International Journal of Plant & Soil Science

Volume 35, Issue 16, Page 302-309, 2023; Article no.IJPSS.101932
ISSN: 2320-7035

Postharvest Impact of Different Sugar Levels on Dragon Fruit (*Hylocereus undatus*) Candy

Arvind Singh [a++*], Devi Singh [a#] and K. Lakshmi Bala [b†]

[a] Department of Horticulture, Sam Higginbottom University of Agriculture Technology and Sciences, Prayagraj- 211007 (U.P.), India.
[b] Department of Food Process Engineering, Sam Higginbottom University of Agriculture Technology and Sciences, Prayagraj- 211007 (U.P.), India.

Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

Article Information

DOI: 10.9734/IJPSS/2023/v35i163157

Open Peer Review History:
This journal follows the Advanced Open Peer Review policy. Identity of the Reviewers, Editor(s) and additional Reviewers, peer review comments, different versions of the manuscript, comments of the editors, etc are available here: https://www.sdiarticle5.com/review-history/101932

Original Research Article

Received: 15/04/2023
Accepted: 19/06/2023
Published: 26/06/2023

ABSTRACT

The Present experiment entitled "Postharvest Impact of Different sugar levels on Dragon fruit Candy" was conducted during year 2022 at the Post Harvest Laboratory in Department of Horticulture, Naini Agricultural Institute, Sam Higginbottom University of Agriculture Technology & Sciences, Prayagraj. The objective of this research work was to analyze the proximate composition of dragon fruit (*Hylocereus undatus)* and to standardize the process for Dragon fruit candy. The experiment was conducted in completely randomized design (CRD) with eight treatments replicated thrice. The dragon fruit candy was made by using gelatin powder, citric acid. The treatment T_6 (Dragon fruit +80% sugar) was found to be best during organoleptic quality and physico-chemical parameters like TSS (°Brix), pH, acidity (%), ascorbic acid (mg/100g), Texture Profile Analysis (TPS), reducing sugar(%), non-reducing sugar(%), total sugar(%). The prepared candies from dragon fruit were stored at ambient temperature (30°*C) conditions up to 90 days. During storage*

[++] M.Sc. Research Scholar;
[#] Associate Professor;
[†] Assistant Professor;
**Corresponding author: E-mail: arvindkalri21@gmail.com;*

study of candy TSS, titrable acidity, reducing sugar, non- reducing sugar and total sugar were increased whereas moisture content, pH, and organoleptic quality was slightly decreased. In cost-benefit ratio, all the treatments were profitable whereas highest cost benefit ratio 1:2 in T_1 (Dragon fruit + 55% sugar) followed by 1:1.99 T_2 (Dragon fruit + 60% sugar) and minimum 1: 1.93 in T_8 (Dragon fruit + 90% sugar).

Keywords: Dragon fruit candy; sugar; gelatin; citric acid; quality parameters.

1. INTRODUCTION

Dragon fruit (*Hylocereus* sp.) is native to Southern Mexico and Central America, which is commonly known as Pitaya. It has unique appearance, sweet taste, and crunchy texture. Its taste is like a combination of a kiwi or watermelon fruit and the flavor is mildly sweet with subtle earthy notes [1-3]. It is being grown commercially in Israel, Vietnam, Taiwan, Nicaragua, Australia and the United States (Merten, 2003). Fruits are rich in Vitamin C (2.5 mg), Protein (1.18 g), Iron (0.74 g) and rich in antioxidants like flavonoids, phenolic acid, and beta- cyanine. Fruits are naturally fat free and high in fiber lowers blood sugar levels, strengthens immune system. Dragon fruit drew the attention of the academic researchers and food processors because of its potential source of dietary ingredients. The fruits are very attractive for its red skin, mouth-melting deep purple-red color pulp with edible black seeds (Vinod *et al.,* 2020). Thailand and Vietnam are the main producing countries and exporting countries of dragon fruit in the world [4,5]. The dragon fruit was introduced in India late 90s [6,7]. But the area under dragon fruit is still very limited. In India, it is cultivated in state Karnataka, Kerala, Tamil Nadu, Maharashtra, Gujarat and Andhra Pradesh. Average weight of fruit is around 350g. Its flowers bloom only at night, hence the plant is sometimes also called 'moonflower' or 'Lady of the Night'

With a shelf life of up to 10 days, dragon fruit is extremely perishable (Hoa *et al.,* 2006). Due to its non-climacteric nature, the best edible quality attained when harvested ripe and tend to decreases after storage. Although largely consumed as fresh, it can be processed into variety of products such as RTS, squash, wine, jam and jelly. There have been few studies focused on expanding the pitaya fruits post-harvest consistency as a newly cultivated crop (Nerd et al., 1999). Additional research-based knowledge is required to improve post-harvest techniques that preserve the quality and extend the availability. Moreover processed products of dragon fruits are rarely available in our markets and very little work has been done in our country on dragon fruit processing [8-12]. Due to high nutritional value the demand for dragon fruit increasing day by day but there is a serious problem with this fruit that the post harvest life is small, so by changing its form to processed product it will be easy to keep product healthy for a long time [13-15]. Candy made from dragon fruit being rich in antioxidants can help in boosting immunity to fight against various diseases.

2. MATERIALS AND METHODS

The experimental work was performed in the Processing laboratory of Department of Horticulture, Naini Agricultural Institute, Sam Higginbottom University of Agriculture Technology and Sciences, Prayagraj, Uttar Pradesh. In this section details regarding to the materials and methods used for the study are described.

Table 1. Treatment details

Treatment no.	Treatment details
T_1	Dragon fruit + 55% sugar
T_2	Dragon fruit + 60% sugar
T_3	Dragon fruit + 65% sugar
T_4	Dragon fruit + 70% sugar
T_5	Dragon fruit + 75% sugar
T_6	Dragon fruit + 80% sugar
T_7	Dragon fruit + 85% sugar
T_8	Dragon fruit + 90% sugar

2.1 Materials

Materials such as sugar, gelatin, food color, citric acid and packaging material such as Plastic boxes, zip polythene bags.

2.2 Instruments

The instruments used in research work are Electronic weighing balance, refrigerator, glass vessels, blender machine, dehydrator, refractometer, TA.XT plus texture profile analyzer.

2.3 Preparation of Dragon Based Candy

For manufacturing of dragon fruit candy, one kg dragon fruit was peeled out and pulp was manually pulped with the help of power mixer then cooked in open pan on 90-105°C for 10-15 minutes and sugar according to different treatment ratio was added and then again cooked for (10-15 minutes), gelatin (10%) was added along with citric acid (2.5g) and food color (pink). This was cooked again for 2-4 minutes then the whole candy mixture was transfer into candy mould trays and cooled in refrigerator.

Table 2. Ingredients of dragon fruit candy

Ingredients	Amount 1kg
Dragon fruit	1000g
Sugar	550,600,650…..900g
Gelatin	80g
Citric acid	2.5g

2.4 Methodology

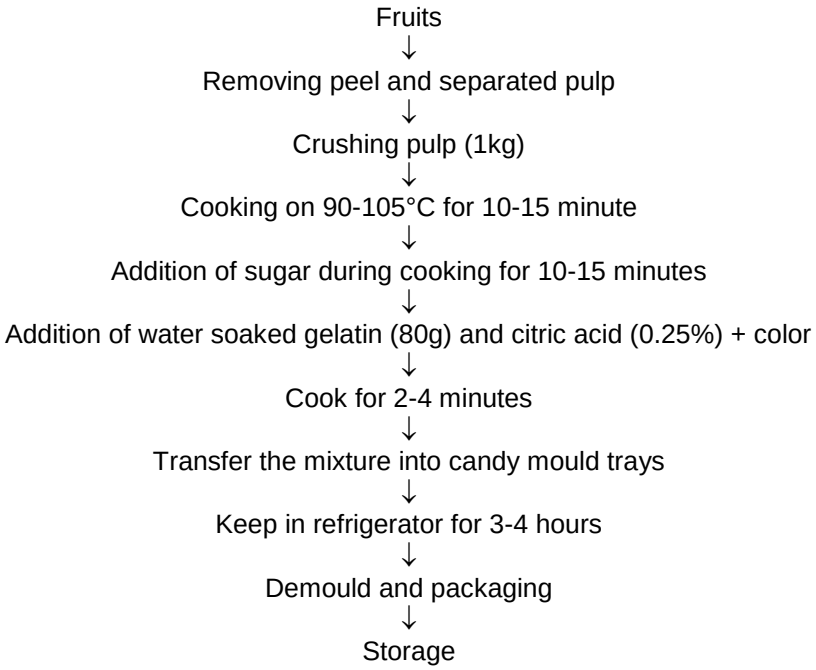

Fig. 1. Flow chart of preparation of dragon fruit candy

3. RESULTS AND DISCUSSION

3.1 Moisture Content (%)

A significant decreasing trend in moisture content is observed up to the end of storage at ambient temperature (Table 3). At initial days the maximum moisture content 30.43% was observed in T8 [Dragon fruit + 90% Sugar] followed by 29.24% in T7 [Dragon fruit + 85% Sugar] and minimum 26.35% was observed in T5 [Dragon fruit + 75% Sugar]. At 90 days, after storage maximum moisture content 28.83% was observed in T8 [Dragon fruit + 90% Sugar] and minimum 24.26% was observed in T5 [Dragon fruit + 75% Sugar].

The decrease in moisture content was observed in guava-carrot jelly during storage (Singh and Chandra, 2012) and in Karonda jelly (Singh, 2010).

3.2 Total Soluble Solids (°Brix)

A significant increasing trend in TSS is observed up to the end of storage at ambient temperature (Table 3). At initial days maximum total soluble solids 88.11 °Brix was observed in T8 [Dragon fruit + 90% Sugar] followed by 83.11 °Brix in T7 [Dragon fruit + 85% Sugar] and minimum 53.06 °Brix in T1 [Dragon fruit + 55% Sugar]. At 90 days after storage, maximum TSS 89.21 ^{0}Brix was recorded in T8 [Dragon fruit + 90% Sugar]

and minimum 54.45 °Brix in T1 [Dragon fruit + 55% Sugar]. Similar findings reported by Manivsagan (2011) in Karonda candy and by Navitha and Mishra (2018) in Ber candy.

3.3 Texture Profile Analysis

Hardness is the force required to suppress a product in the first cycle and shows the strength of the gel structure (Mahardika *et al.,* 2014). Maximum hardness in dragon fruit candy 722.57g/s. in T5 [Dragon fruit + 75% Sugar] and minimum 617.14 g/s. in T1 [Dragon fruit + 55% Sugar] shown in (Table 3).

Cohesiveness is the strength of the internal bond that composes a product from the degree of deformation under mechanical stress (Hurler et al., 2012). Maximum cohesiveness in dragon fruit candy 0.75 g/s. in T8 [Dragon fruit + 90% Sugar] and minimum 0.61 g/s. in T1 [Dragon fruit + 55% Sugar].Gumminess is the force required to oppose the direction of the probe force and is influenced by cohesion and adhesion forces (Kusumaningrum *et al.,* 2016). Maximum gumminess in dragon fruit candy 332.92 g/sec in T5 [Dragon fruit + 75% Sugar] and minimum 328.81g/s in T4[Dragon fruit + 70% Sugar].Chewiness determines the energy required to chew food until it is ready to be swallowed (Yusof *et al.*, 2019). Maximum chewiness in dragon fruit candy 48.84g/s in T7 [Dragon fruit + 85% Sugar] and minimum 41.31g/s. in T1 [Dragon fruit + 55% Sugar].

3.4 Titrable Acidity (%)

A significant increasing trend in acidity is observed up to the end of storage at ambient temperature (Table 4). At initial days maximum acidity 0.38% was observed in T1 [Dragon fruit + 55% Sugar] followed by 0.36 % was observed in T2 [Dragon fruit + 60% Sugar] and minimum 0.21% in T8 [Dragon fruit + 90% Sugar]. At 90 days after storage maximum acidity recorded is 0.42% in T1 [Dragon fruit + 55% Sugar] and minimum 0.28% in T7 [Dragon fruit + 85% Sugar].

The increase in acidity (%) in Dragon fruit candy during storage can be the result of chemical interaction between candy constituents induced by temperature and action of enzyme. Similar results were reported by Neelesh (2014) in papaya candy and Navitha and Mishra (2018) in Mango candy.

3.5 Ascorbic Acid Content (%)

A significant decreasing trend in moisture content is observed up to the end of storage at ambient temperature (Table 4). At initial days maximum Ascorbic acid 3.48 mg/100g was observed in T1 [Dragon fruit + 55% Sugar] followed by 3.45 mg/100g observed in T2 [Dragon fruit + 60% Sugar] and minimum is 2.86 mg/100g in T8 [Dragon fruit + 90% Sugar]. At 90 days after storage maximum Ascorbic acid recorded is 2.91 mg/100g in T1 [Dragon fruit + 55% Sugar] and minimum 2.52 mg/100g in T8 [Dragon fruit + 90% Sugar]. Similar results of declining trend in ascorbic acid were reported from (Pawar and Patil 2013) studied sensory attributes changes in Aonla *(Emblica officinalis)* candy during the storage.

3.6 Sugar (%)

The data indicates that there is significant increasing trend in sugar content (Total sugar, reducing, non- reducing) is observed up to the end of storage at ambient temperature (Tables 4, 5). Maximum reducing sugar at 90 days after storage recorded is 34.52% in T8 [Dragon fruit + 90% Sugar] followed by 32.92 % observed in T7 [Dragon fruit + 85% Sugar] and minimum 23.54% in T1 [Dragon fruit + 55% Sugar].

Maximum non-reducing sugar at 90 days after storage recorded is 38.97% in T8 [Dragon fruit + 90% Sugar] followed by 36.79% observed in T7 [Dragon fruit + 85% Sugar] and minimum 26.37% in T1 [Dragon fruit + 55% Sugar].

Maximum total sugar at 90 days after storage recorded is 73.51% in T8 [Dragon fruit + 90% Sugar] followed by 69.74% observed in T7 [Dragon fruit + 85% Sugar] and minimum 49.94% in T1 [Dragon fruit + 55% Sugar].

Similar results were reported by Krishnaveni *et al*. (2001) in jack fruit RTS, Jain *et al.* (2004) in papaya cubes.

3.7 Organoleptic Evaluation

The result of organoleptic evaluation of dragon fruit candy including color and appearance, taste, texture and overall acceptability are presented in the Tables 5, 6. There is a significant difference in all the treatments. With respect to the color and appearance, texture, taste and overall acceptability of dragon fruit candy.

Table 3. Effect of storage period on moisture content (%), total soluble solids (°Brix), texture profile analysis of dragon fruit candy

Treatment	Moisture content (%)				Total Soluble Solid (^{0}Brix)				Texture Profile Analysis (g/sec)				
No	Initial	30 DAS	60 DAS	90 DAS	Initial	30 DAS	60 DAS	90 DAS	Hardness	Cohesiveness	Elasticity	Gumminess	Chewiness
T_1	28.97	28.86	28.73	27.43	53.06	53.51	53.96	54.45	617.14	0.61	0.41	331.48	41.31
T_2	28.72	28.53	28.06	27.86	58.07	58.58	58.94	59.18	620.12	0.62	0.41	332.19	41.59
T_3	28.86	28.4	27.96	26.43	63.10	63.51	64.13	64.25	631.23	0.64	0.42	329.67	42.72
T_4	28.36	27.63	26.9	25.46	68.11	68.56	69.23	69.72	664.23	0.65	0.45	328.81	43.85
T_5	26.35	25.70	25.12	24.26	73.07	73.56	74.05	74.45	722.57	0.68	0.45	332.92	44.63
T_6	27.36	26.81	26.03	25.80	78.10	78.72	79.03	79.44	721.11	0.71	0.45	331.64	47.50
T_7	29.24	28.93	28.86	27.57	83.11	83.44	84.12	84.47	696.39	0.73	0.47	331.73	48.84
T_8	30.43	29.66	29.14	28.83	88.11	88.42	89.04	89.21	681.38	0.75	0.43	330.81	47.27
F. test	S	S	S	S	S	S	S	S	S	S	S	S	S
S.Ed. (+)	0.199	0.175	0.157	0.189	0.071	0.09	0.186	0.142	1.695	0.003	0.002	0.13	0.157
C.D at 0.5%	0.424	0.374	0.336	0.405	0.153	0.193	0.397	0.304	3.625	0.006	0.005	0.279	0.337

Table 4. Effect of storage period on ascorbic acid content (mg/100g), Acidity (%), reducing sugar (%) of dragon fruit candy

Treatment No	Acidity (%)				Ascorbic acid (%)				Reducing sugar (%)			
	Initial	30 DAS	60 DAS	90 DAS	Initial	30 DAS	60 DAS	90 DAS	Initial	30 DAS	60 DAS	90 DAS
T_1	0.38	0.40	0.41	0.42	3.48	3.41	3.28	2.91	23.15	23.26	23.32	23.54
T_2	0.36	0.38	0.39	0.40	3.45	3.39	3.25	2.85	25.14	25.23	25.33	25.43
T_3	0.33	0.35	0.37	0.38	3.30	3.26	3.12	2.80	26.51	26.61	26.72	26.83
T_4	0.31	0.32	0.34	0.36	3.09	3.05	2.91	2.75	28.91	28.97	28.97	28.99
T_5	0.28	0.30	0.31	0.33	2.98	2.88	2.78	2.66	29.63	29.72	29.80	28.99
T_6	0.25	0.27	0.29	0.30	2.95	2.91	2.76	2.61	31.14	31.22	31.33	31.42
T_7	0.23	0.25	0.27	0.28	2.82	2.79	2.66	2.58	32.61	32.71	32.82	32.92
T_8	0.21	0.24	0.26	0.28	2.86	2.79	2.66	2.52	34.21	34.31	34.42	34.52
F. test	S	S	S	S	S	S	S	S	S	S	S	S
S.Ed. (+)	0.006	0.007	0.008	0.009	0.03	0.013	0.024	0.009	0.018	0.011	0.009	0.008
C.D at 0.5%	0.012	0.014	0.018	0.02	0.064	0.028	0.051	0.018	0.039	0.023	0.019	0.017

Table 5. Effect of storage period on non-reducing sugar (%), total sugar (%), color & appearance of dragon fruit candy

Treatment No	Non- reducing sugar (%)				Total sugar (%)				Color & appearance			
	Initial	30 DAS	60 DAS	90 DAS	Initial	30 DAS	60 DAS	90 DAS	Initial	30 DAS	60 DAS	90 DAS
T_1	26.18	26.24	26.31	26.37	49.32	49.55	49.66	49.94	7.70	7.36	7.06	6.56
T_2	28.14	28.22	28.31	28.41	53.25	53.45	53.64	53.84	7.86	7.33	6.93	6.43
T_3	30.51	30.60	30.69	30.77	57.11	57.22	57.35	57.65	7.66	7.13	6.73	6.44
T_4	31.57	31.63	31.98	31.99	60.81	60.96	60.96	61.12	7.66	7.16	6.76	6.41
T_5	32.61	32.66	32.70	32.85	62.24	62.41	62.60	62.75	7.96	7.43	7.24	6.83
T_6	34.10	34.21	34.25	34.34	65.23	65.43	65.63	65.83	8.80	8.43	7.96	7.36
T_7	36.61	36.66	36.74	36.79	69.22	69.42	69.62	69.74	7.67	6.90	6.56	6.16
T_8	38.72	38.84	38.85	38.97	73.13	73.28	73.43	73.51	7.26	6.81	6.27	5.80
F. test	S	S	S	S	S	S	S	S	S	S	S	S
S.Ed. (+)	0.165	0.17	0.033	0.15	0.019	0.013	0.013	0.047	0.349	0.422	0.359	0.325
C.D at 0.5%	0.352	0.363	0.071	0.322	0.04	0.028	0.029	0.101	0.746	0.903	0.768	0.695

Table 6. Effect of storage period on taste, texture and overall acceptability of dragon fruit candy

Treatment No	Taste				Texture				Overall acceptability			
	Initial	30 DAS	60 DAS	90 DAS	Initial	30 DAS	60 DAS	90 DAS	Initial	30 DAS	60 DAS	90 DAS
T_1	7.83	7.41	7.26	6.36	8.01	7.50	7.03	6.53	7.33	7.12	6.74	6.06
T_2	7.86	7.46	7.26	6.24	8.22	7.74	7.20	6.71	7.66	7.40	7.05	6.36
T_3	7.56	7.16	7.05	6.11	7.93	7.43	6.93	6.43	7.83	7.46	7.06	6.52
T_4	8.26	7.83	7.66	6.73	7.81	7.31	6.76	6.26	7.18	6.83	6.53	5.93
T_5	8.61	8.24	8.03	7.13	8.50	8.07	7.51	7.06	8.16	7.73	7.31	6.70
T_6	9.01	8.56	8.23	7.80	9.04	8.50	8.03	7.53	8.83	8.36	7.83	7.13
T_7	7.80	7.43	7.16	6.13	8.23	7.73	7.23	6.76	7.21	6.73	6.32	5.86
T_8	7.22	6.81	6.56	5.70	7.61	7.11	6.50	6.13	7.16	6.70	6.26	5.72
F. test	S	S	S	S	S	S	S	S	S	S	S	S
S.Ed. (+)	0.181	0.174	0.197	0.183	0.359	0.352	0.342	0.318	0.373	0.383	0.44	0.406
C.D at 0.5%	0.387	0.372	0.420	0.390	0.767	0.753	0.731	0.68	0.797	0.818	0.941	0.868

At 90 days, the highest score for color and appearance was noted (7.36) in T6 [Dragon fruit + 80% Sugar] followed by T5 (6.83) while the least score for color and appearance was noted (5.8) in T8 [Dragon fruit + 90% Sugar]. Similar results were reported by Heredia (2004) and Singh *et al.,* (2012) in Ber candy.

At 90 days, the highest score for taste was noted (7.80) in T6 [Dragon fruit + 80% Sugar] followed by T5 while the least score for taste was noted (5.70) in T8 [Dragon fruit + 90% Sugar]. At 90 days, the highest score for texture was noted (7.53) in T6 [Dragon fruit + 80% Sugar] followed by T5 while the least score was noted (6.13) in T8 [Dragon fruit + 90% Sugar]. At 90 days, the highest score for Overall acceptability yet again was noted (7.13) in T6 [Dragon fruit + 80% Sugar] followed by T5 while the least score was noted (5.72) in T8 [Dragon fruit + 90% Sugar]. Similar results were also reported by (Gupta et al., 2013) during a study of sugar concentration and time interval on quality and storability of Ber chuhara, (Balaji *et al.,* 2014) during the comparative study of varieties, honey coating and storage duration on Aonla candy, (Patil *et al.,* 2014) in sensory quality and economics of preparation of Karonda candy.

4. CONCLUSION

It can be concluded that from the present finding that the better quality of dragon fruit candy can be prepared by using 1000 g dragon fruit extract, 800 g sugar and gelatin 80 g i.e. T6 [Dragon fruit + 80% Sugar] with better organoleptic properties as well as physico-chemical properties and good storage ability at ambient condition up to 3 months storage periods**.**

COMPETING INTERESTS

Authors have declared that no competing interests exist.

REFERENCES

1. Kruger F, Lemmer D. Postharvest Management of Dragon Fruit. 2017:1–50. Available:https://amorentia.co.za/wpcontent/uploads/2017/05/4.-Postharvest-Dragon-Fruit-Frans-Kruger.pdf
2. Ram B. Studies on processing and preservation of aonla fruit candy M.Sc. Thesis, N.D.U.A. & T, Kumarganj, Faizabad; 1982.
3. Islam MZ, Khan MTH, Hoque MM, Rahman MM. Studies on the processing and preservation of dragon fruit (*Hylocereus undatus)* jelly. The Agriculturists; 2012.
4. Daisy, Gehlot R. Physical and bio-chemical changes in fresh aonla fruits and preserve of cvs. Banarasi and Chakaiya. Haryana Journal of Horticulture Sciences. 2006; 35(1):57-59.
5. Jothi JS, Monirul Islam MD, Serajul Islam MD, Rahman RT, Shireen Akther. Development and Shelf-Life predication of Pineapple (*Ananas comosus*) Preserve and Candy. International Journal of Innovation and Scientific Research. 2014; 10(1):77-85.
6. Kumar A, Deen B. Studies on preparation and storage of candy from papaya fruits. Journal of Pharmacognosy and Phytochemistry; 2017.
7. Chandu, Prasad M. Development of guava candies. Journal of Food Science and Technology. 2006; 43:210-212.
8. Hiremath JB, Rokhade AK. Preparation of sapota candy. International Journal of Food, Agriculture and Veterinary Sciences. 2012;2(1).
   ISSN: 2277-209X
9. Bal JS. A study on biochemical changes during room and refrigerator storage of ber. Progressive Horticulture. 1982; 14:158-161.
10. Patel KK, Kushwaha NK. Impact of Aonla varieties and pre-treatments on quality of aonla preserve (murabba) during storage. Life Sciences Leaflets. 2021; 47:37-49.
11. Pathak Nivedita, Saket Dubey, Satish Verma. Sensory evaluation and nutritional composition of developed papaya-jam and papaya candy. Journal of Pharmacognosy and Phytochemistry. 2021; 10(1):207-210.
12. Divya AR, Jayashree S, Basavarajapa B. Effect of storage methods on the nutritional quality of candy made from sapota. Asian J. Dairy & Food Res. 2012; 33(2):104-108.
13. Kaikadi MA, Chavan UD, Adsule RN. “Studies on preparation and shelf-life of ber candy”. 2016; 22(8):49-50.

14. Kustangi KU. Studies on processing of sapota (*Achras zapota*) Fruits. M.Sc. (Hort.) Thesis, University of Agricultural Sciences, Dharwad. 2002;44.

15. Lande R, Kale PB, Takey SM. Studies on dehydration of ber fruit. 4th Agricultural Sciences Congress, Jaipur, India. 1999; 21-24:214.

Peer-review history:
The peer review history for this paper can be accessed here:
https://www.sdiarticle5.com/review-history/101932