

Quality assessment of apple (*Malus pumila* L.) juice treated with different chemical preservatives

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Abstract

The present investigation was conducted to evaluate the quality of Apple juice treated with sodium benzoate and potassium sorbate. The samples were packed in 500ml PET bottles and stored at ambient temperature for 3 months. The ascorbic acid content was declined during storage from 8.66 to 5.10 mg/100g. Minimum reduction recorded in AJ₃ (7.81)27.68% while maximum in AJ₀ (6.17)54.02%. The pH content of sweet cherry juice reduced from 4.38 to 3.32 while maximum reduction happened in AJ₀ (3.46)29.09% and minimum in AJ₃ (3.66)20.85%. Total soluble solids content was increased from 14.73 to 15.17°brix maximum increment was note in AJ₀ (15.37)7.21% while minimum in AJ₃ (14.83)1.80%. An increased in titratable acidity was found range from 0.85 to 1.15% maximum was recorded in AJ₀ (0.95)27.27 at the same time lowest in AJ₃ (0.04)25.21%. The sugar acid ratio was declined during storage period from 17.42 to 13.37 peck was note in AJ₀ (16.35)24.57% and minimum in AJ₃ (14.41)21.62%. Reducing sugar content of cherry juice was increased from 10.38 to 11.25% highest in AJ₀ (10.62)12.78% and lowest in AJ₃ (10.77)3.18% and reduction in non-reducing sugar was observed, the value ranged from 1.52 to 1.29% greatest in AJ₀ (1.29)40.90% and AJ₃ (1.88)8.33%.

Keywords: apple juice, chemical preservatives, cultivars, Gilgit Baltistan

1. Introduction

Apple (*Malus pumila* L.) belongs to genus *Malus*, is one of the most famous fleshy, stone, pulpy and temperate fruit. Apple fruit can be eaten as fresh, dried, pickled and processed into in jam, marmalades, and juices or canned product. The Apple fruits grown in more than 40 countries throughout the world commonly in those areas which having latitudes between 358N and 558S of temperate climates (Chadha, 2003). Swat, Chitral, Quetta and Gilgit Baltistan are the leading apple producing areas of Pakistan. According to statistical data the production and area under cultivation of apple fruits was estimated at 1,065 thousand hectares and 1,981 thousand tons respectively (Fruit. Veg. Condiments Stat. Pak. 2012-13)^[9]. In Gilgit Baltistan area under cultivation and production of apple fruits were estimated at 1302 hectares and 2,384 tons respectively (Agri. Stat. Dptt. Gilgit Baltistan. 2011-2012)^[1]. The values of pH, titratable acidity and total soluble solids in Apricot are ranged from 3.98 to 5.62, 1.5 to 2.55 and 15.51 to 24.56 respectively (Diaz-Mula *et al.*, 2009)^[7]. Sugar and organic acid ranged between 129-278 and 4.54 to 9.88 g/kg of fresh weight (Usenik *et al.*, 2008)^[22]. In the balance diet of human nutrition fruit juices play a key role because these are rich source of nutrients and instant source of energy and provide necessary nutrients such as fructose, glucose, ascorbic acids, folic acid, other vitamins, minerals, antioxidant, polyphenol and organic acids. (Kranz *et al.*, 2006)^[14]. Sodium benzoate and sorbates are widely used preservatives in soft drink industries.

At lower pH the effectiveness of sorbic acid reached its peak against yeasts and moulds growth but some time it also works at pH of 6.6 (Varnam & Sutherland., 1999)^[22]. Sorbates are efficient, flexible, tasteless, odorless, and non-toxic chemical

additives, due to it is widely range of foods such as juices, jams, breads, cheese, yogurt and other types of fruit (Sofa & Naidu, 2000). The aim of present investigation is minimize the post-harvest loses of Apricot fruits grown in Gilgit Baltistan, as Apple is one of the main cash crop of Gilgit Baltistan.

2. Materials and Methods

The Apple fruit were brought from the local orchard to PCSIR (Pakistan Council of Scientific and Industrial Research), Skardu Gilgit Baltistan.

2.1 Samples Preparation:

The Apple fruits were washed, graded and sorted after that juice were extracted by using fruit pulper. Sodium benzoate and Potassium sorbate were used as preservatives to the Apple juice and each sample were packed in PET (polyethylene terephthalate) bottles of the volume 500 ml.

Treatments

Following are the treatments

- AJ₀ = Apple juice without preservatives
- AJ₁ = Apple juice + 0.05% sodium benzoate + 0.1% citric acid
- AJ₂ = Apple juice + 0.05% potassium sorbate + 0.1% citric acid
- AJ₃ = Apple juice + 0.1% sodium benzoate + 0.1% citric acid
- AJ₄ = Apple juice + 0.1% potassium sorbate + 0.1% citric acid

Storage

The samples were store at room temperature for the period of

90 days and physicochemical, microbial and sensory analysis was conducted at 30 days interval during storage.

Physico-chemical Analysis

All the physico chemical analysis such as pH, Ascorbic acid, Total soluble solids (TSS, Titratable acidity, Sugar acid ratio, Reducing sugars and Non-reducing sugars were determined by the standard method of AOAC (2012) [2].

Statistical Analysis

All analytical parameters were tested in triplicates and the obtained data were calculated statistically by using Complete Randomized Design (CRD) two factor factorial experiment and means were compared by LSD test as followed by (Steel & Torrie, 1980) [21].

3. Results and Discussions

The Apple juice samples were analyzed for ascorbic acid content at the first stage the ascorbic acid content of Apple juice samples (CJ₀ to CJ₄) 8.69, 8.45, 8.55, 8.75 and 8.80 mg/100g then gradually decreased to 4.00, 5.65, 4.38, 6.40 and 4.10 mg/100g during the storage period. The result revealed that mean value of ascorbic acid content of Apple juice was reduced significantly ($p < 0.05$) from 8.66 to 5.10 mg/100 g during storage period. The treatment AJ₃ (7.81) contained large mean value as followed by AJ₁ (6.97) mg/100g as well as the treatment AJ₀ (6.17) was contained minimum mean followed by AJ₄ (6.20). For the period of the three months storage, maximum percentage reduction in ascorbic acid was examined in AJ₀ (54.02%) go after treatment AJ₄ (53.40%) and minimum decrease was recorded in treatment AJ₃ (27.68%) when contrasted to AJ₁ (33.52%) (Table-1). Ascorbic acid content of sweet cherry juice was significantly affected by the treatment applied and the storage time. Ayub *et al.* (2010) [3] checked the effect of potassium sorbate and sodium benzoate on ascorbic acid content they concluded that reduction of ascorbic acid from 49.9mg to 32.8mg recorded. Ascorbic acid is nominal stable vitamin since it is responsive and ruined as the temperature boost and affected by light during storage. The outcome of this research study is excellent conformity with the termination of Muhammad *et al.* (1986) they inspected that the ascorbic acid decreased (18.96mg to 12.93mg) in citrus through the passage of time. Durrani *et al.* (2010) also stated the humiliation of the ascorbic acid content (25.98 to 21.45 mg/100g) during the preservation of apple pulp. Sabina *et al.* (2011) work is also evidenced in reduction of ascorbic acid (48.1 to 35.9).

The pH of Apple juice was analyzed at every 30 days interval during three month of storage result indicated that pH was declined. At the first time pH of treatments (AJ₀ to AJ₄) were 4.33, 4.15, 4.82, 4.22 and 4.50, that has been decreased up to 3.07, 3.25, 3.65, 3.34 and 3.30. Reduction in mean value of pH occurred significantly ($p < 0.005$) from 4.38 to 3.32. Highest fall off was noted in treatment AJ₂ (3.99) followed by AJ₃ (3.66). On other hand lowest fall off was recorded in AJ₀ (3.46) contrast to AJ₁ (3.62). Reduction in term of percentage, the highest was found in AJ₀ (29.09%) followed by AJ₄ (26.66) while at the same time minimum was note in AJ₃ (20.85 %) go after AJ₁ (21.68) (Table-2). The tenure of storage and applied treatments had significant ($p < 0.05$) effect on the

pH of Apple juice. The cause of reduction of pH was pectin conversion in pectic acid which was explored by Imran *et al.* (2000) [11]. Ali (1965) [4] research work was also evidence that the acidity in juice raised when the pH declined during storage. Hussain *et al.* (2011) also concluded that as acidity was enhanced after that pH (4.30 to 2.90) were decreased. During apple pulp preservation Durrani *et al.* (2010) also confirmed that pH was declined from (3.71 to 3.65).

During three month of storage the Apricot juice was examined at every 30 days interval for total soluble solids content. The result showed that TSS was increased. At the early TSS of treatments (AJ₀ to AJ₄) were 14.80, 14.75, 14.70, 14.73 and 14.77°Brix that enhanced to 15.95, 15.05, 15.00, 15.00 and 15.65° Brix. The mean value increased significantly ($p < 0.05$) from 14.73 to 15.17. The highest mean value was reported in AJ₀ (15.37° Brix) followed by AJ₄ (15.05° Brix) at the same time lowest value was obtained in AJ₂ (14.82° Brix) nearby AJ₃ (14.83° Brix). In term of percentage increment highest was noted in AJ₀ (7.21%) go after AJ₄ (5.62%) although the smallest increment was noted in sample AJ₃ (1.80%) next with AJ₁ (1.90%) (Table-3). The percentage increase in total soluble solids of Apple juice may be that the sucrose content is upturned in fructose and glucose because of temperature. The conclusion of Ayub *et al.* (2010) is a harmony with our outcome that they found increment in TSS (16.5 to 17.4°). Rab *et al.* (2011) [18] preserved orange with heat treatments concluded that enrichment in TSS. Durrani *et al.* (2010) during apple pulp preservation also reported that increment in TSS (9.71 to 11.36°). Muhammad *et al.* (2011) *et al.* reported that an increment was occurred in TSS (9.75 to 11.39°) in apple pulp during the period of storage.

The Apple juice samples were analyzed at every 30 days of interval, results indicated that the titratable acidity was increased significantly ($p < 0.05$) during 3 month of storage statistically the data was shown in appendix-IV. At the beginning in treatment (AJ₀ to AJ₄) it was 0.80, 0.87, 0.85, 0.89 and 0.83, after 3 month storage increased up to 1.10, 1.17, 1.15, 1.19 and 1.13. Mean value increased from 0.80 to 1.15. Treatment AJ₃ (1.04) contained highest % acidity nearby AJ₁ (1.02), on the other hand AJ₀ (0.95) indicated minimum mean value nearby AJ₄ (0.98). The peak enhance was verified in treatment AJ₀ (27.27%) next with AJ₄ (26.54%) as well lowest increment was found in AJ₃ (25.21%) go after AJ₁ (25.64%) (Table_4). Titratable acidity of Apricot juice was affected significantly ($p < 0.05$) by storage time and treatment applied. Nunes *et al.* (2011) [16] worked on strawberry is witness of our study they investigated that % acidity increased significantly due to treatments applied and storage time. Main reason of increment in acidity may be due by the effect of sugar content and temperature. The work of Clydesdale *et al.* (1972) [5] is a proof that they concluded that the breakdown of pectin in to pectic acid increased the acidity. This research was also accordance with Iqbal *et al.* (2001) [12]. During the period of preservation of strawberry juice Sabina *et al.* (2011) [20] also found upgrading in % acidity (1.31 to 2.09).

When the Apricot juice samples were analyzed at every 30 days of interval during storage, reduction in sugar acid ratio was found, at initial stage in treatments (AJ₀ to AJ₄) it was 18.50, 16.95, 17.29, 16.55 and 17.79, then declined up to 14.50, 12.86, 13.04, 12.60 and 13.84 throughout storage

tenure. The table-5 contained significantly ($p < 0.05$) degraded mean value from 17.42 to 13.37. Greatest mean value of sugar acid ratio hold by treatment AJ₀ (16.35) followed by AJ₄ (15.53) at the same time treatment AJ₃ (14.41) enclosed minimum value next with AJ₁ (14.73). Reduction in term of percentage, highest was observed in AJ₀ (24.57%) go after AJ₄ (24.12%) at the same time as treatment AJ₃ (21.62%) and AJ₁ (22.17%) illustrated the minimum fall off in sugar acid ratio (Table-5). This research work exposed that the storage intervals and applied treatments had significant ($p < 0.05$) impact on the sugar acid ratio of sweet cherry juice. Reduction in sugar acid ratio (14.31 to 13.81) also experienced in apple pulp preservation using various chemical preservatives by Durrani *et al.* (2010)^[7]. Muhammad *et al.* (2011)^[15] described that drop off in sugar acid ratio (29.14 to 28.13) during preservation of mashaday variety of apple.

In all the products which based on fruits, the sugars are a crucial constituent because it worked as flavor contributor and natural preservatives. Reducing sugar increment in treatments (AJ₀ to AJ₄) was occurred from 10.03, 10.75, 10.10, 10.65 and 10.35 to 11.50, 11.45, 11.05, 11.00 and 11.40. The mean values were enhanced significantly ($p < 0.05$) from 10.37 to 11.25. Maximum mean value was found in treatment AJ₁ (11.00) go after AJ₃ (10.77) at same time the lowest mean value was found AJ₂ (10.40) nearby AJ₀ (10.62). Increment in term of percentage, highest was found in treatment AJ₀ (12.78%) compared to AJ₄ (9.21%) while AJ₃ (3.18%) showed minimum increment followed to AJ₁ (6.11%) (Table-6) The treatment applied and duration of storage had significant ($p < 0.05$) impact no reducing sugar content of Apricot juice. Kink *et al.* (2001) concluded that in the rise of temperature

and action of acid present in juice convert the sucrose content in reducing sugar. Conversion of pectin into glucose and fructose due to temperature increase during storage had studied by Patil *et al.* (2013)^[17]. Ruiz-Nieto *et al.* (1997)^[19] research worked is good resemblance of our outcome. Increment in reducing sugar from 16.3 to 18.1 was also observed by Ayub *et al.* (2010).

When the Apricot juice was analyzed at every 30 days of interval during three month of storage the mean value of non-reducing sugar was decrease significantly ($p < 0.05$). Initially in treatments (AJ₀ to AJ₄) non reducing sugars were 1.55, 1.15, 1.45, 1.95 and 1.40, that later on declined up to 1.10, 1.00, 1.25, 1.80 and 1.20. Reduction happened in mean values significantly from 1.52 to 1.29. Among treatments the highest mean value was found in AJ₃ (1.88) go after AJ₂ (1.34) at the same time minimum was observed in AJ₁ (1.07) as compared to AJ₄ (1.28). Reduction in term of percentage, maximum was shown by treatment AJ₀ (40.90%) followed by AJ₄ (16.66%) while lowest reduction noted in AJ₃ (8.33%) nearby AJ₁ (15.00%) (Table_7). Result illustrated that the storage duration and applied treatment had significant impact on Apricot juice. During canning of citrus fruit Karim (1966)^[13] reported that increment in reducing sugar and reduction in non-reducing sugar occurred at ambient temperature is good accordance of our results. Ali (1965) finds out the breakdown of sucrose into glucose and fructose results in enhancement of reducing sugar while reduction of non-reducing sugar. Similarly Hussain *et al.* (2010)^[11] concluded in their research work that degradation in non-reducing sugar from (8.82 to 7.3) and Akesowan, (2010)^[6] also found same result.

Table 1: Effect of chemical preservatives and storage period on ascorbic acid content (mg/100g) of Apple juice

Treatments	Storage Interval (30 days)				% Decrease	Means
	Initial	30	60	90		
AJ ₀	8.74	6.39	5.61	4.01	54.01	6.12c
AJ ₁	8.47	7.47	6.22	5.62	33.55	6.91b
AJ ₂	8.59	6.86	5.32	4.35	49.03	6.32bc
AJ ₃	8.82	8.51	7.41	6.41	27.62	7.84a
AJ ₄	8.79	6.40	5.51	4.11	53.41	6.25c
Means	8.63a	7.31b	6.13c	5.09d		

Mean values followed by different small letters are significantly ($P < 0.05$) different from each other

Table 2: Effect of chemical preservatives and storage period on pH of Apple juice

Treatments	Storage Interval (30 days)				% Decrease	Means
	Initial	30	60	90		
AJ ₀	4.33	3.28	3.18	3.07	29.09	3.46c
AJ ₁	4.15	3.63	3.45	3.25	21.68	3.62bc
AJ ₂	4.82	3.81	3.70	3.65	24.27	3.99a
AJ ₃	4.22	3.65	3.39	3.34	20.85	3.66b
AJ ₄	4.50	3.45	3.35	3.30	26.66	3.65b
Means	4.38a	3.59b	3.43bc	3.32c		

Mean values followed by different small letters are significantly ($P < 0.05$) different from each other

Table 3: Effect of chemical preservatives and storage period on TSS of Apple juice

Treatments	Storage Interval (30 days)				% Decrease	Means
	Initial	30	60	90		
AJ ₀	14.80	14.85	15.90	15.95	7.21	15.37a
AJ ₁	14.75	14.80	14.85	15.05	1.99	14.86b

AJ ₂	14.70	14.75	14.84	15.00	2.00	14.84b
AJ ₃	14.73	14.77	14.82	15.00	1.80	14.83b
AJ ₄	14.77	14.80	15.01	15.65	5.62	15.05ab
Means	14.73b	14.87b	14.88ab	15.17a		

Mean values followed by different small letters are significantly ($P < 0.05$) different from each other

Table 4: Effect of chemical preservatives and storage period on acidity of Apple juice

Treatments	Storage Interval (30 days)				% Increase	Means
	Initial	30	60	90		
AJ ₀	0.80	0.90	1.00	1.10	27.27	0.95bc
AJ ₁	0.87	0.97	1.07	1.17	25.64	1.02a
AJ ₂	0.85	0.95	1.05	1.15	26.08	1.00c
AJ ₃	0.89	0.99	1.09	1.19	25.21	1.04c
AJ ₄	0.83	0.93	1.03	1.13	26.54	0.98ab
Means	0.85c	0.94c	1.04b	1.15a		

Mean values followed by different small letters are significantly ($P < 0.05$) different from each other

Table 5: Effect of chemical preservatives and storage period on sugar acid ratio of Apple juice

Treatments	Storage Interval (30 days)				% Decrease	Means
	Initial	30	60	90		
AJ ₀	18.50	16.50	15.90	14.50	24.57	16.35a
AJ ₁	16.95	15.25	13.87	12.86	22.17	14.73c
AJ ₂	17.29	15.52	14.13	13.04	23.83	14.99d
AJ ₃	16.55	14.91	13.59	12.60	21.62	14.41e
AJ ₄	17.79	15.91	14.57	13.84	24.12	15.53b
Means	17.42a	15.62b	14.42c	13.37d		

Mean values followed by different small letters are significantly ($P < 0.05$) different from each other

Table 6: Effect of chemical preservatives and storage period on reducing sugar of Apple juice

Treatments	Storage Interval (30 days)				% Decrease	Means
	Initial	30	60	90		
AJ ₀	10.03	10.05	10.90	11.50	12.78	10.62bc
AJ ₁	10.75	10.85	10.95	11.45	6.11	11.00a
AJ ₂	10.10	10.15	10.30	11.05	8.59	10.40c
AJ ₃	10.65	10.70	10.75	11.00	3.18	10.77ab
AJ ₄	10.35	10.40	10.45	11.40	9.21	10.65abc
Means	10.38b	10.43b	10.72b	11.25a		

Mean values followed by different small letters are significantly ($P < 0.05$) different from each other

Table 7: Effect of chemical preservatives and storage period on non-reducing sugar of Apple juice

Treatments	Storage Interval (30 days)				% Decrease	Means
	Initial	30	60	90		
AJ ₀	1.55	1.30	1.18	1.10	40.90	1.29b
AJ ₁	1.15	1.10	1.05	1.00	15.00	1.07c
AJ ₂	1.45	1.35	1.30	1.25	16.00	1.34b
AJ ₃	1.95	1.90	1.85	1.80	8.33	1.88a
AJ ₄	1.40	1.30	1.24	1.20	16.66	1.28b
Means	1.52a	1.41b	1.34bc	1.29c		

Mean values followed by different small letters are significantly ($P < 0.05$) different from each other

Conclusion

The present investigation was carried out on the Apple juice treated with two different chemical preservatives like potassium sorbate and sodium benzoate and it was revealed that the treatments and storage periods had significant ($p < 0.05$) impact on Apricot juice physico chemically. The Apple juice was packed in PET (polyethylene terephthalate) bottles at a volume of 1000 ml and stored at room temperature for 90 days. Treatment AJ₃ that contained 0.1% sodium benzoate + 0.1% citric acid had shown the best result

maintaining maximum quality followed by AJ₁, AJ₂ and AJ₄ on the other hand, AJ₀ (control) Apple juice without preservative had shown worse results under the sensory acceptability grade. The result showed that sodium benzoate had excellence effect on keeping maximum quality of sweet cherry juice as compare to potassium sorbate.

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