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RESEARCH PAPER

Influence of wax coating and indigenous potassium permanganate based ethylene absorbents on shelf life of banana cv. DWARF CAVENDISH

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SUMMARY : The present investigation was carried out to study the influence of wax coating and indigenous potassium permanganate based ethylene absorbents on self life of banana cv. DWARF CAVENDISH at farmer's field in Ashrawal village, Allahabad, U.P. India. Locally available indigenous materials like thermocol, filter paper, blotting paper, clay, coir pith, saw dust, chalk were used as base materials as ethylene absorbents. It was observed that an indigenous ethylene scrubber made out of filter paper delayed ripening of fruits (35.20) days meanwhile the control fruits ripened within (19.80) days and the peel colour was green with traces of yellow in all the treated fruits. The control fruits were yellow with green tips. Wax coating in combination with hot water and ethylene absorbent had effectively extended green life than when wax alone used at different concentration. Maximum green life was observed in 6 per cent wax coated fruits in combination with hot water and ethylene absorbent. Meanwhile green life for control was only (21.80) days. Wax coating also reduced PLW to the minimum (3.2 to 4.84 %) as against (7.27%) in the control.

Key Words : Banana (*Musa* sp.), cv. DWARF CAVENDISH, Wax, Potassium permanganate, Shelf life

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Banana is one of the most popular fruits in India and it is the only fruit available throughout the years, relatively inexpensive and within the reach of all classes of buyers. Banana is rich in calories, but very low in fats. The fruit contains a good amount of health benefiting anti-oxidants, minerals and vitamins. India is the second largest producer of fruits in the World and is known as fruit basket of the World. Banana ranks third in area with 7.09 lakh ha next to mango and citrus. However, it stands first in total fruit production (26.21 MT), being nearly one third of the total fruit production (38.3%, NHB data base 2009). India is exporting fresh banana to nearly fifty countries of the World and earning good foreign exchange from the world market. Indian bananas are the favorites in many countries of the World, but large portion of export consignment is routed to UAE (44.6%), Saudi Arabia, Bahrain, Kuwait and Nepal. In spite of the leading role played by India in the production of banana, its share in the International trade is only meager *i.e.* 1 per cent (NHB data base 2009). Banana being highly perishable fruit suffers from heavy post harvest losses often to the extent up to 20- 30 per cent. (Chadha, 1996 and Liu and Jia, 2008). When it is harvested at the pre climacteric matured green stage, the fruit undergoes various physio-chemical changes while some of the changes are desirable,

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most are not desirable from consumer stand point (Adeyeni and Oladji, 2009). Post harvest changes in fresh fruits cannot be stopped but can be slowed down within certain limits. Ethylene a natural plant hormone which plays a central role in initiation on ripening in banana and accelerating the senescence. Its removal from the storage atmosphere is known to extend the green life of banana. The skin of the ripe fruit especially that of Dwarf cavendish variety, rapidly darkens by enzymatic oxidation. Various authors reported that various chemical treatments, skin coatings with wax and plastic emulsions extended shelf life of fruits (Ben-Yehoshua, 1966; Rao and Rao,1979; Rao and Chundawat,1984 ; Sarkar *et al.* 1995). The present study was, therefore, undertaken to develop a viable indigenous potassium permanganate based ethylene absorbents suitable for packaging and to evaluate the efficacy of different wax coating treatments in enhancing the shelf life of banana cv. DWARF CAVENDISH.

EXPERIMENTAL METHODS

Present investigations were carried out on banana cv. Dwarf Cavendish which was grown during 2006-2007 at farmer's field in Ashrawal village, Allahabad following standard agronomic practices. The banana bunches were harvested at 116 days (from shooting (flowering) to harvest) fixed as 90 per cent maturity. After harvest, the fruit bunches were brought to lab carefully by holding vertically during the road journey to avoid physical damage. On reaching the laboratory the fruits were de handed by making sharp cut along the crown cushion and washed in clean water to remove dirt and dust. The experiments were conducted in the Department of Horticulture, Sam Higginbottam Institute of Agriculture, Technology and Sciences, Allahabad during winter months (November-December) in 2006 during which the prevailing average temperature was 14-15^{0}C.

Experiment 1: Effect of indigenous potassium permanganate materials as ethylene absorbent on the banana cv. Dwarf cavendish:

Locally available indigenous materials like thermocol, filter paper, blotting paper, clay, coir pith, saw dust, chalk were used as base materials as ethylene absorbents. These materials were soaked in saturated $KMnO_4$ solutions for 24 hours, and then they were slightly dried to avoid dripping of excess solution and they were made into blocks of 4 x 4 cm size. They were placed in muslin cloth bags and sealed in unglazed soft tissue papers. Six fruits were packed in transparent polythene covers of 200 gauge thickness and allowed to ripen along with an ethylene absorbent block placed inside the sealed cover and kept at ambient temperature. The experiment was laid out in simple CRD with 8 treatments including control and 5 replications each. Observations were recorded on days to ripe, peel colour. To determine the peel colour, colour reference chart developed by united fruits sales corporation, USA was used. The chart describes seven stages of banana ripeness on the basis of appearance (Armstrong, 1982).

Experiment 2: Influence of waxol 4 per cent, 6 per cent and 8 per cent and in combination with hot water and ethylene absorbents on banana cv. DWARF CAVENDISH:

In this experiment the wax emulsion (Waxol) was used at 4 per cent, 6 per cent and 8 per cent concentration. The fruits of 90 per cent maturity were dipped in the wax emulsion of the required strength for 30 to 60 seconds and dried in shade. Fruits were also treated with hot water at 52^{0}C and dried before wax emulsions and stored in polythene bags containing potassium permanganate based ethylene absorbents. The experiment was laid out in a CRD with 10 treatments and 5 replications including control. The treatments consisted of waxol 4 per cent , 6 per cent, 8 per cent, waxol 4 per cent + ethylene absorbent, waxol 6 per cent + ethylene absorbent, waxol 8 per cent + ethylene absorbent, waxol 4 per cent + hot water+ ethylene absorbent, waxol 6 per cent + hot water + ethylene absorbent, waxol 8 per cent + hot water + ethylene absorbent and control (no treatment). The data were recorded on green life (This is well defined period after harvest, during which fruits remain green (till the fruit becomes full yellow) and firm. It is also referred to as the pre climacteric life or green life (Peacock, 1966; Blake and Pea cock, 1971), pulp peel ratio (it was recorded by dividing the weight of the pulp with the weight of the peel of fully ripe fruits), and PLW .The initial weight of fresh fruits was recorded individually. The final weight was taken as and when fruits reached the stage of yellow flecked with brown in each treatment. PLW was calculated at the end of full ripening stage on weight/weight basis by adopting the following formula and the mean expressed in per cent age.

$$\text{PLW \%} = \frac{\text{Initial weight of the fruit} - \text{Final weight of the fruit}}{\text{Initial weight of the fruit}} \times 100$$

Statistical analysis:

The data recorded were subjected to appropriate statistical tools by analysis of variance. The significance was tested by F test. The S E (d) and critical difference at 5 per cent probability levels were worked out. All the statistical designs were analyzed by using computer soft ware programme, Windostat version 8.6 developed by Indostat services, Hyderabad.

EXPERIMENTAL FINDINGS AND ANALYSIS

The results of the present study as well as relevant discussions have been presented under following sub

heads:

Effect of indigenous potassium permanganate materials as ethylene absorbent on the banana cv. DWARF CAVENDISH:

In the present investigation, the materials employed include thermocol, filter paper, blotting paper, chalk, coir pith, clay ash, rice hull and saw dust. They were tested individually for their efficacy as base materials. Most of these materials are easily available in the country as waste or by products and possess good absorbing capacity. The efficiency of above materials were tested on banana cv. DWARF CAVENDISH packed in 200 gauge polythene covers in which the absorbent blocks were kept and sealed. The study was conducted under ambient conditions and no refrigeration was employed. The efficacy was judged based on the number of days taken for ripening and the development of peel colour. The days to ripe and peel colour influenced by the different indigenous absorbents of ethylene are presented in Table 1.

Table 1 : Effect of indigenous $KMnO_4$ materials as ethylene absorbent on days to ripe and peel colour in banana cv. DWARF CAVENDISH

Sr. No.	Treatments	Days to ripe	Peel colour
1.	Chalk	34.40	2
2.	Blotting paper	34.00	2
3.	Filter paper	35.20	2
4.	Saw dust	34.40	2
5.	Clay	33.80	2
6.	Coir block	31.00	2
7.	Thermocol	28.00	2
8.	Control	19.80	5
	Mean	31.32	2.4
	C.D. (P=0.05)	1.97	0.01
	SE (mean)	0.81	0.16
	F-test	S	NS

Note : S-Significant
NS- Non significant

Days to ripe:

Based on the number of days taken for ripening, the tests have indicated that control fruits ripened with in (19.80) days which was significantly different with that of treatments. Among the treatments with indigenous $KMnO_4$ absorbents, days to ripe ranged from (28.00 to 35.20) days.

All the treatments significantly influenced the days taken to ripe in banana. The fruits without absorbents (control) ripened within (19.80) days. Among all the treatments having indigenous carriers, filter paper had taken more number of days to ripe (35.20) days.

Peel colour:

In respect of peel colour between control and indigenously made ethylene absorbent carrier materials, the difference in the colour development in banana fruits was marked. The peel colour of fruits in control were yellow with green tips only (5.0) and the fruits with all other ethylene absorbents remained green with traces of yellow (2.0). There was no significant variation between the treatments with regard to peel colour.

The present results also confirm to the findings emanated from the experiments conducted earlier by Esguerra *et al*. (1978) and Claud and Clavo (1993). A more practical material $KMnO_4$ on vermiculite has been developed and tested successfully by the Australians (Scotts and Roberts, 1966; Scotts *et al*., 1968).

The development and testing of such low cost indigenous ethylene absorbent blocks will have enormous impact on the banana export industry especially because bananas are transported overseas through ship and takes considerable time to reach the destinations abroad. The cost of indigenous scrubber is negligible and within the reach of the growers, middleman and traders.

Influence of waxol 4 per cent, 6 per cent and 8 per cent and in combination with hot water and ethylene absorbents on banana cv. DWARF CAVENDISH:

Banana is a climacteric fruit and its rate of respiration rises up to the peak during ripening. A high rate of respiration is usually associated with a short storage life. Hence, care should be taken to reduce respiration rate during storage especially in tropical and subtropical countries like India. Improvement of shelf life may be done with the application of a good skin coating as it reduces respiration rate (Pantastica, 1975). Thus the present studies were undertaken to investigate the effect of skin coating by waxol alone and in combination with hot water and ethylene absorbents.

Green life:

From the data presented in Table 2. It is evident that the green life of treatments was significantly different from that of control. The results indicated that green life varied from (37.20 to 54.60) days among the treatments which significantly varied with control (21.80) days. The treatment with 6 per cent wax + hot water + ethylene absorbent shown highest green life with (54.60) days and the least were with control (21.80) days. However, there was no significant difference between the treatments of wax alone *viz*., 4 per cent wax, 6 per cent wax and 8 per cent wax. Other treatments with wax alone and in combination with ethylene absorbent and hot water also showed at par relationship with each other. Wax acts as a physical barrier on banana skin and checks respiratory losses from banana and retains quality of fruits and their physical appearance.

The green life of banana observed in present study are supported by the findings of Rao and Chundawat (1988); Desai *et al*. (1973); and Islam *et al*. (2001). Rao and Rao (1979) reported

Table 2 : Influence of waxol treatments at 4 %, 6% and 8% in combination with hot water treatment and ethylene absorbents on some harvest characters of banana cv. DWARF CAVENDISH

Sr. No.	Treatments	Green life (Days)	Pulp- peel ratio	PLW
1.	4 % Wax	39.20	1.60	4.84
2.	6% Wax	40.20	1.49	3.18
3.	8 % Wax	37.20	1.38	3.06
4.	4 % Wax + Ethylene absorbent	48.60	1.62	4.60
5.	6 % Wax + Ethylene absorbent	49.80	1.45	3.14
6.	8 % Wax + Ethylene absorbent	44.00	1.35	3.02
7.	4 % Wax + Hot water treatment + Ethylene absorbent	46.20	1.60	4.73
8.	6 % Wax + Hot water treatment + Ethylene absorbent	54.60	1.56	3.08
9.	8 % Wax + Hot water treatment + Ethylene absorbent	45.80	1.40	3.79
	Control	21.8	1.81	7.27
	Mean	42.74	1.53	4.07
	C.D. (P=0.05)	4.24	0.15	0.81

that the shelf life and fruit quality were greater and the spoilage due to fungal infection was nil in the fruits treated with wax emulsion and stored in polythene bags containing $KMnO_4$ and $Ca(OH)_2$.

Pulp / peel ratio:

The pulp peel ratio varied significantly among the treatments and in the control (Table 2.). Highest pulp peel ratio was observed (1.81) in the control. Meanwhile narrow peel ratio was noticed with 8 per cent wax+ Ethylene absorbent due to higher peel thickness (1.35). There was no significant difference among the treatments with ethylene absorbents and hot water.

The highest peel weight of waxol coated banana might be that, wax coating acts as physical barrier to the loss of water from the peel through transpiration. The results are in conformity with Tripathi *et al*. (2007); Rao and Rao (1979); and Islam *et al*. (2001).

Physiological loss in weight:

The effect of waxol treatment on physiological loss in weight is presented in Table 2. Maximum weight losses were recorded in control (7.27%). Fruits with wax coating showed minimum weight losses. Least physiological loss in weight (3.02%) was with the fruits treated with 8 per cent wax in combination with ethylene absorbent. All the treatments with 6 and 8 per cent wax with or without combination of hot water and ethylene absorbent recorded minimum PLW and were at par with each other. All the treatments with 4 per cent wax alone and in combination with hot water and ethylene absorbent recorded high PLW. 4 per cent wax alone recorded 4.84 per cent, 4 per cent wax +ethylene absorbent recorded 4.6 per cent and in combination with hot water recorded 4.73 per cent. Minimization of weight loss in wax coated fruits might be due to the action of wax as a physical barrier to gas diffusion from fruit stomata through which the gas exchange takes place between tissue and external atmosphere (Islam *et al*., 2001).

It is apparent from the study that shelf life of banana var. Dwarf Cavendish could be best extended by use of all indigenous carrier materials for potassium permanganate. However, filter paper recorded maximum green life with (35.20) days. Wax treatment in combination with hot water and ethylene absorbent was found to be best not only in extending the shelf life but also in maintaining the quality.

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