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Effect of Ethy-Gen II® Ripening Concentrate on Ripening and Sensory Properties of Mangoes (*Mangifera indica L.*)

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Abstract: This study investigates whether the use of ethy-gen II® ripening concentrate (150-300ppm of ethylene) as an alternative to the traditional method of off vine ripening would support ripening of locally cultivated mangoes. Mangoes, Keith variety, were treated with the ripening concentrate for 15 h in Graff® standard reefer of 66.5 m^3. Humidity was sustained by knapsack spraying of 20 litres of water inside the reefer. Fruits were stored for 6 days after treatment at ambient temperature 23±2°C, vented 30 min per day (1000 hGMT) in an air tight room to further ripe the mangoes. Total Soluble Solids (TSS) and sensory quality were studied at an interval of 2 days during the storage period. Sensory quality was assessed specifically on day 2 of storage. Results showed that ethy-gen II® treated mangoes ripened uniformly and faster than untreated mangoes Treated mangoes had higher average TSS, attaining an average brix (14.8°) at day 2 of storage. The control had brix of 12.18° at the end of the storage period. Treated mangoes had the highest percentage (100%) while the control had 34.81% at day 6 of storage. The fruity odour of the ripening concentrate had an impact on the taste of treated mangoes, however sensory evaluation revealed no significant difference ($p \leq 0.05$) among treatments. Ethylene produced from ethy-gen II® supports uniform ripening of locally cultivated mangoes and increased period of ventilation during storage helps to remove the fruity odour.

Key words: Ripening concentrate, uniform ripening, mango (keith variety), sensory attributes

INTRODUCTION

Mango (*Mangifera indica L.*) is an increasingly popular fruit grown in tropical and subtropical regions. Recently the global production of mango is known to have attained 26.5×10^6 Mt in 2004 (Nagle *et al*., 2005). It is most probably based on this recent demand that prompted the global drive to step-up the approach of selecting desired as well known commercial cultivars (Du Plooy, 2006). The importance of ripening fruits "off vine" is underscored in avoiding post-harvest losses caused by tree ripening (Mtebe *et al*., 2006). It is has been reported that the ripening stages of avocado is initiated by low concentration of ethylene as low as 0.1ppm (Hatton and Reeder, 1972) even though several ripening techniques have also adopted ethylene.

Ethylene gas has served a great deal in the ripening of fruit such as tomatoes, bananas, pears, etc in commercial quantities. According to Blankenship (2000), ethylene initiates post-harvest ripening via three main ways namely: a) gas from a cylinder, b) catalytic generator and c) ethephon. In Ghana, the increasing preference, production and seasonality of locally cultivated mangoes cumulatively suggest the need to device economic and feasible ripening methods which would limit post-harvest losses and promote wide acceptability of the mango fruit.

Thus in this study work the use of catalytic generator to produce ethylene from ethy-gen II® concentrate to support uniform ripening was investigated on locally cultivated mangoes (Keith variety).

MATERIALS AND METHODS

Sampling and selection of fruits: Locally cultivated mango fruits (Keith variety) for this study were obtained from the FIAT (Fruit Inspection and Assurance Team) Department of Blueskies Company, Dobro and Eastern Region of Ghana. A total of 450 fruits were randomly selected for the study. Selection of fruits was based on the following attributes; a) uniformity of size, b) absence of physical defects, c) no sign of infection, d) attainment of maturity and e) no sign of ripeness. They were divided into two equal groups, control (untreated) and treated respectively. Fruits per group were divided into three equal groups. Each group was further divided into three groups and used as replicates.

Fruit treatment: The method of Anonymous (2007) was adopted with modification. Fruits were kept in box-like net perforated plastic trays. Each tray contained an average of 15 mangoes. Trays were placed in a Graff® standard reefer on plastic pallets spaced equidistantly along each other. The Graff® standard reefer has a volume of 66.5 m^3 and air temperature of 23±1°C and equipped with a regulated circulation system. The pallet served to avoid the tray from touching the metal floor of the reefer.

Fruits were treated with ethy-gen II® concentrate pumped using the Easy Ripe® Catalytic Generator into the reefer for 15 h with pulp temperature of 20-23°C (Catatherm® Temperature probe). The humidity of the room was sustained by knapsack spraying with total of 20L tap water-15L first and the remaining 5L after 12 h during the treatment. The reefer was left open 20 min approximately while ethy-gen II® was still applied after the first 12 h.

Fruits storage: Fruits per treatment in the same plastic trays were stored in airtight, clean well dried rooms at an ambient temperature 23±2°C. This was done for further ripening of the fruits. Tray arrangement in storage room followed same as the reefer. The storage rooms were opened for approximately 30 min per day (1000 hGMT) to vent the rooms. Fruits were assessed for 6 days at interval of 2 days for Total Soluble Solids (TSS). The sensory attributes for fruits at day 2 of storage were evaluated.

Processing and evaluation of fruits: Processing of fruits (sanitization, peeling, acid flashing, packaging and labeling) was done at temperatures of 12-15°C.

TSS (Total Soluble Solids) determination: Fruits from each treatment were sanitized in a stainless steel tank using chlorine solution tested at 120 ppm (Lovibond Test®) for 20 min. Fruits were further sanitized in 1% Citrox solution for 1 min. Fruits were peeled and assessed for TSS using (Atago® Refractormeter) to determine percentage ripening (minimum brix 13°).

Sensory evaluation: Fruits (brix ≥ 13°) were sliced and manually acid flashed in citric and ascorbic acid solution in a ratio 1:1 (ascorbic acids concentration 600 mg/l) with a residual time of 1 min. Thereafter, fruits were then weighed into a plain 25 mm square Polyvinyl Chloride (PVC) plastic, sealed with a FFP 180 film and 4-digit coded. The packed fruits were sent to the blast chill for fruits to attain a temperature of <5°C.

Samples were evaluated by 15 member panel made up of workers from a commercial fruit processing company specifically from the Quality Assurance Department and Fruit Inspection and Assurance Department. They were asked to rate the ripening attributes:-using taste, flesh colour, texture and overall acceptability. Panelists were asked to open the fruit package after which they scored using a 9 hedonic scale (1-dislike very much, 9-like very much).

Statistical analysis: Statistical analysis of the data was computed using the Statistical Package for Social Science (SPSS) 13 programme for independent t-test ($p \leq 0.05$)

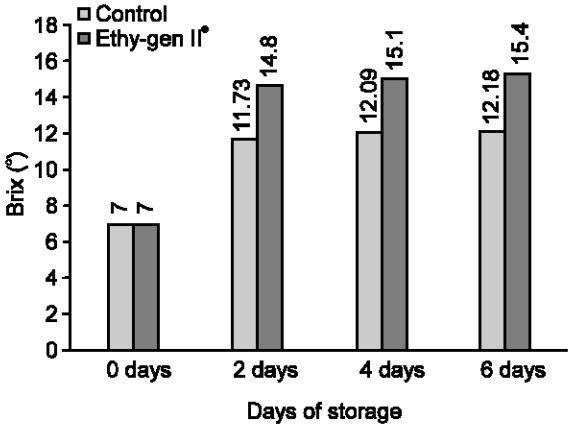

Fig. 1: Changes in brix over time (days of storage)

Table 1: Percentage of fruits ripened with respect to days of storage

	Days of storages		
Treatment	2 days	4 days	6 days
Ethy-gen II®	82.33%*	85.45%*	100%*
Control	25.43%*	29.68%*	34.81%*

Mean scores obtained from mangoes have minimum brix of 13° in any given sample. *Means values in the column are significantly different at ($p \leq 0.05$)

RESULTS AND DISCUSSION

The results of this study are presented in Fig. 1, Table 1 and 2. There was an increase in average TSS for both treated and control mangoes (Fig. 1). The increase in TSS was be due to the alteration in cell wall structure and breakdown of complex carbohydrates into simple sugars (Kays, 1991; Kittur *et al*., 2001 cited by Rathore *et al*., 2007). Treated mangoes had higher average TSS as compared with the control with respect with storage days. Treated mangoes attained an average brix (14.8°) at day 2 of storage while the control attained 12.18° at the end of the storage period. This difference may be due to the ethylene influencing significantly the chemical composition of the pulp, particularly the concentration of total soluble solids (Yah *et al*., 1998). Thus there was an increase in reducing sugars and degradation of ascorbic acid as compared to the untreated (Metha *et al*., 1980; Mattoo and Modi, 1969).

There was an increase in the percentage of fruits attaining a minimum brix 13% in both treatments in storage (Table 1). Fruit treated with ethy-gen II® had the highest percentage (100%) while the control had 34.81% at day 6 of storage, hence showing uniform ripening as compared to the control which corroborates similar climacteric fruits reports (Jeong *et al*., 2002). The difference in percentage ripening could be attributed to the fact that treated mangoes fully ripens and is edible 3 days after treatment (Lagunes *et al*., 2007) as compared to untreated mangoes take a minimum

Table 2: Effect of ripening treatment on sensory characteristics of semi-processed mango pulp

	Sensory attributes score				
Treatment	Appearance	Taste	Texture	Overall	Acceptability
Control	6.93[a]	6.87[b]	6.86[c]		6.73[d]
Ethy-gen II® Concentrate	6.80[a]	6.53[b]	6.73[c]		6.67[d]

Mean scores obtained from 15 panelists using a 9-point hedonic scale. Values with the same superscript in the columns are not significantly different at 95% level of confidence

ripening period of 9 days at room temperature, 26±2°C (Mtebe *et al*., 2006) and/or edible after 6-7 days (Lagunes *et al*., 2007).

Sensory panel acceptability scores for appearance, taste, texture and overall acceptability are found in Table 2. The control in general performed better than treated mangoes for all sensory attributes; however no significant difference was observed ($p>0.05$).

Panelist attributes a uniform yellow to orange pulp color to score higher for colour and texture based on soft but firm and also a good mouth feel. Panelists attributed powdery aftertaste, an odd mouth feel and a perfume like odour for treated mangoes to reduce score for taste although treated mangoes had a higher brix than the control. This could be due to excessive breakdown of the mango tissue (pulp) which is as a result of the degradation/solubilization of pectin (Lohani *et al*., 2004) which leads to a sharp decrease in firmness (Miranda *et al*., 2002), since internal increase of ethylene results in a loss of firmness (Wang and Mellenthin, 1972). The odd mouth feel and perfume like odour observed was due to fruity odour of the ripening concentrate which served as indication that ethylene was being produced. However, all fruits scored above the minimum score of 5, hence were all acceptable.

In an attempt to remove the fruity odour in the treated mangoes, they were left in the open air for approximately 1 h 30 min and sensory evaluated to find out whether the fruity odour was still present. Panelists (100%) detected no difference between the treated mangoes and untreated mangoes.

Conclusion: In conclusion, ethy-gen II® ripening concentrate support uniform ripening and impacts a fruity odour on locally cultivated mangoes. However, improved or increased ventilation during storage and before processing ethy-gen II® treated mangoes is important in removing/reducing the fruity odour from/in treated mango.

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