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Research Article

Quality assessment of apricot jam supplemented with *Sea buckthorn* pulp

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Abstract
This study was conducted to assess the quality of apricot jam supplemented with sea-buckthorn pulp. The treatments were AS_0 (Whole apricot), AS_1 (90% apricot and 10% sea buckthorn), AS_2 (80% apricot and 20% sea buckthorn), AS_3 (70% apricot and 30% sea-buckthorn) and AS_4 (50% apricot and 50% sea buckthorn). Physicochemical, sensory and microbial analysis was conducted at an interval of 15 days for two months storage. The ascorbic acid content was declined during storage from 51.65 to 43.53 mg/100g, the lowest decrease was noted in AS_4 (6.58%) while maximum reduction was in AS_0 (54.82%). The pH was declined during storage from 3.62 to 3.39. Total soluble contents were increased during storage from 66.88 to 67.30 ^{0}Brix. Titratable acidity also increased during storage from 0.65 to 1.09 %. Total reducing sugar content was increased during storage from 32.66 to 34.66%. The lowest non reducing sugar content was recorded in AS_4 (10.64%) while maximum in AS_0 (17.22%). Total phenolic content also declined during storage from 442.98 to 256.01 mgGAE/g, where minimum decreases was noted in AS_4 (39.20%) while maximum in AS_0 (43.86%). The color score given by the panel of judges was decreased from 8.0 to 4.96. The flavor score decreased from 7.86 to 4.78. The overall acceptability was decreased from 7.76 to 4.7, and minimum loss in score was noticed in AS_4(16.31%) andthe highestin AS_0 (79.30%). On the base of physico-chemical and sensory evaluation; treatment AS_4 (apricot pulp 50% + sea-buckthorn 50%) found to be good as compared to others treatments.

Keywords: Apricot; Gilgit-Baltistan; Jam; Phenolic contents *Seabuckthorn*; Supplementation

Introduction

Apricot botanically known as *Prunus armeniaca* is an important member of the family Rosaceae. "Khubani" is commonly used as local name for apricot in Pakistan. Apricot is considered as an important and vital fruit that is grown around the world. The worldwide production of apricots is about 38,31883 tones and the total area under apricot cultivation is 5,20455 hectares [1]. Globally Pakistan stands on third spot when it comes to the production of apricot and annual fresh production volume [2, 3]. The main apricot producing regions in Pakistan include Gilgit-Baltistan, Malakand division of Khyber Pakhtunkhwa (KPK), andthe upper parts of Balochistan [4]. Apricots are considered as the most delightful temperate fruit. Apricot fruit is a good source of glucose, sucrose, and fructose. It also good source of various mineral, vitamins and phenolic compounds [5, 6]. The imminence of vitamin C, E, carotenes, polyphenols and flavonoids

additionally add to the cancer prevention agent action of this fruit. Due to its natural antioxidant activity, apricot shows prominent defense and guard against malignancy (cancer) and coronary diseases like heart disease [7]. Apricot is also utilized as drug in the treatment of skin illnesses, parasitic infections and diseases. The fruit is considered as antipyretic, emetic, antiseptic and ophthalmic [8].

Sea-buckthorn botanically known as *Hippophae rhamnoides* is referred as a distinctive remedial, medicinal, and fragrant plant. It is an important member of the family Elaegnaceae. Sea-buck thorn is an middling and average sized and minor deciduous tree and an outsize shrub of 2.5-6 meter tall. The major stalk has a broad and bumpy woof or bark. Immature twigs or branches stay smooth and even whereas from color point of view grey and light ash in color with piercing spines and thorns [9]. Sea buckthorn bears yellow or orange red color berries [10]. In Pakistan sea buckthorn (*Hippophae rhamnoides*), is scattered in Northern regions like Kurram Agency, Chitral, upper Swat, Utror-Gabral, Gilgit, Astore, Ganche, Baltistan, Ladak and everywhere throughout the Northern regions from elevation of 1219 to 4266 m [11]. In general, the major components of the seabuck thorn seeds or berries are vitamin C, flavonoids, carotenoids, vitamin E, fatty acids, triacylglycerol, phytosterols, organic acids, phenolic compounds and proanthocyanins. Sea-buckthorn does not consist of anthocyanins usually for red and blue berries, and only very slight amounts of ellagitannins (hydrolysable tannins) have been detected [12]. The flesh or pulp of seabuck thorn carries a considerable superior quality oil that is very much important in health and therapeutic value [13]. Maximum sum of seed/kernel oil is 17.8% in *Hyppophae rhamnoides* sub spp. tibetana and lowest one is 7.8% in Hyppophaeneurocarpa [14]. In these days, it is well-known that sea buckthorn is affluent in bioactive compounds, and their health effects are studied precisely. A significant number of studies have been carried out in China, Russia, and other Asian countries [15]. Other fruit pulps were mixed with seabuckthorn berry's pulp to present a product with enhanced nutritional quality and complex amounts of carotenoids, vitamin E and antioxidants. This value-added invention could play an important role in human nutrition [16]. Keeping in view the above mentioned facts, this study was conducted to develop nutritionally rich apricot jam blended with sea-buckthorn pulp and evaluate the quality of jam among different treatments.

Materials and Methods

This study was conducted at Institute of Food and Nutritional Sciences, Pir Mehr Ali Shah Arid Agriculture University, Rawalpindi, Pakistan.

Collection of raw materials

The raw materials like apricot and sea buckthorn for jam preparation was collected from Gilgit-Baltistan a province of Pakistan with the help of Agriculture Department Skardu Baltistan.

Preparation of samples

The apricot and sea buckthorn sample were cleaned and washed properly for pulp preparation. The pulp was prepared by using pulpier machine and all the required samples were prepared accurately keeping in mind the treatment ratios. The treatment formulation is given in (Table 1).

Physicochemical analysis

Different physic-chemical parameters like ascorbic acid, total soluble solids, titratable acidity of the pH, reducing sugar and non-reducing sugar of blended jam prepared from apricot and sea buckthorn was determined by the standard method [17]. Total phenolic content of sample was determined by Folin-Ciocalteiu reagent method [18].

Table 1. Supplementations ratio of Sea-buckthorn pulp with Apricort

Code	Treatments
AS_0	Whole Apricot
AS_1	90:10 (Apricot: Sea buckthorn)
AS_2	80:20 (Apricot: Sea buckthorn)
AS_3	70:30 (Apricot: Sea buckthorn)
AS_4	50:50 (Apricot: Sea buckthorn)

Sensory evaluation

In order to examine the overall acceptability and quality of blended jam; sensory evaluation was carried out bya panel of trained judges.Jam samples were scored for quality parameters like color, flavor, taste and overall acceptability, according to the method [19].

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 [20].

Results and Discussion

pH

Apricot sea-buckthorn blended jam samples were analyzed for pH at every 15 days intervals during two months of storage. During storage pH value of the samples were decreased with the passage of time. As initially pH of apricot sea buckthorn blended jam samples (AS0 to AS4) were 3.80, 3.65, 3.60, 3.55 and 3.50, which is decreased up to 3.44, 3.37, 3.39, 3.38 and 3.41 respectively. Significantly pH values of the samples were decreased from 3.62 to 3.39 during storage. The revealed that maximum mean value (3.61) observed in AS_0 while minimum (3.50) in AS1. Decreases in pH may cause due to the formation and production of acidic compounds. The pH value of jam sample may also be change due to conversion of pectin into pectic acid (Table 2) [21].

Table 2. Effect of storage period and treatments on pH of apricot *Sea buckthorn* mixed jam

Treatments	Storage interval (days)						Means
	0 Day	15 Days	30 Days	45 days	60 Days	% decrease	
AS_0	3.80	3.71	3.6	3.53	3.44	9.47	**3.61a**
AS_1	3.65	3.58	3.5	3.44	3.37	7.67	**3.50b**
AS_2	3.60	3.55	3.51	3.44	3.39	5.83	**3.49b**
AS_3	3.55	3.51	3.47	3.43	3.38	4.78	**3.46b**
AS_4	3.50	3.48	3.45	3.43	3.41	2.57	**3.45b**
Means	**3.62a**	**3.56a**	**3.50b**	**3.45b**	**3.39c**		

AS_0= (Whole apricot), **AS_1**=(90:10 (Apricot: *Sea buckthorn*), **AS_2**=(80:20 (Apricot: *Sea buckthorn*), **AS_3**=(70:30 (Apricot: *Sea buckthorn*), **AS_4**=(50:50 (Apricot: *Sea buckthorn*)

Total soluble solids

Apricot sea-buckthorn blended jam samples were analyzed for total soluble solids at every 15 days intervals during two months of storage. During storage total soluble solids of the samples were increased with the passage of time. At initial stage the TSS of apricotsea-buckthorn blended jam (AS0 to AS4) were 65.53, 65.98, 66.51, 67.64and 68.75 ^{o}Brix which is increased up to 66.25, 66.50, 66.93, 67.92 and 68.90^{o}Brix respectively. The revealed that

maximum mean value (68.83) observed in AS_4 while minimum in AS_0. The results are close conformity with Durrani et al, (2008) who reported that TSS contents of apple and pear mixed fruit jam increased during storage with the passage of time. TSS contents in jam samples may be increased during storage due to the conversion of sucrose into glucose and fructose (Table 3) [22].

Table 3. Effect of storage time and treatments on TSS (^{0}Brix) of apricot sea buckthorn blended jam

Treatments	Storage interval (days)						Means
	0 Day	15 Days	30 Days	45 days	60 Days	% decrease	
AS_0	65.53	65.71	65.89	66.07	66.25	1.08	**65.89e**
AS_1	65.98	66.11	66.24	66.38	66.50	0.78	**66.24d**
AS_2	66.51	66.69	66.71	66.80	66.93	0.62	**66.72c**
AS_3	67.64	67.71	67.78	76.85	67.92	0.41	**67.78b**
AS_4	68.75	68.79	68.82	68.89	68.90	0.21	**68.83a**
Means	**66.88d**	**67.00c**	**67.08bc**	**67.19ab**	**67.30a**		

AS_0= (Whole apricot), **AS_1**=(90:10 (Apricot: *Sea buckthorn*), **AS_2**=(80:20 (Apricot: *Sea buckthorn*), **AS_3**=(70:30 (Apricot: *Sea buckthorn*), **AS_4**=(50:50 (Apricot: *Sea buckthorn*)

Titratable acidity

Apricot sea-buckthorn blended jam samples were analyzed for titratable acidity at every 15 days intervals during two months of storage. During storage titratable acidity value of the samples were increased with the passage of time. As initially titratable acidity of apricot sea buckthorn blended jam samples (AS0 to AS4) were 0.60, 0.65, 0.67, 0.69 and 0.68 % which is increased up to 1.10, 1.10, 1.12, 1.10 and 1.07 % respectively. Treatment AS3 (0.89) obtained highest mean value among all other treatments, followed by AS4 (0.87). On the other hand, the lowest mean value was recorded in the treatment AS0 (0.83) nearby AS1 (0.85). The titratable acidityof jam samples was increased due to hydrolysis of pectin into pectic acid (Table 4) [23-25].

Table 4. Effect of storage period and treatments on the titratable acidity (%) of apricot sea buckthorn blended jam

Treatments	Storage interval (days)						Means
	0 day	15 Days	30 Days	45 days	60 Days	% decrease	
AS_0	0.60	0.71	0.83	0.91	1.1	45.45	**0.83c**
AS_1	0.65	0.74	0.84	0.95	1.1	40.90	**0.85b**
AS_2	0.67	0.78	0.89	0.98	1.12	40.17	**0.88a**
AS_3	0.69	0.79	0.88	0.99	1.1	37.27	**0.89a**
AS_4	0.68	0.77	0.87	0.99	1.07	36.44	**0.87ab**
Means	**0.65e**	**0.75d**	**0.86c**	**0.96b**	**1.09a**		

AS_0= (Whole apricot), **AS_1**= (90:10 (Apricot: *Sea buckthorn*), **AS_2**=(80:20 (Apricot: *Sea buckthorn*), **AS_3**=(70:30 (Apricot: *Sea buckthorn*), **AS_4**=(50:50 (Apricot: *Sea buckthorn*)

Reducing sugar

Sugars are referred as crucial and vital constituent of all fruit based products due to their flavor contribution and natural preservative property. Apricot sea-buckthorn blended jam samples were analyzed for reducing sugar at every 15 days intervals during two months of storage. During storage reducing sugar value of the samples were increased significantly ($p< 0.05$) from 27.21 to 38.88 %. The greater reducing sugar content was

noted in AS0 (10.80%) whereas lowest value found AS1 (6.50%).During storage hydrolysis of sugar may be occurred therefore the reducing sugar content of the sample may be increased (Table 5) [26].

Table 5. Effect of storage time and treatments on reducing sugar content (%) of apricot sea buckthorn blended jam

Treatments	Storage interval (days)						Means
	0-Day	15 Days	30 Days	45 days	60 Days	% decrease	
AS_0	32.20	32.60	32.80	33.45	36.10	10.80	**33.43a**
AS_1	32.50	33.20	33.60	34.10	34.76	6.50	**33.63a**
AS_2	33.10	33.40	33.75	34.22	34.65	4.47	**33.82a**
AS_3	32.00	32.10	32.50	32.80	33.30	3.90	**32.62b**
AS_4	33.50	33.80	33.90	34.30	34.51	2.92	**34.00a**
Means	**32.66c**	**33.02bc**	**33.31b**	**33.70c**	**34.66a**		

AS_0= (Whole apricot), **AS_1**=(90:10 (Apricot: *Sea buckthorn*), **AS_2**=(80:20 (Apricot: *Sea buckthorn*), **AS_3**=(70:30 (Apricot: *Sea buckthorn*), **AS_4**=(50:50 (Apricot: *Sea buckthorn*)

Non-reducing sugar

Apricot sea-buckthorn blended jam samples were analyzed for non-reducing sugarat every 15 days intervals during two months of storage. During storage non-reducing sugarvalue of the samples were decreased with the passage of time. As initially non-reducing sugarof apricot sea buckthorn blended jam samples (AS0 to AS4) were41.50, 43.30, 42.79, 42.33 and 43.57% which is declined up to 34.35, 35.94, 37.55, 38.43 and 38.93 % respectively. The sugar content reduced from 42.67 to 37.04 significantly. In the treatment AS4 (41.25) maximum mean value was noted, go after treatment AS3 (40.83) (Table 6).

Table 6. Effect of storage period and treatments on non-reducing sugar content (%) of apricot sea buckthorn blended jam

Treatments	Storage interval (days)						Means
	0-day	15 Days	30 Days	45 Days	60 Days	% decrease	
AS_0	41.50	39.71	37.92	36.13	34.35	17.22	**37.92d**
AS_1	42.30	40.70	39.11	37.53	35.94	15.03	**39.11c**
AS_2	42.79	41.48	40.17	38.86	37.55	12.24	**40.17b**
AS_3	43.23	42.03	40.83	39.63	38.43	11.10	**40.83a**
AS_4	43.57	42.41	41.25	40.09	38.93	10.64	**41.25a**
Means	**42.67a**	**41.26b**	**39.85c**	**38.44d**	**37.04e**		

AS_0= (Whole apricot), **AS_1**=(90:10 (Apricot: *Sea buckthorn*), **AS_2**=(80:20 (Apricot: *Sea buckthorn*), **AS_3**=(70:30 (Apricot: *Sea buckthorn*), **AS_4**=(50:50 (Apricot: *Sea buckthorn*)

Ascorbic Acid

Apricot sea-buckthorn blended jam samples were analyzed for ascorbic acid at every 15 days intervals during two months of storage. During storage ascorbic acid value of the samples were decreased with the passage of time. As initially ascorbic acid of apricot sea buckthorn blended jam samples (AS0 to AS4) were 16.80, 32.62, 48.44, 64.26 and 96.15 mg/100g which is subsequently declined up to 7.59, 23.77, 39.92, 56.58 and 89.32 mg/100g respectively. The ascorbic acid content was reduced significantly ($p < 0.05$) from 51.65 to 43.53mg/100g. The treatment AS4 (92.99) demonstrated the maximum mean value followed by AS3 (60.43), as well as the lowest mean value was noted in AS0

(12.19). The degradation of the ascorbic acid might proceed anaerobically when once the devoured oxygen has been devoted by the chemical reactions; to form furfural ascorbic acid worsens by several steps under the anaerobic conditions [27, 28] also studied that in a strawberry jam there was a considerable decrease in the ascorbic acid content (Table 7).

Table 7. Effect of storage period and treatments on the ascorbic acid content (mg/100g) of apricot sea buckthorn blended jam

Treatments	Storage interval (days)						Means
	0 Day	15 days	30 Days	45 Days	60 Days	% decrease	
AS_0	16.80	14.50	12.20	9.89	7.59	54.82	**12.19e**
AS_1	32.62	30.40	28.19	25.98	23.77	27.13	**28.19d**
AS_2	48.44	46.31	44.18	42.05	39.92	17.58	**44.18c**
AS_3	64.26	62.34	60.42	58.58	56.58	11.95	**60.43b**
AS_4	96.15	94.59	93.00	91.41	89.82	6.58	**92.99a**
Means	**51.65a**	**49.62b**	**47.59c**	**45.58d**	**43.53e**		

AS_0= (Whole apricot), **AS_1**=(90:10 (Apricot: *Sea buckthorn*), **AS_2**=(80:20 (Apricot: *Sea buckthorn*), **AS_3**=(70:30 (Apricot: *Sea buckthorn*), **AS_4**=(50:50 (Apricot: *Sea buckthorn*)

Total phenolic content

Apricot sea-buckthorn blended jam samples were analyzed for total phenolic contents at every 15 days intervals during two months of storage. During storage total phenolic contents of the samples were decreased with the passage of time. As initially total phenolic contents of sea-buckthorn blended jam samples (AS0 to AS4) were514, 485.3, 456.6, 427.9 and 331.11 mg GAE/100gwhich is decreasedupto 288.52, 275.3, 263.8, 251.14 and 201.3 mg GAE/100g. In term of percentage reduction of total phenolic content, highest increase was noted in AS0 (43.86%) go after treatment AS1 (43.27%). Rababah *et al.* [29] also reported that total phenolic content of apricot jam reduced during storage. Our results also close conformity with the findings (Table 8) [30].

Table 8. Effect of storage period and treatments the on total phenolic content (mg GAE/100g) of apricot sea buckthorn blended jam

Treatments	Storage interval (days)						Means
	0- Day	15 Days	30 Days	45 days	60 Days	% decrease	
AS_0	514.0	457.63	401.26	344.89	288.52	43.86	**401.26a**
AS_1	485.3	432.8	380.3	327.8	275.3	43.27	**380.3b**
AS_2	456.6	408.4	360.2	312	263.8	42.22	**360.2c**
AS_3	427.9	383.71	339.52	295.33	251.14	41.30	**339.52d**
AS_4	331.11	291.72	252.33	212.94	201.3	39.20	**257.88e**
Means	**442.98a**	**394.85b**	**346.72c**	**298.59d**	**256.01e**		

AS_0= (Whole apricot), **AS_1**=(90:10 (Apricot: *Sea buckthorn*), **AS_2**=(80:20 (Apricot: *Sea buckthorn*), **AS_3**=(70:30 (Apricot: *Sea buckthorn*), **AS_4**=(50:50 (Apricot: *Sea buckthorn*)

Sensory evaluation

Color

Apricot sea-buckthorn blended jam samples were analyzed for color score at every 15 days intervals during two months of storage. During storage color score of the samples were decreased with the passage of time. As initially color score of sea-buckthorn blended jam samples (AS0 to AS4) were 7.50, 7.80., 8.0, 8.20 and 8.50, which reduced up to 2.12, 4.80, 5.16, 6.12 and 6.64.Highest mean value was observed in

AS4 (7.51) while lowest was noted in AS1 (6.30). [31] reported the reduction in color score (7.55 to 6.6) in apricot apple blended jam. Our results also closely related to the results of Chauhan et al, (2013) who also reported the declining tendency of color of coconut jam during storage time (Table 9).

Table 9. Effect of storage time and treatments on color (score rate) of apricot sea buckthorn mixed jam

Treatments	Storage interval (days)						Means
	0-Day	15 Days	30 Days	45 days	60 days	% decrease	
AS_0	7.50	6.13	4.77	3.47	2.12	71.73	**4.79d**
AS_1	7.80	7.05	6.30	5.56	4.80	38.46	**6.30c**
AS_2	8.0	7.29	6.58	5.87	5.16	35.50	**6.58bc**
AS_3	8.20	7.68	7.16	6.64	6.12	25.36	**7.16c**
AS_4	8.50	7.99	7.48	6.97	6.64	21.88	**7.51d**
Means	**8.0a**	**7.22b**	**6.45c**	**5.70d**	**4.96d**		

AS_0= (Whole apricot), **AS_1**= (90:10 (Apricot: *Sea buckthorn*), **AS_2**=(80:20 (Apricot: *Sea buckthorn*), **AS_3**=(70:30 (Apricot: *Sea buckthorn*), **AS_4**=(50:50 (Apricot: *Sea buckthorn*)

Flavor

The aroma and the taste of any food substance collectively essential to form the flavor. Apricot sea-buckthorn blended jam samples were analyzed for flavor at every 15 days intervals during two months of storage. During storage flavor of the samples were decreased with the passage of time. As initially flavor score of sea-buckthorn blended jam samples (AS0 to AS4) were 7.0, 7.40, 8.01, 8.30 and 8.60, which is declined up to 1.32, 4.15, 5.09, 6.34 and 7.04 respectively. The highest means value was found in AS4 (7.82) while lowest value observed in AS1 (7.32). During storage interval the loss of volatile aromatic compounds and substances might be one of the basic reasons due to which the flavor was decreased (Table 10) [32].

Table 10. Effect of treatments and storage period on flavor (score rate) of apricot sea buckthorn blended jam

Treatments	Storage interval (days)						Means
	0-Day	15 days	30 Days	45 days	60 Days	% decrease	
AS_0	7.0	5.58	4.17	2.74	1.32	81.14	**4.16d**
AS_1	7.4	6.59	5.78	4.98	4.15	43.91	**5.78c**
AS_2	8.01	7.28	6.55	5.82	5.09	36.45	**6.55bc**
AS_3	8.30	7.81	7.32	6.83	6.34	23.61	**7.32ab**
AS_4	8.60	8.21	7.82	7.43	7.04	18.13	**7.82a**
Means	**7.86a**	**7.32ab**	**6.32bc**	**5.56c**	**4.78d**		

AS_0= (Whole apricot), **AS_1**= (90:10 (Apricot: *Sea buckthorn*), **AS_2**=(80:20 (Apricot: *Sea buckthorn*), **AS_3**=(70:30 (Apricot: *Sea buckthorn*), **AS_4**=(50:50 (Apricot: *Sea buckthorn*)

Overall acceptability

Apricot sea-buckthorn blended jam samples were analyzed for overall acceptability at every 15 days intervals during two months of storage. During storage overall acceptability of the samples were decreased with the passage of time. As initially overall acceptability of sea-buckthorn blended jam samples (AS0 to AS4) were marked by judges as 8.02, 7.90, 7.50, 7.80 and 7.60 that subsequently declined up to 1.66, 4.34, 5.06, 6.08 and 6.36 respectively. The mean value of overall acceptability was declined

significantly ($p < 0.05$) from 7.76 to 4.7. As the color and flavor of jam samples were also decreased during storage period, so these collective changes also declined the overall acceptability of the jam samples (Table 11). Decrease in overall acceptability was also reported by [31].

Table 11. Effect of treatments and storage period on overall acceptability (score rate) of apricot sea buckthorn blended jam

Treatments	Storage interval (days)						Means
	0 Day	15 days	30 Days	45 Days	60 Days	% decrease	
AS_0	8.02	6.43	4.84	3.25	1.66	79.30	**4.84b**
AS_1	7.90	7.01	6.12	5.23	4.34	45.06	**6.12a**
AS_2	7.50	6.89	6.28	5.67	5.06	32.53	**6.28a**
AS_3	7.80	7.37	6.94	6.51	6.08	22.05	**6.94a**
AS_4	7.60	7.29	6.98	6.67	6.36	16.31	**6.98a**
Means	**7.76a**	**6.99ab**	**6.23bc**	**5.46cd**	**4.7d**		

AS_0= (Whole apricot), **AS_1**= (90:10 (Apricot: *Sea buckthorn*), **AS_2**= (80:20 (Apricot: *Sea buckthorn*), **AS_3**=(70:30 (Apricot: *Sea buckthorn*), **AS_4**=(50:50 (Apricot: *Sea buckthorn*)

Conclusion

Results revealed that the treatments and the storage time have a significant effect and impact on all parameters. On the base of physico-chemical and sensory evaluation treatment AS_4 (apricot pulp 50% + sea buckthorn 50%) found to be good as compare to others treatments.

Authors' contributions

Conceived and designed the experiments: Z Abbas & A Sohail, Performed the experiments: Z Abbas, M Mazahir & A Mehdi, Analyzed the data: M Mazahir, W Ali & M Asim, Contributed materials/ analysis/ tools: A Sohail & Azher Mehdi, Wrote the paper: Muhammad, S Bashir & M Mazahir.

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