Journal of Food Technology 4 (4): 253-254, 2006
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Physicochemical Changes in Ripening Plantain Stored at Tropical Ambient Conditions

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Abstract: Biochemical reactions and changes have been reported by many workers in ripening fruits. This study therefore investigated such changes in plantain fruits stored at ambient conditions (28±2°C and 80±2% RH). The changes in the physicochemical properties of plantain were monitored over the storage period. Physical properties measured were the color and weight loss; while chemical composition such as the total soluble solids, pH and acidity were also determined. The minerals measured were Iron, Potassium, Sodium, Calcium and Phosphorus. The Total soluble solids increased as the number of days increased. So also was the acidity. The pH also reduced with storage. The magnitude of weight loss and TSS were directly proportional to the number of storage days ie the longer the fruits were stored, the higher were the weight loss and TSS values. Mineral contents (Iron, Potassium, Sodium and Calcium) decreased with increase in storage days but the reverse was observed with phosphorus. Benomyl (fungicide) application at 500 ppm to the fruit proved efficacious in reducing fungal growth on treated fruits.

Key words: Ripening fruit, plantain, physicochemical

INTRODUCTION

Plantain fruits (*Musa aab*) which is an important source of carbohydrate in the tropics is reported to be also rich in minerals such as iron, potassium, sodium, calcium and phosphorus[1,2]. As important as these minerals are, there is dearth of information as to changes in their composition during the storage of plantain. The objectives of this work is to study these changes and also investigate some other physicochemical changes such as weight loss, changes in color, Total soluble solids, pH and acidity during storage.

MATERIALS AND METHODS

Plantain fruits (Musa AAB) used for this study were sorted for uniformity in color. They were still hard and green, weighing between 280 and 300 g. They were divided into two treatment groups of twenty plantain fingers each. One group was dipped into 500 ppm of Benomyl fungicide solution for 5 min, for microbial observation, while the other group was used as Control (untreated) and replication of four fingers for each test date (i.e., Days 0, 4, 7 and 10) for the physicochemical evaluations. Both groups were stored at room temperature of 28±2°C and 80±2% RH in a 2 by 3 wire net cage. The net was to prevent rodents attack but with facility for opening and closing as the need arises.

The changes in the physicochemical properties of plantain were monitored over the storage period. Physical properties measured were the color and weight loss; while chemical compositions such as the Total soluble solids, pH and acidity were also determined according to the methods of AOAC[3]. The minerals measured were Iron, Potassium, Sodium and Calcium which were determined using Atomic Absorption Spectrophotometric method (AAS) while phosphorus was determined by Colorimetric method. The weight loss was determined by weighing the fruits at the first day of storage and subsequently on each test dates,using methods described by Wade and Bishop[4]. At the end of the storage period the mould counts were also determined using methods described by Adams and Moss[5]. The data obtained for the physicochemical parameters were subjected to Analysis of Variance (ANOVA) and Duncan multiple range test.

RESULTS AND DISCUSSION

Results from Table 1 shows that there was a significant effect of storage days on the weight loss ($p \leq 0.05$). An increase in weight loss of 2.88, 6.67 and

Table 1: Changes in Physicochemical parameters of Plantain stored at the ambient conditions of 28±2°C and 80±2%RH

	Storage period (days)			
Parameter	1	4	7	10
Weight loss (%)	0.00±0.00^a	2.88±0.18^b	6.67±0.17^c	14.05±0.24^d
Total Soluble solids (%)	0.00±0.00^a	2.38±0.24^b	20.10±0.06^c	26.38±0.31^d
Acidity (mg mL^{-1})	1.40±0.02^a	2.80±0.03^b	8.40±0.16^c	9.10±0.02^d
PH	7.20±0.06^a	6.28±0.03^b	5.66±0.06^c	4.57±0.08^d
Peel color*	1.00±0.00^a	1.75±0.25^a	4.25±0.25^b	6.57±0.25^c

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Table 2: Changes in the mineral composition of plantain stored at ambient conditions of 28±2°C and 80±2% RH

	Storage period (days)			
Parameters	1	4	7	10
Fe	101.00±1.47[a]	54.50±1.27[b]	44.50±1.27[c]	39.00±0.91[d]
K	119.00±1.83[a]	87.50±0.65[b]	37.50±0.65[c]	26.00±1.83[d]
Na	94.00±1.83[a]	63.00±1.83[b]	52.00±1.47[c]	25.00±0.91[d]
Ca	59.50±1.04[a]	53.00±1.83[b]	34.00±2.20[c]	27.50±0.65[d]
P	145.80±1.54[a]	145.80±2.03[a]	166.70±1.11[b]	187.50±1.04[c]

Table 3: Moulds identified on ripening plantain fruits after 10 days of storage

	Colony counts (cfu)	
Moulds identified	Treated (500 ppm benomyl)	Untreated
Fusarium sp.	3	Numerous
Aspergillus niger	9	"
Penicillium notatum	5	"
Rhizopus stolonifer	Nil	"

14.01% were observed in days 4, 7 and 10, respectively. This corresponds with increase in the rate of respiration and ripening of the plantain fruits[6,7]. The Total soluble solids increased from 2.38% on the 4th day to 26.38% on the 10th day. So also was an increase in the acidity with the number of days. There was a corresponding reduction in the pH as storage progressed.

This finding of increase in acidity as the fruit ripens is however contrary to what is reported for most other fruits[7], but agrees with earlier findings of Loesecke[8] and Falana[9]. There was no significant difference in the peel color up to the 4th day but between the 7th and the 10th day, there was a significant increase in ripeness and the development of yellow peel color. With the exception of Phosphorus, there were significant decreases in the Iron, Potassium, Sodium and Calcium contents as storage progressed.

The fungicide treatment with Benomyl was found to be effective in reducing fungal growth on plantain fruits. Though no growth was observed on both treated and untreated fruits up to the 7th day of storage. But on the 10th day, numerous growth of *Fusarium* sp., *Aspergillus niger*, *Penicillum notatum* and *Rhizopus stolonifer* were observed on the untreated fruits, while only few colonies of *Fusarium* sp., *Aspergillus niger* and *Penicillum notatum* were seen on the treated ones Table 3.

CONCLUSION

This study has shown that storage of plantain fruits under ambient condition was accompanied with rapid changes in their physicochemical composition within 10 days of storage. Result Table 2 also showed that the nutritional advantage of the mineral content of plantain would be better harnessed at the green stage when the values are higher. Treatment of fruits with 500 ppm fungicide (Benomyl) solution reduced their susceptibility to fungal attack.

Therefore storage of plantain fruits at tropical ambient condition is not suitable for extended green-life of the fruit. Deliberate attempts and technologies aimed at reducing storage temperature and minimizing moisture loss from the fruit in addition to fungicide treatment would be appropriate for delaying ripening and spoilage in the fruit.

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