

Full Length Research Paper

Quality assessment of plantain (*Musa paradisiaca* L.) as affected by different ripening methods

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There are increasing reports of food poisoning due to preservatives used for the processing of certain food items, especially in developing countries of Africa. Also, very scanty information is available on the effect of these preservatives on the nutritional status of the food being processed and preserved. This experiment therefore reports on the quality assessment of plantain (*Musa paradisiaca* L.) as affected by different ripening agents used to accelerate the period of plantain ripening. The experiment consisted of 4 ripening agents, namely: calcium carbide, *Irvingia gabonensis* fruits, *Newbouldia laevis* leaves and control, where no ripening agents were applied to the blossoms of plantain. The unripe and ripened blossoms of plantain were analyzed for their physicochemical properties using standard methods. Ripened plantains without any ripening accelerator had significantly ($p < 0.05$) higher values of crude protein (3.51%), crude fat (0.33%), total ash (2.55%), crude fiber (0.42%) and reducing sugar (10.42%) when compared with other treatments. Least values of this proximate composition (crude protein, crude fat, total ash, crude fiber and reducing sugar) with no significant difference were obtained when calcium carbide (1.31, 0.04, 1.28, 0.04 and 7.07%) and *Irvingia gabonensis* (1.53, 0.06, 1.04, 0.03 and 9.17%) were applied, respectively. It was concluded that since these ripening agents have adverse affects on the nutritional status of plantains, an effective food safety program and control measures need be put in place to monitor various methods of plantain ripening with a view to ultimately safeguarding public health.

Key words: Calcium carbide, food poisoning, *Irvingia gabonensis*, *Newbouldia laevis*, plantain blossoms.

INTRODUCTION

Food contamination through poisons is on the increase in Nigeria (Ali, 2009). The rate is becoming alarming with the way people died after the consumption of certain food items. Awofadeji (2008) reported the death of two people after they had eaten cooked beans in Calabar, Nigeria. Adeleke (2009) also reported on the use of certain lethal preservatives for the processing of yam flour which eventually caused food poisoning among three families in Kano, Nigeria. 'Amala', a local diet in Nigeria is prepared from the poisoned yam flour. Adeleke (2009) reported further that the affected people however, recovered after treating them of diarrhea, vomiting, abdominal pain and convulsion. Complaints about the ripening methods used on mature plantain blossoms before they ripened are on

the increase. Most often, in West Africa, mature plantain bunches are harvested just before they begin to ripe and thereafter sold to market women.

Blossoms of plantain are consumed as a vegetable by most people in Nigeria raw, boiled, roasted or fried with rice/beans. The unripe but mature blossoms of plantain are sometimes processed to flour for other diets. The over-ripened plantains are even processed into a local wine called 'agadangidi'. Asiedu (1980) reported that the blossoms of plantain are consumed at five different stages of ripeness.

The National Agency for Food, Drugs and Administrative Control (NAFDAC) in Nigeria that is charged with the responsibility of enforcing all laws, guidelines, policies and compliance that sub-standard or adulterated food and drugs are not found in the country concentrates mostly on 'canned' items. People take advantage of this inadequacy to process and preserve 'uncanned' food items, including plantain blossoms without any regard to

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Table 1. Physicochemical properties of plantain blossoms.

Property (%)	Treatment				
	UP	RP1	RP2	RP3	RP4
Crude protein	4.82 ± 0.02a	1.34 ± 0.02b	1.31 ± 0.00b	1.53 ± 0.22b	3.51±0.44a
Moisture content	59.25 ± 0.75b	61.25 ± 0.75b	64.99± 0.55a	64.89±0.11a	64.35±0.30a
Fat	0.62 ± 0.02a	0.55 ± 0.02a	0.04 ± 0.00c	0.06 ± 0.00c	0.33 ± 0.01b
Total ash	2.79 ± 0.01a	2.47 ± 0.25a	1.28 ± 0.02b	1.04 ± 0.02b	2.55 ± 0.20a
Crude fiber	0.57 ± 0.02a	0.38 ± 0.03a	0.04 ± 0.00b	0.03 ± 0.00b	0.42 ± 0.02a
Carbohydrate	31.78 ± 0.59b	33.99 ± 1.22a	32.35±0.01ab	32.45±0.10ab	28.88±0.43b
Dry matter	40.75 ± 0.75a	38.75 ± 1.25b	34.51±0.49c	35.11±0.11c	35.15±0.20c

Values within a row followed by different letter(s) are significantly different according to new Duncan Multiple Range Test at $p < 0.05$.

UP = Unripe plantain blossoms, RP1 = ripened plantain blossoms using *N. laevis* leaves as ripening agent, RP2 = ripened plantain blossoms using calcium carbide as ripening agent, RP3 = ripened plantain blossoms using *I. gabonensis* fruit as ripening agent and RP4 = ripened plantain blossoms with zero ripening agent as control.

methods being used. *Newbouldia laevis* leaves and *Irvingia gabonensis* fruits are now being used as ripening agents to accelerate the ripening period by the local farmers. Previous works on these plants had always been on their medicinal importance. Ogunlana and Ogunlana (2008) reported the antioxidant property in *N. laevis* stem bark. Also, the fresh fruit of *I. gabonensis* is found useful in the treatment of Type II diabetics and in reducing obesity (Judith et al., 2005). Ndjouenekeu et al. (1996) worked on the usefulness of the kernels of *I. gabonensis* as a condiment and food thickening property in preparing draw soup locally called 'ogbono'. The study location, Ile-Ife, is a semi-urban city in Osun State and had earlier been mapped by Enwezor et al. (1989) as one of the restricted areas where plantain grows well in Nigeria. This study, therefore attempts to assess the quality of plantain (*Musa paradisiaca* L.) as affected by different ripening methods commonly used and give recommendation on the best method that could be adopted and promoted to the market as an ideal ripening method for blossoms of plantain.

MATERIALS AND METHODS

This study was conducted in the Institute of Ecology and Environmental Studies, Food Analytical Laboratory and Central Services Laboratory of the Obafemi Awolowo University, Ile-Ife, Nigeria in 2009. Preliminary studies were carried out to establish the ripening methods commonly used in the study area prior to the commencement of the main work, since no studies have previously been reported on it. The preliminary studies identified three commonest plantain ripening agents used to accelerate the ripening period. These are: *N. laevis* (Seem) leaves, *I. gabonensis* (Aubry-Lecomte, Baill.) fruits and calcium carbide.

Freshly harvested and mature, but unripe one plantain bunch that contained 40 blossoms was procured from a fruit orchards private farmer at the Obafemi Awolowo University, Ile-Ife, Nigeria. With the help of a clean kitchen knife, the plantain blossoms were carefully separated from the bunch.

In this study, the three identified ripening agents and the control (zero ripening agent) made up the four treatments were used. Each treatment was replicated three times to give a total of 12 replicates.

Each replicate contained three blossoms of plantain of relatively uniform weight (700.00 g). Also, relatively uniform weights (0.50 g) of the ripening agents were used to either wrap the blossoms (*N. laevis* leaves) or drop with the blossoms [*I. gabonensis* fruits and calcium carbide (wrapped with transparent nylon)] and each replicate was put inside a bag and tied up. All the replicates were stored in the same room to ripe.

Daily room temperature and time taken for the plantain blossoms to ripe were recorded. The physicochemical properties of unripe and ripened plantain blossoms were determined according to the standard methods of Association of Official Analytical Chemists (AOAC, 1990). The remaining blossom samples were visually observed for the presence of fungal colonies and deterioration rates were monitored till 4 days after the blossoms have fully ripened.

RESULTS AND DISCUSSION

Table 1 presents a summary of the physicochemical properties of unripe and ripened plantain blossoms using different ripening agents. The crude protein of unripe plantain was 4.82% while the protein content of ripened plantain ranged from 1.31 to 3.51%. There was no significant difference in the crude protein of unripe and ripened blossoms of plantain when no ripening agent (RP4) was used. However, significant ($p < 0.05$) reduction in protein contents were recorded when ripening agents were used. In fact, less than 50% of the protein content was retained in plantain when any of the ripening agents was used to accelerate the ripening period. The ripening agents might have contributed positively to the loss of nitrogen.

The moisture contents of the ripened blossoms varied from 61.25 to 64.99% which were higher than the unripe (59.25%) blossoms. The ripened plantain due to the *N. laevis* leaves (RP1) had the least moisture content of 61.25%. This may be attributed to the fact that as the leaves were decaying, they absorbed moisture from the plantains. Crude fat of the ripened plantains varied from 0.04 to 0.55%. These were significantly ($p < 0.05$) lower than the crude fat of unripe plantain. Over 50% of the fat was retained in the ripened plantain when no ripening agent

Table 2. Vitamin C, sugar and pH values of plantain blossoms.

Treatment	Property				
	UP	RP1	RP2	RP3	RP4
pH	5.87 ± 0.03a	4.94 ± 0.22a	5.37 ± 0.20a	5.28 ± 0.24a	5.05 ± 0.15a
Brix (%)	0.00 ± 0.00d	20.00 ± 0.00a	20.00 ± 0.00a	18.00 ± 2.00b	15.00 ± 0.15c
Reducing sugar (%)	0.00 ± 0.00c	10.30 ± 0.20a	7.07 ± 0.23b	9.17 ± 0.25ab	10.42 ± 0.25a
Vitamin C (mg/100 g)	4.24 ± 0.20c	9.09 ± 0.15a	8.48 ± 0.17ab	7.27 ± 0.20ab	6.06 ± 0.10b

Values within a row followed by different letter(s) are significantly different according to new Duncan Multiple Range Test at $p < 0.05$.

UP = Unripe plantain blossoms, RP1 = ripened plantain blossoms using *N. laevis* leaves as ripening, RP2 = ripened plantain blossoms using calcium carbide as ripening agent, RP3 = ripened plantain blossoms using *I. gabonensis* fruit as ripening agent and RP4 = ripened plantain blossoms with zero ripening agent as control.

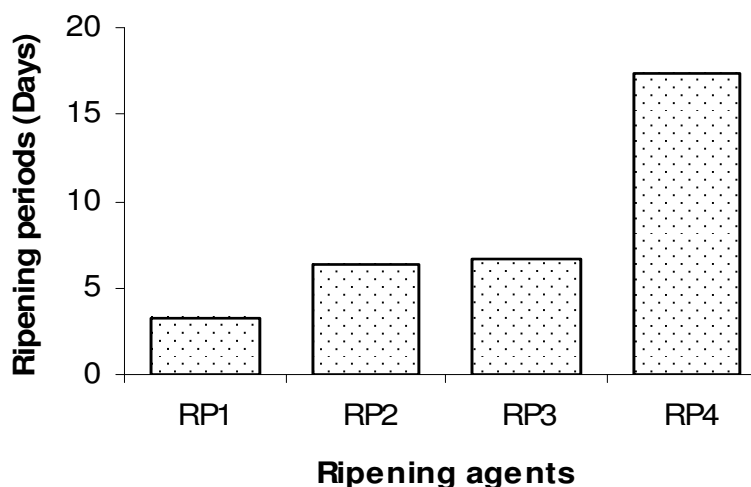


Figure 1. Ripening periods of blossoms of plantain as affected by different ripening agents. RP1 = Ripened plantain blossoms using *N. laevis* leaves as ripening agent; RP2 = ripened plantain blossoms using calcium carbide as ripening agent; RP3 = ripened plantain blossoms using *I. gabonensis* fruit as ripening agent; RP4 = ripened plantain blossoms with zero ripening agent as control.

(0.33%) was used while with carbide (RP2) (0.04%) and *I. gabonensis* fruits (RP3) (0.06%) the fat contents were exceedingly low.

Total ash of the ripened plantains ranged from 1.04 to 2.55 %. The total ash of RP4 and RP1 were not significantly different, while in RP2 and RP3, the total ash significantly ($p < 0.05$) reduced. The crude fiber, which is the bulk of roughages in food was moderate in all plantains, but very low with RP2 and RP3 which may be due to loss of nutritional values as a result of these ripening agents.

The carbohydrate contents in the ripened plantains ranged from 28.88 to 33.99% while the unripe plantain had 31.78%. Only RP1 showed significant higher value (33.99%) when compared with control (RP4) having 28.88% carbohydrate. The dry matter content of the ripened plantains followed this pattern also.

The pH values of the ripened plantains ranged from 4.94 to 5.37 showing slight acidity as shown in Table 2.

There was no significant difference in the pH values of the ripened plantains by the different ripening agents, though the pH with RP1 had the least while with RP2 had the highest value. The calcium ions in carbide may have enhanced this alkalinity condition. Total (brix) sugar and available (reducing) sugar of the unripe plantains was zero. This is normal; since it is the breaking down of carbohydrates which occur during ripening gives rise to sugar. After full ripening of the plantains, RP4 gave the highest value of available sugar (10.42%) while RP2 gave the significantly ($p < 0.05$) lowest (7.07%) value. The vitamin C in ripened plantains with RP1 was the highest, which however, was not significant when compared with RP2 and RP3 but significantly ($p < 0.05$) higher than in RP4.

Figure 1 gives the period it takes each of the treatments to ripe after the application of the ripening agents. Figure 2 give the plantains' conditions before and 4 days after ripening. RP1 was the first to ripe while RP4 ripened

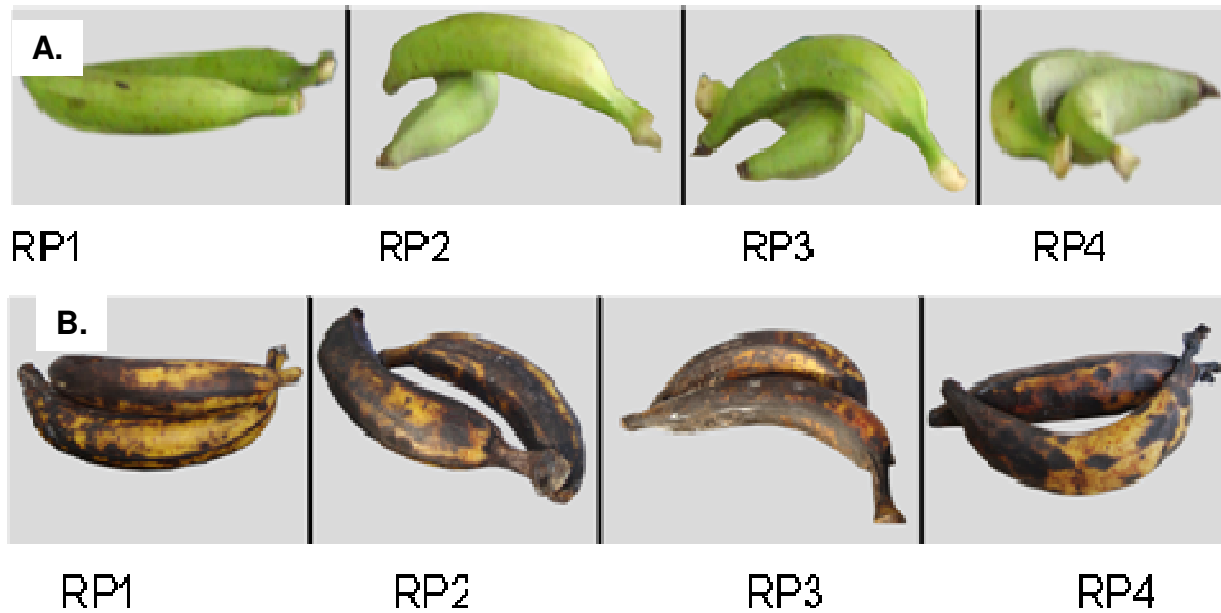


Figure 2. A. Unripe plantain blossoms. **B.** Plantain blossoms 4 days after ripening using different ripening agents. RP1 = Ripened plantain blossoms using *N. laevis* leaves as ripening agent; RP2 = ripened plantain blossoms using calcium carbide as ripening agent; RP3 = ripened plantain blossoms using *I. gabonensis* fruit as ripening agent; RP4 = ripened plantain blossoms with zero ripening agent as control.

last. This confirms the effectiveness of the ripening agents over zero application. However, four days after the blossoms of plantain have fully ripened, the visual observation on them confirmed the presence of fungal colonies in the order: RP2 > RP3 > RP1, whereas, RP4 had no fungi infestation.

Conclusion and recommendation

This study has shown the effect of ripening agents on the quality of the ripened blossoms of plantain. It has provided empirical data on the physicochemical properties of unripe and ripened plantains. There is evidence of nutritional quality reduction when ripening agents are used to accelerate the period of ripening of the blossoms of plantain. Low level of ignorance on the part of the farmers about what these ripening agents can do is capable of preventing the plantain from making its full nutritional values available to the consumers. An effective food safety programme must be put in place by the government(s) to seriously monitor various methods of plantain ripening so as to guide against anything that would have negative impact on human health.

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