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Influence of Packaging Material and Rates of Potassium Permanganate on Post Harvest Ripening of African Eggplant (*Solanum Macrocarpon*)

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Abstract

Climacteric fruits (banana, apple, pear, avocado, garden egg and mango) are actually eaten when ripen; but garden egg is not palatable when ripens and decreases demand. Influence of packaging material and rates of potassium permanganate (KMnO4) on postharvest ripening of garden egg was evaluated to access the interactive effect of KMnO4 and packaging material in delaying ripening. Two packaging materials; polythene and jute bags, KMnO4 at 0g, 3g, 6g and 9g were used. The experiment was a 2 x 4 factorial laid in completely randomized design (CRD) with three replications. Eight treatment combinations were randomly distributed. Fruits were stored for seven days and were observed every 2 days. Result revealed that packaging material influenced postharvest ripening of garden egg with polythene bag reducing the intensity of ripening and significantly reduced shrinkage. Similarly, KMnO4 at (3g and 9g) significantly delayed ripening intensity at 4 and 6 days of storage.

Keywords: Packaging material, Potassium permanganate, Postharvest, Garden egg, Intensity rate, Polythene, Shrinkage, Jute bag.

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Contents

Contribution of this paper to the literature
This study has showed that polythene bags with little KMnO4 can extend the shelf -life of garden egg fruit without refrigerator. Also maintaining the moisture and appearance of the fruit. There is a dearth of knowledge on controlling garden egg post-harvest losses.

1. Introduction

Eggplant is one of the fruity vegetables in the night shade (Solanaceae) family which includes bell pepper, tomatoes and potatoes. Eggplants are usually planted as annuals, although some varieties may live into a second season. Eggplant can be seen in almost every market in West and Central Africa, where it is one of the five most important fruity vegetables together with tomatoes, onions, pepper and okra [1].

Eggplant is commonly called garden egg. Garden egg can be combined with groundnut or groundnut paste to entertain visitors. Although far from being nutritional power house, these colourful egg-like fruits provide protein, vitamin and minerals, low in sodium and calories, high in dietary fiber and a good source of potassium [2].

Postharvest losses in tropical fruits vary widely from 10 – 80% in both developed and developing countries [3]. It is estimated to range from 10 – 30% per year despite the use of modern storage facilities and techniques [4]. In the tropics, these losses are due to tropical weather, poorly developed infrastructure, poor farm practices, inadequate postharvest handling knowledge, poor storage facilities and epileptic power supply. These losses occur along the supply chain beginning from time of harvest right up to packaging, storage, transportation, retailing and consumption [5]. The average shelf life of garden egg is 3 – 7 days depending on harvesting frequency and conditions [6]. Several days after harvest, garden egg change colour from white, cream or stripped green to yellow and or intense orange. At the same time the water content of the fruit also declines causing it to shrivel thus affecting the appearance which changes from a glossy looking skin to a pale/dull appearance. The retail price drops compared to the original value, also the shelf-life reduces making it more susceptible to pest attack. These lead to decrease in its consumption as consumers prefer a freshly looking and unripe fruit causing a loss to the farmer and to the seller respectively.

2. Material and Methods

An experiment was conducted in 2008 at the laboratory of Crop Science and Technology, Federal University of Technology, Owerri to study the influence of packaging materials and rates of potassium permanganate on post harvest ripening of garden egg (*Solanummacrocarpon*). The treatment consisted two (2) types of packaging materials (polythene bag and jute sack bag) and four (4) levels of potassium permanganate ($KmnO_4$) (May and Baker Ltd., Dagenham, England) which was packaged in sachet (1 x 1 inch) made from muslin cloth, of which each sachet contained 3g of $KmnO_4$ in pellets of 0.3 – 0.5cm in diameter. The levels are 0, 1, 2 and 3 sachet.

Completely randomized design was used with three (3) replications. Garden egg (*Solanum macrocarpon*) variety was randomly picked, weighed (200g) each was packaged into each packaging material. Treatments were factorially arranged 2 x 4 x 3 making a total of 24. $KmnO_4$ was added to the packaged garden egg as 0 (control), 1 sachet (in the centre of the packaging materials i.e. (polythene and jute sack bags) 2 sachets (one at each end of the packaging materials), 3 sachets (one in the centre and one at each end of the packaging materials). The fruits were stored for seven (7) days and were observed after every two (2) day. Data were collected on percentage ripening and intensity of ripening.

$$\text{Percentage ripening} = \frac{\text{number of ripe garden egg in the unit}}{\text{total number of garden egg in the unit}} \times \frac{100}{1}$$

Intensity of ripening; the following grading system was used to access the intensity of ripening:

Extremely ripe - 4
Very ripe - 3
Moderately ripe - 2
Slightly ripe - 1
Not ripe - 0

The data collected were subjected to analysis of variance (ANOVA). Genstat statistical package 6th edition, where significant difference existed between treatments, least significant difference was used to separate them at 5% probability level.

3. Results and Discussion

The study revealed that packaging materials significantly ($p \leq 0.05$) influenced the intensity and rate of garden egg ripening at 4 and 6 days of storage (Table 1and Table 2). However there was no significant ($p < 0.05$) difference at 2 days of storage, hence packaging material has little or no effect on ripening. Polythene bags at 4 and 6 days (Table 1and Table 2) of storage significantly ($p < 0.05$) affected ripening rate and intensity. This can be due to reduced temperature and oxygen in the packaging material. Ferris [7] reported that reduced fruit respiration causes decreased ripening and increases storage life. Packaging material also significantly ($p < 0.05$) influences shrinkage after storage (Table 3). Garden egg packaged or stored in polythene bags did not record any shrinkage, however jute sack recorded some level of shrinkage. This study was in conformity with the work reported by Forney and Lipton [8] that polymeric films influences the development of chilling injury on fresh produce by creating a modified atmosphere around the commodity and by slowing loss of moisture.

Intensity and rate of ripening of garden egg stored with different rates of potassium permanganate did not differ statistically throughout the period of the storage (Table 4 and Table 5). However, there were significant ($p \leq 0.05$) effect at 6 days of storage in respect to potassium permanganate on ripening rate. Jobling [9] reported that sufficient potassium permanganate should be made available and sprayed over a large surface area for proper reaction with ethylene, hence an increased rate of potassium permanganate may possibly show a significant effect on both ripening intensity and rate. Garden egg ripening intensity and rates was not significantly influenced by the interaction between packaging material and potassium permanganate at 2 days of storage (Table 6 and Table7) in this study, but recorded significantly ($p < 0.05$) interactive effect between the packaging materials and potassium

permanganate on the intensity and rate of garden egg ripening, with garden egg stored in polythene bag treated with 3 and 9 grams of potassium permanganate showed delayed ripening intensity at 4 and 6 days of storage as compared with others. This revealed that garden egg stored on or before 2 days using the packaging materials and treated with potassium permanganate does not influence the fruit ripening. This could be probably due to the fact that no active physiological activities at the early time of fruits under storage condition. This is in line with [10] on their work to evaluate the effects of $KMnO_4$ on the extension of postharvest life of 'Sunrise Golden' papaya reported that at 4 days after bag sealing, carbon dioxide (CO_2) concentration was higher in bags without $KMnO_4$ and was stabled in those treated with varying rates of $KMnO_4$.

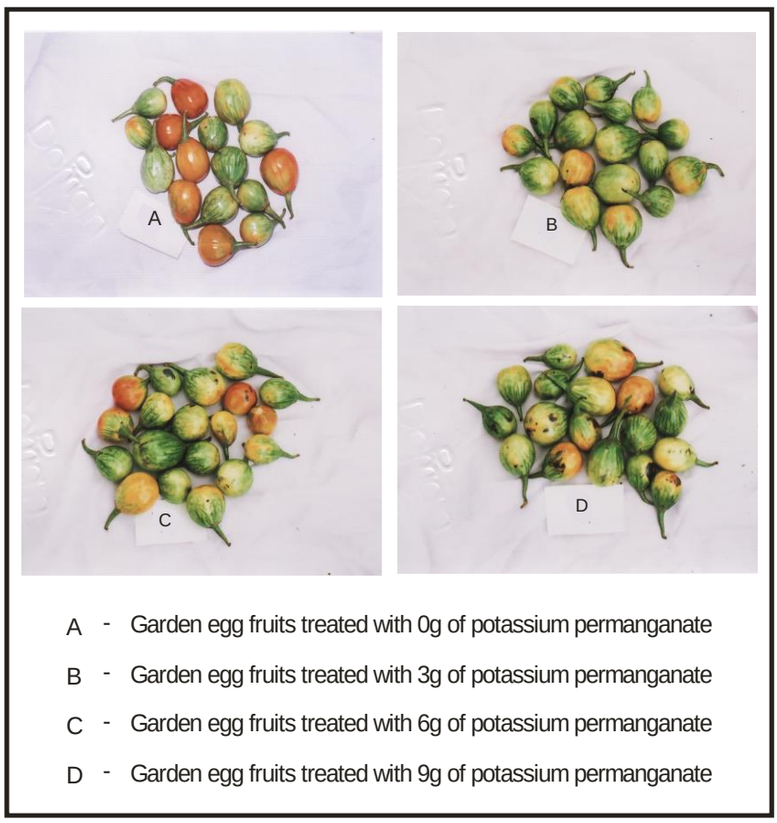

Figure 1. Illustrates garden egg fruits in polythene bag, treated with different rate of $KMnO_4$ at 6 days.

3g of $KMnO_4$ sealed in polythene bag after 4 and 6 days (Figure 1 and Figure 2) show significant reduction in the rate and intensity of ripening, and weight loss when compared to that of jute bag. This is because $KMnO_4$ is efficient at lower concentrations (1.5g - 3g) in polythene bag irrespective of the thickness, in delaying ripening of fruits, extending shelf life and improving textural quality under ambient temperature (26 - 28 °C). This agrees with those reported by Silva, et al. [10], Wabali and Esiri [11], Azad, et al. [12], Anyasi, et al. [13] and Wabali, et al. [14] that bags with lower concentration of KMnO4 reduces the concentration of CO_2 after 2 days of storage. The oxidation of ethylene by $KMnO_4$ leads to the formation of water (H_2O) and CO_2, but in jute bag the water may have been absorbed by the bag resulting into significant deterioration of garden egg fruit after 2 days and above.

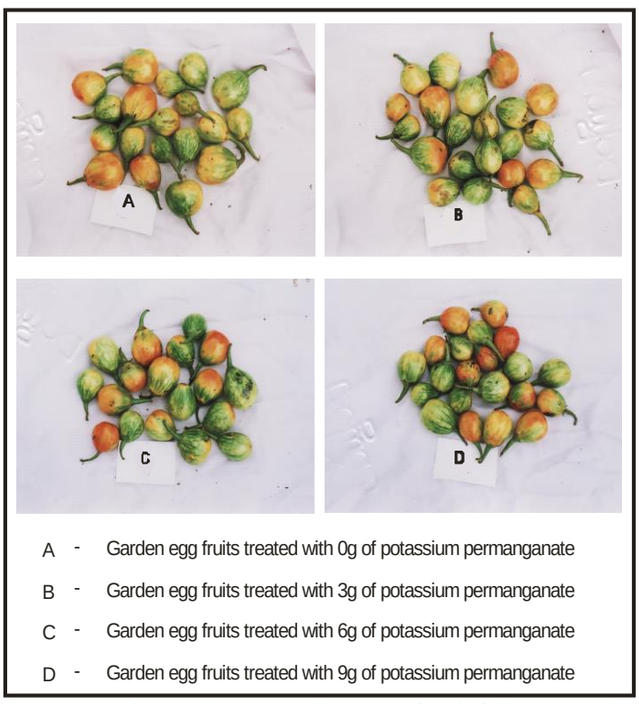

Figure 2. Illustrates garden egg fruits in jute bag, treated with different rate of $KMnO_4$ at 6 days.

Table 1. Effect of packaging materials on intensity of ripening with increasing days to storage.

Packaging materials	Days of storage		
	2	4	6
Polythene bag	0.500	0.840	1.525
Jute bag	0.833	1.650	2.019
$LSD_{(0.05)}$	NS	0.55	0.359

Table 2. Effect of packaging materials on the rate of ripening with increasing days of storage.

Packaging materials	Days of storage		
	2	4	6
Polythene bag	11.30	23.50	54.20
Jute bag	22.20	48.20	69.80
$LSD_{(0.05)}$	NS	16.98	15.58

Table 3. Effect of packaging materials on shrinkage and weight loss after storage.

Packaging Materials	Shrinkage	Weight loss
Polythene bag	0.000	4.200
Jute bag	1.880	7.800
$LSD_{(0.05)}$	0.280	NS

Table 4. Effect of $KMnO_4$ on intensity of ripening with increasing days of storage.

Packaging materials	Days of storage		
	2	4	6
0	0.833	1.500	2.015
3	0.667	1.100	1.545
6	0.500	1.230	1.725
9	0.667	1.050	1.803
$LSD_{(0.05)}$	NS	NS	NS

Table 5. Effect of $KMnO_4$ on the rate of ripening with increasing days of storage.

Packaging materials	Days of storage		
	2	4	6
0	23.40	46.20	80.90
3	14.30	27.00	57.10
6	12.70	41.70	57.50
9	16.70	28.60	52.40
$LSD_{(0.05)}$	NS	NS	22.03

Table 6. Interactive effect of packaging materials and $KMnO_4$ on intensity of ripening with increasing days of storage.

Packaging materials	$KMnO_4$ (g)	Days of storage		
		2	4	6
Polythene bag	0	0.667	1.500	2.093
	3	0.333	0.667	1.083
	6	0.667	0.860	1.600
	9	0.333	0.333	1.333
Jute bag	0	1.000	1.667	1.947
	3	1.000	1.533	2.007
	6	0.333	1.610	1.850
	9	1.000	1.777	2.273
$LSD_{(0.05)}$		NS	1.030	0.719

Table7. Interactive effect of packaging materials and $KMnO_4$ on the rate of ripening with increasing days of storage.

Packaging materials	$KMnO_4$ (g)	Days of storage		
		2	4	6
Polythene bag	0	21.40	40.00	77.80
	3	4.80	11.10	42.90
	6	14.30	33.30	48.40
	9	4.80	9.50	47.60
Jute bag	0	25.40	52.40	84.10
	3	23.80	42.90	71.40
	6	11.10	50.00	66.70
	9	28.60	47.60	57.10
$LSD_{(0.05)}$		NS	33.96	31.15

4. Conclusion

Base on this study, packaging materials influenced post harvest ripening of garden egg, with polythene bag reducing the rate and intensity of ripening and significantly reduce the shrinkage of garden egg fruit. Potassium permanganate in this study showed very little effect in its ability to absorb ethylene released from ripening garden egg fruits which was due to the rate or quantity used, however the interaction of polythene bag with 3g and 9g of potassium permanganate delayed the ripening of garden egg.

5. Recommendation

Further studies are thereby recommended to validate these findings and to also identify proper or other suitable package that will absorb moisture in packaging potassium permanganate to avoid dilution.

Egg fruit borers (*Darabalaisalis* and *Sceliodeslaisalis*) should be effectively controlled on the field as their activities affect the post harvest life of garden egg.

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