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Ghanwat Archana B
PG Student, Department of Horticulture, Vasantrao Naik Marathwada Krishi Vidyapeeth, Parbhani, Maharashtra, India

Khandare VS
Research Officer, Horticulture Research Scheme, Vegetable Vasantrao Naik Marathwada Krishi Vidyapeeth, Parbhani, Maharashtra, India

Syed SJ
Ph.D. Scholar, Department of Horticulture, College of Agriculture, Parbhani, Vasantrao Naik Marathwada Krishi Vidyapeeth Parbhani, Maharashtra, India

Correspondence
Ghanwat Archana B
PG Student, Department of Horticulture, Vasantrao Naik Marathwada Krishi Vidyapeeth, Parbhani, Maharashtra, India

Effect of various treatments on physico-chemical composition of Indian gooseberry (*Emblica officinalis*) candy during storage

Ghanwat Archana B, Khandare VS and Syed SJ

Abstract
The present investigation was carried out during 2015-16, at Department of Horticulture, V.N.M.K.V., Parbhani, Maharashtra. The aonla candy was made up by using different treatments i.e. sugar syrup solutions, dipping time and drying methods. There are two levels of sugar syrup concentrations i.e. 60% and 70%, three dipping times i.e.36 hrs. 42 hrs. and 48 hrs. and 3 drying methods i.e. sun drying, solar drying and cabinet drying.. 18 treatment combinations were taken in FCRD with 3 replications. The aonla candy was evaluated for various physico-chemical constituents after preparation of candy and during storage of candy. During storage period there is significant decrease was observed in TA, ascorbic acid and tannins whereas TSS was increased in aonla candy. A gradual and significant decrease in TA of aonla candy was observed during 120 days storage period. The decrease in TA during storage might be due to the co-polymerization of organic acids with sugars and amino acids and loss of volatile acids during storage. The decrease in ascorbic acid during storage was observed during storage, the possible reason of reduction in vitamin C could be due to oxidation by oxygen, which resulted in formation of Dehydroascorbic acid. Gradual decline in tannin during storage might be due to their condensation into brown pigments. A significant increase in TSS was observed during storage period.

Keywords: Aonla, sugar, candy, titratable acidity, ascorbic acid

Introduction
Aonla is one of the oldest Indian fruits and considered as "Wonder fruit for health" (Ganachari *et al*., 2010) [5]. Aonla (*Phyllanthus emblica* L.), a member of family Euphorbiaceae and sub family Phyllanthoides, is native to India, Ceylon, Malaya and China (Mishra *et al.*, 2010) [10]. It is also known as Indian gooseberry, Amalaki, Amla, Amlet, Amolphal, Aovla, Aurna, Chukna, Dhatriphala, Emblic myrobalan, Nelli and Sobju in different parts of world (Agarwal and Chopra, 2004) [2]. India ranks first in the world in area and production of aonla crop (Priya and Khatkar, 2013) [14, 17]. Its cultivation is concentrated mainly in Uttar Pradesh, Maharashtra, Gujarat, Rajasthan, Andhra Pradesh, Karnataka and Tamil Nadu (Sahu *et al.*, 2010) [20]. The main cultivated varieties are Banarasi, Bansi Red, Chakaiya, Desi, Krishna, Kanchan (NA-4), Francis (Hathijool), NA-6, NA-7, NA-8, NA-9, NA-10 and Pink tinged (Pathak *et al.*, 2002; Alam and Singh, 2010) [13, 4]. The area under aonla cultivation in India is about 1, 08,060 hectares with an annual production of 12, 66,460 tonnes (NHB, 2012-13). Aonla is one of the most important medicinal fruits available in North India and is, therefore, used as a major constituent in several Ayurvedic preparations (Rajkumar *et al.*, 2001) [18]. It is a rich source of vitamin C and its content of ascorbic acid is next to that of Barbados cherry (Ganachari *et al.*, 2010) [5]. About 600–900 mg of vitamin C is found in 100 g of aonla pulp (Pokharkar, 2005) [16]. The edible fruit tissues of aonla contain about 3 times more protein and 160 times more vitamin C as compared to apple. The fruits contain leucoanthocyanin or polyphenols which retard the oxidation of vitamin C. Tannins contain gallic acid, elagic acid and glucose, which retard the oxidation of vitamin C and render its value as antiscorbutic in fresh as well as dried conditions (Pareek and Kaushik, 2012) [15]. Aonla has been reported to be hepatoprotective and possesses expectorant, purgative, spasmolytic, antibacterial, hypoglycemic and hypolipidemic activities (Mishra *et al.*, 2010) [10]. Aonla fruits are astringent, carminative, digestive, stomachic, laxatic, altrant, aphordisac, diuretic, antipyretic and trichogenous. They are useful in curing many diseases like diabetes, cough, asthma, bronchitis, headache, ophthalmic disorders, dyspepsia, colic, flatulence, skin diseases, leprosy, jaundice, scurvy, diarrhoea and greyness of hair (Ganachari *et al*., 2010) [5].

Material and Methods
The details of materials used and methods adopted for the conduct of experiment are presented in this chapter under appropriate headings.

Experimental details

1. Factor A(S) - Standard of Sugar Syrup

S1-60%
S2-70 %

2. Factor B(T) -Dipping Time

T1-36hrs
T2-42hrs
T3-48hrs

3. Factor C(M) -Drying Methods

M1-Sun drying
M2-Solar drying
M3-Cabinet drying

The details of treatments are given in following Table

Table 1: Details of treatments

Treatments	Treatment Combination	Treatment Details
T_1	$S_1T_1M_1$	60% Sugar conc.+ dipping for 36 hrs + sun drying
T_2	$S_1T_1M_2$	60% Sugar conc.+ dipping for 36 hrs + solar drying
T_3	$S_1T_1M_3$	60% Sugar conc. + dipping for 36 hrs + cabinet drying
T_4	$S_1T_2M_1$	60% Sugar conc.+ dipping for 42 hrs + sun drying
T_5	$S_1T_2M_2$	60% Sugar conc. + dipping for 42 hrs + solar drying
T_6	$S_1T_2M_3$	60% Sugar conc. + dipping for 42hrs + cabinet drying
T_7	S1T3M1	60% Sugar conc. + dipping for 48hrs + sun drying
T_8	S1T3M2	60% Sugar conc. + dipping for 48hrs + solar drying
T_9	S1T3M3	60% Sugar conc. + dipping for 48hrs + cabinet drying
T_{10}	S2T1M1	70% Sugar conc. + dipping for 36 hrs + sun drying
T_{11}	S2T1M2	70% Sugar conc. + dipping for 36 hrs + solar drying
T_{12}	S2T1M3	70% Sugar conc. + dipping for 36 hrs + cabinet drying
T_{13}	S2T2M1	70% Sugar conc. + dipping for 42 hrs + sun drying
T_{14}	S2T2M2	70% Sugar conc. + dipping for 42 hrs + solar drying
T_{15}	S2T2M3	70% Sugar conc. + dipping for 42 hrs + cabinet drying
T_{16}	S2T3M1	70% Sugar conc. + dipping for 48 hrs + sun drying
T_{17}	S2T3M2	70% Sugar conc. + dipping for 48 hrs + solar drying
T_{18}	S2T3M3	70% Sugar conc. + dipping for 48 hrs + cabinet drying

Physico-chemical and organoleptic quality of aonla candy

Total soluble solids

Total soluble solids (TSS) were measured by using hand refractometer (Erma, Japan) and the results were expressed as percent (^{0}B) according to standard procedure as given in (Ranganna, 2003) [13]. The refractometer was calibrated with distilled water before use.

Titratable acidity

Titratable acidity was determined by titrating a known quantity of sample (10ml) against standard solution of 0.1 N Sodium hydroxide to a faint pink colour using phenolphthalein as an indicator. The results were expressed using per cent citric acid (A.O.A.C. 1990) [1].

$$\text{Titratable acidity \%} = \frac{\text{titer} \times \text{normality of alkali used} \times \text{equivalent wt. of acid} \times \text{volume of sample} \times 100}{\text{Vol. of aliquot (ml)} \times \text{Wt. or volume of sample (g or ml)}} \times 1000$$

Ascorbic acid

Determination of ascorbic acid was done by 2, 6 – dichlorophenolindophenol dye method of Johnson (1948) as described by Ranganna (1997). A known quantity of sample was blended with 3 per cent metaphosphoric acid (HPO_3) to make the final volume of 100 ml and then filtered. A known quantity of aliquot was titrated against 0.025 per cent 2, 6 - dichlorophenolindophenol dye to a pink color end point. The ascorbic acid content of the sample was calculated taking into consideration the dye factor and expressed as mg Ascorbic acid per 100g (Association of Vitamin Chemist, 1966).

$$\text{Ascorbic acid (mg/100g)} = \frac{(\text{Titre} \times \text{Dye factor} \times \text{Volume made up})}{\text{Aliquot of extract taken} \times \text{weight of sample}} \times 100$$

Tannin

Total phenols (expressed as tannins) were estimated by the method of A.O.A.C. (1990) [1]. Reagents 1. Folin Ciocalteau reagents (2N) 1:1. 2. Sodium carbonate 35 g Volume 1 L. 3. Tannic acid 100 mg Volume 1 L Preparation of standard curve Aliquots (0 to 10 ml) of standard tannic acid solution were pipetted into 100 ml volumetric flask and 75 ml of distilled water was added to it. After this, five ml of Folin Ciocalteau reagent and 10 ml of sodium carbonate solution was added. Its volume was then made to 100 ml with water, mixed well and the absorbance was taken after 30 minutes at 760 nm, and standard curve was prepared. Preparation of sample 5 grams of candy powder was boiled for 30 minutes with 400 ml of water, cooled and transferred to a 500 ml volumetric flask and diluted to 500 ml, mixed well and filtered. Estimation One ml of above aliquot was taken and followed the same procedure as for the preparation of standard curve and estimated tannic acid (mg) from the standard curve.

$$\text{Tannins as tannic acid (mg/100g)} = \frac{\text{mg of tannic acid} \times \text{dilution}}{\text{ml of sample taken for colour development} \times \text{weight of sample}} \times 100$$

Results and Discussion

Effect of various treatments on titratable acidity of aonla candy during storage

The data regarding effect of various treatments *viz* concentration of sugar syrup, dipping time and drying methods on titrable acidity of aonla candy is presented in Table 2. A significant difference was observed in different treatments (S, T and M) during storage of aonla candy.

The data presented in table 2 revealed that combination of sugar solution concentration and dipping time had significant effect on titrable acidity of aonla candy. The mean values were ranged from 0.17 to 0.35. The minimum value of titrable acidity (0.12%) was observed in treatment combination S_1T_1 and S_2T_2 on 120 days of storage followed by in treatment

combination S_2T_1 (0.14%), while at initially maximum value (0.40%) was found in S_1T_2.

The data presented in table 2 showed that combination of sugar solution concentration and drying methods had significant effect on titrable acidity of aonla candy. The mean values were ranged from 0.13 to 0.40. For treatment combination S_2M_3on 120 days of storage showed minimum value (0.13%) followed by S_2M_2 on 120 days of storage (0.15%), while at initially S_1M_1 showed maximum value (0.40%).

Table 2: Effect of various treatments on titrable acidity (%) of aonla candy during storage

Treatments	Storage period (days)				
	Initial	30	60	90	120
Factor A: Sugar syrup concentration (S)					
S1	0.36	0.32	0.28	0.24	0.19
S2	0.34	0.30	0.24	0.19	0.14
SE	0.003	0.004	0.002	0.003	0.003
CD	0.009	0.012	0.007	0.009	0.009
Factor B: Dipping time (T)					
T1	0.33	0.27	0.22	0.17	0.13
T2	0.34	0.32	0.26	0.22	0.17
T3	0.38	0.34	0.31	0.27	0.21
SE	0.04	0.005	0.003	0.004	0.004
CD	0.01	0.014	0.009	0.011	0.011
Factor C: Drying method (M)					
M1	0.35	0.34	0.29	0.24	0.18
M2	0.33	0.29	0.24	0.20	0.15
M3	0.37	0.31	0.26	0.22	0.17
SE	0.004	0.005	0.003	0.004	0.004
CD	0.011	0.014	0.009	0.011	0.011
Interaction Sx TxM					
$S_1T_1M_1$	0.32	0.28	0.21	0.15	0.09
$S_1T_1M_2$	0.25	0.20	0.16	0.11	0.08
$S_1T_1M_3$	0.38	0.34	0.30	0.26	0.20
$S_1T_2M_1$	0.44	0.41	0.38	0.31	0.26
$S_1T_2M_2$	0.38	0.34	0.28	0.24	0.20
$S_1T_2M_3$	0.38	0.34	0.29	0.27	0.23
S1T3M1	0.34	0.42	0.39	0.36	0.30
S1T3M2	0.38	0.32	0.30	0.27	0.20
S1T3M3	0.32	0.29	0.27	0.27	0.22
S2T1M1	0.35	0.34	0.30	0.24	0.19
S2T1M2	0.32	0.27	0.21	0.18	0.14
S2T1M3	0.38	0.20	0.16	0.11	0.09
S2T2M1	0.25	0.28	0.21	0.18	0.12
S2T2M2	0.32	0.27	0.21	0.17	0.14
S2T2M3	0.32	0.28	0.20	0.16	0.11
S2T3M1	0.32	0.31	0.28	0.21	0.16
S2T3M2	0.38	0.34	0.30	0.24	0.18
S2T3M3	0.44	0.41	0.34	0.28	0.21
SE	0.010	0.0132	0.0080	0.001	0.010
CD @ 5%	0.028	0.036	0.022	0.027	0.028

The data presented in table 2 revealed that, combination of dipping time and drying methods had significant effect on titrable acidity at initially and at 60 days while there is non-significant effect at 30, 90 and 120 days. The mean values were ranged from 0.17 to 0.35. The minimum value (0.11%) was found in treatment combination T_1M_2 on 120 days of storage followed by T_1M_1 on 120 days of storage (0.14%), while at initially maximum value (0.38%) was observed in treatment combination. T_1M_3.

The data presented in table 2 showed that, combination of sugar syrup concentration, dipping time and drying methods had significant effect on titrable acidity. The mean values were ranged from 0.17 to 0.34%. For treatment combination $S_1T_1M_2$ on 120 days of storage showed minimum value (0.08%) followed by $S_1T_1M_1$ on 120 days of storage (0.09%), while at initially $S_2T_3M_3$ showed maximum value (0.44%).

Similar results have also been reported by Krishnaveni *et al*., (2001). Nayak *et al.* (2011) [12], Verma *et al.,* (2006) [22] and Kumar *et al.,* (2015) [15] reported similar observations in aonla segments in syrup, Darunj peel candy and papaya leather respectively. For treatment combination $S_1T_1M_2$ on 120 days of storage showed minimum value (0.08%) followed by $S_1T_1M_1$ on 120days of storage (0.09%), while $S_2T_3M_3$ on 0 day of storage showed maximum value (0.44%). During storage period (120 days) candy showed significant decrease in titrable acidity content and the mean value of treatments decreased from 0.34 to 0.17.

Effect of various treatments on ascorbic acid of aonla candy during storage

The data revealed that, combination of sugar solution concentration and dipping time had significant effect on ascorbic acid of aonla candy. The mean values were ranged from 246.75 to 271.08 mg/100g. For treatment combination S_2T_3 at initial of storage showed maximum value (320.0 mg/100g) followed by S_1T_3 on 30 days of storage (313.6mg/100g), while S_1T_2 on 120days of storage showed minimum value (164.6 mg/100g).

The data presented in table 3 showed that, combination of sugar solution concentration and drying methods had significant effect on ascorbic acid of aonla candy. The mean values were ranged from 246.75 to 271.08mg/100g. For treatment combination S_2M_2 at initial day of storage showed maximum value (320.0mg/100g) followed by S_2M_2 on 60 days of storage (315.3 mg/100g), while S_1M_1 on 120days of storage showed minimum value (196.6mg/100g).

The data presented in table 3 showed that, combination of dipping time and drying methods had significant effect on ascorbic acid of aonla candy. The mean values were ranged from 246.77 to 271.11mg/100g. For treatment combination T_3M_3 at initial day of storage showed maximum value (400.0mg/100g) followed by T_3M_3 on 30 days of storage (391.0mg/100g), while T_1M_1 on 120days of storage showed minimum value (169.5mg/100g).

Table 3: Effect of various treatments on ascorbic acid (mg/100g) content of aonla candy during storage

Treatments	Storage period (days)				
	Initial	30	60	90	120
Factor A: Sugar syrup concentration (S)					
S1	248.89	242.78	238.22	232.67	226.11
S2	293.33	287.67	283.00	276.67	267.44
SE	2.48	4.63	4.77	4.64	4.46
CD	6.87	12.8	13.21	12.85	12.35
Factor B: Dipping time (T)					
T1	253.33	248.50	243.00	237.17	228.83
T2	240.00	234.00	231.00	226.50	219.00

T3	320.00	313.17	307.83	300.33	292.50
SE	3.04	56.76	5.84	5.68	5.46
CD	8.42	15.70	16.18	15.74	15.13
Factor C: Drying methods (M)					
M1	240.0	233.83	228.17	221.17	213.33
M2	266.6	262.17	259.50	253.67	246.33
M3	306.6	299.67	294.17	289.17	280.67
SE	3.04	5.67	5.84	5.68	5.46
CD	8.42	15.70	16.18	15.74	15.13
Interaction SxTxM					
$S_1T_1M_1$	160.0	155.0	151.0	145.0	139.0
$S_1T_1M_2$	240.0	236.0	230.0	226.0	220.0
$S_1T_1M_3$	320.0	312.0	309.0	304.0	294.0
$S_1T_2M_1$	240.0	232.0	226.0	221.0	216.0
$S_1T_2M_2$	160.0	155.0	150.0	146.0	140.0
$S_1T_2M_3$	160.0	154.0	151.0	145.0	138.0
S1T3M1	240.0	235.0	230.0	224.0	220.0
S1T3M2	240.0	236.0	231.0	224.0	218.0
S1T3M3	480.0	470.0	466.0	459.0	450.0
S2T1M1	240.0	232.0	222.0	215.0	200.0
S2T1M2	320.0	322.0	318.0	314.0	309.0
S2T1M3	240.0	234.0	228.0	219.0	211.0
S2T2M1	240.0	235.0	229.0	221.0	216.0
S2T2M2	320.0	312.0	319.0	312.0	300.0
S2T2M3	320.0	316.0	311.0	314.0	304.0
S2T3M1	320.0	314.0	311.0	301.0	289.0
S2T3M2	320.0	312.0	309.0	300.0	291.0
S2T3M3	320.0	312.0	300.0	294.0	287.0
SE	7.45	1.39	14.3	13.9	13.3
CD @ 5%	20.6	38.4	39.6	38.5	37.0

The data reveals that combination of sugar syrup concentration, dipping time and drying methods had significant effect on ascorbic acid. The mean values of ascorbic acid content were ranged from 246.77 to 271.11mg/100g. For treatment combination $S_1T_3M_3$ at initial day of storage showed maximum value (480.0 mg/100g) followed by $S_1T_3M_3$ on 30days of storage (470.0mg/100g), while $S_1T_2M_3$ on 120 days of storage showed minimum value (138.0mg/100g).

Rani and Bhatia (1986) [19] and Ayub *et al.,* (2005) also reported a declining trend in ascorbic acid in intermediate moisture bagughosa and sweetened guava slices, respectively during storage. A declining trend in ascorbic acid content of aonla preserve (Tripathi *et al.*, 1988) [21], ber candy (Kaikadi *et al*., 2006), karonda candy (Manivasagan *et al*., 2006), Sethi (1980) in aonla preserve, Rani and Bhatia (1985) in pear candy, Kumar and Singh (2001) [7] Rani and Bhatia (1986) [19] and Ayub *et al.,* (2005) also reported a declining trend in ascorbic acid in intermediate moisture bagughosa and sweetened guava slices, respectively during storage. Similar results were also reported from Priya and Khatkar (2013) [14, 17] during study on effect of processing methods on keeping quality of aonla preserve, Nayak *et al.*,(2012) [11] during study on changes in nutritional and organoleptic quality of flavored candy prepared from aonla during storage.

Effect of various treatments on total soluble solids (%) of aonla candy during storage.

The data presented in table 4 revealed that combination of sugar solution concentration and dipping time had significant effect on TSS at initially and 30 days of storage of aonla candy, while there was non-significant effect at 60, 90 and 120 days of storage. The mean values were ranged from 83.2 to 85.1%. The maximum value (85.5%) was recorede in treatment combination S_1T_2 at 120days of storage followed by in treatment S_1T_1 (85.4%), while at 30days of storage of aonla candy, minimum value (82.6%) was recorded in treatment S_2T_1.

The data presented in table 4 revealed that combination of sugar solution concentration and drying methods on 0, 30, 90 and 120 days of storage period had significant effect on TSS while non-significant effect was observed at 60 days of storage of aonla candy. The mean values were ranged from 83.18 to 83.85%. The maximum value (84.4%) of TSS was recorded in treatment combination S_1M_1 on 120 days of storage of aonla candy followed by in treatment S_1M_3 (83.3%), while at initially minimum value (82.3%) of TSS was recorded in treatment S_1M_3.

The data presented in table 4 showed that combination of dipping time and drying methods had significant effect on TSS at 30 days of storage, while non-significant effect was observed on 0, 60, 90 and 120 days of storage of aonla candy. The mean values were ranged from 83.20 to 85.8%. At 120day of storage of aonla candy, maximum value (85.8%) of TSS was observed in treatment combination T_2M_1 followed by T_2M_3 (85.1%), while minimum value (82.9%) was observed in treatment T_1M_1 at 30days of storage of aonla candy.

Table 4: Effect of various treatments on total soluble solids (%) of aonla candy during storage

Treatments	Storage period (days)				
	Initial		Initial		Initial
Factor A: Sugar syrup concentration (S)					
S1	83.0	83.34	83.96	84.61	85.33
S2	83.4	83.12	83.71	84.36	84.91
SE	0.107	0.065	0.32	0.16	0.11
CD	0.297	0.180	NS	NS	0.31
Factor B: Dipping time (T)					
T1	83.16	83.05	83.73	84.35	85.01
T2	83.50	83.51	84.10	84.78	85.31
T3	83.00	83.13	83.68	84.33	85.03
SE	0.13	0.079	0.40	0.19	0.14
CD	0.36	0.22	NS	NS	NS
Factor C: Drying methods (M)					
M1	83.33	83.50	83.98	84.73	85.31
M2	83.33	83.28	83.86	84.45	85.05
M3	83.0	82.91	83.66	84.28	85.00
SE	0.13	0.079	0.40	0.19	0.14
CD	NS	0.22	NS	NS	NS
Interaction SxTxM					
$S_1T_1M_1$	83.0	83.6	84.1	84.9	85.4
$S_1T_1M_2$	84.0	84.2	84.9	85.3	85.9
$S_1T_1M_3$	82.0	82.6	83.4	84.1	85.0
$S_1T_2M_1$	84.0	84.5	85.0	85.9	86.4
$S_1T_2M_2$	83.0	83.7	84.0	84.6	85.0
$S_1T_2M_3$	82.0	82.9	83.6	84.2	85.2
S1T3M1	83.0	83.7	84.1	84.9	85.6
S1T3M2	83.0	82.9	83.6	84.1	85.4
S1T3M3	83.0	82.0	83.0	83.5	84.1
S2T1M1	83.0	82.2	83.0	83.9	84.6
S2T1M2	83.0	82.3	83.1	83.7	84.2
S2T1M3	84.0	83.4	83.9	84.2	85.0
S2T2M1	84.0	83.6	84.0	84.6	85.3
S2T2M2	84.0	83.4	84.0	84.7	84.9
S2T2M3	84.0	83.0	84.0	84.7	85.1
S2T3M1	83.0	83.4	83.7	84.2	84.6
S2T3M2	83.0	83.2	83.6	84.3	84.9
S2T3M3	83.0	83.6	84.1	85.0	85.6
SE	0.32	0.19	0.98	0.48	0.34
CD @ 5%	0.89	0.54	NS	NS	NS

The data presented in table 4 that combination of sugar syrup concentration, dipping time and drying methods had significant effect on TSS at 0 and 30 days of storage of aonla candy and non-significant effect was observed at 60, 90 and 120 days of storage. The mean values was ranged from 83.22 to 85.12%. At 120days of storage of aonla candy, maximum value (86.4%) of TSS was found in treatment combination $S_1T_2M_1$ followed by in treatment $S_1T_1M_2$ (85.9%), while at 30 days of storage of aonla candy, minimum value (82.0%) of TSS was found in treatment $S_1T_3M_3$.

The stored IM Bagughosa suffered loss of moisture, which correspondingly increased TSS in the product (Rani and Bhatia, 1986) [19]. Ayub *et al*., (2005) also showed an increase in TSS of intermediate moisture sweetened guava slices during storage. The data reveals that combination of sugar syrup concentration, dipping time and drying methods had significant effect on TSS on 0 and 30 days of storage and non-significant effect was observed on 60, 90 and 120 days of storage. The mean values ranged from 83.22 to 85.12. For treatment combination $S_1T_2M_1$ on 120 days of storage showed maximum value (86.4) followed by $S_1T_1M_2$ on 120 days of storage (85.9), while $S_1T_3M_3$ on 30 days of storage showed minimum value (82.0). Similar results were also found by Kumar *et al*. (2015) [15] during study on development of value added product from citrus peel and Aggrawal and Michael (2014) [3] during study on effect of replacing sucrose with fructose on the physico-chemical sensory characteristics of kinnow candy.

Effect of various treatments on tannin content of aonla candy during storage

The data presented in table 5 revealed that combination of sugar solution concentration and dipping time had significant effect on tannin at 30 and 60 days of storage of aonla candy, while there is non-significant effect at 0, 90 and 120 days of storage of aonla candy. The mean values were ranged from 0.37 to 1.15mg/100g. At 120 days of storage of aonla candy lowest tannin (0.27mg/100g) content was found in treatment combination S_2T_3 followed in treatment by S_2T_2 (0.33mg/100g), while at initially highest tannin content (1.23mg/100g) was found in treatment combination S_2T_1.

The data presented in table 5 showed that combination of sugar solution concentration and drying methods at 0, 30, 90 and 120 days of storage of aonla candy had non-significant effect on tannin content while significant effect was observed at 60 days of storage of aonla candy. The mean values were ranged from 0.37 to 1.15mg/100g. The highest tannin content (0.30mg/100g) was recorded in treatment combination S_2M_1 at 120 days of storage of aonla candy followed by in treatment combination S_2M_2 (0.33mg/100g), while at initially,

the highest tannin content (1.19mg/100g) was recorded in treatment combination S_2M_3.

In interaction effect of dipping time and drying methods on tannin content had significant at 90 days of storage of aonla candy, while non-significant effect was observed at 0, 30, 60 and 120 days of storage of aonla candy. The mean values were ranged from 0.38 to 1.15mg/100g. At 120 day of storage the highest tannin content (0.31mg/100g) was observed in treatment combination T_3M_2 followed by in treatment T_2M_3 (0.33mg/100g), while at initially the highest tannin content was observed in treatment T_1M_1 (1.22mg/100g).

Table 5: Effect of various treatments on tannin (mg/100g) content of aonla candy during storage

Treatments	Storage period (days)				
	Initial		Initial		Initial
Factor A: Sugar syrup concentration (S)					
S1	1.13	0.98	0.89	0.64	0.43
S2	1.17	0.92	0.73	0.48	0.33
SE	0.015	0.019	0.008	0.020	0.018
CD	NS	0.053	0.022	0.056	0.049
Factor B: Dipping time (T)					
T1	1.21	0.94	0.82	0.59	0.44
T2	1.15	1.03	0.84	0.60	0.35
T3	1.09	0.89	0.77	0.49	0.35
SE	0.018	0.023	0.010	0.025	0.022
CD	0.051	0.065	0.027	0.069	0.061
Factor C: Drying methods (M)					
M1	1.14	0.96	0.80	0.62	0.37
M2	1.14	0.95	0.82	0.52	0.38
M3	1.16	0.94	0.80	0.53	0.38
SE	0.018	0.023	0.010	0.025	0.022
CD	NS	NS	NS	0.069	NS
Interaction SxTxM					
$S_1T_1M_1$	1.20	0.09	0.86	0.65	0.48
$S_1T_1M_2$	1.19	0.95	0.85	0.66	0.57
$S_1T_1M_3$	1.20	0.93	0.90	0.78	0.43
$S_1T_2M_1$	1.13	1.10	0.92	0.84	0.38
$S_1T_2M_2$	1.12	1.10	0.91	0.65	0.39
$S_1T_2M_3$	1.15	1.12	0.97	0.61	0.34
S1T3M1	1.05	0.91	0.87	0.60	0.47
S1T3M2	1.08	0.92	0.86	0.53	0.35
S1T3M3	1.09	0.94	0.88	0.46	0.46
S2T1M1	1.24	1.00	0.76	0.51	0.33
S2T1M2	1.20	0.91	0.86	0.48	0.39
S2T1M3	1.25	0.95	0.70	0.50	0.47
S2T2M1	1.17	0.99	0.78	0.67	0.33
S2T2M2	1.18	0.97	0.75	0.42	0.34
S2T2M3	1.20	0.90	0.72	0.41	0.33
S2T3M1	1.10	0.89	0.64	0.50	0.25
S2T3M2	1.11	0.86	0.69	0.43	0.28
S2T3M3	1.12	0.85	0.68	0.42	0.30
SE	0.045	0.058	0.024	0.061	0.054
CD @ 5%	NS	NS	NS	NS	NS

In interaction effect of sugar syrup concentration, dipping time and drying methods on tannin content during storage of aonla candy had non-significant. The mean values were ranged from 0.38 to 1.15mg/100g. At 120 days of storage of aonla candy the highest tannin content was recorded in treatment combination $S_2T_3M_1$ (0.25mg/100g) followed by in treatment $S_1T_3M_2$ (0.28mg/100g), while at initially the highest tannin content was recorded in treatment combination $S_1T_1M_1$ (1.24mg/100g).

Similar results were reported by Priya and Khatkar (2013) [14, 17] in aonla preserves and by Nayak *et al.,* (2012) [11] during study on changes of nutritional and organoleptic quality of flavoured candy prepared from aonla during storage. Candy showed significant decrease in tannins during storage period and the mean value decreased from 1.15 to 0.38.For treatment combination S2T3M1 on 120 days of storage showed minimum value (0.25) followed by $S_1T_3M_2$ on 120 days of storage (0.28), while $S_1T_1M_1$ on 0 day of storage showed maximum value (1.24).

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