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# Impact of some chemical preservatives on physicochemical quality of pulpy juice of black mulberry grown in northern area of Pakistan

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**Abstract**
This work is carried out investigate the effect of some chemical preservatives like (Potassium metabisulphite, citric acid, Potassium-sorbate and Sodium-benzoate) on physicochemical quality of black mulberry pulpy juice for the period of three months with 15 days interval. Acidity, pH, sugar/acid ratio, total soluble solids, ascorbic acid, reducing sugar, non-reducing sugar as well as organolyptically color, flavor and overall acceptability changes were monitored. Ascorbic acid, pH, sour acid ratio, non-reducing sugar, colour, flavor, and overall acceptability was declined from 25.21-9.69 mg/100g, 3.61-3.16, 12.60-8.78, 1.85-1.40%, 5.97-4.10, 7.07-3.65, 7.22-3.23 respectively. While during the storage period TSS was increased 18.10-19.72, titrate able acidity was augmented 1.44 to 2.25mg% and increment in reducing sugar was recorded 6.10 to 7.06%. Sample $MJ_3$ was most acceptable among the other treatments whereas $MJ_0$ showed poorest result during storage period.

**Keywords:** physicochemical, preservation, potassium sorbate, sodium benzoate, mulberry pulpy juice

## 1. Introduction
Mulberry (*M. nigra* L.) belongs to the family Moraceae and genus Morus and grows in tropical, subtropical and temperate regions of the world (Arabshahi-Delouee and Urooj, 2007) [4]. It is used as traditional fruit in china and is consumed fresh and also used in wine making, production of jam, juices and in canning industries (Ning *et al*., 2005) [24]. It has good medicinal value and some chemical compounds in it can protect against cancer and chronic diseases (Du *et al*., 2008; Perez-Gregorio *et al*., 2011) [28]. Mulberry fruits are of three types: red, black and white mulberry. The western Asia is the origin of white mulberry, north and South America is an origin of red mulberry while black mulberry originated from Southern Russia (Doymaz, 2004) [11]. According to different studies the fully ripped mulberry fruit possess 12% sugar content by average with countable malic and citric acid, but in some cases more than 20% sugar also observed in different varieties (Ahmad and Sadozai 2003) [1]. Two different studies (Elmac and Altuq, 2002 [14]; Ercisli and Orhan, 2007) [15] reported pH 3.52 to 5.6, acidity 0.25 to 1.79%, TSS 15.9 to 20.4 and ascorbic acid 19.4-22.4mg/100gm in different varieties of mulberry fruit. The products like these juices have very short shelf life and can spoil rapidly, so to increase storage life of juices; pasteurization is applied but this process give rise to produce irreversible changes in organoleptic properties as well as loss nutritional values (Patras *et al*., 2009 [27]; Cao *et al*., 2012 [8]; Zhou *et al*., 2009) [40]. Potassium metabisulphite is water soluble preservative that is commonly used in pulp and fruits drying with different permissible limits. Citric acid is naturally found in most of the fruits and is also practiced as preservative. Sorbic acid and potassium sorbate are permitted and most effective preservatives against food spoiling microorganism. They are odorless, flavorless and effective against molds, fungi and bacteria (Sofos and Naidu, 2000) [37]. Potassium sorbate is a common preservative quickly dissolve in water and restrains yeast and bacteria efficiently without damaging the organoleptic effects of juices and beverages (Rajashekhara *et al*., 2000 [31]; Varnam and Sutherland, 1999) [38]. Potassium salt (0.05 to 0.1%) is used in apple cider. (Davidson *et al*., 2002) [10] and also in preservation of figs, orange juice, apple juice and dehydrated prunes (Robach, 1980) [32]. The sorbic acid and potassium sobate are commonly used as preservatives in beverages because of their efficient action against bacteria yeast growth and molds (Varnam and Sutherland, 1999) [38]. In Cranberries, prunes and cloves benzoic acid is present naturally. When benzoic acid/benzoate is used in low concentrations, it is harmless without damaging organoleptic effects as well. It has remarkable preservation effects on beverages, acidic nature foods and fruit juices (Ihekoronye and Ngoddy, 1995) [17]. When these chemicals are used in concentration of 0.05 to 0.1 percent it shows efficacious results against fungi and most of the yeast species in pH ranges from 2.5 to 4.0 (Baird-Parker, 1980)[7]. Moreover benzoate is more economical as compare to other antimicrobial agents (Raju *et al*., 2000) [30].

## 2. Materials and Methods
Healthy fresh and ripe mulberry fruits were brought from the market of Skardu (Gilgit Baltistan) Northern Area of Pakistan, and transported to the analytical lab of PCSIR (Pakistan Council of Scientific and Industrial Research Centre) Skardu Pakistan station to carry out this research. After washing, sorting and grading, juice was extracted by pulper. The juice was pasteurized at 150 °F for 20 min (Awan, 1999) [5]. Four different chemical preservatives potassium metabisulphite, citric acid, potassium-sorbate and sodium-benzoate were added combine and separately.

The treatments were $MJ_0$ (Mulberry juice without preservatives),

- $MJ_1$ (Mulberry pulpy juice + 0.1 % sodium benzoate + 0.05 % citric acid).

- $MJ_2$ (Mulberry pulpy juice + 0.1 % potassium sorbate + 0.05 % citric acid).
- $MJ_3$ (Mulberry pulpy juice + 0.05 % sodium benzoate + 0.05 % potassium sorbate + 0.05 % citric acid).
- $MJ_4$ (Mulberry pulpy juice + 0.05 % sodium benzoate + 0.05 % potassium metabisulphite, 0.05 % citric acid).
- $MJ_5$ (Mulberry pulpy juice + 0.05 % potassium sorbate, + 0.05 % potassium metabisulphite + 0.05 % citric acid).

These treated Mulberry pulpy juice was then packed in 250ml transparent bottles (PET). Immediately each physical and chemical parameter was performed as initial sample for the all treatments and control. Consequently these samples were stored at (20-30$^o$C) ambient temperature and same parameters were repetitively accomplished for 90 days with 15 days intervals.

Different parameters like Ascorbic acid, pH, acidity, TSS, reducing sugar and non-reducing sugars were determined by using AOAC (2005) methods 967.21, 945.27, 942.15, 932.12, 925.36 and 925.35 respectively.

A panel of 10 judges selected from research students and staff of PCSIR research center Pakistan evaluated the juice for color, flavor and overall acceptability according to suggested method of Larmond (1977) [21]. Samples were compared by panel and score was assigned from 1-9, where 1 indicates extremely dislike and 9 indicates extremely like.

## 3. Results and Discussion

### i) Ascorbic acid

The effect of chemical preservatives on ascorbic acid in mulberry pulpy during the storage periods of three months has shown in table 1. The results show the ascorbic acid composition in mulberry juice affected by the storage time and treatments. The mean value of ascorbic acid for mulberry pulpy juice, dropped significantly ($p < 0.05$) from 25.21mg to 9.69 mg/100g. $MJ_3$ (20.13 mg/100g) has utmost mean value amongst all treatments while the sample $MJ_0$ (14.76) and $MJ_4$ (16.39) had lowest position in terms of mean value. In duration of three months storage maximum decrease was recorded in $MJ_0$ (79.96%) and lowest drop was in sample $MJ_3$ (43.63%). Ayub *et al.* (2010) [6,13] shown that addition of potassium sorbate and sodium benzoate would minimize loss of ascorbic acid content during storage period. With increase in time and temperature there was steady decrease (49.9mg to 32.8mg) in ascorbic acid content was detected. Ascorbic acid is slightest stable and sensitive vitamin and doomed when temperature increased. The value of this present work is good agreement with the conclusion of Muhammad (1986). They searched that the ascorbic acid decreases (18.96mg to 12.93mg) in citrus with passage of time.

### ii) pH

Variation in pH of treated mulberry juice during the storage period was presented in Table 2. The mean pH value was reduced significantly ($p < 0.005$) from 3.61 to 3.16. $MJ_3$ (3.48) has maximum mean value within all treatments whereas minimum mean value was studied in $MJ_4$ (3.26). Maximum drop was observed in sample $MJ_0$ (21.29 %) as compare to all treatments besides lowest decline in $MJ_3$ (8.24%).The effect of storage duration and treatments was significant ($p < 0.05$) on pH of mulberry pulpy juice. The investigation of Imran *et al.* (2000) revealed the reason to decrease in pH, they stated that when pectin breakdowns in organic acid then the pH of samples decrease. Muhammad *et al*., (2008) observed the similar finding during his research work and they scrutinized that pH decreased with passage of time while acidity increased during storage of apple jam. The conclusions of Hussain *et al.* (2010) [16] also supported the same inversely changes in acidity and pH. Safdar *et al.* (2010) also described reduction in pH during storage of tomato concentrate at three different temperatures.

### iii) TSS

The effects of preservatives on total soluble solids (TSS) of mulberry pulpy juice for three months storage period was shown in table 3. The mean value of TSS value was increased significantly ($p < 0.05$) from 18.10 to 19.73$^0$ brix. The maximal mean value of TSS among all treatments was examined in $MJ_4$ (19.06° brix) followed by $MJ_0$ (18.94° brix) while minimal value of mean was recorded in $MJ_3$ (18.63° brix) followed by $MJ_2$ (18.76° brix). Maximal increment in TSS was identified in $MJ_0$ (9.95%) followed by $MJ_4$ (9.50%) whereas minimal fall off was noted in sample $MJ_3$ (6.22%). TSS of mulberry pulpy juice was inclined by storage duration and treatments significantly ($p < 0.05$). The increment in TSS would be the result of inversion of sucrose into fructose and glucose due to low pH and temperature. The analyzed result of Ayub *et al.* (2010) [6,13] is same to our result. The work of Rab *et al.* (2011)[ 29] stated increase in TSS of orange preserved with wet heat treatment during storage at room temperature. Sabina *et al* (2011) [34] also reported significant increment in TSS during storage of strawberry juice.

### iv) Acidity

Acidity Change in percent acidity of treated mulberry pulpy juice was presented in Tables 4. Mean value of percent acidity increased significantly ($p < 0.05$) from 1.44 to 2.25. Sample $MJ_4$ (1.90) had shown the maximum mean value of % acidity followed by $T_5$ (1.88), although $MJ_3$ (1.73) showed the lowest mean value followed by $MJ_2$ (1.79). Greatest increase was recorded in sample $MJ_0$ (40.43%) that was followed by $MJ_4$ (38.56%) and minimum increase was shown in sample $MJ_3$ (31.55%) followed by $MJ_2$ (33.80%). Treatments and storage periods affect titrate able acidity of mulberry pulpy juice significantly ($p<0.05$). Nunes *et al.* (1995) had also reported that acidity of strawberry had significantly increased as time increases by the effect of treatments and storage. Dissolved or crumbled of pectin in pectinic acid is the main reason of increase in acidity. These results resembled to the research work of Iqbal *et al.* (2001). Increase in acidity due to degradation of pectin into organic compound was also observed by the Durani *et al.* (2010).

### v) Sugar /acid ratio

Impact of preservatives on sugar/acid ratio of mulberry pulpy juice was shown in Table.5. During storage intervals, the mean value of sugar/acid value significantly reduced from 12.60 to 8.78. $MJ_3$ had shown the greater mean value of sugar/acid ratio (10.93) and after that of MJ2 (10.62). The sample $MJ_4$ (10.20) had shown the least mean value followed by sample $MJ_1$ (10.24). Samples $MJ_0$ (33.82%) and $MJ_4$ (32.13%) had shown the maximum decrease in sugar/acid ratio while sample $MJ_3$ (27.05%) and $MJ_2$ (28.70%) showed the low decrease in sugar/acid ratio. The research work has revealed that storage intervals and applied treatments have a significant ($p < 0.05$) effect on sugar/acid ratio of black mulberry pulpy juice. In 1992 Chyau *et al*. analyzed that reducing sugar and sugar acid ratio increased during storage in guava fruit pectin. Randomness in

reducing sugar of treated mulberry juice was presented in Table 6. During the storage period the reducing sugar was increased significantly ($p<0.05$) from 6.10 to 7.06%. The samples $MJ_2$ (6.67%) and $MJ_3$ (6.62%) has shown the greatest mean value of reducing sugars and the least mean value in sample $MJ_0$ (6.50%) followed by MJ5 (6.53%). Reducing sugar was greatly increased in sample $MJ_0$ (15.45%) and then in sample $MJ_4$ (14.23%) while minimal increment was noted in $MJ_3$ (12.00%) followed by MJ2 (12.68%). Sugars are very important constituent of fruit based products. It acts as natural preservatives and contributes in flavor of products. Significant effect ($p < 0.05$) was observed in reducing sugar of black mulberry pulpy juice, due to the storage interval and treatments. It had also been studied that conversion of sucrose into reducing sugars speed up by the addition of acids and temperature Kinh *et al*. (2001) [20]. In 2013, Patil *et al.* had also reported the increase in glucose and fructose by degradation of pectin into organic acid at high temperature. Our present work is also resembles with the result of Ruiz-Nieto *et al.* (1997) [33] and Ayub *et al.* (2010) [6,13].

Unlike reducing sugars, non-reducing were gradually decreased and that variation was recorded in Table.7. During storage the non-reducing sugar of mulberry pulpy juice was gradually decreased. Mean value of non-reducing sugar was decreased significantly ($p<0.05$) from 1.85 to 1.40% during storage period. Sample $MJ_5$ (1.73) has shown the maximum mean value after $MJ_0$ (1.72). While sample $MJ_4$ (1.50) showed the minimum mean value followed by $MJ_1$ (1.52). Maximal fall off was noted in $MJ_0$ (27.86%) as compared to $MJ_4$ (25.00%) whereas minimum fall off was noted in sample $MJ_3$ (21.11%) followed by $MJ_2$ (23.16%).Storage intervals and treatments have a significant ($p < 0.05$) effect on reduction of reducing sugar of black mulberry pulpy juice. In 2008, Muhammad *et al*., reported the inversely change in reducing and non-reducing sugar during storage of apple jam. Yadav *et al*., (2014) [39] also described the addition in reducing sugar in juice of mulberry grown in India; however recorded reducing sugar content was by far lowered than present study. Research study of Hussain *et al.* (2010) [16] and Akesowan (2010) [2] are same to this work who stated that non reducing sugar decreased during storage.

**vi) Sensory evaluation**

Color is an important characteristic for consumer's attraction. Any food and drink can attract by its appearance and color. Color impacts the appealing effect to the consumer. Mulberry juice color hue was affected by storage intervals and treatments significantly. Reduction in sensory evaluated color of mulberry pulpy juice within 90 days storage period is shown in Figure 1. Most decline in color was occurred in sample $MJ_0$ (56.00%) followed by $MJ_4$ (50.00%) and $MJ_5$ (50.00%) while minimum reduction was showed in sample $MJ_3$ (13.10%) and $MJ_2$ (23.75%).

Diminution in flavor of treated mulberry juice is shown in Figure 1. Mulberry pulpy juice flavor was affected by storage intervals and applied treatment significantly ($p < 0.05$). Maximum loss was observed in sample $MJ_0$ (86.49%) followed by $MJ_4$ (64.81%) and minimum loss was noted in sample $MJ_3$ (17.28%) followed by $MJ_2$ (30.38%). Flavor of any food stuff is basically consists of taste and aroma that greatly influenced by the storage period. During storage the flavor of mulberry pulpy juice was decreased progressively and significantly at room temperature. Loss of flavor happened due to increased furfural and decreased ascorbic acid levels. In 1981 Shimoda and Osjima and in 2007 Hashmi *et al.* also studied that effect of storage resulting in loss of flavor in mango juice and regular decline was recorded. Higher loss in overall acceptability was noted in $MJ_0$ (86.84%) and $MJ_4$ (83.61%) while minimal loss was noted in sample $MJ_3$ (19.75%) followed by $MJ_2$ (32.91%). From the results it has been concluded that the overall acceptability of mulberry pulpy juice was affected significantly ($p < 0.05$) by storage intervals and treatments.

In the light of these facts result it is concluded that sample $MJ_3$ that containing 0.05% of sodium benzoate in combination with 0.05% potassium sorbate and 0.05% of citric acid, had shown best results. On the other hand sample $MJ_0$ (control) mulberry pulpy juice except preservative had worse results against physicochemical parameters as well as under the sensory acceptability grade.

**Table 1:** Effect of chemical preservatives and storage time on Ascorbic acid (mg/100g) of black mulberry pulpy juice

| Treatments | Storage time (Days) | | | | | | | Decrease (%) | Means |
|---|---|---|---|---|---|---|---|---|---|
| | Initial | 15 | 30 | 45 | 60 | 75 | 90 | | |
| | Mean ascorbic acid (mg/100g | | | | | | | | |
| $MJ_0$ | 25.20 | 21.81 | 17.11 | 14.75 | 11.01 | 8.40 | 5.05 | 79.96 | 14.76e |
| $MJ_1$ | 25.21 | 23.16 | 20.67 | 18.11 | 16.70 | 13.06 | 10.12 | 59.86 | 18.15bc |
| $MJ_2$ | 25.23 | 23.90 | 21.75 | 19.18 | 17.70 | 14.60 | 12.01 | 52.40 | 19.20ab |
| $MJ_3$ | 25.21 | 24.12 | 22.17 | 20.60 | 18.55 | 16.03 | 14.21 | 43.63 | 20.13a |
| $MJ_4$ | 25.21 | 22.16 | 19.60 | 16.11 | 13.70 | 10.01 | 7.96 | 68.43 | 16.39d |
| $MJ_5$ | 25.22 | 23.10 | 20.96 | 17.81 | 14.22 | 10.89 | 8.78 | 65.19 | 17.28cd |
| Mean | 25.21a | 23.04b | 20.38c | 17.76d | 15.31e | 12.17f | 9.69g | | |

**Table 2:** Effect of chemical preservatives and storage time on pH of black mulberry pulpy juice

| Treatments | Storage time (Days) | | | | | | | Decrease (%) | Means |
|---|---|---|---|---|---|---|---|---|---|
| | Initial | 15 | 30 | 45 | 60 | 75 | 90 | | |
| | Mean pH | | | | | | | | |
| $MJ_0$ | 3.71 | 3.58 | 3.41 | 3.29 | 3.17 | 3.06 | 2.92 | 21.29 | 3.31cd |
| $MJ_1$ | 3.61 | 3.55 | 3.49 | 3.41 | 3.36 | 3.29 | 3.24 | 10.25 | 3.42ab |
| $MJ_2$ | 3.62 | 3.51 | 3.47 | 3.43 | 3.38 | 3.34 | 3.29 | 9.12 | 3.43a |
| $MJ_3$ | 3.64 | 3.58 | 3.52 | 3.46 | 3.42 | 3.37 | 3.34 | 8.24 | 3.48a |
| $MJ_4$ | 3.50 | 3.43 | 3.32 | 3.25 | 3.18 | 3.11 | 3.03 | 13.43 | 3.26d |
| $MJ_5$ | 3.58 | 3.50 | 3.43 | 3.35 | 3.26 | 3.19 | 3.15 | 12.01 | 3.35bc |
| Mean | 3.61a | 3.53b | 3.44c | 3.37cd | 3.30de | 3.23ef | 3.16f | | |

**Table 3:** Effect of chemical preservatives and storage time on total soluble solids (TSS) of black mulberry pulpy juice

| Treatments | Storage time (Days) | | | | | | | Increase (%) | Means |
|---|---|---|---|---|---|---|---|---|---|
| | Initial | 15 | 30 | 45 | 60 | 75 | 90 | | |
| | Mean total soluble solids (TSS)/Brix | | | | | | | | |
| $MJ_0$ | 18.1 | 18.2 | 18.4 | 18.8 | 19.2 | 19.7 | 20.1 | 9.95 | 18.93a |
| $MJ_1$ | 18.1 | 18.3 | 18.5 | 18.7 | 18.9 | 19.3 | 19.6 | 7.65 | 18.77b |
| $MJ_2$ | 18.1 | 18.2 | 18.4 | 18.7 | 19.1 | 19.3 | 19.5 | 7.18 | 18.76b |
| $MJ_3$ | 18.1 | 18.2 | 18.4 | 18.6 | 18.8 | 19.0 | 19.3 | 6.22 | 18.63b |
| $MJ_4$ | 18.1 | 18.4 | 18.7 | 19.1 | 19.4 | 19.7 | 20.0 | 9.50 | 19.06a |
| $MJ_5$ | 18.1 | 18.3 | 18.6 | 18.9 | 19.3 | 19.5 | 19.8 | 8.59 | 18.93a |
| Mean | 18.10g | 18.27f | 18.50e | 18.80d | 19.12c | 19.42b | 19.72a | | |

**Table 4:** Effect of chemical preservatives and storage time on titrate able acidity of black mulberry pulpy juice

| Treatments | Storage time (Days) | | | | | | | Increase (%) | Means |
|---|---|---|---|---|---|---|---|---|---|
| | Initial | 15 | 30 | 45 | 60 | 75 | 90 | | |
| | Mean titrate able acidity | | | | | | | | |
| $MJ_0$ | 1.40 | 1.55 | 1.71 | 1.85 | 2.03 | 2.19 | 2.35 | 40.43 | 1.87a |
| $MJ_1$ | 1.46 | 1.60 | 1.73 | 1.87 | 1.99 | 2.13 | 2.27 | 35.68 | 1.86a |
| $MJ_2$ | 1.43 | 1.56 | 1.64 | 1.80 | 1.92 | 2.04 | 2.16 | 33.80 | 1.79b |
| $MJ_3$ | 1.41 | 1.52 | 1.61 | 1.71 | 1.82 | 1.95 | 2.06 | 31.55 | 1.73c |
| $MJ_4$ | 1.45 | 1.60 | 1.75 | 1.90 | 2.06 | 2.21 | 2.36 | 38.56 | 1.90a |
| $MJ_5$ | 1.47 | 1.60 | 1.74 | 1.88 | 2.01 | 2.15 | 2.29 | 35.81 | 1.88a |
| Mean | 1.44g | 1.57f | 1.70e | 1.84d | 1.97c | 2.11b | 2.25a | | |

**Table 5:** Effect of chemical preservatives and storage time on sugar/acid ratio of black mulberry pulpy juice

| Treatments | Storage time (Days) | | | | | | | Decrease (%) | Means |
|---|---|---|---|---|---|---|---|---|---|
| | Initial | 15 | 30 | 45 | 60 | 75 | 90 | | |
| | Mean sugar/acid ratio | | | | | | | | |
| $MJ_0$ | 12.92 | 11.74 | 10.76 | 10.16 | 9.45 | 8.99 | 8.55 | 33.82 | 10.37c |
| $MJ_1$ | 12.39 | 11.43 | 10.69 | 10.00 | 9.49 | 9.06 | 8.63 | 30.35 | 10.24c |
| $MJ_2$ | 12.65 | 11.66 | 11.21 | 10.38 | 9.94 | 9.46 | 9.02 | 28.70 | 10.62b |
| $MJ_3$ | 12.83 | 11.97 | 11.42 | 10.87 | 10.32 | 9.74 | 9.36 | 27.05 | 10.93a |
| $MJ_4$ | 12.48 | 11.5 | 10.34 | 10.31 | 9.41 | 8.91 | 8.47 | 32.13 | 10.20c |
| $MJ_5$ | 12.31 | 11.43 | 10.68 | 10.05 | 9.60 | 9.06 | 8.64 | 29.81 | 10.25c |
| Mean | 12.60a | 11.62b | 10.85c | 10.30d | 9.70e | 9.20f | 8.78g | | |

**Table 6:** Effect of chemical preservatives and storage time on reducing sugars of black mulberry pulpy juice

| Treatments | Storage time (Days) | | | | | | | Increase (%) | Means |
|---|---|---|---|---|---|---|---|---|---|
| | Initial | 15 | 30 | 45 | 60 | 75 | 90 | | |
| | Mean reducing Sugar (%) | | | | | | | | |
| $MJ_0$ | 6.02 | 6.19 | 6.27 | 6.44 | 6.65 | 6.78 | 7.12 | 15.45 | 6.50d |
| $MJ_1$ | 6.11 | 6.35 | 6.42 | 6.58 | 6.76 | 6.90 | 7.08 | 13.70 | 6.60b |
| $MJ_2$ | 6.13 | 6.49 | 6.57 | 6.69 | 6.82 | 6.94 | 7.02 | 12.68 | 6.67a |
| $MJ_3$ | 6.16 | 6.38 | 6.48 | 6.52 | 6.83 | 6.96 | 7.00 | 12.00 | 6.62ab |
| $MJ_4$ | 6.09 | 6.31 | 6.42 | 6.51 | 6.73 | 6.92 | 7.10 | 14.23 | 6.58bc |
| $MJ_5$ | 6.07 | 6.24 | 6.31 | 6.49 | 6.67 | 6.89 | 7.05 | 13.90 | 6.53cd |
| Mean | 6.10g | 6.33f | 6.41e | 6.54d | 6.74c | 6.90b | 7.06a | | |

**Table 7:** Effect of chemical preservatives and storage time on non-reducing sugars of black mulberry pulpy juice

| Treatments | Storage time (Days) | | | | | | | Decrease (%) | Means |
|---|---|---|---|---|---|---|---|---|---|
| | Initial | 15 | 30 | 45 | 60 | 75 | 90 | | |
| | Mean non-reducing Sugars (%) | | | | | | | | |
| $MJ_0$ | 2.01 | 1.90 | 1.81 | 1.73 | 1.61 | 1.52 | 1.45 | 27.86 | 1.72a |
| $MJ_1$ | 1.73 | 1.67 | 1.60 | 1.53 | 1.46 | 1.38 | 1.30 | 24.86 | 1.52d |
| $MJ_2$ | 1.90 | 1.83 | 1.75 | 1.66 | 1.57 | 1.50 | 1.46 | 23.16 | 1.67b |
| $MJ_3$ | 1.80 | 1.72 | 1.63 | 1.56 | 1.49 | 1.45 | 1.42 | 21.11 | 1.58c |
| $MJ_4$ | 1.72 | 1.67 | 1.57 | 1.49 | 1.42 | 1.36 | 1.29 | 25.00 | 1.50d |
| $MJ_5$ | 1.96 | 1.90 | 1.81 | 1.72 | 1.65 | 1.56 | 1.48 | 24.49 | 1.73a |
| Mean | 1.85a | 1.78b | 1.70c | 1.62d | 1.53e | 1.46f | 1.40g | | |

## 4. Conclusion

The basic purpose of this study is to utilize these fragile fruit in the form of preserved juice and investigate the effect of different chemical additives to conserve quality of mulberry pulpy juice and it is expected that the results of this study will be helpful to fulfill the market demands and also to increase shelf/storage stability besides minimizing the harvest loss of mulberry fruit in Pakistan as well as in other countries as Mulberry is quite perishable fruit. This research work can also be helpful in preserving the nutritional aspects of Mulberry. The results of this study would not only helpful for utilizing this fragile fruit in the form of preserve juice but also to conserve its quality. It is expected that this study will be helpful to fulfill the market demands and also to increase in shelf/storage stability besides minimizing the harvest loss of mulberry fruit.

## 5. Appendices

| | |
|---|---|
| MJ | Mulberry Juice |
| Jo - $J_5$ | Treatments 1 -5. |

## 6. Acknowledgments

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