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# Influence of different animal fat coating on storage stability of mango fruit

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## Abstract

Influence of different animal fat coating (Buffalo fat, cow's fat, poultry fat, sheep fats, Goat fats and Control) on storage stability of mango fruit was examined during storage. The coated fruits along with control (without coating) were studied for selected physico-chemical parameters (pH, titratable acidity, fruit firmness, total soluble solid, ascorbic acid, weight loss and decay index) and organoleptic properties (color, taste, texture and overall acceptability). This is revealed from statistical analysis that animal coating had significantly ($p<0.05$) influence all the quality parameters studied, except ascorbic acid. Mean values showed that pH, TSS, ascorbic acid and firmness of the all the coated samples along with control reduced during storage of 25 days. On the other hand, percent acidity, weight loss and percent decay of all the mango fruit samples were increased. Sensory studies revealed that color, taste, texture and overall acceptability of the coated mango fruits were increased with passage of time during storage. In conclusion, this was observed that mango fruits coated with buffalo fat showed more stability in quality degradation when compared to rest of the animal coated fruits and to control. Further investigation like microbial study, micro structure, consumer wellbeing test (CATA), hazards to human health, etc. like are required to commercialize the application of animal coating of mango fruits for increasing shelf life.

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## Introduction

Mango (*Mangifera indica*) is one of the well-known fruits grown around the world, which belongs to the family Anacardiaceae. Mango is known to be the King of fruits, inherent to East India, Burma and Southern Asian regions. Mango fruit are known for the its use in the provision of many products like canned slices, jams, dried, jellies, and ice creams etc. The nutritious importance of mango is very important for overall health and wellbeing as mango consist of Potassium (168gm), Vitamin A (54mg), Vitamin C (36.4mg), Vitamin B6 (0.119mg) and Vitamin E (0.9 mg). The energy gained from mango is 250 kJ or 60 Kcl/100 g pulp (USDA, 2010).

In Pakistan mangoes are cultivated on 170.7 thousand hectare with production of 1785 thousand tons (Pakistan Economic Survey, 2016-17). Provincial contribution to mango production is as; In Punjab the area under mangoes cultivation is 107.05 thousand hectares with production of 1313.6 thousand tones, in Sindh the cultivated area is 62.7 thousand hectare with production 392.1 thousand tones while KPK and Baluchistan have the cultivated area and production as 0.3 and 0.5 thousand hectare and 2.9 and 1.07 thousand tons respectively (MINFA, 2014-2015).

Coating materials (edible) can be defined as the "Application of tinny substance that forms a protecting cover surrounded by the usable produce, and employed with coatings material" (Guilbert, 1986). Mostly the edible coating materials comprised of natural substance such as waxes, polysaccharides, and proteins (Moldo-Martins *et al.*, 2003). The consumers always expect worthy coating materials as regards of health security (Chien *et al.*, 2007).

The edible coating materials provide best conditions and environment to fruit for losing the quality characteristics at lowest amount in storages and during transportation (Baldwin, 1994). Coating material and some edible ingredients are mainly used for storing the food commodities in fresh and healthy form for an elongate time. In China, from 12th century the wax trend is used for coating purpose (Dalal *et al.*, 1971). Diverse coating constituents are being developed to allow certain of the particular molecules like oxygen and carbon dioxide which exists responsible to minimize the respiration process and the production of ethylene in coated fruits that subsequently result in decline of growth and also the attack of the microorganisms (Cuq *et al.*, 1995).

The aim of the study was to replace various chemicals coating materials with natural coating materials such as animal fats in order to reduce post-harvest losses and extend the storage stability of mango fruits.

## Materials and methods

The research was conduct to examine the effect of poultry, buffalo, cow, sheep and goat fat coatings on the quality and shelf life of mango fruit. For this purpose fresh but commercially mature (green) mango fruits were collected from the government nursery farm Peshawar. In order to remove the contamination, the fruits were washed with clean water before the application of coating material. The fruits after washing were air dried and were coated as discuss below.

*Dip technique*

For the purpose mango fruits were divided in to six lots, 1st lot was for control mean without coating. Selected animal fats were being melted at temperature of 70 ˚C, for twenty minutes, and then were cooled at the desired temperature of 30±1 ˚C. The remaining 5 lots of mangoes were then dipped in melted buffalo, cow, goat sheep and poultry fat for 5 second separately and then removed, dried and packed in paper cotton. Data was recorded on fresh basis and then after each 5 days of interval during storage until fruits were spoiled using CRD with two factors as shown in plan of study below (Table 1).

*Physicochemical characteristic and organoleptic evaluation*

Physical characteristics: The firmness of samples was measured by using the penetrometer (Effigi, FT-011) having 8 mm probe. For each sample and replications were recorded, average was calculated and used for

analysis (Mohsenin, 1986).All treated mangoes sample weight loss in percent was determined by following the same method as described by Srivastava and Tandon (1968).

Chemical characteristics: The standard method of AOAC (2012) was followed for determining the pH, total soluble solids, percent acidity and ascorbic acid content of mango fruit coated with different animal fats. The decay index was recorded by using the method of Wang *et al.* (2005).

Organoleptic characteristics: All the samples were assessed for organoleptic attributes (taste, color, texture, and overall acceptability) by using the prescribed method of Larmond (1977). A group of ten panelists observed these samples and scored them 1 to 9, where 1 shows minimum while 9 showed maximum value.

*Statistical analysis*

All the treatment were replicated three times and after collection of the data CRD with two factors (animal fat treatment and storage intervals) was used for statistical analysis (using statistix 8.1) and means were disconnected by using LSD as described by (Steel and Torrie, 1997).

**Results and discussion**

*Physical characteristics*

Mango fruits coated with various animal fats had retained the firmness for longer time than that of control samples. However, with passage of time the firmness was slightly decreased in coated samples (Fig 4). This was also observed that firmness of control sample was acceptable until 10 days of storage, whereas, in coated samples the firmness was remain acceptable up to 15 days of storage.

**Table 1.** Plan of work.

| S. No. | Factor A: Coating materials | Factor B: Days intervals |
|---|---|---|
| 1 | Control | $D_0$ = 0 day |
| 2 | BF = Buffalo fat | $D_1$ = 5 day |
| 3 | CF = Cow fat | $D_2$ = 10 day |
| 4 | GF = Goat fat | $D_3$ = 15 day |
| 5 | SF = Sheep fat | $D_4$ = 20 day |
| 6 | PF = Poultry fat | $D_5$ = 25 day |

The maximum mean value was recorded for mango fruits coated with CF (6.2 Kg/cm2) and minimum mean value was observed for control sample (5.03 Kg/cm2). This loss in firmness might be due to deterioration of cell structure, cell wall composition and the intra cellular materials (Seymour *et al.*, 1993; Ali *et al.*, 2011). They further observed reduced softening of the fruits with increasing chitosan concentrations. Chitosan had significantly maintained the firmness of the fruit.

This might be due to its higher antifungal activity and covering of cuticle and lenticels that reduced fruits infection, reduced respiration rate and other ripening process, which in turn maintained the firmness of the fruits (Ali *et al.*, 2005).

Weight loss of mango fruits coated with selected animal fat along with control sample. Both storage and animal fat coating had significantly ($p < 0.05$) influenced the weight loss of the mango fruits (Fig 5). Results revealed that control sample had higher weight loss than rest of the samples during storage that increased from 0% to 29.1% after 25 days of storage with mean value of 15.08% (maximum). On the other hand, coated samples weight loss was in range of 11.3 (BF coated samples) to 20.3% PF coated samples) after 25 days of storage with mean value of 5.02% (minimum) in sample coated with BF and maximum mean value of 9.41% (PF coated samples).

Weight loss occurs due to evaporation from the surface of the fruit and buffalo fat coating was very

effective in retaining moisture and reduce the moisture loss from the fruit surface as it act as a strong barrier between fruit surface and atmosphere (Chien *et al*., 2005).

*Chemical characteristics*

In pH both the treatment and storage intervals had significantly incremented the pH of mango fruits during the storage period of 25 days (Fig 1).

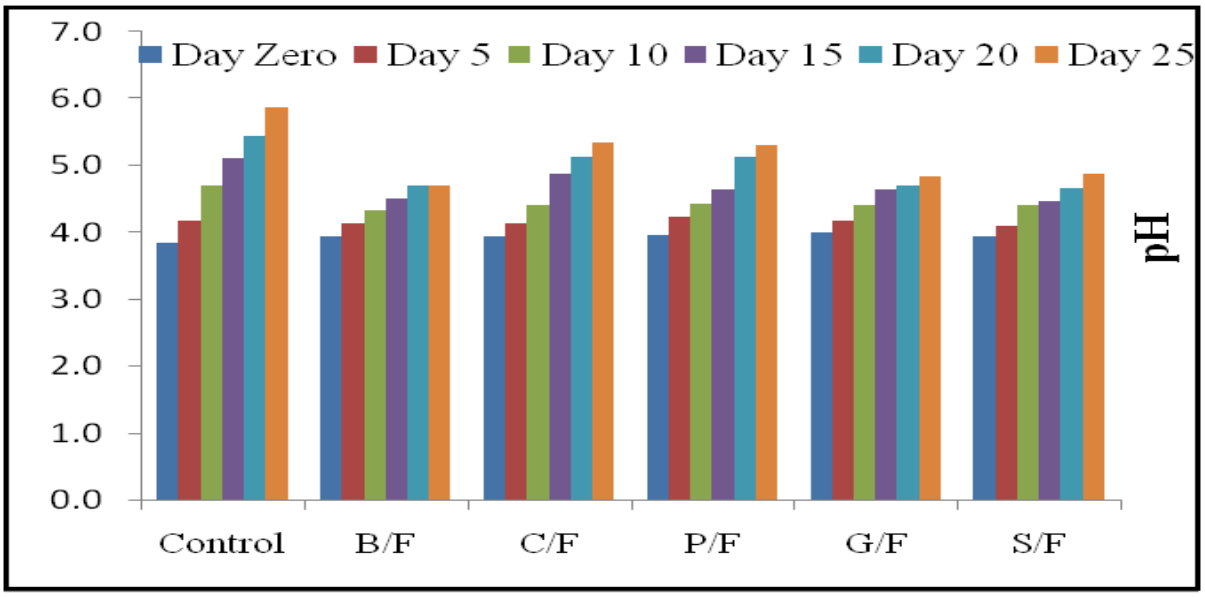


**Fig. 1.** Influence of various animal fats and storage on the pH of mango fruit.

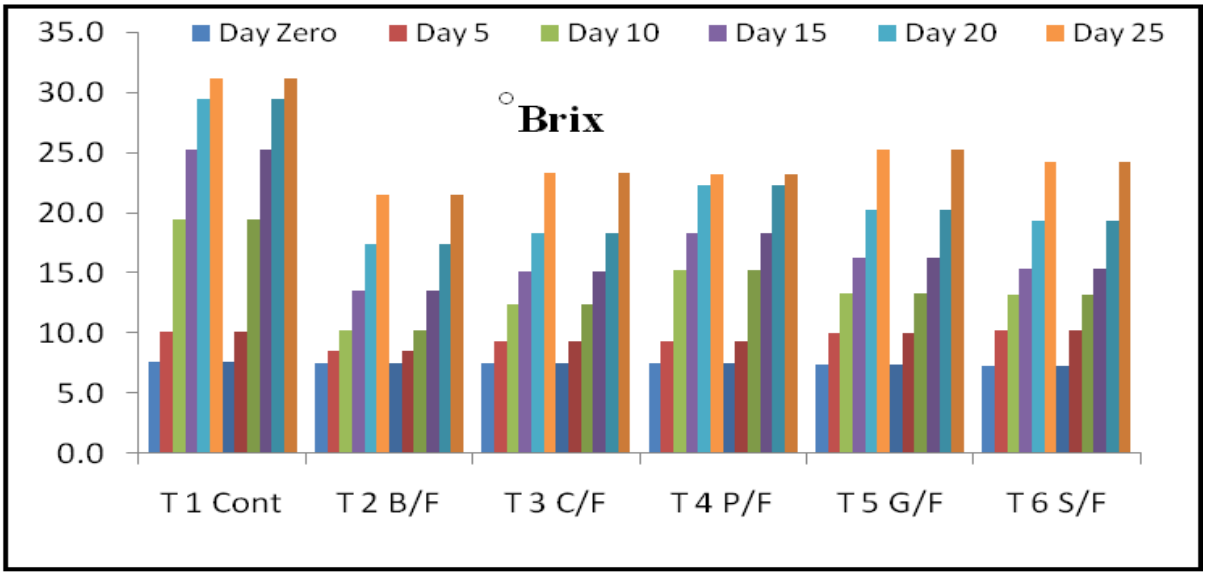


**Fig. 2.** Influence of various animal fats and storage on the TSS of mango fruit.

The maximum mean pH value (4.85) was observed in control sample, while minimum mean pH value (4.38) was shown by mango fruit samples coated with buffalo fat. The increase in pH in control sample remained highest which indicates that the physiological changes in the fruit lead to further ripening, thus reducing the acidity and increasing the sugar content of the mango fruit. Parallel results were also obtained by Habib *et al*., (2009). The variation in pH is related to a many of reasons; it may because of the effect of chitosan coating on the biochemical situation of the fruit, and sluggish rate of the respiration and metabolism activities (Jitareerat *et al*., 2007). The increment of pH possibly be due to the breaking down of certain acids with the respiration throughout storage (Pesis *et al*., 1999).

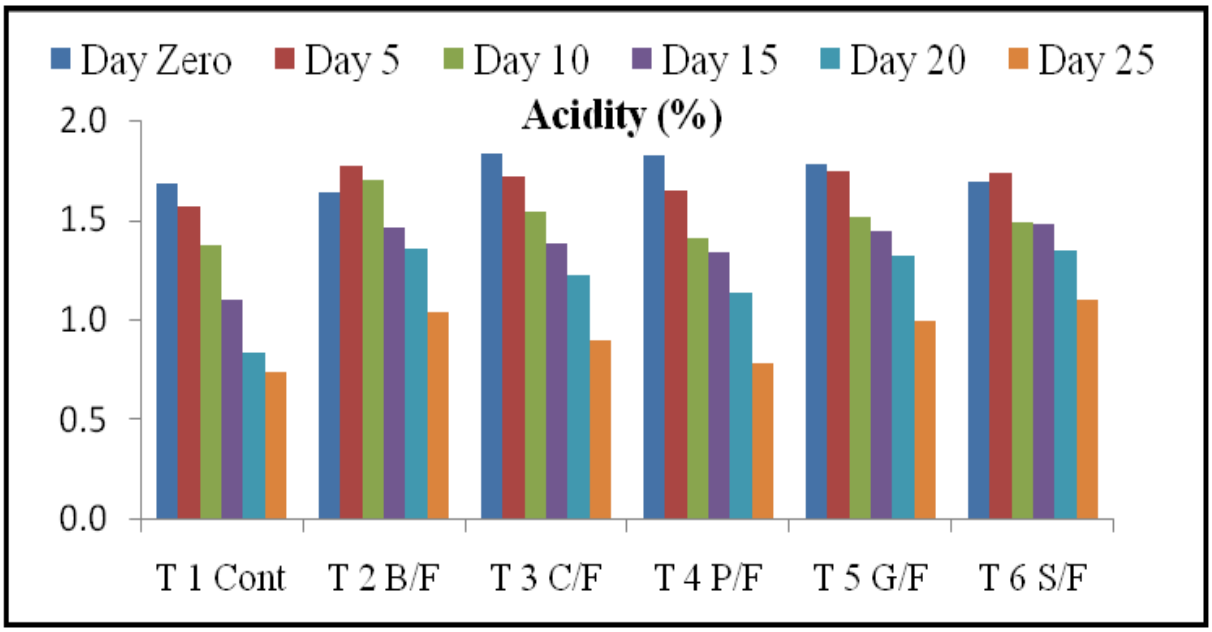


**Fig. 3.** Influence of various animal fats and storage on the Acidity (%) of mango fruit.

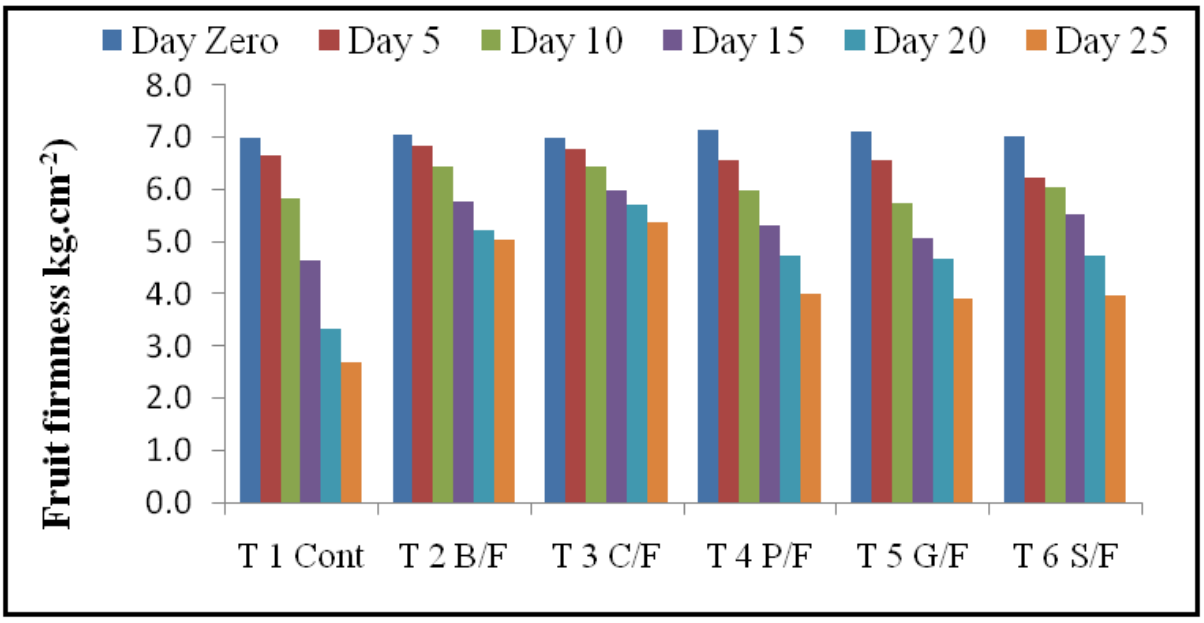


**Fig. 4.** Influence of various animal fats and storage on the firmness of mango fruit.

Mango fruit was also analyzed for titratable acidity with 5 days interval for 25 days. The fats coated mangoes showed gradual but significant ($p<0.05$) changes in titratable acidity during storage (Fig 3). The maximum mean value of (1.49) for titratable acidity was recorded for buffalo fat coated mangoes and minimum means value (1.22) was observed in control samples. Minimum decrease in acidity could be due to cause that buffalo fat coating slowed the respiration process and the water losses from the fruit. Findings in this research are in similarities with Bai*et al.*, (1998) who specified that the fruit coatings could help the fruits to reduce water loss and low down the respiration level. Coating is the barrier to alter the gases exchange which can increase in internal carbon dioxide contents and decreases the acidity which slows down the maturing method of the fruits (Bai *et al.*, 1998). The change in acidity is related to numerous reasons; it may be because of the effect of treatments (coating) on the biochemical state of the fruit and lower level of respiration rate and metabolic activities (Jitareerat *et al.*, 2007).

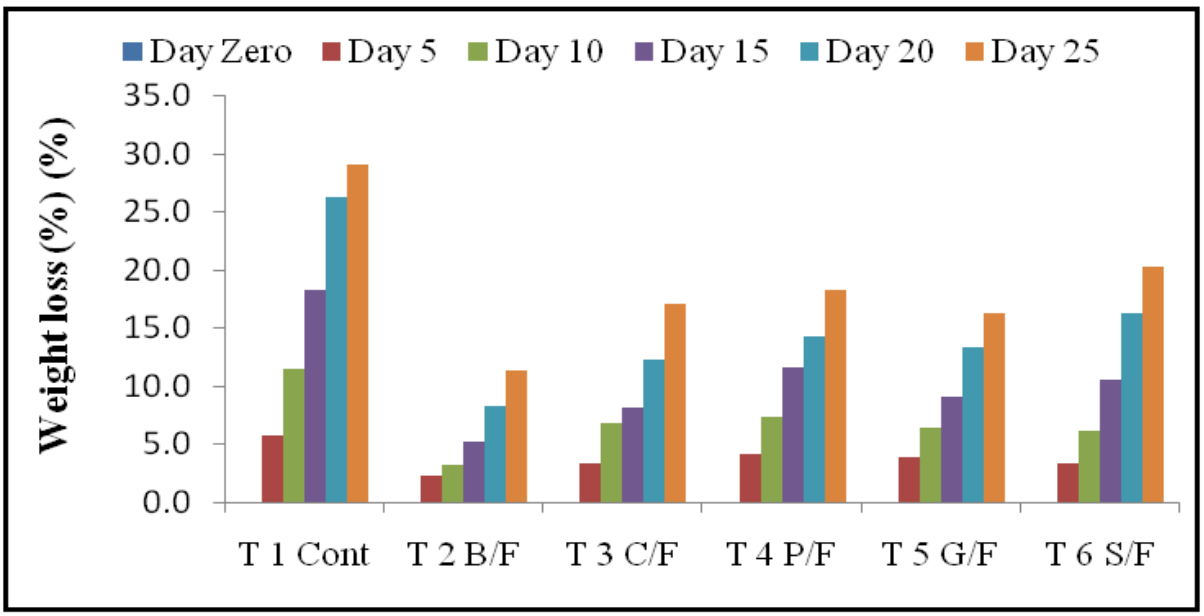


**Fig. 5.** Influence of various animal fats and storage on the weight loss (%) of mango fruit.

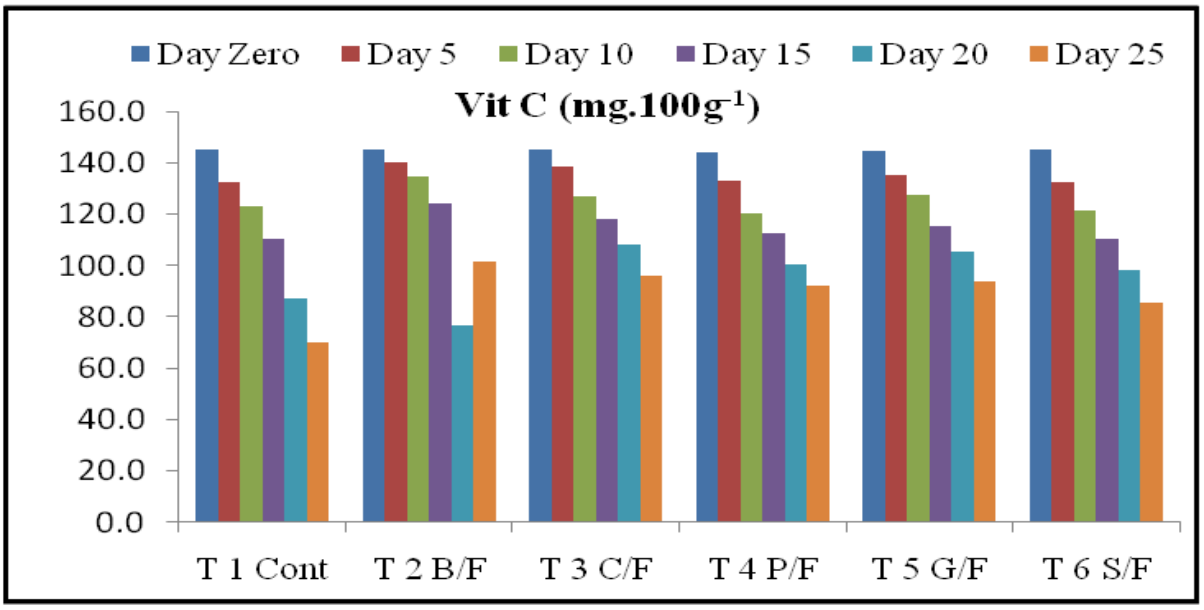


**Fig. 6.** Influence of various animal fats and storage on the vitamin c of mango fruit.

Data regarding total soluble solid (TSS) was investigated with 5 days of interval during 25 days of storage. This is revealed from the results that TSS was increased during storage (Fig 2). Maximum mean value was observed for Control samples (20.48 ˚Brix), while minimum mean value (13.13 ˚Brix) was observed for sample coated with BF.

The maximum mean value (24.77 ˚Brix) in storage was observed on day 25 and lowermost mean values (7.44 ˚Brix) were perceived on zero day of storage. The rise in TSS might be due to conversion of sucrose into glucose and fructose and increase in temperature, and also due to the conversion of polysaccharide into soluble sugar. Majid*et al.*, (2007) reported that the conversion of soluble polysaccharides into sugar affects the total soluble solids during storage. TSS content of preserved mango pulp during storage was probably due to conversion of free polysaccharides into monosaccharide (Jain and Nema, 2007). The increase in soluble solid contents could be attributed to the breakdown of carbohydrate into simple sugar and glucose (Kittur *et al.*, 2001).

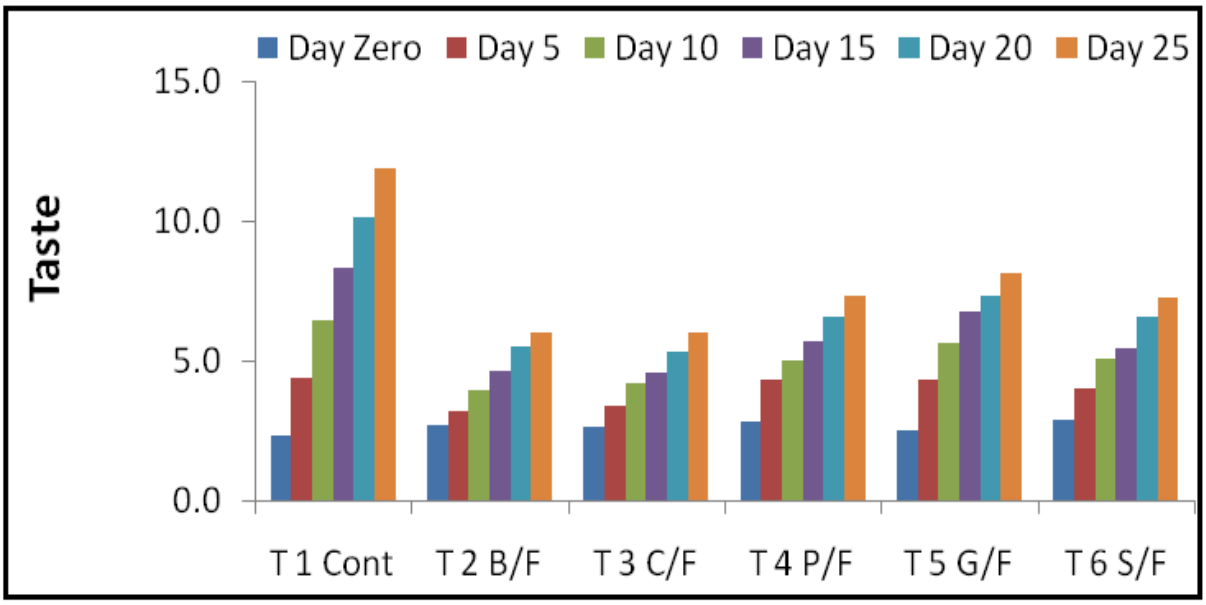


**Fig. 7.** Influence of various animal fats and storage on the taste of mango fruit.

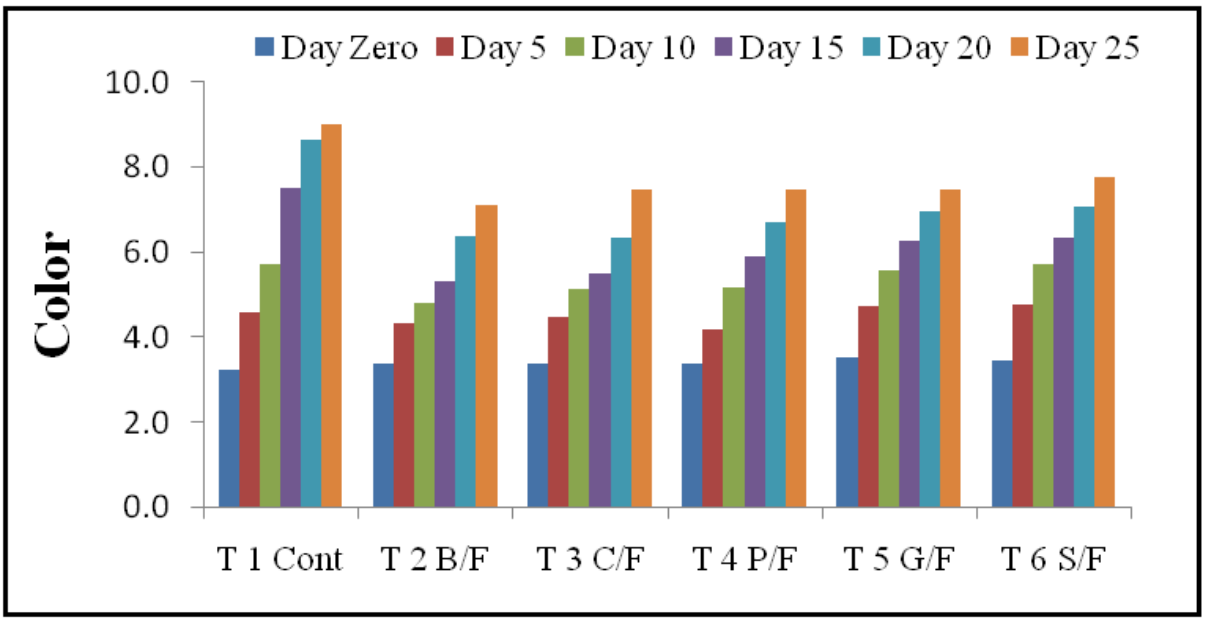


**Fig. 8.** Influence of various animal fats and storage on the color of mango fruit.

Both animal fat coatings and storage intervals had significant ($p<0.05$) effects on the ascorbic acid content of mango fruits (Fig 6). In control samples the reduction in ascorbic acid content was much higher than mango fruits coated with selected animal fats. Among the treated samples maximum mean value of ascorbic acid was recorded for mango fruits coated with CF (122.1 mg/100 g) and minimum was observed in the samples coated with PF (115.4 mg/100 g).This is also observed from the present study that ascorbic acid level was low in ripe fruits as compared to unripe fruits. However, coating of mangoes had slowed down the maturing (ripening) process of the fruits. Vitamin C content declined when fruits coated at low temperature of 2°C with chitosan. Vitamin C is very susceptible to oxygen and hence it is converted into dehydro ascorbic acid during storage (Willis *et al.*, 1981). Ahmed *et al.*, (2007) stated that Valencia oranges layered with 30% concentrated jojoba oil has less losses of ascorbic acid than uncoated fruits. Mathooko (2003) had also observed same results in tomato, stored at high carbon dioxide. Ayranci and Tunc, (2004) reported that vitamin C losses can be decreased by keeping the

food away from oxygen. They also stated that the losses of Vitamin C are suppressed by chitosan coating by creating a modified atmosphere.

Decay index (%) was observed in both in control and couple of coated samples was observed after 8 days of storage, which gradually increased with the progressing in storage days (**Fig** 11). This is shown from the data that maximum mean value of decay was recorded in control (10.83 %) and minimum was observed in BF coated mangoes (1.0%). As expected, coating of mango fruits with selected animal fat had decreased the percent decay by lowering the respiration and ripening process effectively. Baldwin *et al.*, (1999) also reported that decay can be reduced by coating material like carnauba wax and polysaccharide treatment in "Tommy Atkins" mango fruit. Similarly, polysaccharide based treatment and carnauba wax coating reduced decay in "Tommy Atkins" mango fruit (Baldwin *et al.*, 1999).

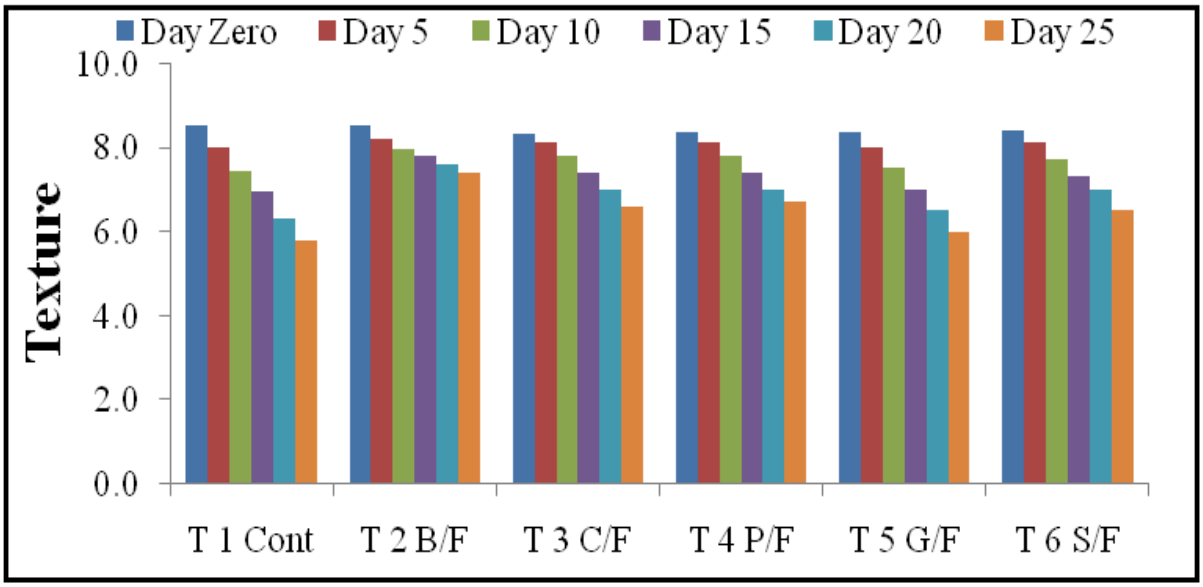


**Fig. 9.** Influence of various animal fats and storage on the texture of mango fruit.

*Sensory attributes*

Mango fruits coated with buffalo, cow, goat sheep and poultry fat along with control samples were studied for color, taste, texture and overall acceptability during 25 days of storage with 5 days of intervals and discussed below.

This is concluded form the statistical analysis that coating and storage both had significantly ($p<0.05$) affected the color of the mango fruits (Fig 8). FRO this research green and immature fruits were selected, so initially the fruits were of same color before storing, which gradually changed to yellow. Changes in color from green to yellow in control were much higher than that of coated ones. Maximum color score (6.43) was noted for control and minimum (5.23) was recorded for BF coated fruits. This ensure and confirm that the coating had reduced ripening process and respiration which in turns maintained the green color of the fruits to extend the shelf life and improved keeping quality. These results are well supported by the findings of (Herianus *et al.*, 2003). Coating material is considered best in term of maintaining natural color, aroma and taste of horticultural products as it reduces rate of respiration and biochemical activities inside fruits (Herianus *et al.*, 2003).

The analysis of variance show significant ($p < 0.05$) difference among the samples during 25 days of storage (Fig 7). Initially during storage taste of the control samples were much better than that of coated samples. Mango fruits coated with BF had higher (3.77) mean and maximum mean for taste score was observe for control (5.89).The change in the taste is due to the anaerobic respiration produced by the

microorganisms. It may be due to variations in pH, sugar/acid ratio and acids (Malundo *et al.*, 1997). Similar result was also reported by Munoz *et al.*, (2006) that chitosan coating has better impact on strawberries at storage temperature of 20°C for 4 days which maintain natural quality of fruit.

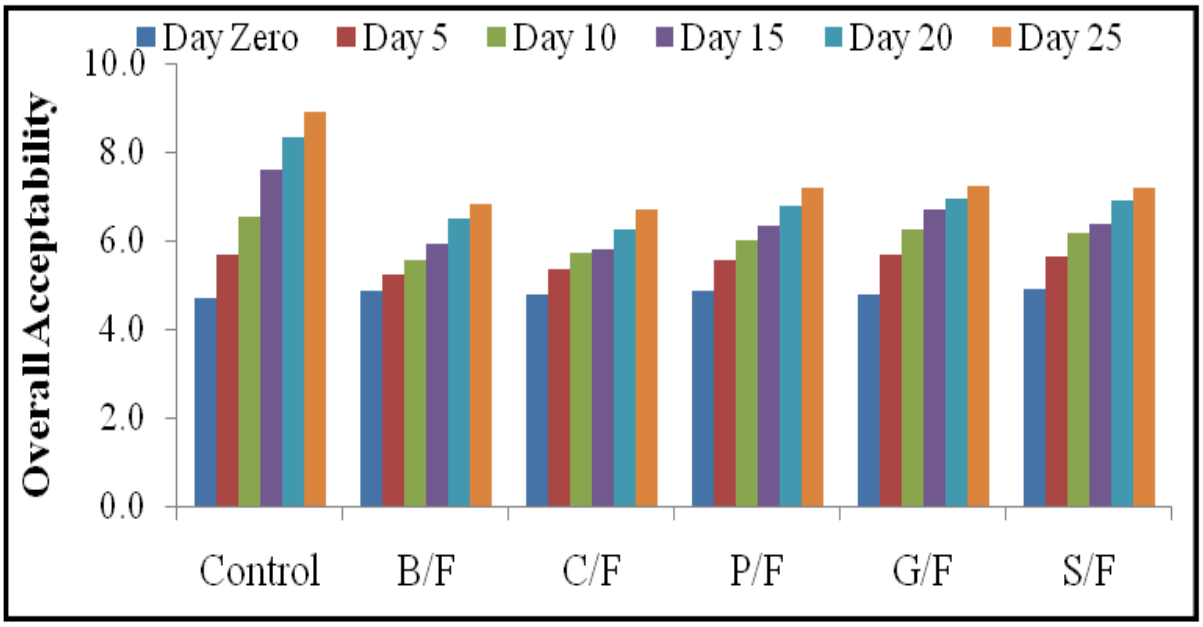


**Fig. 10.** Influence of various animal fats and storage on the overall acceptability of mango fruit.

Animal fat coating fat had significantly (p 0.05) influenced the texture of the mangoes during storage (Fig 10). Means regarding treatment showed that mangoes coated with BF had higher (7.91) texture score and control mango samples had lower (7.16).

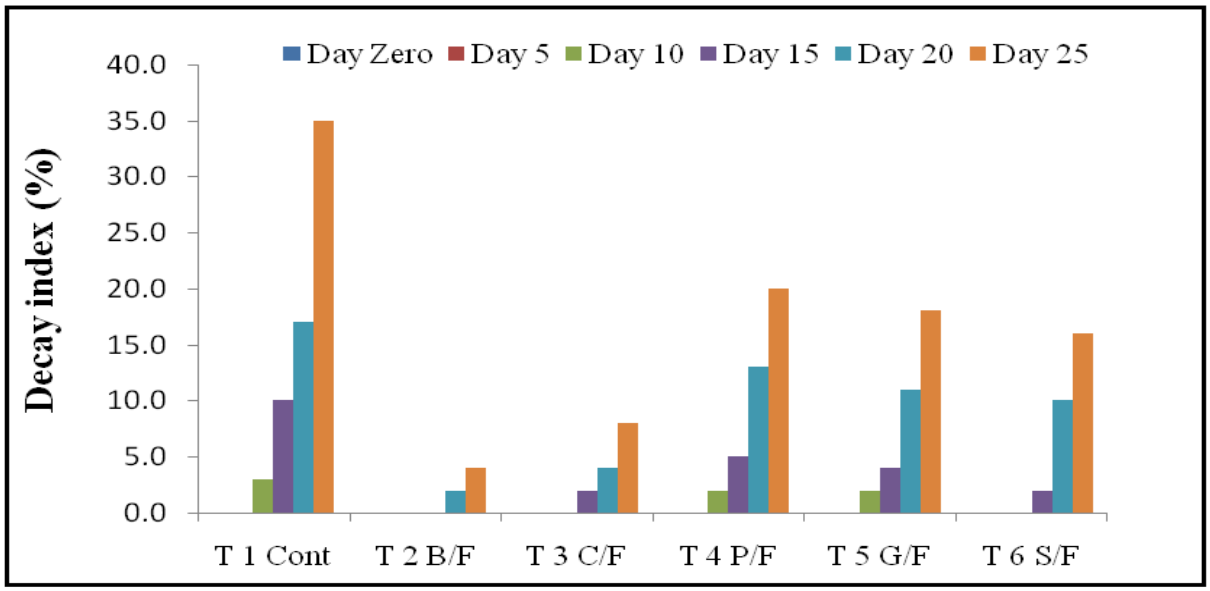


**Fig. 11.** Influence of various animal fats and storage on the overall acceptability of mango fruit.

This was also very clear from the mean values of storage interval that texture of the mango fruits was reduced significantly from (8.39) at zero day to (6.24) at day 25. Coating reduce evaporation rate from the fruit. Ripening process can be reduced by reducing physic-chemical changes in fruits by controlled or modified environment. Coating materials modify atmosphere around the fruit surface which help in

delaying changes in texture by reducing changes in pectin substances (Ahmed *et al.*, 2017).

This is observed that with passage of time the overall acceptability of all the sample fruits was increased (Fig 11). This might be due to the selection of immature (green) fruits for the study, which during storage softens, change color from green to yellow and also developed its characteristic taste and flavor and in turns positively influenced the sensory attribute collectively. Control samples had higher (6.5) over all acceptability, while least mean value was recorded for mango fruits coated with BF (5.6).

The result are in line with Majid *et al.*, (2007) and Akhtar *et al.*, (2009) who suggested that usage chemical preservative is very useful in retaining overall acceptability as it have maximum sensory value and nutrient stability at room temperature. (Akhtar *et al.*, 2009) reported that pulp of chaunsa mango were highly acceptable for judges regarding the test for various sensory attributes.

**Conclusion**

Mangoes fruits were coated with buffalo, cow, goat, sheep and poultry fat and were studied for various physico-chemical and sensory attributes.

It was revealed from the study that mangoes coated with buffalo fat shown best result than rest of the samples including control. All the selected animal coating had significantly influence mango fruit pH, TSS, ascorbic acid, titratable acidity, fruit firmness, weight loss, percent decay, taste, color, texture, overall acceptability and delays the ripening process up to 25 days of storage.

On the other hand uncoated fruit were deteriorated after 12 days during storage as fungal growth was evident. However, this was observed that mangoes coated with buffalo fat were stayed sound for longer time than rest of the coated samples. After 23 days of storage mangoes coated with buffalo fat were start changing color to yellow and were fit for consumption as no fungal growth was detected.

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