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Study the effect of ripening agent(s) on colour changes in the fruit of Dashehari mangoes during ripening at ambient condition

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Abstract

The effect of ripening agent(s) on colour changes of Dashehari mango (*Mangifera indica*) fruits during ripening was examined. Physiological mature fruits were given different treatment of ripening agent(s) @ (T₀) without treatment (T₁) ethephon (T₂) dried plash leaves (T₃) Wet Kachnar leaves, (T₄) Wet Amaltas leaves, (T₅) wheat straw, (T₆) Rice straw, (T₇) Newspaper, (T₈) White paper, (T₉) Tissue Paper, (T₁₀) Brown paper bag, (T₁₁) Wheat grain, (T₁₂) Jute bag, (T₁₃) Cadamom for six days. Treated fruit were packed in CFB boxes placed at ambient conditions for ripening. Fruit peel colour was determined daily till six days till fruits were ripened after ripening treatment using hunter lab scale. Results revealed that all ripening agent(s) treatments enhanced colour development as compared to control. The luminosity of peel increased with increase in ripening period. The greenness of peel as reflected by 'a' value decreased with ripening treatments and period. However the fruit peel developed yellowish colour with treatment of ripening agent(s) as evidenced increase in value of 'b'. The effect of ripening agent(s) on colour changes b, hue, chroma was highest in T₇ (newspaper) while L and a was highest in T₁ (ethephon) significantly during ripening period.

Keywords: Mango, ripening agent(s), ambient conditions, Hunter Lab, colour development

Introduction

Mango (*Mangifera indica* L.) known as "The King of Fruits" is widely accepted by consumers throughout the world for its succulence, sweet taste and exotic flavor. In northern region of India, Dashehari is leading cultivar due to high yield potential and good quality. The fruits of mango harvested at physiological maturity at that time they have attained hard green stage. In developing countries like India they are subjected to artificial ripening by calcium carbide and ethephon it develops attractive surface colours, but makes the fruit inferior in taste, flavor and it spoil faster (Rahman *et al.* 2008). Ripening of fruits with calcium carbide is banned under Prevention of Food Adulteration (PFA) act. However, on tree under natural conditions, ripening of mango fruit is slow and heterogeneous. Ripening agent(s) has been used to hasten ripening process and improves the peel colour. After subjected to ripening agent(s) treatments, the breakdown of green colour of mango fruits occurs with ripening. The ripening level is critical for the development of ideal flavor quality of mango fruit. The Dashehari cultivar visual colour is important factor to determine consumer acceptability. Richard Hunter used Hunter L,a,b system for measuring ripeness of food commodities including mango (Slaughter, 2009) [6]. The present investigation was conducted to examine the efficacy of different ripening agent(s) as post harvest treatment on colour development of Dashehari mangoes during ripening under ambient conditions.

Materials and Methods

The study was carried out during June 2016 at Department of Horticulture, Rajasthan College of Agriculture, MPUAT, Udaipur. Uniform sized and physiologically mature fruits of mango cv. Dashehari were procured from Fruit Research Station (FRS), Banswara. The fruits were treated with different ripening agents such as (T₀) without treatment (T₁) ethephon 1000ppm (100 ml in 1 litre water) was sprayed with pump pressure sprayer, (T₂) dried plash leaves harvested in morning and dried under shade for five days (800 gm), (T₃) Wet Kachnar leaves collected in morning (1.50 kg), (T₄) Wet Amaltas leaves were collected in morning (1.50 kg), (T₅) wheat straw (2.5 kg), (T₆) Rice straw (700gm), (T₇) Newspaper (250 gm), (T₈) White paper (160 gm), (T₉) Tissue Paper (110 gm), (T₁₀) Brown paper bag (210 gm), (T₁₁) Wheat grain (4kg), (T₁₂) Jute bag (3.25 kg), (T₁₃) Cadamom (4 in number) and Control

(without treatment) for 3kg mangoes having size approx 150 gm per replicae per treatment were layered alternately in a CFB Box. However, four replication 12 kg mangoes having size approx 150 gm were used per treatment. Therefore treated 168 kg mangoes fruits were packed in fifty six corrugated fibre boards. All boxes were tagged as per treatment and stored under ambient condition. Observations were recorded daily till fruit ripen upto 6 days by the following methods. The peel colour was measured by using Hunter Lab scale (model ColorFlex, Reston, USA), with reflectance mode (Hunter, 1975) [2]. Before taking down observation the instrument was calibrated with a standard white ceramic tile and black tile and set up for D65 as illuminated and a 10° observer angle. The colour was determined using L,a,b colour system, where L indicate luminosity or lightness (L=0 for black and L=100 for white), positive a indicate measure of red; negative a indicate green while, b represent blue (-) to yellow (+) space. The different color indexes were calculated according to the following equations: hue: $\tan^{-1} (b^*/a^*)^2$; chroma: $(a^{*2} + b^{*2})^{0.5}$. The data were statistically analyzed to a completely randomized design.

Results and Discussion

Changes in 'L' values of peel

Changes in the peel pigments during the maturing process determine the colour of the fruit (Bejo and Kamaruddin, 2014) [1]. Different post harvest ripening agent(s) treatments significantly affected the luminosity (L) of mango peel (Table 1). The L value increased with ripening of fruit induced by ripening agent(s) as well as ripening period. The mean maximum value observed 58.22 T₁ (Ethephon @1000 ppm) followed by 57.20 T₇ (News paper) treatment. The mean minimum peel brightness observed in 35.39 T₀ (Control). However, it treatment T₁ (Ethephon @1000 ppm) during ripening showed increasing value in L value upto 5 days of ripening but on 6th day showed decreasing value. The increase in lightness of the skin with ripening agent(s) treatments and advancement of ripening time may be attributed to loss of dark green colour of the fruits. Exposure to endo-ethylene increased colour, producing high quality fruit in a shorter time (Kato, 1990) [3].

Changes in 'b*' values of peel

The yellowness of peel indicated by 'b*' value for peel colour was significantly affected by various ripening agent(s) treatments. The presence of yellowness on the peel increased with ripening treatments as indicated by higher 'b' values (Table 2). The mean maximum development of yellowish colour was recorded with 38.25 T₇ (Newspaper) treatment. The control fruit recorded minimum development of yellow colour 22.30. Significant increase in 'b' values was observed with ripening period due to increase in ethylene production that trigger the rate of respiration rate. In bananas ethylene stimulates chlorophyll loss and the appearance of yellow

colour (Saltveit, 1999) [5].

Changes in 'a*' values of peel

The decrease in 'a*' value with ripening agent(s) treatments represents the gradual loss of greenness of peel. The intensity of peel green colour was significantly decreased with ripening agent(s) treatments. Control fruits retained maximum value (-8.20) of 'a' while maximum loss in green colour (-4.73) was noted in T₁ (Ethephon @ 1000 ppm at the 6th day of ripening period (table 3).

Changes in 'Hue' values of peel

Hue is the common distinction between colors positioned around a color wheel. The results indicate that the Hue value of ripened mangoes was increased with the advancement of ripening period (Table 4). The mean maximum Hue (33.46) was recorded in the treatment T₇ (news paper) and mean minimum Hue (-61.41) was recorded T₁₂ (Jute bag)

Changes in 'Chroma' values of peel

Chroma change during ripening is a good indicator of mangoes because it essentially is an expression of the purity or saturation of a single color (different colors may have the same chroma values). In the case of mango ripening, different colors are present simultaneously since chlorophyll is degraded from green to yellow (carotenoids) compounds. Additionally, as chroma is calculated by squaring a* and b* values it makes positive the negative a* values (green color) masking its influence. Lastly, the lower values tend to be those where a* readings are close to 0 (turning stage). Because chroma reflects color purity or saturation, it could be a good indicator of consumer acceptance when mangoes are completely ripe. Changes in chroma and hue angle: The changes in chroma and hue angle were calculated using equation 2 & 3 and plotted against ripening period (Fig. 4). Ripening had significant (P<0.01) effect on both the chroma and hue angle value. The chroma increased gradually with advancement of ripening and in the later stage of ripening it decreased. But hue angle was in negative side till the maximum colour change. When the mango attained maximum colour change during 6th day, the hue angle steeply increased to a maximum value and after that, no much change was observed in hue values. It can be inferred that, when the ripening expedites, the hue value increases drastically. T₇ (Newspaper) retained maximum value 40.54 of Chroma while minimum mean value T₁₂ (Jute bag) 25.98 at the 6th day of ripening period (table 5)

In conclusion, thus, to fetch early price in market T₁ (ethphon@ 1000ppm) recorded highest 'L' and 'a' but shelf life of Dashehari mango was short. However, T₇ (news paper) as organic ripening agent(s) influence the colour changes b, hue, chroma of Dashehari mango during ripening period of 6th day was found best from health point of view and also increase the shelf life of mango during storage as compared other ripening agent(s).

Table 1: Effect of ripening agent(s) on 'L' content of mango cv. Dashehari during ripening time

Treatment	Ripening time (days)						Mean
	1	2	3	4	5	6	
T ₀ (Control)	29.24	30.84	33.81	34.00	39.00	45.50	35.39
T ₁ (Ethephon @ 1000ppm)	42.78	44.63	57.96	64.00	75.50	64.50	58.22
T ₂ (Dried plash leaves)	36.20	39.19	41.76	52.50	70.50	74.00	52.35
T ₃ (Wet kachnar leaves)	32.40	38.39	40.51	49.50	73.00	73.50	51.21
T ₄ (Wet Amaltas leaves)	35.54	38.09	40.01	50.00	71.50	72.00	51.19

T ₅ (Wheat straw)	32.14	32.30	36.76	43.00	64.00	66.00	45.70
T ₆ (Rice straw)	30.64	31.47	34.00	44.11	66.50	69.00	45.95
T ₇ (News paper)	32.45	42.77	54.50	63.00	74.00	76.50	57.20
T ₈ (White paper)	31.98	39.42	48.04	52.94	73.00	74.00	53.23
T ₉ (Tissue paper)	30.40	35.10	40.94	52.00	69.00	72.00	49.90
T ₁₀ (Brown paper bag)	30.12	39.38	45.48	57.00	70.50	74.00	52.74
T ₁₁ (Wheat grain)	29.89	32.20	38.20	45.00	68.00	72.50	47.63
T ₁₂ (Jute bag)	29.14	30.12	31.60	38.00	44.00	47.50	36.72
T ₁₃ (Cardamom)	31.54	38.81	45.34	52.87	71.00	72.00	51.92
SEm±	0.21	0.26	0.29	0.34	0.95	0.88	
CD at 5 %	0.82	1.02	1.13	1.33	3.62	3.36	

Table 2: Effect of ripening agent(s) on 'b' content of mango cv. Dashehari during ripening time

Treatment	Ripening time (days)						Mean
	'b'						
	1	2	3	4	5	6	
T ₀ (Control)	8.66	17.26	18.77	25.9	29.09	34.15	22.30
T ₁ (Ethepon @ 1000 ppm)	11.98	34.95	36.14	39.45	40.14	42.45	34.18
T ₂ (Dried plash leaves)	9.81	16.25	28.91	36.8	45.95	58.78	32.75
T ₃ (Wet kachnar leaves)	8.90	12.62	25.73	33.24	42.39	54.67	29.59
T ₄ (Wet Amaltas leaves)	7.40	12.00	24.16	33.14	41.94	53.18	28.63
T ₅ (Wheat straw)	10.85	14.54	20.2	31.5	38.75	40.45	26.04
T ₆ (Rice straw)	9.67	18.84	20.78	31.45	39.12	40.96	26.80
T ₇ (News paper)	16.66	21.00	30.37	45.16	57.6	58.76	38.25
T ₈ (White paper)	15.53	19.92	24.09	28.67	32.89	39.83	26.82
T ₉ (Tissue paper)	7.12	14.1	18.00	21.5	48.6	52.06	26.89
T ₁₀ (Brown paper bag)	15.26	17.46	18.18	45.97	50.88	52.73	33.41
T ₁₁ (Wheat grain)	8.19	15.84	19.2	25.14	32.00	36.14	22.75
T ₁₂ (Jute bag)	7.39	12.58	23.4	25.61	31.12	33.76	22.31
T ₁₃ (Cardamom)	9.23	15.75	20.89	40.97	45.91	54.87	31.27
SEm±	0.22	0.44	0.60	0.77	0.87	0.78	
CD at 5 %	0.64	1.28	1.73	2.22	2.52	2.27	

Table 3: Effect of ripening agent(s) on 'a' content of mango cv. Dashehari during ripening time

Treatment	Ripening time (days)						Mean
	'a'						
	1	2	3	4	5	6	
T ₀ (Control)	-9.48	-9.07	-8.74	-8.16	-7.44	-6.31	-8.20
T ₁ (Ethepon @ 1000 ppm)	-7.47	-6.71	-5.52	-3.75	-2.97	-2.00	-4.73
T ₂ (Dried plash leaves)	-8.02	-7.17	-6.36	-5.41	-3.15	-2.50	-5.43
T ₃ (Wet kachnar leaves)	-8.60	-7.11	-6.72	-4.05	-3.94	-2.75	-5.52
T ₄ (Wet Amaltas leaves)	-8.00	-7.00	-6.42	-4.04	-3.77	-2.43	-5.27
T ₅ (Wheat straw)	-9.03	-8.77	-8.35	-7.37	-6.70	-5.15	-7.56
T ₆ (Rice straw)	-9.30	-9.10	-8.64	-7.14	-6.55	-5.51	-7.70
T ₇ (News paper)	-8.19	-7.40	-6.12	-5.17	-3.02	-2.17	-5.34
T ₈ (White paper)	-8.88	-8.27	-7.47	-6.37	-5.85	-3.17	-6.66
T ₉ (Tissue paper)	-6.60	-1.45	-9.45	-6.11	-3.40	-9.15	-6.02
T ₁₀ (Brown paper bag)	-8.60	-7.76	-6.15	-5.91	-4.54	-3.19	-6.02
T ₁₁ (Wheat grain)	-9.65	-8.50	-8.15	-7.14	-5.60	-3.14	-7.03
T ₁₂ (Jute bag)	-9.67	-9.03	-8.79	-8.3	-7.43	-6.15	-8.22
T ₁₃ (Cardamom)	-8.93	-7.98	-6.50	-5.43	-4.16	-2.19	-5.86
SEm±	0.22	0.12	0.06	0.06	0.06	0.05	
CD at 5 %	0.85	0.47	0.23	0.26	0.25	0.22	

Table 4: Effect of ripening agent(s) on 'Hue' content of mango cv. Dashehari during ripening time

Treatment	Ripening time (days)						Mean
	'Hue'						
	1	2	3	4	5	6	
T ₀ (Control)	-25.09	-45.29	-87.7	81.70	68.03	70.42	10.34
T ₁ (Ethepon @ 1000ppm)	-58.03	-82.29	79.74	69.47	62.95	59.48	21.88
T ₂ (Dried plash leaves)	-28.55	-60.53	-73.84	87.77	75.15	75.19	12.53
T ₃ (Wet kachnar leaves)	-25.56	-43.89	-75.33	89.87	78.05	74.87	16.33
T ₄ (Wet Amaltas leaves)	-22.33	-40.58	-73.81	89.89	78.15	74.78	17.68
T ₅ (Wheat straw)	-29.67	-48.68	-67.51	-80.29	85.97	75.88	-10.71
T ₆ (Rice straw)	-26.60	-59.47	-69.78	-87.88	79.04	74.27	-15.07
T ₇ (News paper)	-43.59	-73.02	85.97	83.43	77.23	70.76	33.46
T ₈ (White paper)	-43.28	-67.42	-72.74	-87.22	85.01	72.58	-18.84
T ₉ (Tissue paper)	-23.20	-50.90	-62.27	-74.10	85.96	69.77	-09.12

T ₁₀ (Brown paper bag)	-40.91	-60.77	-83.22	-87.58	80.43	70.93	-20.18
T ₁₁ (Wheat grain)	-22.61	-43.81	-52.91	-65.88	-73.27	-85.00	-57.25
T ₁₂ (Jute bag)	-20.58	-48.73	-67.96	-71.81	-78.11	-81.29	-61.41
T ₁₃ (Cardamom)	-30.07	-57.61	-80.45	81.04	78.68	70.69	10.37
SEm±	0.79	0.26	0.05	0.08	0.01	0.02	
CD at 5 %	3.03	1.02	0.21	0.31	0.06	0.10	

Table 5: Effect of ripening agent(s) on 'Chroma' content of mango cv. Dashehari during ripening time

Treatment	Ripening time (days)						Mean
	'Chroma'						
	1	2	3	4	5	6	
T ₀ (Control)	20.40	24.27	18.78	26.17	41.06	48.75	29.91
T ₁ (Ethephon @ 1000ppm)	14.11	35.26	36.72	42.11	45.05	49.26	37.09
T ₂ (Dried plash leaves)	20.51	18.65	30.09	36.82	47.52	60.78	35.73
T ₃ (Wet kachnar leaves)	20.61	18.19	26.59	33.24	43.32	56.62	33.09
T ₄ (Wet Amaltas leaves)	19.46	18.43	25.15	33.14	42.84	55.10	32.35
T ₅ (Wheat straw)	21.90	19.35	21.85	31.95	38.84	41.70	29.26
T ₆ (Rice straw)	21.58	21.86	22.13	31.47	39.84	42.54	29.90
T ₇ (News paper)	24.15	21.95	30.44	45.45	59.05	62.22	40.54
T ₈ (White paper)	22.64	21.56	25.22	28.70	33.01	41.73	28.81
T ₉ (Tissue paper)	18.06	18.16	20.32	22.35	48.71	55.47	30.51
T ₁₀ (Brown paper bag)	23.29	20.00	18.30	46.00	51.59	55.77	35.83
T ₁₁ (Wheat grain)	21.28	22.87	24.06	27.53	33.40	36.27	27.57
T ₁₂ (Jute bag)	21.01	16.73	25.23	26.95	31.79	34.15	25.98
T ₁₃ (Cardamom)	18.41	18.64	21.18	41.47	46.81	58.12	34.10
SEm±	0.17	0.14	0.17	0.24	0.56	0.56	
CD at 5 %	0.68	0.56	0.68	0.93	2.16	2.16	

References

1. Bejo SK, Kamaruddin S. Detemination of Chokanan mango sweetness (*Mangifera indica*) using non-destructive image processing technique. Australian J. Crop Sci. 2014; 8:475-480.
2. Hunter S. The Measurement of Appearance. John Wilsey and Sons. New York. 1975; 304-305.
3. Kato K. Astringency removal and ripening in persimmons treated with ethanol and ethylene. HortScience 1990; 25:207
4. Rahman A, Chowdhury FR, Alam MB. Artificial ripening: what we are eating, Journal of Medicine. 2008; 9:42-44.
5. Saltveit ME. Effect of ethylene on quality of fresh fruits and vegetables. Postharvest Biology and Technology. 1999; 15:279-292.
6. Slaughter DC. Nondestructive maturity assessment methods of mango: A review of literature and identification of future research needs. National Mango Board, Orlando, Fl, USA. 2009.