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RESPONSE OF MANGO CULTIVARS TO MODIFIED ATMOSPHERE STORAGE AT AN AMBIENT TEMPERATURE CV. ALPHANSO AND CHOUNSA

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The study was carried out to evaluate the Modified Atmosphere Packaging techniques at two different maturity stages of 'Alphanso' and 'Chounsa' mangoes to reduce the post harvest losses and extend the shelf life of mango at ambient conditions. Results revealed that mangoes packed in polyethylene bags ripened slowly as indicated by skin colour, texture and conversion of starch into sugar but produced brown colour on the peep of the fruit. Less mature furit (½ mature) showed higher weight loss than mature fruits. Packaging of mangoes in 0.037 mm polyethylene bags resulted in the accumulation of CO_2 concentration, which ultimately led to the incidence of CO_2 injury. It is concluded that mangoes should be harvested at the advance stage of maturity and the use of polyethylene bags for packaging of fruit in ambient conditions is not practicable to extend the shelf life of mangoes but it might be applicable after further investigation in controlled low temperature and high humidity.

Keywords: Accumulation, alphanso, brown, maturity, polyethylene, shelf life

INTRODUCTION

The mango (*Magnifera indica* L) is one of the important fruit crops of the tropic and subtropics. It is climacteric fruit therefore usually harvested at mature green stage (unripe); before the onset of climacteric (Mitra and Baldwin, 2005). The stage of maturity of in climacteric fruit at harvest has pronounced influence on ripe fruit colour (Kader, 2008) and quality (Ahmad, 2001). Harvest maturity has an important effect on the consumer's level of satisfaction at consumption it is because a fully mature fruits can develop good flavor when fully ripe (Kader, 2008) therefore it is important for individuals harvesting fruit to have effective methods of determining mango maturity. Maturity measurements for mangoes are not standardized. However, fruit maturity indices such as aroma, color, composition, defects, firmness, shape, size and specific gravity can be used to check the maturity of the mango fruit. These can differ from variety to variety and growing areas.

Alphanso and Chounsa are most important cultivars and commercially grown in Indo-Pak subcontinent. Alphanso fruits are oval in shape and 4 to 6 inches long. Chaunsa is medium to large size fruit. Mango fruit is also known as 'King of fruit due to delicious taste and aromatic flavour. It is an excellent source of vitamin A and C. These varieties have a great export potential but in Pakistan mangoes sales are restricted and heavy losses occur due to harvesting at improper stage of maturity, improper packaging material, improper handling and inadequate transport and storage facilities (Farooqi, 1985). Mangoes are classified as climacteric fruit which ripen rapidly after harvest and have very limited shelf life. Therefore these fruit some time can not reach to the consumers during that period and heavy losses occur. Packing of fruits in polyethylene bags can result in beneficial atmosphere around the fruit to extend their shelf life (Abdullah and Pantastico, 1990). Ripened fruit produce some ethylene which may be accumulated inside the bags and could shorten the shelf life of the fruit. It assumed that in the next few years, modified atmosphere will be used more widely to manage the supply and improve the marketable fruit quality (Turner, 2005).

There is ample evidence that shelf life of many fruits and vegetables can be extended to a considerable extent using modified atmosphere packaging (MAP). It has been known for a long time that fruits or vegetables packed in plastic films, when properly sealed, can create modified atmosphere conditions (Rogers, 1963). The O_2 concentration inside the packaging decreased and that of CO_2 increased. The permeability of films affects the rate of O_2 depletion and CO_2 build up (Hardenburg, 1954). It has long been known that respiration rate is influenced by temperature (Hruschka, 1971) as is film permeability (Hardenburg, 1954), which in turn influences the surrounded atmosphere of the fruit. The reported response of mangoes to MAP has been variable (Chaplin, 1989). Ben-Arie (2001) reported that MAP is still not commercial technique for mangoes because it delays the

ripening but fruits suffer from the appearance of red or green spots around the lenticels. Lalel *et al*. (2006) recommended that storage of mangoes in 1.5% or 2% O_2 in combination with 8% CO_2 extend the shelf life with good eating quality. Ferrer *et al*. (2002) reported that MAP could be used as technology to extend the shelf life of mango but they further mentioned that slight difference between fresh and MAP mangoes in taste was found by the sensory evaluations. Srinivasa *et al*. (2004) reported that mangoes packed in low density polyethylene for 9 days showed off flavour due to fermentation and fungal growth on the stalk and around the fruits. Pesis *et al*. (2000) created a modified atmosphere (approximately 5% CO_2 and 10% O_2) in 4-kg film lined cartons by using micro perforated polyethylene (PE) or Xtend TM film (XF) to reduce the chilling injury (CI) and reported that most effective reduction in CI was found in fruits which were packed in XF film. The present investigation was carried out to study the storage behaviour of Alphonso and Chaunsa mangoes at two maturity stages, designated as mature and ½ mature, stored in sealed 125 gauge PE bags to make them airtight or without packaging in ambient conditions in Pakistan

MATERIALS AND METHODS

The research was carried out at the Mango Research Station Shujabad, Pakistan. Two separate experiments were conducted on Alphonso and Chaunsa mangoes. Fruit of both varieties was harvested from the orchard, a few hours before starting the experiments. Freshly harvested mangoes were selected and graded into two maturity groups, considering them as ½ mature (<1.00 specific gravity) and mature mangoes (>1.00 but <1.02 specific gravity) as described by Roy and Joshi (1989). Sound and uniform fruit of both varieties were selected for these experiments. Each fruit was individually marked to monitor the weight loss during storage. Four mangoes of each group were packed in airtight PE bags of 0.037 mm thickness. PE bags were made airtight by knotting the neck and then with a rubber band. Each treatment was replicated four times. The other fruit kept as a control were placed on a table. Fruits of both experiments were stored in a well-ventilated room where the conditions were monitored as 30 to 37°C with 50 to 70% relative humidity. The fruits were subjected to physicochemical analysis after the first and second weeks of storage. Weight losses were measured as:

The fruit were weighed, using a Precisa 6000D digital balance with ±0.01 g resolution, before and after storage. The cumulative weight gain or loss % was calculated as follows:

$$\text{Weight change \%} = \frac{W_0 - W_1}{W_0} \times 100$$

Where:

W_0 = Weight before storage.

W_1 = Weight after removal from the storage

Peel colour of individual fruit was estimated using the Royal Horticultural Society colour chart. These recorded colours were measured using a colorimeter (Minolta Chroma Meter CR-200). Readings were taken at three predetermined points and results were recorded in a* and b* values. A positive a* value represents the degree of redness while a negative a* value indicates the greenness. A positive b* value represents the degree of yellowness and the negative one the blueness. Fruit firmness of mangoes was measured using an Effegi penetrometer fitted with an 8 mm diameter flat end probe. The force exerted on the probe to penetrate (rupture the skin) the fruit was recorded in pounds and then converted into Newton. TSS was measured using a hand held refractometer. The juice of each fruit was extracted and then an undiluted juice sample was put into the detector of the refractometer. The mango juice was extracted and 10 ml of the juice diluted with 10 ml of distilled water, then homogenised using a food processor. The prepared juice sample was titrated against 0.1N sodium hydroxide (NaOH) using a few drops of phenolphthalein as an indicator to a definite pink colour end point. Total acidity was expressed as % of citric acid.

RESULTS AND DISCUSSION

Mangoes were subjected to analysis after the first and second weeks of storage in both experiments and results are presented separately.

***Weight loss (%)*:** Fruit packed in PE bags showed significantly much lower weight losses than those stored without packaging in both varieties (Table 1and 2). Likewise ½ mature fruit showed significantly higher weight losses than mature ones. The interaction between packaging and storage period was the obvious one that the rate of weight loss was significantly higher between one and two weeks for the non-packed fruit than the packed fruit. It is clear that lower relative humidity of ambient storage conditions was the major factor responsible for higher weight losses in fruits kept without packaging. The lower relative humidity of ambient storage conditions was the major factor responsible for higher weight losses in fruits kept without packaging. Fruits were shrivelled and wrinkled and the freshness of their appearance was reduced. The reduced weight losses in fruit with PE packaging could be due to build up of humidity in PE bags. Previous work (Ferris *et al.,* 1993; Wilkinson, 1970) has shown that high humidity reduced weight losses in stored fruits and vegetables. These results are in line with those reported by Miller *et al.* (1986), who showed that film wrapping of mangoes at various stages of ripeness significantly reduced their weight losses. The higher weight loss of the more immature fruit is consistent with previous work reported by Salunkhe *et al.* (1991). They claimed that these high weight losses were due to higher respiration rates of more immature fruit. Fruit in PE packaging, irrespective

Table 1. Effect of packaging and maturity stages on weight loss (%) of Alphonso mangoes stored in ambient conditions in Pakistan

Storage period	Weight loss %				Interaction between packaging x Storage period			
	Packaging		Non packaging		Packaging		Non packaging	
	Mature	½ Mature	Mature	½ Mature	Mature	½ Mature	Mature	½ Mature
I week	4.9	4.1	21.0	18.9	4.1	4.9	18.9	21.0
2 week	6.0	5.1	29.6	28.4	5.1	6.0	28.4	29.6
$LSD_{0.05}^{Z}$ (Packaging)		0.51			$LSD_{0.05}^{u}$ Maturity			
$LSD_{0.05}^{y}$ (Storage Period)		0.51			$LSD_{0.05}^{T}$ Maturity X storages period			
$LSD_{0.05}^{x}$ (Packaging X Maturity)		NS						
$LSD_{0.05}^{w}$ (Maturity X Storage Period)		0.72						
$LSD_{0.05}^{v}$ (Packaging X Maturity X Storage Period)		NS						
CV (%)		5.0						

Table 2. Effect of packaging and maturity stages on weight loss (%) of Chaunca `mangoes stored in ambient conditions in Pakistan

Storage period	Weight loss %				Interaction between packaging x Storage period			
	Packaging		Non packaging		Packaging		Non packaging	
	Mature	½ Mature	Mature	½ Mature	Mature	½ Mature	Mature	½ Mature
I week	2.5	2.6	23.1	24.4	4.1	4.9	18.9	21.0
2 week	4.3	4.5	27.8	28.1	5.1	6.0	28.4	29.6
$LSD_{0.05}^{Z}$ (Packaging)		0.59			$LSD_{0.05}^{u}$ Maturity	NS		
$LSD_{0.05}^{y}$ (Storage Period)		0.59			$LSD_{0.05}^{T}$ Maturity X storages period	0.84		
$LSD_{0.05}^{x}$ (Packaging X Maturity)		NS						
$LSD_{0.05}^{w}$ (Maturity X Storage Period)		NS						
$LSD_{0.05}^{v}$ (Packaging X Maturity X Storage Period)		NS						
CV (%)		6.0						

of their maturity stages, retained a considerable amount of greenness and produced brown discoloration of the peel. This condition could be due to increased CO_2 concentration and decreased O_2 concentration of the internal atmosphere of the packaging which retarded chlorophyll breakdown and developed CO_2 injury. Similar conditions were reported by Chaplin *et al.* (1982), and Kane and Marcellin (1979). Chaplin *et al.* (1982) also measured the CO_2 concentration of sealed PE bags containing mangoes as being as high as 31.5% at 20°C. The reason for the lower brown discoloration of Chaunsa mangoes could be that different varieties of the same fruit react differently to the same treatment. Burton (1974) described CO_2 injury as causing a brown discoloration in fruit and that it has long been known that varieties of the same fruit differ markedly in their susceptibility to CO_2 damage. The variation observed in the current work might have been related to the fact that Chaunsa grows best in high temperature with low humidity compared to Alphonso which grows better in moderate temperature and a comparatively humid atmosphere. Similarly, development of yellow colour (an important ripening characteristic) was depressed in fruits packaged in PE bags, which suggests the failure of chlorophyll breakdown and carotenoid synthesis. This was shown by Medlicott *et al.* (1986), to be a consequence of accumulation of higher CO_2 concentration and depletion of O_2. Moreover, it might be due to the high ambient temperature of the MAP. It is because the role of MAP is temperature dependant (Sandhya, 2010). It was also observed (Gonzalez-Agular, 2003) that post harvest life of papaya was better and enhanced in MAP which were stored at lower temperature as compared those which were stored at higher temperature. It was observed that harvest maturity did not affect the development of peel colour in the current investigations, which suggests that the storage atmosphere had similar effects on both the maturity grades of mangoes.

***Peel Colour*:** Packing fruit in PE bags significantly affected their peel colour compared to those held without packaging (Table 3 and 5). Fruit stored for two weeks showed significantly lower greenness than those held for one week. The interaction between the packaging and storage period was that the fruit packed in PE bags and stored for one week showed significantly different greenness than those stored for two weeks in PE packaging. The results for yellowness (b*) of peel colour are presented in Table 4 & 6. Same trend was found in both experiments. Fruit packed in PE bags were significantly dissimilar to those kept without packaging regarding b* values of the peel colour. Fruit of the two harvest maturity grades showed no difference between each other. Fruit stored for two weeks showed significantly lower

Table 3. Effect of packaging and maturity stages on greenness (a*) of the peel colour of Alphonso mangoes stored in ambient conditions in Pakistan

Storage period	Greenness (a*)				Interaction between packaging x storage period			
	Packaging		Non packaging		Packaging		Non packaging	
	Mature	½ Mature	Mature	½ Mature	Mature	½ Mature	Mature	½ Mature
I week	-11.2	-11.6	-20.8	-20.8	-11.2	-11.6	-20.8	-20.8
2 week	-9.6	-9.2	-21.2	-20.5	-9.2	-9.6	-21.2	-20.5
$LSD_{0.05}^{Z}$ (Packaging)		0.91			$LSD_{0.05}^{u}$ Maturity		NS	
$LSD_{0.05}^{y}$ (Storage Period)		0..91			$LSD_{0.05}^{T}$ Maturity X storages period		1.28	
$LSD_{0.05}^{x}$ (Packaging X Maturity)		NS						
$LSD_{0.05}^{w}$ (Maturity X Storage Period)		NS						
$LSD_{0.05}^{v}$ (Packaging X Maturity X Storage Period)		NS						
CV (%)		8.0						

Table 4. Effect of packaging and maturity stages on yellowness (b*) of the peel colour of Alphonso mangoes stored in ambient conditions in Pakistan

Storage period	Greenness (a*)				Interaction between packaging X storage period			
	Packaging		Non packaging		Packaging		Non packaging	
	Mature	½ Mature	Mature	½ Mature	Mature	½ Mature	Mature	½ Mature
I week	+62.8	+61.9	+67.5	+67.5	+62.8	+	-20.8	-20.8
2 week	+43.7	+41.4	+62.7	+58.2	+43.7	-9.6	-21.2	-20.5
$LSD_{0.05}^{Z}$ (Packaging)		0.91			$LSD_{0.05}^{u}$ Maturity		NS	
$LSD_{0.05}^{y}$ (Storage Period)		0..91			$LSD_{0.05}^{T}$ Maturity X storages period		1.28	
$LSD_{0.05}^{x}$ (Packaging X Maturity)		NS						
$LSD_{0.05}^{w}$ (Maturity X Storage Period)		NS						
$LSD_{0.05}^{v}$ (Packaging X Maturity X Storage Period)		NS						
CV (%)		8.0						

Table 5. Effect of packaging and maturity stages on greenness (a*) of the peel colour of Chaunsa mangoes stored in ambient conditions in Pakistan

Storage period	Greenness (a*)				Interaction between packaging X storage period			
	Packaging		Non packaging		Packaging		Non packaging	
	Mature	½ Mature	Mature	½ Mature	Mature	½ Mature	Mature	½ Mature
I week	-28-2	-28.2	-3.0	-5.0	-28.4	-28.2	-3.0	-5.0
2 week	-22.5	-19.4	-1.2	-1.7	-22.5	-19.4	-1.2	-1.7
$LSD_{0.05}^{Z}$ (Packaging)		2.62			$LSD_{0.05}^{u}$ Maturity		NS	
$LSD_{0.05}^{y}$ (Storage Period)		2.62			$LSD_{0.05}^{T}$ Maturity X storages period		NS	
$LSD_{0.05}^{x}$ (Packaging X Maturity)		NS						
$LSD_{0.05}^{w}$ (Maturity X Storage Period)		NS						
$LSD_{0.05}^{v}$ (Packaging X Maturity X Storage Period)		NS						
CV (%)		26						

Table 6. Effect of packaging and maturity stages on yellowness (b*) of the peel colour of Chaunsa mangoes stored in ambient conditions in Pakistan.

Storage period	Greenness (a*)				Interaction between packaging X storage period			
	Packaging		Non packaging		Packaging		Non packaging	
	Mature	½ Mature	Mature	½ Mature	Mature	½ Mature	Mature	½ Mature
I week	46.8	47.9	77.6	71.2	46.8	47.9	77.6	71.2
2 week	41.4	37.2	83.4	83.1	41.4	37.2	83.4	83.1
$LSD_{0.05}^{Z}$ (Packaging)		4.03			$LSD_{0.05}^{u}$ Maturity		NS	
$LSD_{0.05}^{y}$ (Storage Period)		NS			$LSD_{0.05}^{T}$ Maturity X storages period		5.70	
$LSD_{0.05}^{x}$ (Packaging X Maturity)		NS						
$LSD_{0.05}^{w}$ (Maturity X Storage Period)		NS						
$LSD_{0.05}^{v}$ (Packaging X Maturity X Storage Period)		NS						
CV (%)		9.0						

yellowness than those stored for one week. The interaction between PE packaging and storage period was that the packaged fruit continued to lose their yellowness more rapidly during storage compared to non packed fruit. Other first order interactions and the second order interaction among PE packaging, harvest maturity and storage periods did not show significant difference in yellowness.). It is clear from the results that fruit packed in PE film bags ripened more slowly as indicated by skin colour change, texture, and TSS. They also lost less weight, as would be expected, and therefore retained a fresher appearance than those stored without packing. These results are consistent with those reported by (Thompson, 1971) and show that they could be used during marketing of mangoes in Pakistan to reduce losses and preserve freshness.

***Fruit firmness*:** Fruit packed in PE bags were significantly firmer than those held without packaging (Table 7 and 8). Fruit of the both harvest maturity grades were not significantly different in firmness. Fruit held for one week showed significantly higher firmness than those stored for two weeks. Fruit packaged in PE bags and stored for one week showed significantly higher firmness than those stored for two weeks. Other first order interactions and the second order interaction between packaging, maturity grades and storage period did not show significant difference of firmness. Fruit kept in PE bags retained their firmness to a considerable extent, suggesting a retarded ripening process, which is supported by their TSS and acidity contents. Similar results were obtained when mangoes were wrapped in polyethylene and stored at 14 or 21°C (Thompson, 1971). Mangoes wrapped in polyethylene were firmer than those non-wrapped because they failed to ripen normally. It is the evidence in the literature that MAP as storage techniques is beneficial for mango cv. kent to maintain the firmness and quality when stored at 8 and 10^0C (Kelany *et al*., 2010)

***TSS (%)*:** The results for TSS % of both varieties are presented in Table 9 & 10. Treatments of the both harvest maturity stages and those of the two storage periods did not show significant difference of TSS (P = 0.05). The interaction between packaging of fruit and storage period showed highly significant results. After one week of storage packaged fruit showed lower TSS contents than those which were stored without packaging. Fruit packed in PE bags in both experiments showed considerably lower TSS contents than those held without packaging. It was interesting to note that the TSS contents of fruit packed in PE bags stored for two weeks were lower than the first week of storage. This was the opposite of what was expected. However the TSS contents of fruits without packaging was higher after two weeks of storage than to the first week of storage. Other interactions were found to be statistically non-significant (P = 0.05). The lower TSS after two weeks of storage in PE film could be due to CO_2 injury. It might be possible that sugars are being broken down at a higher rate in the presence of high CO_2 levels in the storage atmosphere. Lakshminarayana and Subramanyam (1970) showed a decrease in TSS contents of mangoes as the concentration of CO_2 in the storage atmosphere increased. But current investigation supports their results.

***Total acidity*:** Packaging fruit in PE bags showed significantly higher acidity than those stored without packaging (Table 11 and 12) ½ mature fruit were shown to be slightly more acidic than mature ones. Fruit stored for one week were significantly more acidic than those stored for two weeks. The interaction between packaging and storage period was found to be significant. It was observed that fruit packaged in PE bags became more acidic during storage while those without packaging became less acidic. Higher acidity in fruits with packaging after two weeks storage could also be attributed to higher CO_2 concentrations of the internal atmosphere in packaged fruit. Lakshminaraya and Subramanyam (1970) noticed a considerable trend of increase in total acidity with increasing levels of CO_2. This is due to CO_2 which is an acid gas being dissolved in the cell sap of fruit

Table 8. Effect of packaging and maturity stages on the firmness (N) of Chaunsa mangoes stored in ambient conditions in Pakistan.

Storage period	Firmness (Pounds)				Interaction between packaging X storage period			
	Packaging		Non packaging		Packaging		Non packaging	
	Mature	½ Mature	Mature	½ Mature	Mature	½ Mature	Mature	½ Mature
I week	38.8	41.5	8.7	9.0	38.8	41.5	8.7	9.0
2 week	30.6	35.5	5.6	5.8	30.6	35.5	5.6	5.8
$LSD_{0.05}{}^{Z}$ (Packaging)		1.03			$LSD_{0.05}{}^{u}$ Maturity		1.03	
$LSD_{0.05}{}^{y}$ (Storage Period)		1.03			$LSD_{0.05}{}^{T}$ Packaging X storages period		1.45	
$LSD_{0.05}{}^{x}$ (Packaging X Maturity)		1.45						
$LSD_{0.05}{}^{w}$ (Maturity X Storage Period)		NS						
$LSD_{0.05}{}^{v}$ (Packaging X Maturity X Storage Period)		NS						
CV (%)		6.0						

Table 9. Effect of packaging and maturity stages on TSS (%) of Alphonso mangoes stored in ambient conditions in Pakistan

Storage period	TSS%				Interaction between packaging X storage period			
	Packaging		Non packaging		Packaging		Non packaging	
	Mature	½ Mature	Mature	½ Mature	Mature	½ Mature	Mature	½ Mature
I week	9.3	9.0	21.0	20.0	9.3	9.0	21.0	20.0
2 week	6.0	5.8	24.0	23.5	6.0	5.8	24.0	23.5
$LSD_{0.05}^{Z}$ (Packaging)	0.57				$LSD_{0.05}^{u}$ Maturity	NS		
$LSD_{0.05}^{y}$ (Storage Period)	NS				$LSD_{0.05}^{T}$ Packaging X storages period	0.80		
$LSD_{0.05}^{x}$ (Packaging X Maturity)	NS							
$LSD_{0.05}^{w}$ (Maturity X Storage Period)	NS							
$LSD_{0.05}^{v}$ (Packaging X Maturity X Storage Period)	NS							
CV (%)	5.0							

Table 10. Effect of packaging and maturity stages on TSS (%) of Chaunsa mangoes stored in ambient conditions in Pakistan

Storage period	TSS%				Interaction between packaging X storage period			
	Packaging		Non packaging		Packaging		Non packaging	
	Mature	½ Mature	Mature	½ Mature	Mature	½ Mature	Mature	½ Mature
I week	13.0	12.5	25.0	24.5	13.0	12.5	25.0	24.5
2 week	10.8	10.0	29.8	29.0	10.8	10.0	29.8	29.0
$LSD_{0.05}^{Z}$ (Packaging)	0.72				$LSD_{0.05}^{u}$ Maturity	NS		
$LSD_{0.05}^{y}$ (Storage Period)	0.72				$LSD_{0.05}^{T}$ Packaging X storages period	1.02		
$LSD_{0.05}^{x}$ (Packaging X Maturity)	NS							
$LSD_{0.05}^{w}$ (Maturity X Storage Period)	NS							
$LSD_{0.05}^{v}$ (Packaging X Maturity X Storage Period)	NS							
CV (%)	5.0							

Table 11. Effect of packaging and maturity stages on acidity (%) of Alphonso mangoes stored in ambient conditions in Pakistan

Storage period	Greenness (a*)				Interaction between packaging X storage period			
	Packaging		Non packaging		Packaging		Non packaging	
	Mature	½ Mature	Mature	½ Mature	Mature	½ Mature	Mature	½ Mature
I week	0.69	0.74	0.26	0.28	0.69	0.74	0.26	0.28
2 week	0.92	0.95	0.23	0.24	0.92	0.95	0.55	0.24
$LSD_{0.05}^{Z}$ (Packaging)	0.02				$LSD_{0.05}^{u}$ Maturity	0.02		
$LSD_{0.05}^{y}$ (Storage Period)	0..02				$LSD_{0.05}^{T}$ Packaging X storages period	0.03		
$LSD_{0.05}^{x}$ (Packaging X Maturity)	NS							
$LSD_{0.05}^{w}$ (Maturity X Storage Period)	NS							
$LSD_{0.05}^{v}$ (Packaging X Maturity X Storage Period)	NS							
CV (%)	4.0							

Table 12. Effect of packaging and maturity stages on acidity (%) of Chaunsa mangoes stored in ambient conditions in Pakistan

Storage period	Greenness (a*)				Interaction between packaging X storage period			
	Packaging		Non packaging		Packaging		Non packaging	
	Mature	½ Mature	Mature	½ Mature	Mature	½ Mature	Mature	½ Mature
I week	0.32	0.35	0.22	0.24	0.32	0.35	0.22	0.24
2 week	0.39	0.41	0.21	0.21	0.40	0.41	0.21	0.21
$LSD_{0.05}^{Z}$ (Packaging)	0.07				$LSD_{0.05}^{u}$ Maturity	0.027		
$LSD_{0.05}^{y}$ (Storage Period)	0..07				$LSD_{0.05}^{T}$ Packaging X storages period	0.10		
$LSD_{0.05}^{x}$ (Packaging X Maturity)	NS							
$LSD_{0.05}^{w}$ (Maturity X Storage Period)	NS							
$LSD_{0.05}^{v}$ (Packaging X Maturity X Storage Period)	NS							
CV (%)	6.0							

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