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Effect of Polyethylene Packaging and Coating Having Fungicide, Ethylene Absorbent and Antiripening Agent on the Overall Physico-Chemical Composition of Chaunsa White Variety of Mango at Ambient Temperature During Storage

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Abstract: Effect of polyethylene packaging and coating having fungicide, ethylene absorbent and antiripening agent on the physico-chemical composition such as weight loss, Total Soluble Solids (TSS), pH, Titratable Acidity (TA) and Ascorbic Acid (AA) of Chaunsa white commercial variety of mango was investigated at ambient temperature (28-33°C and 56.7-69.7% relative humidity) during storage. It was examined that uncoated fruit packed in polyethylene or coating emulsions having fungicide, ethylene absorbent and antiripening agent had significant effect ($p<0.05$) on overall physico-chemical constituents of Chaunsa at ambient temperature during storage. It was investigated that treated fruit packed in polyethylene had minimum weight loss ranged from 1.92-3.98 %, lower TSS (15.17-18.43%), lower pH (3.88-4.4), higher retention of TA (0.81-0.97%) and lower AA (19.81-30.91 mg/100 g) with an average mean of 3.20, 15.84, 3.99, 0.87 and 24.48 respectively at ambient temperature during storage. On the other hand the control (T_1) had highest weight loss (9.39%), TSS (20.83%), pH (4.91), lowest TA (0.44%) and highest AA (42.06 mg/100 g) respectively during storage. The coated fruit packed in polyethylene had minimum weight loss, slower increase of TSS, pH, higher retention of acidity and slower increase in AA respectively of fruit during the storage period. Whereas, fruit packed only in polyethylene had lowest weight loss, higher TSS, pH, highest retention of acidity and higher AA respectively. It is obvious from these studies that coated fruit having other protective chemicals when packaged in polyethylene had played a very effective role to control compositional changes by delaying the ripening process and with a minimum quality loss during 30 days of storage at ambient temperature, as compared to the control sample that had greater compositional changes with maximum quality loss during storage at ambient temperature. The control fruit were unacceptable after 12 days of their storage due to its unattractive skin, brown pulp color and poor taste as compared to treated fruit having good keeping quality even after one month of their storage.

Key words: Fruit, Chaunsa mango, packaging, ascorbic acid, acidity, TSS, polyethylene, physico-chemical composition

INTRODUCTION

The ripening process of mango fruit involves a series of biochemical reactions or metabolic activities that cause chemical changes, increased respiration, ethylene production, changed structural polysaccharides causing softening, degradation of chlorophyll develop pigments by carotenoid biosynthesis, changes in carbohydrates or starch conversion into sugars, organic acids, lipids, phenolics, volatile compounds, etc thus leading to ripening of fruit with softening of texture to acceptable quality (Herianus *et al*., 2003). Different studies have been carried out in different countries on ripening of mango and its control by using different techniques. The ripening process of fruit depends on many factors such as climatic conditions like temperature, variety of mango fruit, post harvest treatments and packaging etc during storage. Normally it takes 4-8 days from the time of harvest for fruit to be eaten ripe and at ambient temperature the shelf life of mango is 7-14 days from harvest to fully ripe, however, fruit can take three times longer to ripen at 13°C than at 22°C. Providing a controlled atmosphere (O_2 level 5%, CO_2 less than 8%) can further reduce the ripening process of mango and otherwise cause abnormal ripening. At 20-22°C, both skin color and flavour are acceptable however, internal quality and flavour is best when ripened at 27°C and above 25°C skin color development is reduced. Storage life is lengthened by high CO_2 and lower O_2, dipping in 4% $CaCl_2$ and removal of ethylene by potassium permanganate. Anthracnose is controlled by hot water at 52°C for 5 min with fungicide or chlorine. Hot water treatment reduces the post harvest diseases and kills fruit fly larvae, but also cause browning of surface and early softening of fruit (Panhar and Panhar, 2008). Mango is packaged from very simple baskets of bamboo, pigeon pea (cajanus) or mulberry with paddy straw as cushioning material because of their easy availability and low cost. This type of packaging was found to be unsatisfactory because of uneven ripening of fruit, excessive shrinkage, bruising and stacking was

also a problem with the use of baskets. However, ventilated Low-density Polyethylene (LDPE) linings have also being found to be beneficial, as this material maintains humidity, which results in less shrinkage during storage (Tharanathan *et al*., 2006). Different concentrations of $CaCl_2$ solutions, wax emulsion and wrapping in polyethylene perforated or non perforated sealed bags containing $KMnO_4$ as an ethylene absorbent when packed in perforated cartons and transported for 36 h showed that wax emulsion at 6 or 7% had the greatest effect in retarding ripening (by 11 days) and resulted in the lowest weight loss as compared to control over-ripe stage (by 9 days). However, the wax emulsion treatment also resulted in the lowest soluble solids content 14.8% after transportation following 6% wax treatment, compared with 18.8% in controls (Yuniarti and Suhardi, 1992). Polyethylene wrapping of $CaCl_2$ treated apple proved very useful for reducing weight loss and shriveling and retained consumer acceptability even after 60 days of storage (Hayat *et al*., 2005). It was observed in other study that decay incidence in perforated packages did not exceed 10-12% as compared to 20% decay in control. The combination of Modified Atmospheric Packaging (MAP) with effective decay controlling measures can extend the post harvest life of mango fruit (Rodov *et al*., 1997). In Israel MAP technique of polyethylene perforated and non perforated sealed packaged coupled with low temperature at 14°C for 3 weeks and then at 20°C for 4 days when applied to Tommy Atkins during storage showed no decay until opening in non perforated pack and then rotted rapidly. Data obtained on shelf life, weight loss, spoilage and retention of Vitamin C indicated that cool chamber was an ideal storage technique (Pal, 1998). The removal of ethylene with ethysord adsorbent, from CFB carton packaged alphonso mango had extended life up to 16 days as compared to its 8 days normal life and controlled black spots completely by washing with 0.01% $KMnO_4$ (Raje *et al*., 1997). Storage life of fruit is affected by storage temperature because higher temperature increases respiration rate, leading to fruit softening and at low-temperature storage metabolism is retarded by a reduction in respiration rate, ethylene production, color changes and softening (Perez *et al*., 2004). The previous studies revealed that different techniques have been applied for improvement or maintenance of the quality of fruit during storage. However, the effect of polyethylene packaging with the combination of other techniques on the storage life or physico-chemical composition of Chaunsa white variety of mango is not available in the literature. Therefore, the present study was designed for the determination of the effect of polyethylene packaging and coating having fungicide, ethylene absorbent and antiripening agent on the quality parameters such as weight loss, TSS, pH, TA, AA of Chaunca white during storage.

MATERIALS AND METHODS

Collection of sample: For present research studies Chaunsa white, very important commercial variety of mango, was selected and for this purpose unripe, matured, hard green and uniform size of freshly arrived fruit was purchased from wholesale fruit market in Islamabad.

Hot water treatment: Chaunsa white variety of mango was immediately transferred from wholesale market to post harvest laboratory of Department of Food Technology in University of Arid Agriculture Rawalpindi and after careful sorting, fruit in cotton bags were subjected to hot water treatment at 53°C for three minutes and immediately cooled by dipping in cold water at 20°C and were dried in air.

Preparation of coating materials: Potassium per magnate saturated solution, potassium per magnate super saturated solution ($KMnO_4$), calcium chloride 1 %, boric acid 1 % solution, sodium hypochlorite NaOCl 800 ppm, 0.85 % saline water, Carboxy Methyl Cellulose (CMC) 4% solution, trichlorophenoxy acetic acid 1% solutions, coating emulsion of Bee wax, oil, saline water, lecithin as emulsifier, CMC as stabilizer and sodium hypochlorite as fungicide were prepared.

Grading, coating, packaging and storage: Chaunsa white late commercial variety of mango fruit was graded according to their size and total 180 selected fruit were divided into 6 groups having 30 mangoes in each group respectively. These groups were under gone into following 6 treatments viz; Control (T_1), Polyethylene (T_2), Wax-CMC having Sodium Hypochlorite coated fruit packed in polyethylene (T_3), Wax-CMC Coated fruit with $KMnO_4$ packaged in Polyethylene (T_4), Wax-CMC Coating having 2, 4, 5-T in Polyethylene (T_5), H_3BO_3 and 2,4,5-T having oil treated fruit packed in Polyethylene (T_6) and then were stored at ambient temperature (28-33°C and 56.7-69.7% relative humidity) for a storage period of 30 days.

Physico-chemical and sensory evaluations: Physico-Chemical parameters such as weight loss, total soluble solids, pH by using HANAS pH meter no. 210 and titratable acidity were evaluated by standard procedures as mentioned in AOAC (1990). Ascorbic acid was determined by standard method as described by Awan and Rehman (1999). The data obtained were statistically analyzed for Analysis of Variance (ANOVA) by using 2-Factorial Complete Randomized Design (CRD) and Duncan's Multiple Range Test (DMRT) was applied to compare the mean values obtained according to the method described by Steel and Torrie (1980).

Table 1: Effect of polyethylene packaging and coating having fungicide, ethylene absorbent and antiripening agent on the overall physico-chemical composition of Chaunsa white variety of mango at ambient temperature during storage

	Treatments						
Parameters	Control T_1	Polyethylene T_2	Coat+ NaOCl +Poly T_3	Coat+ $KmnO_4$ +Poly T_4	Coat+ 2,4,5-T +Poly T_5	Coat+2,4,5-T having oil+ H_3BO_3-$CaCl_2$ +Poly T_6	Overall effect of poly-coat
Wt. loss	9.39^{b}	1.92^{m}	2.58^{l}	3.10^{k}	3.98^{g}	3.13^{k}	3.20
TSS	20.83^{a}	18.43^{c}	16.45^{f}	15.83^{g}	15.89^{g}	15.17^{h}	15.84
pH	4.91^{a}	4.44^{d}	3.87^{h}	3.98g	4.06^{f}	4.06^{f}	3.99
TA	0.44^{l}	0.97^{a}	0.95^{ab}	0.87^{cde}	0.84^{efg}	0.81^{gh}	0.87
AA	44.06^{a}	30.91^{d}	26.04^{h}	31.40^{c}	19.81^{p}	20.69^{o}	24.48

Mean values with similar letters in same row are not significantly different; otherwise they are significantly different to each other at ($p<0.05$)

RESULTS AND DISCUSSION

Weight loss: It is evident from Table 1 that statistically treatments and their interactions had significant difference on percent weight loss except T_4 (3.10%) and T_6 (3.13%) showed insignificant effect, however, these treatments were significantly different from others in percent weight loss during 25 days of their storage. It was observed that coated mango fruit packed in polyethylene had lower percent weight loss from 1.92-3.98% with an average mean of 3.20% and Chaunsa white mango sealed in polyethylene bags alone minimized the weight loss very effectively in T_2 (1.92) followed by its combination as poly-coating with chlorox T_3 (2.58 %), poly-coating with ethylene absorbent T_4 (3.10 %), coated with firming and fungicide combination packed in polyethylene T_6 (3.13%) and poly-coating having antiripening agent in T_5 (3.98 %) as compared to control T_1 (9.39 %) with maximum weight loss at ambient temperature during 25 days of storage. The effectiveness of polyethylene packaging with the combination of coating, ethylene absorbent used, fungicide or antiripening agent to minimize the loss was varied, may be due to the difference in created modified atmosphere in Modified Atmosphere Packaging (MAP), that might be increased the relative humidity, CO_2 levels and decreased O_2 levels which reduce respiration rates. The saturated atmosphere created by higher percent relative humidity more than 90% slowed down the transpiration as result prevented water loss and maintain mango quality. The decay was effectively controlled by fungicide and it was also observed that ethylene absorbent or antiripening agents worked more effectively in saturated Relative Humidity (RH) conditions of polyethylene packing. These results are generally in agreement with those reported by Ladaniya and Sonkar (1997). It is evident from our studies that combination of wax coating with $KMnO_4$ had reduced the weight loss, might be due to creation of modified atmosphere by removing ethylene with ethylene absorbent and decreased rate of respiration by degrading ethylene produced by the fruits into carbon dioxide and water. These results are agreed with the findings of Yuniarti and Suhardi (1992). They used calcium chloride, wax emulsion, wrapped mangoes in perforated polyethylene bags containing $KMnO_4$ and reported that lower weight loss was observed in case of treated mangoes as compared to control. The other scientists also reported an increasing trend of weight loss in treated fruit (Carrillo *et al*., 2000; Chitarra *et al*., 2001 and Hayat *et al*., 2005). Therefore, it is understandable that Chaunsa white without coating either packaged in polyethylene or coating having ethylene absorbent or antiripening agent and antiripening agent with oil and disinfectant treated fruit might be more effective to delay ripening with minimum percent weight loss during storage.

Total Soluble Solids (TSS): Treatments and their interactions had highly significant effect on percent total soluble solid contents of mango except (T_4) 15.83% and T_5 (15.89%) with insignificant effect, however significant differences in total soluble solids of these treatments to others were found during 25 days of their storage (Table 1). The TSS of coated fruit packaged in polyethylene ranged from 15.17-18.43% with an average means of 15.84% as compared to first day of their storage having minimum percent of total soluble solids (10.0%). The increasing trend of the percent total soluble solids contents of fruit during storage that could be attributed mainly due to breakdown of starch into simple sugars during ripening along with a proportional increase in TSS and further hydrolysis decreased the TSS during storage. It is obvious from Table 1 that the maximum percent total soluble solid contents of late Chaunsa white mango were observed in T_2 (18.43%) followed by T_3 (16.45 %), T_5 (15.89 %), T_4 (15.83%) and T_6 (15.17%), however, all of the treatments showed a slower increasing rates or the more retaining trend in percent total soluble solid contents for longer period as compared to control T_1 (20.83%). The effectiveness to minimize or retain the percent TSS contents was varied, may be due to the difference in the modified atmosphere created by packaging, coatings, ethylene absorbent, fungicide or antiripening agent used. It was observed that Wax-CMC polysaccharide based coatings with

fungicide, coating with ethylene absorbent or coating with antiripening agent or antiripening agent with oil and disinfectant treated fruit packed in polyethylene had slowed down the metabolic activities and delay ripening with reduced TSS contents during storage. These results are in line with earlier findings (Kittur *et al*., 2001; Raje *et al*., 1997; Rosa, *et al*., 2001; Ladaniya and Sonkar, 1997). Therefore, uncoated Chaunsa white or coating having ethylene absorbent or antiripening agent or antiripening agent with oil and disinfectant packed in polyethylene combinations may be the best treatments for delay ripening with minimum percent total soluble solid contents during storage.

pH value: The Table 1 reveals that the pH value of coated fruit packaged in polyethylene was 3.87-4.44 with an average mean of 3.99 as compared to control having higher pH (4.91) after 18 days of storage at ambient temperature. The treatments and their interactions had highly significant effect on pH value of mango during storage except T_5 and T_6 (4.06) with insignificant effect, however a significant difference of pH value of these treatments to others was found during 25 days of their storage. The fluctuations of pH might be due to the variations in titratable acidity or temperature of storage and decline of acidity is attributed due to increased activity of citric acid glyoxylase during ripening or reduction in acid content may be due to their conversion into sugars and further utilization in metabolic process during storage. These results are correspond with Srinivasa *et al*. (2002), who described that pH values of Alphonso mango had an increasing trend from 4.06-6.73 on 12th day in control fruit at ambient temperature 27±1^{o}C at 65% RH. Doreyappy-Gowda and Huddar (2001) also observed that Green mature Alphonso and other 7 varieties of mango fruit stored at 18-34^{o}C undergone a series of physico-chemical changes during ripening and the major changes were considerably increased in pH from 2.85-4.38 during ripening. These results are comparable with those of Hayat *et al*. (2005) who reported that there was a gradual increase of pH from 4.22-4.78 in Banky apple during storage at ambient temperature. These results are not agreed with those of Manzano *et al*. (1997) who reported that pH value showed decreasing trend from 4.82-3.82 during 20 days of their storage, however there was an agreement with their 2nd part of statement that temperature of storage also affected pH value and lower pH value 4.21 at 12^{o}C as compared to higher pH value 4.67 at 25^{o}C was observed during 20 days of storage. These results are in line with the findings of Kudachikar *et al*. (2001) who described that the pH value of Neelum mango was decreased (3.0) and acidity increased (1.9%) upto 90 days after the fruit set. Later, pH slightly increased (3.1) and acidity slightly decreased (1.5%) at 110 days after fruit set which is optimum stage of maturity after the fruit set.

The maximum pH value of coated late Chaunsa white mango was observed in T_2 (4.44), followed by T_5 and T_6 (4.06), T_4 (3.98) and T_3 (3.87), as compared to first day with very low pH value (3.85) however, these treatments having comparatively lower pH as compared to control with highest pH value (4.91), after 18 days of storage at ambient temperature. Whereas, control sample (T_1) had significantly higher pH value (4.91) than other treatments after 25 days of their storage might be due to free atmospheric conditions of temperature, O_2 and relative humidity that caused more oxidation and degradations of acids as compared to coated fruit. The treated fruit with CMC-Bee-wax polysaccharide based coating having NaOCl (T_3), $KmnO_4$ (T_4) or 2, 4, 5-T (T_5) packed in polyethylene respectively had lower pH value might be due to the slower metabolic process of conversion of sugar or degradation of acids compared to other treatments that might be due to the difference in the modified atmosphere created by different types of coatings or might be due to formation of carboxylic acid by dark fixation of CO_2 due to high internal CO_2 levels. The ripening process was more effectively controlled in those treatments having NaOCl fungicide as compared to H_3BO_3. Similar pattern was observed by Carrillo-Lopez *et al*. (2000) who reported that Haden mangoes coated with different concentrations of Semperfresh had lower pH (4.75) as compared to non-coated fruit (5.66) at the end of storage at 13^{o}C during 32 days of storage and coating was more effective in maintaining a lower pH during storage. These results are confirmed by (Manzano *et al*., 1997) who reported that pH value of Hadden mango treated with wax coating were depending on types of coating and had no significant effect on pH content in between Prolong and control (4.60, 4.54) or Fomesa and Primafresh (4.23, 4.25), however a significant difference in between three groups Fomesa and Prolong (4.23, 4.54) or Fomesa and control (4.23, 4.60) or Primafresh and control (4.25, 4.60) was noted during storage. These results are in line with those Baldwin *et al*. (1999) who observed that pH value depends on type of coating and showed significantly lower pH (4.6, 4.7) in Natural-Seal (NS), a polysaccharide-based edible coated fruit or Tropical Fruit Coating (TFC) respectively, compared to control (5.5) at 10 or 15^{o}C with 90-95% RH for 19 days, followed simulated marketing conditions at 20^{o}C with 56% RH for 4 days. These results are comparable with Hayat *et al*. (2005) who reported that apple had higher pH (4.60) in control than paraffin wax coating (4.47) or polyethylene (4.42) during storage. This might be due to less oxidation of the fruits and calcium decrease in the degradation of acids thus maintaining the integrity of cells and polyethylene to delay the metabolic changes in fruits. Similarly polyethylene bags were sealed so air was not available for various chemical reactions resulting in less increase in pH. These investigations

are similar to those of Srinivasa *et al.* (2002) who described that pH values of Alphonso mango was higher in control (4.06-6.73) as compared to chitosan (5.04) coating or LDPE film (5.79) treated with 500 ppm Carbendazim fungicide in carton boxes on 12th day at ambient temperature 27±1°C at 65% RH during ripening. The results of the present studies show that coated Chaunsa white packaged in polyethylene had maintain the lower pH value from 3.87-4.44 during storage that was very near to first day having minimum value of pH (3.85) as compared to control with very high pH value T_1 (4.91) after 18 days of storage at ambient temperature. Therefore, it is evident that the polyethylene with coating having antiripening agent with or without fungicide, or ethylene absorbent are very effective combinations to control the pH value by delaying ripening with minimum pH value during storage.

Titratable acidity: The treatments and their interactions had highly significant effect on percent acidity of Chaunsa mango during storage and a decreasing trend of percent acidity in all treatments was ranged from 0.87 -0.91%, with an average mean of 0.77% after 25 days of storage as compared to the first day having TA 1.28% (Table 1). This might be due to less oxidation of the fruits and calcium decrease in the degradation of acids thus maintaining the integrity of cells. Low concentration of calcium chloride and wax coating were less effective in reducing oxidations or to prevent the conversion of acids into sugars as compared to higher concentration of calcium chloride or polyethylene to delay the metabolic changes in fruits. This might be due to the fact that more concentration of calcium chloride prevented decrease in acidity and biochemical changes resulting in less increase in pH, similarly polyethylene bags were sealed, so air was not available for various chemical reactions resulting in less increase in pH. There was gradual increase in pH during storage. It might be due to decrease in acidity through the biochemical changes within the fruits during storage. These results are in correspond with Srinivasa *et al.* (2002) who found that Titratable acidity values also showed a decreasing trend, the initial value of 2.17% being reduced to 0.08% in control fruit on 12th day in desapped, washed with tap water then dipped Alphonso mango in 500 ppm Carbendazim fungicide for 15 min and after drying fruit were kept in carton boxes whose top was covered with Chitosan (100 gauge) or with low-density polyethylene (100 gauge) or kept as such as control at ambient temperature 27+_1°C at 65% RH. Similar changes were noted by Kudachikar *et al.* (2001) in Neelum mango which had optimum stage of maturity 110 days after the fruit set and pH value decreased (3.0) and acidity increased (1.9%) upto 90 days after the fruit set. Later, pH slightly increased (3.1) and acidity slightly decreased (1.5%) at 110 days after fruit set. It is obvious from Table 1 that statistically there was a significant effect of treatments on percent titratable acidity of mango except T_2 (0.97%) and T_3 (0.95%), however these treatments are significantly different in percent acidity from other treatments during 18 days of their storage. The maximum percent acidity of late Chaunsa white mango was observed in T_2 (0.97%) followed by T_3 (0.95%), T_4 (0.87%), T_5 (0.84%) and T_6 (0.81%), however, these treatments maintained comparatively higher percent acidity compared to control T_1 (0.44%) had very low percent acidity after 18 days of storage at ambient temperature as compared to first day with very high percent acidity (1.28%) that might be due to higher CO_2 and lower levels of O_2 in the internal atmosphere, an aerobic respiration produced carbonic acid and as a result increased in acidity. These results are in line with those of Baldwin *et al.* (1999) who observed that Tomy Atkins mango treated with Natural Seal, a polysaccharide-based edible coating had higher TA (0.28) than TFC (0.21) or uncoated (0.16) fruit at 10° or 15°C with 90-95% RH for 19 days, followed simulated marketing conditions at 20°C with 56% RH for 4 days. These results are confirmed by Manzano *et al.* (1997) who reported that Hadden mango treated with wax coating stored at different temperatures had no significant effect on titratable acidity percent in between Prolong and control (0.33%) or Fomesa and Primafresh (0.40%), however a significant difference in between three groups Fomesa and Prolong (0.40, 0.33%) or Fomesa and control (0.40, 0.27%) or Primafresh and control (0.40, 0.27%) was noted during storage. However, our research studies disagree with this statement that titratable acidity percent showed increasing trend from 0.18-0.57% during 20 days of their storage. Therefore, it is obvious from the results of the present studies that polyethylene with combination of coating, antiripening agent with or without fungicide, or ethylene absorbent were very effective to maintain the maximum percent acidity (0.87-0.97%) and delay ripening process as compared to control with minimum acidity retention.

Ascorbic acid: It is evident from Table 1 that treatments and their interactions had highly significant effect on ascorbic acid contents of mango during storage and in the treated fruit packed in polyethylene, the ascorbic acid content was 19.81-30.91 mg/100g with an average mean of 24.48 mg/100 g as compared to very low ascorbic acid contents at first day (13.49 mg/100 g) during 25th day of storage at ambient temperature. The increasing trend of ascorbic acid contents during storage might be due to changes in the atmospheric conditions, the unripe fruit was going to optimum ripening stage that caused an increase in AA contents and after that the degradation of AA by oxidation reduced AA with the passage of time. Overall a decreasing trend

of ascorbic acid contents was observed during storage. These results are confirmed by Kudachikar *et al.* (2001) who reported that the ascorbic acid content of Neelum mango fruit increased from 42 mg/100 g at 30th day after the fruit set to a maximum of 74 mg /100 g on fresh weight bases at 70th day, thereafter it decreased to 70.5 mg/100 g at 110th day that was the optimum stage of maturity of Neelum mango after the fruit set. The maximum ascorbic acid contents of late Chaunsa white mango in coated fruit packaged in polyethylene were observed in T_4 (31.40 mg/100 g), followed by T_2 (30.91 mg/100 g), T_3 (26.04 mg/100 g), however T_6 (20.69 mg/100 g) and T_5 (19.81 mg/100 g) as compared to control with maximum ascorbic acid contents T_1 (42.06 mg/100g) or having very low ascorbic acid contents at first day (13.49 mg/100 g) during storage that might be due to free atmospheric conditions, oxidation of AA was higher in control that caused rapid increase of AA content compared to other coated fruit retained more AA at later stage, might be due to slower decrease of AA in the higher concentration of CO_2 inside the fruit package after 18 days of storage at ambient temperature. These results are in line with the findings of Rana *et al.* (1992) who reported that decrease in ascorbic acid content was observed when sweet oranges were treated with oil emulsion stored in wooden box with a polyethylene bag. These results are comparable with Carrillo-Lopez *et al.* (2000) who examined that ascorbic acid had decreasing trend in Haden mangoes coated with different concentrations of Semperfresh at 13°C during 32 days of storage but decrease was slower in coated fruit as compared to uncoated fruit. These results further support the findings of Raje *et al.* (1997) in India who prescribed that the ascorbic acid content of alphonso mangoes in CFB carton depends on type of absorbent used and was higher in Halogen releaser 66.62-93.98 mg/100 g, followed by control 88.49mg/100 g and in $KmnO_4$ dipped 75.42 mg/100 g after 8th day at 32-36°C and RH of 70-75% during storage. There was a gradual decline in the ascorbic acid content during storage, however, the maximum retention of ascorbic acid was noted in $KMnO_4$ treated fruit (9.53mg/100 g), followed by ethysord (8.49 mg /100 g) after 16th day of storage period as compared to the combination of ethysord and SO_2 releaser (1.90 mg/100 g), Oxidizer (1.85 mg/100g) and halogen releaser (1.49 mg /100 g) having less retention of ascorbic acid during storage as compared to control that was spoiled after 8th day of their storage. It is obvious from the results that Chaunsa white packaged only in polyethylene was higher in ascorbic acid contents as compared to coated fruit packaged in polyethylene with ethylene absorbent, antiripening agent or antiripening agent with or without disinfectant are very effective in delay of ripening with reduced ascorbic acid during storage.

Conclusion: After a through study, it is concluded that fruit packed either in Polyethylene alone, or coating with combination of Wax-CMC-NaOCl, Wax-CMC coating with combination of $KMnO_4$, coating with combination of Wax-CMC-2, 4, 5-T and coating with combination of Wax-CMC-2, 4, 5-T having oil-H_3BO_3-$CaCl_2$ treated fruit packed in polyethylene had played a very effective role to control the weight loss and other compositional changes such as total soluble solids, pH, titratable acidity and ascorbic acid of Chaunsa white commercial variety of mango at ambient temperature during storage. These treatments have delayed the ripening process more effectively and with a minimum quality loss, as compared to the control sample which had greater compositional changes with maximum quality loss during storage at ambient temperature.

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Abbreviations: Polyethylene (poly), Weight loss (Wt. loss), Total Soluble Solids (TSS), Titratable acidity (TA), and Ascorbic Acid (AA)