than 50 days when as low as 10° C temperatures are used.

The mesophyll part of the shea fruit is edible in most African cultures with the nuts thrown away. A better use of butter from this nuts bring added value to shea butter. As this butter is often used as medicines in developing economies and skin treatments in developed economies, this infers that its use cannot be harmful to health. Its use as a coating wax can be an additional benefit for developing economies as that of Nigeria.

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