Asian Journal of Bio Science, Vol. 3 No. 2 : 233-236 (October, 2008)

Effect of ethylene absorbent and different packaging materials on storage life of banana

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(Accepted : April, 2008)

The experiment was conducted to assess the shelf life of unripe banana with ethylene absorbent stored in different packaging materials *viz*., HDPE, polyethylene and polypropylene (non-perforated) bags of different gauges. Significantly minimum weight loss, spoilage, TSS and Pulp/peel ratio recorded by fruits stored in 250 gauged non-perforated HDPE bags followed by 175 gauges non –perforated HDPE bags with ethylene absorbent at all the sampling dates. However, highest acidity was recorded at all the storage period due to the same packaging materials. The spoilage was recorded on 15 days of storage to the tune of 2.15% and 1.054%, respectively by fruits stored in 175-gauged HDPE bags and 250-gauged HDPE bags. The control fruits were spoiled on 9th day.

Key words : Ethylene absorbent, TSS, Cumulative weight loss, Pulp/peel ratio, Titratable acidity.

INTRODUCTION

Banana (*Musa paradisiaca* L) is one of the most delicious, refreshing and nourishing fruit of the world. Banana is a commercially important global food commodity after rice, wheat and milk in terms of gross values of production and of great socio-economic significance. India contributing 26% of the total fruit production, with a growing appreciation for the role of banana in nutrition and medicinal properties added with high economic returns per unit area, sustainable income to marginal farmers. In India banana is the predominant and popular among the people. Though it is called as poor man's apple, it is liked and consumed by rich people also. The higher concentration of production is in tropical America and India is second largest among the banana growing country. The major banana growing areas in India lies in the state of Kerala, Maharashtra, Tamilnadu, Andhra Pradesh, Gujarat, Karnataka, Assam and West Bengal of which Kerala, Tamilnadu and Maharashtra occupying 49.33% of total area under this crop. Jalgaon district is the major Banana growing area having about 34600 ha of land under banana cultivation producing over 8,60,200 tonnes of banana every year.

To make banana growing as a profitable business it is necessary to produce, transport and market quality banana. When fruits approach maturity, they release ethylene. Ethylene promotes the ripening of fruits. Among the many changes that ethylene causes is the destruction of chlorophyll. With the breakdown of chlorophyll, the red and / or yellow pigments in the cell of the fruits are unmasked and the fruit assumes its ripened color. It can also be very harmful to many fruits, vegetables, flowers, and plants by accelerating ageing process and decreasing the product quality and shelf life. Thus ethylene plays an essential role in the ripening of climacteric fruit. Banana being climacteric fruit, control of ethylene will solve many of the problems; there are different stages where ethylene absorbent can be used with the advantage.

In the field, if bunches are equipped with ethylene absorbent prior to 70% maturity, the inception of climacteric can be prolonged and for long distance transport a quality banana at 90% to 95% maturity levels can be harvested and transported safely. Use of ethylene absorbent at such temporary storage will postpone the untimely climacteric process. Use of ethylene absorbent during transport will retard the chances of untimely repining during transport. With a view to make this technology available to regional farmers at a reasonable price, to enhance shelf life of banana by using ethylene absorbent and storing banana in different packaging materials.

MATERIALS AND METHODS

The experiment on storage of unripe banana was conducted with ethylene absorbent and different packaging materials. Fruits were brought from the village Pandhari near Anjangaon (Surji) in the month of May, 06. The variety of the fruits was Grand-9. After cleaning with

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tap water and drying at room temperature, the fruits kept for storage under room condition in 175 gauged HDPE bags (T_1), 250 gauged HDPE bags (T_2), 200 gauged PE bags (T_3), 300 gauged PE bags (T_4), 200 gauged PP bags (T_5), 300 gauged non-perforated PE bags (T_6), open (T_7) and open without ethylene absorbent (T_8). The ethylene absorbent was added in each treatment except T_8.All packaging materials were non-perforated. The experiment was laid in analysis of variance technique –one-way classification with eight treatments. Samples of fruits were tested at an interval of three days to examine the changes in weight loss, pulp/peel ratio, TSS and titratable acidity. The weight loss was determined on fruits initial weight basis, pulp and peel ratio, by taking weight of pulp and peel,TSS by refractometer and titratable acidity by titrating fruit juice with 0.1 NaOH with phenolphthalein as an indicator (Ranganna, 1986).The data was statistically analyzed as per the method given in Gomez and Gomez (1984).The temperature during storage was recorded in the range of 26 °C to 29 °C and R.H 58 %.

RESULTS AND DISCUSSION

It revealed that, cumulative weight loss (Table1) increased with increased storage period. At the end of 6th day, lowest cumulative weight loss was observed in fruits packed in 250 gauge non-perforated HDPE bags as compared to all other treatments. At 9th day of storage period fruits packed in 250-gauged HDPE bags recorded minimum cumulative weight loss. Similar trends of results were observed at the end of 12th and 15th day of storage.

The data presented in Table 1 indicates the per cent spoilage of banana fruits stored in different packaging materials with ethylene absorbent. No spoilage was recorded upto 6th day in all-packaging materials except fruits stored open with ethylene absorbent (T7) and without ethylene absorbent (T8) which recorded 20.71% and 37.03% spoilage, respectively. Moreover, fruits packed in 250 gauge and 175 gauge non-perforated HDPE bags up to 12 days of storage found better as compared to all other treatments in maintaining no spoilage. At the end of 15th day, fruits stored in 250 gauge non–perforated HDPE bags found significantly better followed by fruits stored in 175 gauge non-perforated HDPE bags with ethylene absorbent showing minimum spoilage of 1.054% and 2.15%, respectively. The spoilage in packaging bags was because of accumulation of moisture inside the package. This can be attributed to the fact that, during the oxidation of ethylene with $KMnO_4$, ethylene (C_2H_4) is initially oxidized to acetaldehyde (CH_3CHO), which in turn is oxidized to acetic acid (CH_3COOH). Acetic acid is further oxidized to carbon dioxide (CO_2) and water (H_2O). Fuchs and Temkin (1971) reported that, banana not sealed in PE bags (control) became ripe after 7 days of storage, while all fruits sealed in bags with / without $KmnO_4$ was still green after 14 days.

The titratable acidity in fruit pulp was found decreasing during storage period (Table 2). The initial acidity of fruit was (0.568%). At the end of 3, 6 and 9 days all treatments (except T7 and T8) were found at par. At the end of 15 days fruits packed in 250 gauge non-perforated HDPE bags recorded higher *i.e.* 0.32% titratable acidity. Jiang *et al.* (2004) reported that, decrease in titratable acidity during storage was significantly retarded by 1-MCP treatments.

The TSS of fruits pulp during storage showed increasing trend (Table 2). At initial days of storage (*i.e.* at the end of 3rd day), fruits packed in 250 gauge HDPE bags found better in recording significantly lowest TSS value. The treatment T1, T4, T3 and T6 at the same time

Table 1 : Effect of different packaging materials and ethylene absorbent on cumulative weight loss and per cent spoilage of banana

Treat. Details	Storage (days)								
	3	6	9	12	15	6	9	12	15
	Cumulative weight loss, %					Spoilage, %			
HDPE -T-1	0.018	0.098	0.16	0.385	0.524	0	0	0	2.15
HDPE -T-2	0.008	0.0123	0.048	0.188	0.465	0	0	0	1.054
PE - T-3	0.067	0.174	0.196	0.468	0.728	0	0	5.96	8.55
PE - T-4	0.058	0.124	0.156	0.455	0.625	0	0	4.2	7.26
PP - T-5	0.151	0.198	0.294	0.556	0.788	0	4.96	9.08	12.12
PP - T-6	0.11	0.184	0.242	0.496	0.745	0	4.2	7.67	11.088
C - T-7	6.98	11.9	14.28	18.7	-	*20.71*	41.28	62.18	100
AC - T-8	7.67	13.86	-	-	-	*37.03*	100	-	-
S.E. $\pm$	0.0328	0.0289	-	-	-	-	-	-	-
C.D. (P=0.05)	0.097	0.0858	-	-	-	-	-	-	-
CV, %	3.022	1.508	-	-	-	-	-	-	-

Table 2 : Effect of different packaging materials and ethylene absorbent on per cent acidity and total soluble solids of banana

Treat. Details	Storage (days)									
	3	6	9	12	15	3	6	9	12	15
	Acidity, %					Total soluble solids, ^{o} brix				
HDPE –T-1	0.544	0.512	0.48	0.394	0.277	4.66	4.73	4.96	5.46	5.63
HDPE –T-2	0.544	0.533	0.48	0.504	0.32	3.66	3.8	4	4.3	4.73
PE - T-3	0.522	0.49	0.458	0.33	0.256	5.33	5.46	6.1	6.76	7.1
PE - T-4	0.533	0.49	0.458	0.341	0.266	5	5.33	5.6	6.26	6.73
PP - T-5	0.512	0.458	0.437	0.33	0.202	6.4	6.76	7.1	7.36	8.2
PP - T-6	0.522	0.469	0.448	0.33	0.234	5.43	5.73	6.26	7.13	7.86
C - T-7	0.49	0.437	0.362	0.256	-	7.46	9.66	12.66	16.66	-
AC - T-8	0.48	0.287	-	-	-	11.33	14.1	-	-	-
S.E. $\pm$	0.014	0.012	-	-	-	0.326	0.073	-	-	-
C.D. (P=0.05)	0.042	0.035	-	-	-	0.97	0.218	-	-	-
CV, %	4.7	4.36	-	-	-	9.18	1.834	-	-	-

Initial value: 1) Acidity:0. 568%
2) TSS: 3.33

were found at par. At the end of 15 days of storage period, the fruits packed in 250 gauge non-perforated HDPE bags recorded significantly lowest value of TSS *i.e.* 4.73 which were followed by fruits packed in 175 gauge non–perforated HDPE bags *i.e.* 5.63 also followed by T4, T3, T6, T5. Ritenour *et al.* (1999), reported that kinnow fruits preconditioned with ethylene at either 0 or 20^{0}C and ripened at either 0 or 20^{0}C softened and accumulated soluble solids content faster than their corresponding control exposed to their same temperature regimes. In the similar study, the soluble solids content of the fruits increased with the storage time. The increased in TSS was probably due to the conversion of starch into soluble sugars such as sucrose, glucose and fructose reported by Bennassi *et al.* (2003) in custard apple treated with 1-MCP –an antagonist to the ethylene action.

The pulp/peel ratio was increased during storage period (Table 3). This may due to decreasing weight of peel during the same period due to respiratory breakdown and osmotic movement of water from peel to pulp. At initial days of storage all packaging treatments and open treatments were found at par with each other. At the end of 6, 9, 12 and 15 day, the fruits packed in 250 gauge and 175 gauge non perforated HDPE bags with ethylene absorbent were found significantly superior over rest of the treatments in maintaining low pulp/peel ratio. The shelf life of banana was extended to 15 days with non-perforated HDPE (250 gauge) with ethylene absorbent by maintaining minimum TSS, weight loss, spoilage and pulp/peel ratio and maximum acidity. Scott, 1974, extended appreciably the storage life of banana at 20^{0}C. The addition of an ethylene absorbent allowed a further marked increase in the storage life (Chiang 1970;Fuchs and Temkin, 1971; Liu, 1970 and Maxie *et al.*, 1971).

Table 3 : Effect of different packaging materials and ethylene absorbent on pulp: peel ratio of banana

Treat. details	Pulp : peel ratio / Storage (days)				
	3	6	9	12	15
HDPE –T-1	1.312	1.476	1.496	1.538	1.593
HDPE –T-2	1.295	1.356	1.402	1.468	1.512
PE - T-3	1.351	1.619	1.68	1.725	1.79
PE - T-4	1.345	1.589	1.635	1.689	1.72
PP - T-5	1.583	1.675	1.797	1.886	1.971
PP - T-6	1.436	1.655	1.782	1.828	1.911
C - T-7	1.738	1.983	2.292	2.45	-
AC - T-8	1.946	2.123	-	-	-
S.E. $\pm$	0.18	0.0207	-	-	-
C.D. (P=0.05)	0.535	0.0616	-	-	-
CV, %	20.79	2.13	-	-	-

Initial value: 1.21

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