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RESEARCH PAPER

Effect of different methods of ripening on mango cv. ALPHONSO

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Abstract : Effect of different methods of mango fruit ripening on Alphonso mango clearly shows that, the fruits ripened in controlled ripening chamber with grass cover recorded best results. Mango ripened in controlled ripening chamber induced early ripening with significantly lower physiological loss in weight and better fruit quality parameters *viz.*, pulp colour, taste, flavour, texture, TSS and total sugars as compared to other methods of ethylene ripening.

Key Words : Alphonso, Ripening, Ripening chamber, Ethrel, Shelf-life

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INTRODUCTION

Mango (*Mangifera indica* L.) is the largest fruit being produced in India and has become an integral part of history and culture of the country. India probably has more commercial planting than the rest of the world (Ochse, 1961). Now-a-days fruits are deliberately being contaminated by chemicals like calcium carbide causing serious health hazards. Artificial ripening is done to achieve faster and more uniform ripening characteristics. But ripening of fruits with certain chemicals like ethrel/ ethephon is permissible up to limited concentrations. The Govt. of India has allowed the use of ethephon/ ethrel for ripening of fruits as it is less harmful. The concentrations of ethylene required for the ripening of various commodities vary, but in most cases they are in the range 0.1-1 ppm (Siddiqui and Dhua, 2010).

In the present investigation, different methods of ethrel/ethphon application was studied to encourage farmers to use 2-chloroethyl phosphoric acid instead of calcium carbide ($CaCl_2$) which was unhealthy and toxic to human body.

MATERIAL AND METHODS

Total seven treatments were applied to assess the ripening behaviour and post-harvest quality of mango during storage. The experiment was laid out in Randomized Block Design (RBD) with three replications. The treatment unit was 60 fruits per replication. The treatments *viz.*, T_1 and T_2. Ripening of mangoes in controlled ripening chamber (temperature, is between 22°C±2, humidity 90±5, CO_2 1 %), ethylene (100 ppm±5) with or without cover of grass, T_3 and T_4 - portable ripening chamber (made up of air tight polythene paper). In this chamber ethylene, level was maintained by

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spraying ethylene (ethylene gas filled in pressurized can). In treatments (T_3 and T_4) fruits were ripened with and without grass cover.

In treatment T_5 and T_6 fruits were dipped in ethephon 39 per cent, (3ml/10 lit) @300 ppm solution and mangoes were kept in wooden boxes for further ripening with or without paddy grass. In treatment T_7, unripe mangoes were kept as layers over paddy husk in wooden boards (control). Data were recorded after 3, 7 and 10 days of storage. During the experimentation, average ambient maximum and minimum temperature was 33.8°C and 24.5°C with average relative humidity 78.8 per cent. Mature fruits of Alphonso were harvested according to maturity indices at specific gravity 1.00 to 1.02 and immediately brought to laboratory for further study.

Physical qualitative characters *viz.*, fruit skin colour (surface colour of ripened fruit was recorded visually at ripening stage matching with the Royal Horticultural Society, colour chart, 1969), flavour and aroma, organoleptic taste and marketability were recorded with panel of 10 judges who scored according to hedonic scale suggested by Amerine *et al*. (1965) and chemical analysis, physiological loss in weight (PLW), decay percentage, TSS, sugar content and acidity was recorded by using standard analytical methods. Statistical analysis was carried out as suggested by Gomez and Gomez (1996). Effect of different methods of ripening on fruit quality were assessed and statistically analyzed. Ripening time required by each treatment was recorded until fruit attained eatable ripening stage.

Treatment details :

T_1- Mango ripening (without straw) in controlled ripening chamber.

T_2- Mango ripening (with straw) in controlled ripening chamber.

T_3- Mango ripening (without straw) in air tight plastic tent.

T_4- Mango ripening (with straw) in air tight plastic tent.

T_5- Mango ripening (without straw) with ethephon 39 per cent.

T_6- Mango ripening (with straw) with ethephon 39 per cent.

T_7- Ripening of mangoes in wooden boxes (control).

RESULTS AND DISCUSSION

The results obtained are presented Tables in 1 to 6. Mango fruits exposed to 100±5 ppm ethylene gas

Table 1 : Time period (days) required by each treatment to reach eatable quality

Treatments	Ripening period (days)		
	Treatment period	Ambient period	Total (Fully yellow colour)
T_1	02	05	07
T_2	02	04	06
T_3	01	07	08
T_4	01	07	08
T_5	01	08	09
T_6	01	10	11
T_7	-	11	11

*Ambient ripening conditions (33.2^0± 0.5, 75-85 V.RH)

Table 2 : Weight loss of Alphonso mangoes after 3rd days

Treatments	Initial weight (kg)	At 3rd day weight (kg)	Total weight loss (kg)	PLW (%)	Rotting %
T_1	17.80	17.27	0.52	2.97	-
T_2	18.22	17.62	0.59	3.26	-
T_3	17.26	16.42	0.83	4.81	-
T_4	17.06	16.18	0.88	5.14	-
T_5	17.33	16.45	0.88	5.07	-
T_6	16.11	15.24	0.86	5.34	-
T_7	16.84	16.27	0.57	5.20	-
S.E. ±	0.22	0.28	0.68	0.21	-
C.D. (P=0.05)	0.68	0.87	0.21	0.66	-

Table 3 : Weight loss of Alphonso mangoes after 7day

Treatments	Initial weight (kg)	After 7 days (kg)	Total weight loss (kg)	PLW (%)	Rotting %
T_1	17.80	16.07	1.73	9.72	5.37
T_2	18.22	16.41	1.81	9.93	8.21
T_3	17.26	15.52	1.74	10.08	9.57
T_4	17.06	15.30	1.76	13.47	11.21
T_5	17.33	15.57	1.76	10.76	10.40
T_6	16.11	13.94	2.17	10.30	12.35
T_7	16.84	13.62	3.22	19.44	13.79
S.E. ±	0.22	0.35	0.04	0.13	2.91
C.D. (P=0.05)	0.68	1.08	0.12	0.41	NS

NS = Non-significant

Table 4 : Weight loss of Alphonso mango after 10 days

Treatments	Initial weight (kg)	After 7 days (kg)	Total weight loss (Kg)	PLW (%)	Rotting %
T_1	17.80	12.58	5.22	18.11	9.67
T_2	18.22	13.29	4.93	16.79	13.24
T_3	17.26	12.93	4.33	29.33	15.96
T_4	17.06	13.97	3.09	25.09	17.86
T_5	17.33	14.42	2.91	27.06	15.87
T_6	16.11	13.09	3.02	18.75	18.00
T_7	16.84	12.10	4.79	28.44	20.72
S.E. ±	0.22	0.42	0.56	0.50	4.09
C.D. (P=0.05)	0.68	NS	NS	1.53	NS

NS = Non-signjificant

Table 5 : Effect of different methods and packaging materials on organoleptic characteristics of fruit without storage

Treatments	Pulp colour	Taste	Flavour	Texture	Organoleptic score
T_1	8.0	8.0	8.0	8.0	8.0
T_2	8.0	8.0	9.0	8.0	8.2
T_3	7.0	8.0	7.0	7.0	7.2
T_4	7.0	8.0	7.0	7.0	7.2
T_5	7.0	8.0	7.0	7.0	7.2
T_6	7.0	8.0	7.0	7.0	7.2
T_7	8.0	8.0	8.0	70.	7.7

Organoleptic score :

9.	Like extremely	6.	Like slightly3	3.	Dislike moderately
8.	Likevery much	5.	Neither like nor dislike	2.	Dislike very much
7.	Like moderately	4.	Dislike slightly	1.	Dislike extremely

Table 6 : Effect of different ripening methods and packaging materials on biochemical characteristics of fruit without storage

Treatments	Shelf-life (Days)	TSS (^{0}B)	Total sugar (%)	Reducing sugar (%)	Acidity (%)
T_1	13.00	19.05	16.31	6.79	0.29
T_2	10.66	19.03	16.28	6.66	0.30
T_3	9.66	17.30	15.87	5.84	0.32
T_4	8.66	17.88	15.94	5.87	0.30
T_5	14.33	18.78	15.89	6.73	0.33
T_6	12.66	19.03	16.02	6.02	0.33
T_7	15.33	19.08	16.38	5.95	0.24
S.E. ±	2.47	0.46	0.63	0.11	0.045
C.D. (P=0.05)	NS	NS	NS	NS	NS

NS = Non-significant

for 24 hours with straw in controlled ripening chamber (T_2) showed early ripening *i.e.* in 6 days (including 48 hours treatment period in ripening chamber) as compared to control. Ripening of mangoes in wooden boxes (T_7) took ten days for ripening of mango fruits and also found that these fruits ripen unevenly. Paull and Chaen (2004) reported that the holding the mango fruits in the temperature range of 20 to 23°C (68.0 to 73.4°F) provide the best appearance, palatability and decay control during ripening. Barmore (1974) reported that exposure of Florida mango cultivars harvested at the mature green stage and exposed to 20-100 ppm ethylene for 24 hours results in faster and more uniform ripening at 21°C (69.8 F) and 92.95 per cent relative humidity. Kader and Mitcham (2008) showed that the rate of ripening can be accelerated by treating the fruits with ethylene at 100 ppm in a low carbon dioxide environment (below 1 %) for 12 to 24 hour period. Slaughter (2009) showed that the fruits were ripened in 5 to 9 days, depending upon cultivar, if held at 18 to 22°C (65 to 72°F).

Mango ripened in T_2 (controlled ripening chamber with straw) showed faster ripening rate followed by T_1 (ripening chamber without straw) while T_7 (non-treated fruits in wooden boxes) were slow in ripening. Early ripening of mangoes under ripening chamber was due to the uniform application of ethylene and more accumulation of exogenous ethylene around mango fruits it triggers the endogenous ethylene production it accelerate ripening rate. Yong (1987), showed that once climacteric fruit produces ethylene in sufficient amount to affect adjacent tissues, autocatalytic ethylene production starts and copious amount of ethylene is produced and triggering ripening process.

T_6 and T_7 took maximum time for mango ripening followed by T_5 (ethephon 39 % treated fruits without straw). Excluding treatment T_1 and T_2, full airtight situation was not created hence such stimulant (ethylene) was reduced which might delay the ripening process.

Biochemical analysis of fruits subjected to different ripening methods is given in Table 6. A total soluble solid (TSS) was maximum (19.05°B) in T_1 (ripening chamber mangoes without straw). The lower TSS (17.30°B) was recorded in T_3 (portable ripening chamber without straw). Higher amount of TSS in fruit ripened in ripening chamber might be due to accelerated rate and metabolism in fruits, as minimum days were required by the same treatment to reach optimum eatable ripening stage.

High acidity found in ethephon 39 per cent and controlled fruits (T_6 and T_7). Maximum total sugars (16.31) was found in T_1 (mangoes ripened in automatic control ripening chamber) while T_3 (portable ripening chamber) fruits showed lowest sugar levels (15.87%). Reducing sugar behaved in same fashion as it was observed in total sugars. The reason might be that the fruits were ripened in controlled situation where more accumulate ethylene along with rise in fruits internal temperature and ultimately accelerated the ripening metabolism results in more total and reducing sugar content in fruits.

Statistically significant differences were found for physiological loss in weight (PLW). T_3 (Mango ripening without straw) showed higher PLW (29.33%) followed by T_7 (wood packed non treated fruits) ten days after treatment. Overall fruits ripened in controlled ripening chamber (T_1 and T_2) showed lower PLW as compared to control. It is due to perfect climatic conditions were deployed during ripening process. Whereas in other treatments ideal conditions were not created and it hindered the ethylene accumulation around fruit and thus, inhibited acceleration of metabolism, which resulted in lesser production of total sugar.

Maximum organoleptic score was obtained by T_2 followed by T_1. Pulp colour rating was given to treatment T_2 followed by T_1. Highest pulp colour development in treatment T_1, T_2 and T_7. It is might be due to higher carotenoid content in the fruits.

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