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Protocol for preparation and preservation of delicious and spicy wood apple nectar

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Abstract
The wood apple nectar was prepared by using 8 recipes which consisted, two levels of pulp content (20 and 22.5%) and TSS (18ºB and 20ºB) with or without spice mixture. Significant differences were observed with respect to physico-chemical and organoleptic quality parameters between the treatments. The chemical constituents *viz.*, TSS, titratable acidity, non-enzymatic browning, reducing sugar and total sugars were found to increase marginally from 19.16 to 19.77ºB, 0.65 to 0.78 per cent, 0.23 to 0.27 (OD value), 4.96 to 5.41 per cent and 16.00 to 16.34 per cent, respectively whereas, ascorbic acid, sugar: acid ratio, and non-reducing sugars content decreased from 1.67 to 1.08 mg/100ml, 24.78 to 20.88 and 10.49 to 10.39 per cent, respectively during the storage of three months. The mean organoleptic scores decreased significantly from an initial value of 8.04 to 7.78 for colour and appearance, 8.43 to 7.80 for flavour, 8.18 to 7.74 for taste, 7.79 to 7.53 for mouth feel and 8.11 to 7.72 for overall acceptability with the advancement of storage period. The results of the organoleptic evaluation indicated that the wood apple nectar prepared with recipe containing 22.5 per cent pulp + 20ºB TSS (T_7) and 22.5 per cent pulp + TSS 18.0ºB (T_5) was found superior in their acceptability than other treatments for all the four organoleptic parameters throughout the study.

Keywords: Wood apple, nectar, spice mixture, organoleptic characters

1. Introduction
India is home to many of the fruit crops and some of them are limited to its growing regions and neglected or underutilized. Most of underutilized fruits are cheap, highly nutritious, known for medicinal and therapeutic properties and are used by the local tribes to cure various diseases. Among underutilized indigenous fruit species, wood apple is one, known by several names like elephant apple, curd apple, monkey fruit, kavat, kathbel, Kotha, Vilanga, Kapith and Vela marum (Mazumder *et al.*, 2006) [1]. In northern parts of Karnataka, it is called as balolakai whereas, bellada hannu in southern parts. The wood apple (*Feronia limonia* Swingle), belongs to the family Rutaceae and it is one of the very hardy trees, tolerant to drought, salinity and thrives better in deep, well drained soils. It grows in the wild and is also planted along roads, the edges of fields and occasionally in orchards (Jayakumar and Geetha, 2012) [2].

Importance of wood apple fruit lies in its curative properties, which makes the tree as one of the useful medicinal plants of India. The fruit is used in India as a liver and cardiac tonic, when unripe, as an astringent means of halting diarrhea and dysentery, effective treatment for hiccups, sore throat and diseases of the gums (Singh, 2001) [3]. The pulp is poultice onto bites and stings of venomous insects (Kirtikar and Basu, 1935) [4] also it has hypoglycemic, antitumor, larvicidal, antimicrobial and hepatoprotective activity (Vidhya and Narain, 2011) [5]. This fruit is considered to be one of the natural sources of anti-oxidants due to its potential radical scavenging activity of various phytochemicals (Nithya and Saraswathi, 2010) [6]. Wood apple has high nutritional value. The pulp is pleasant and sweet, contains (for 100 g) moisture (74.0%), protein (8.00%), fat (1.45%), carbohydrates (7.45%), ash (5.0%), calcium (0.17%), phosphorus (0.08%), iron (0.07%) and tannins (1.03%) (Peter, 2008) [7].

People consume the raw fruit pulp as such with or without sugar or jaggery, or as a beverage after blending it with other ingredients (cardamom, salt, ginger *etc.*). Popular drink known as Simhalese as dimbulkiri (wood apple milk) is prepared by mixing ripened wood apple pulp with coconut milk and palm sugar (Morton, 1987) [8]. The pulp is also suitable for making processed products such as juice, sherbet, nectar, jam, fruit bar, wine, chutneys, pulp powder *etc.*

Because of its excellent flavour and nutritive value, this fruit has a great potential for value addition especially in beverage industry. The fruit is not popular as a desert fruit as it has hard shell containing mucilaginous pulp with numerous seeds. Therefore, it is not easily marketed in the fresh form therefore it has to be processed into acceptable products. Many of wood apple products are new to consumers, sincere efforts need to be made to introduce them in the market and to evaluate the consumer acceptance and economic viability for commercialization of such products. Therefore, the present study was undertaken to exploit the excellent and delightful pulp characters having exceptional medicinal value of this fruits in beverage industry.

2. Materials and Methods

An experiment was carried out during 2019-20 in the Department of Post harvest Technology, KRC College of Horticulture, Arabhavi (UHS, Bagalkot), Karnataka. The fully ripe fruits at edible stage were purchased from local market, opened by breaking against the hard surface. The pulp along with the seeds and fiber was separated with the help of stainless steel spoon from the hard shell. Pulp was extracted from the wood apple fruits by using 1:2 water and pectinase + cellulase enzyme @ 0.1 per cent after incubating for 2 hours at 50ºC. The extracted pulp was pasteurized at 75ºC for 5 minutes to inactivate the enzymes and used for preparation of wood apple nectar.

Pulp was mixed with sugar, spice mixture (salt, pepper powder, dry ginger powder and cardamom powder) and water as per recipes mentioned in the treatment details (Table 1). The TSS of the neatar was adjusted by adding cane sugar as specified in the treatment details using hand refractometer (Erma make). Chemical preservative in the form of potassium metabisulphite was added @ 100 ppm and nectar was filled in clean, sterile bottles and sealed with crown corks and pasteurized at 85ºC for 25 minutes and stored at ambient condition for further studies.

The TSS was measured by using an 'Erma' make hand refractometer and expressed as ºBrix after necessary corrections. Acidity was estimated by titration method and expressed in terms of citric acid as per cent titrable acidity. Ascorbic acid (mg/100ml) content was estimated titrimetrically using 2, 6-dichlorophenol indophenol dye as per the modified procedure of AOAC (Anon., 1984) [9]. The non-enzymatic browning was estimated by using spectrophotometric method suggested Srivastava and Sanjeevkumar (1998) [10] and expressed as optical density (OD). Reducing sugars was estimated as per the Dinitro - salicylic acid method (Miller, 1972) [11]. The total sugars content was estimated by the same method as in case of reducing sugars after inversion of the non-reducing sugars using dilute hydrochloric acid (Anon., 1984) [9]. The per cent non-reducing sugars was obtained by subtracting the values of reducing sugar from that of total sugar. Sugar: acid ratio was calculated by dividing of total sugars (%) by the respective value of titratable acidity (%) of the particular sample.

The organoleptic characters like colour and appearance, flavour, taste, mouth feel and overall acceptability were evaluated by a panel of semi- trained judges consisting of teachers and post-graduate students of KRC College of Horticulture, Arabhavi, on a nine point hedonic scale and the mean scores given by panelist were used for statistical analysis (Ranganna, 2010) [12]. The total bacterial count was taken as per the method of Harrigan and Mc-Cance (1966) [13].

The data recorded on the physico-chemical and organoleptic parameters were subjected to statistical analysis in Completely Randomized Design (CRD). The interpretation of data was carried out in accordance with Panse and Sukhatme (1985) [14]. The level of significance used in 'F' test was p=0.01.

Table 1: Nectar prepared by incorporating different level of wood apple pulp, sugar and spice mixture

T_1	20% pulp + 18ºB TSS
T_2	20% pulp + 18ºB TSS + 0.5% Spice mixture
T_3	20% pulp + 20ºB TSS
T_4	20% pulp + 20ºB TSS + 0.5% Spice mixture
T_5	22.5% pulp + 18ºB TSS
T_6	22.5% pulp + 18ºB TSS + 0.5% Spice mixture
T_7	22.5% pulp + 20ºB TSS
T_8	22.5% pulp + 20ºB TSS + 0.5% Spice mixture

3. Result and Discussion

3.1 Effect of different recipes on nutritional quality of wood apple nectar

Several changes in nutritional quality have occurred in wood apple nectar during the storage period of three months. The TSS and titratable acidity of nectar was found increased (19.16 to 19.77ºB and 0.65 to 0.78%, respectively) whereas, ascorbic acid content decreased (1.67 to 1.08 mg/100ml) during storage period (Table 2). An increase in TSS content in nectar during storage period could be attributed to slow hydrolysis of polysaccharides, pectin, acids *etc.* that might have resulted in production of soluble compounds particularly the sugars. Degradation of pectin substances of pulp into soluble solids which might have contributed towards an increase in titrable acidity of nectar. Kumar and Deen (2017) [15] reported that, slight increase in titratable acidity content might be due to formation of organic acids by the degradation of the ascorbic acid during storage. Decrease in ascorbic acid content was observed during storage was may be due to oxidation of ascorbic acid into dehydroascorbic acid. Similar findings *i.e*, increase in TSS, titratable acidity and decrease in ascorbic acid during storage were also reported by Manikanta (2005) [16] in case of guava beverages; Upale. (2005) [17] in case of jamun beverages; Chandana (2016) [18] and Kumar and Deen (2017) [15] in case of wood apple beverages.

Progressive increase (0.23 to 0.27) in browning (in term of O.D. values) of nectar was observed with the advancement of storage period (Table 2). Reduction in ascorbic acid content of the fruit product may be one of the possible reasons for browning of the product (Stadman, 1948) [19]. The present investigation also support the contention that reduction in ascorbic acid content during storage of nectar corresponding an increase in browning. The browning of beverages during storage due to non-enzymatic reaction was also reported in bael beverages (Verma *et al.*, 2008) [20]; in wood apple RTS (Kumar and Deen, 2017) [15]; in wood apple squash (Kumar and Deen, 2018) [21].

The reducing, total sugars were increased (4.96 to 5.41 and 16.00 to 16.34%, respectively) and non-reducing sugar (10.49 to 10.39%) of nectar decreased throughout the entire period of storage (Table 3). The increase in reducing and total sugars content of nectar could be due to inversion of non-reducing sugar into reducing sugars and hydrolysis of polysaccharides like pectin and starch could also be another reason for increase in the sugars content. On the other hand, the non-reducing sugar of nectar, decreased throughout the entire

period of storage which might be because of inversion. The results were in accordance with findings of Manikanta (2005) [16] in guava beverages; Upale (2015) [17] in jamun beverages; Chandana (2016) [18] in wood apple beverages; Kumar and Deen (2017) [15] in wood apple RTS. Further, the sugar:acid ratio decreased (24.78 to 20.88) throughout the entire period of storage (Table 3), which might be because of continuous increase in total sugars and acidity content during storage in nectar. The brix:acid ratio is often better indicator of acceptability than either sugar or acid alone.

Table 2: Changes in TSS, acidity, ascorbic acid and non-enzymatic browning of wood apple nectar as influenced by treatments and storage period

Treatments	TSS (ºB)				Acidity (%)				Ascorbic acid (mg/100ml)				Non enzymatic browning (OD)			
	Initial	1 MAS	2 MAS	3 MAS	Initial	1 MAS	2 MAS	3 MAS	Initial	1 MAS	2 MAS	3 MAS	Initial	1 MAS	2 MAS	3 MAS
T_1	18.19	18.35	18.55	18.82	0.59	0.64	0.70	0.74	1.58	1.46	1.28	0.94	0.218	0.224	0.236	0.248
T_2	18.12	18.29	18.49	18.73	0.61	0.67	0.72	0.77	1.63	1.52	1.30	1.04	0.222	0.228	0.247	0.277
T_3	20.15	20.32	20.47	20.65	0.62	0.68	0.72	0.75	1.60	1.44	1.26	0.99	0.225	0.229	0.244	0.251
T_4	20.20	20.45	20.77	20.92	0.64	0.70	0.76	0.81	1.61	1.39	1.20	1.03	0.229	0.238	0.257	0.280
T_5	18.15	18.47	18.59	18.77	0.67	0.71	0.75	0.78	1.71	1.59	1.33	1.18	0.234	0.244	0.253	0.267
T_6	18.22	18.49	18.73	18.87	0.70	0.72	0.80	0.83	1.76	1.62	1.40	1.21	0.238	0.245	0.267	0.287
T_7	20.12	20.40	20.53	20.74	0.66	0.70	0.76	0.79	1.72	1.55	1.38	1.15	0.235	0.247	0.257	0.269
T_8	20.09	20.38	20.54	20.67	0.69	0.73	0.78	0.80	1.75	1.53	1.34	1.13	0.240	0.248	0.271	0.288
Mean	19.16	19.39	19.58	19.77	0.65	0.69	0.75	0.78	1.67	1.51	1.31	1.08	0.23	0.24	0.25	0.27
S.Em±	0.024	0.025	0.022	0.019	0.011	0.011	0.012	0.013	0.013	0.014	0.013	0.011	0.001	0.001	0.001	0.001
C.D. @ 1%	0.098	0.103	0.091	0.079	0.044	0.045	0.048	0.055	0.053	0.056	0.055	0.045	0.002	0.002	0.004	0.004

Treatment Details

T_1 - 20% pulp + 18ºB TSS
T_2 - 20% pulp + 18ºB TSS + 0.5% Spice mixture
T_3 - 20% pulp + 20ºB TSS
T_4 - 20% pulp + 20ºB TSS + 0.5% Spice mixture
T_5 - 22.5% pulp + 18ºB TSS
T_6 - 22.5% pulp + 18ºB TSS + 0.5% Spice mixture
T_7 - 22.5% pulp + 20ºB TSS
T_8 - 22.5% pulp + 20ºB TSS + 0.5% Spice mixture

Table 3: Changes in sugars and sugar: acid ratio of wood apple nectar as influenced by treatments and storage period

Treatments	Reducing sugars (%)				Non-reducing sugars (%)				Total sugars (%)				Sugar: acid ratio			
	Initial	1 MAS	2 MAS	3 MAS	Initial	1 MAS	2 MAS	3 MAS	Initial	1 MAS	2 MAS	3 MAS	Initial	1 MAS	2 MAS	3 MAS
T_1	4.06	4.23	4.36	4.51	10.22	10.17	10.16	10.07	14.82	14.93	15.05	15.11	25.14	22.98	21.52	20.45
T_2	4.27	4.48	4.61	4.70	10.20	10.13	10.13	10.12	15.01	15.14	15.27	15.35	24.62	22.62	21.22	19.94
T_3	5.69	5.88	6.03	6.14	10.82	10.79	10.77	10.75	17.08	17.24	17.37	17.46	27.58	25.37	24.14	23.29
T_4	5.82	6.02	6.15	6.26	10.73	10.68	10.65	10.61	17.11	17.26	17.36	17.43	26.74	24.68	22.85	21.53
T_5	4.17	4.34	4.47	4.59	10.17	10.12	10.09	10.06	14.88	14.99	15.09	15.18	22.22	21.12	20.13	19.48
T_6	4.32	4.52	4.70	4.80	10.11	10.09	10.04	10.03	14.96	15.14	15.27	15.36	21.38	20.20	19.10	18.51
T_7	5.58	5.78	5.91	6.09	10.83	10.81	10.80	10.70	16.98	17.16	17.28	17.35	25.74	24.53	22.76	21.97
T_8	5.76	5.90	6.03	6.15	10.81	10.81	10.79	10.77	17.14	17.28	17.39	17.49	24.85	23.37	22.30	21.88
Mean	4.96	5.14	5.28	5.41	10.49	10.45	10.43	10.39	16.00	16.14	16.26	16.34	24.78	23.11	21.75	20.88
S.Em±	0.013	0.017	0.012	0.014	0.015	0.018	0.016	0.015	0.017	0.017	0.014	0.011	0.421	0.413	0.336	0.365
C.D. @ 1%	0.054	0.069	0.050	0.056	0.062	0.074	0.068	0.060	0.068	0.070	0.057	0.044	1.740	1.707	1.388	1.507

Treatment details

T_1 - 20% pulp + 18ºB TSS
T_2 - 20% pulp + 18ºB TSS + 0.5% Spice mixture
T_3 - 20% pulp + 20ºB TSS
T_4 - 20% pulp + 20ºB TSS + 0.5% Spice mixture
T5 - 22.5% pulp + 18oB TSS
T6 - 22.5% pulp + 18oB TSS + 0.5% Spice mixture
T7 - 22.5% pulp + 20oB TSS
T8 - 22.5% pulp + 20oB TSS + 0.5% Spice mixture

3.2 Effect of different recipes on organoleptic quality and safety of wood apple nectar

The nectar prepared by incorporating different level of wood apple pulp, sugar and spice mixture exhibited significant variations with respect to all the aspects of organoleptic qualities (Table 4). Organoleptic quality determines the storage life of the nectar and is an important tool in deciding the consumers' acceptability besides its nutritional qualities. At 3MAS, maximum score for appearance in terms of colour was recorded in the nectar developed without addition of spice mixture *i.e.* T_7, T_5 (8.00 each) followed by T_3 (7.92) and T_1 (7.83). Whereas minimum score for colour and appearance was recorded in the nectar developed with addition of spice mixture *i.e.* T_4, T_2, T_6 and T_8. This might be due to the browning caused by spices incorporated in the beverage that darken the product during storage. This is corroborated by the maximum non- enzymatic browning values observed for these treatments. Highly acceptable flavour might have been achieved in the treatments T_7 (8.25), T_5 (8.17), T_3 (8.08) and T_1 (8.00) prepared without addition of spice mixture. Whereas

minimum score for flavour was recorded in the nectar developed with addition spice mixture *i.e.* T_2, T_4, T_6 and T_8. This could be attributed to the presence of spices (cardamom and pepper) which masks the aroma of pulp as wood apple which has its unique pleasant aromatic flavour. Similarly, the treatments containing spice mixture recorded least score for mouth feel.

The treatments containing spice mixture *i.e.* T_8, T_6, T_4 (8.00 each) and T_2 (7.83) had shown highest organoleptic score for taste at initial and subsequent stages of storage. The salt present in spice mixture balances the acidic nature and sweetness and their by increases the palatability of product. The wood apple nectar containing 22.5 per cent pulp + 20ºB TSS (T_7) treatment scored better than other treatments for all the four organoleptic parameters initially as well as during storage. Another recipe of nectar containing 22.5 per cent pulp + 18ºB TSS (T_5) was on par with T_7 with respect to all the organoleptic parameters. The lower organoleptic scores for the recipes containing spice mixture may be due to the spices mask the flavour of wood apple as it has its unique pleasant aromatic flavour. Apart from this, the recipe containing spice mixture retains tart and tangy flavour after consumption. The extent of sensory changes during the storage of beverage depends on the type of fruit, ingredients used, method of processing and storage conditions (Paull, 1979) [22].

The acceptability of nectar was reduced with advancement of storage period because of undesirable changes in the product. Temperature plays an important role in inducing certain undesirable biochemical changes in the processed product which leads to development of off flavour as well as discoloration (browning) and there by masking the original colour and flavour of the beverage. Similarly, reduction in organoleptic quality has also been reported by many workers [Upale (2005) [17]; Manikanta (2005) [16]; Singh *et al*. (2013) [23]; Chandana (2016) [18] and Kumar and Deen (2018)] [21].

The microbial population (total bacterial count) showed a slight increase in their number during the storage period of three months (Table 5). However, such a marginal increase did not affect the wholesomeness of product. Potassium metabisulphite preservative was used for preservation of wood apple pulp based nectar beverages in the present study. Pasteurization of wood apple nectar after addition of chemical preservative might have helped in controlling and limiting the bacterial population to a safe level.

Table 4: Changes in organoleptic qualities of wood apple nectar as influenced by treatments and storage period

Treatments	Colour and appearance				Flavour				Taste				Mouth feel				Overall acceptability			
	Initial	1 MAS	2 MAS	3 MAS	Initial	1 MAS	2 MAS	3 MAS	Initial	1 MAS	2 MAS	3 MAS	Initial	1 MAS	2 MAS	3 MAS	Initial	1 MAS	2 MAS	3 MAS
T_1	8.00	8.00	7.92	7.83	8.58	8.50	8.33	8.00	8.00	7.83	7.67	7.50	8.00	8.00	7.92	7.92	8.15	8.08	7.96	7.81
T_2	8.00	7.83	7.83	7.58	8.00	7.67	7.33	7.08	8.17	8.00	7.83	7.83	7.50	7.42	7.33	7.17	7.92	7.73	7.58	7.42
T_3	8.00	8.00	7.92	7.92	8.50	8.42	8.33	8.08	8.00	7.83	7.67	7.50	8.00	8.00	7.92	7.83	8.13	8.06	7.96	7.83
T_4	8.00	7.83	7.83	7.50	8.00	7.67	7.33	7.17	8.25	8.17	8.08	8.00	7.58	7.50	7.33	7.17	7.96	7.79	7.65	7.46
T_5	8.17	8.17	8.08	8.00	8.83	8.67	8.42	8.17	8.00	7.83	7.67	7.50	8.17	8.17	8.08	8.00	8.30	8.21	8.06	7.92
T_6	8.00	7.83	7.75	7.67	8.33	8.00	8.00	7.83	8.47	8.17	8.08	8.00	7.42	7.33	7.17	7.00	8.06	7.84	7.75	7.63
T_7	8.17	8.08	8.00	8.00	8.83	8.67	8.50	8.25	8.08	7.83	7.67	7.58	8.17	8.17	8.08	8.08	8.31	8.19	8.06	7.98
T_8	8.00	8.00	7.92	7.75	8.33	8.00	7.92	7.83	8.50	8.42	8.17	8.00	7.50	7.42	7.17	7.08	8.08	7.96	7.79	7.67
Mean	8.04	7.97	7.91	7.78	8.43	8.20	8.02	7.80	8.18	8.01	7.85	7.74	7.79	7.75	7.63	7.53	8.11	7.98	7.85	7.72
S.Em±	0.068	0.099	0.088	0.093	0.110	0.098	0.114	0.088	0.098	0.093	0.080	0.085	0.106	0.110	0.121	0.072	0.054	0.054	0.055	0.046
C.D. @ 1%	NS	NS	NS	0.385	0.455	0.404	0.471	0.365	0.406	0.385	0.330	0.351	0.439	0.455	0.502	0.298	0.224	0.221	0.227	0.189

Treatment details

T_1 - 20% pulp + 18ºB TSS
T_2 - 20% pulp + 18ºB TSS + 0.5% Spice mixture
T_3 - 20% pulp + 20ºB TSS
T_4 - 20% pulp + 20ºB TSS + 0.5% Spice mixture
T_5 - 22.5% pulp + 18ºB TSS
T_6 - 22.5% pulp + 18ºB TSS + 0.5% Spice mixture
T_7 - 22.5% pulp + 20ºB TSS
T_8 - 22.5% pulp + 20ºB TSS + 0.5% Spice mixture

Table 5: Changes in total bacterial count of wood apple nectar as influenced by treatments and storage period

Treatments		Total bacterial count (10^{-3}cfu/ml))		
		1 MAS	2 MAS	3 MAS
T_1 -	20% pulp + 18ºB TSS	0.41	0.55	0.62
T_2 -	20% pulp + 18ºB TSS + 0.5% Spice mixture	0.33	0.38	0.43
T_3 -	20% pulp + 20ºB TSS	0.39	0.5	0.59
T_4 -	20% pulp + 20ºB TSS + 0.5% Spice mixture	0.31	0.33	0.41
T_5 -	22.5% pulp + 18ºB TSS	0.37	0.43	0.55
T_6 -	22.5% pulp + 18ºB TSS + 0.5% Spice mixture	0.28	0.33	0.38
T_7 -	22.5% pulp + 20ºB TSS	0.33	0.45	0.53
T_8 -	22.5% pulp + 20ºB TSS + 0.5% Spice mixture	0.30	0.33	0.35
Mean		0.34	0.41	0.48

4. Conclusion

From the above results it can be concluded that, better quality wood apple nectar could be prepared from wood apple pulp with recipe consisting 22.5 per cent pulp + 18 to 20ºB TSS (T_7 and T_5) and can be stored up to three months without much deterioration in physic-chemical and sensory quality.

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6. References

1. Mazumder R, Bhattacharya S, Mazumder A, Pattnaik AK, Tiwary PM, Chaudhary S, *et al*. Antidiarrahoeal evaluation of *Aegle marmelos* (Correa) Linn. root extract. Phytotherapy Ressearch 2006;20:82-84.
2. Jayakumar A, Geetha K. Wood Apple: Uses and Benefits. Market Survey 2012; pp. 23-24.
3. Singh IS, Minor fruits and their uses. Indian Journal Horticulture 2001;58(1-2):178-182.
4. Kirtikar KR, Basu BD, Indian Medicinal Plants, Vol. II, Lalit Mohan Publication, Allahabad 1935; p 496-497.
5. Vidhya R, Narain A. Development of preserved products using under exploited fruit, Wood apple (*Limonia acidissima*). American Journal of Food Technology 2011;6(4):279-288.
6. Nithya N, Saraswathi U. *In vitro* antioxidant and antibacterial efficacy of *Feronia elephantum* Correa fruit. Indian Journal of Natural Products and Resources 2010;1(3):301-305.
7. Peter KV. Under-utilized and under-exploited horticultural crops. New India publishing house, New Delhi 2008, pp 267-288.
8. Morton J. Wood Apple. Fruits of warm climates, Florida Flare Books 1987, pp. 190-191.
9. Anonymous. Official Method of Analysis. 14th Edition Association Official Analytical Virginia 1984, pp. 424-462.
10. Srivastava RP, Sanjeev Kumar. Fruit and Vegetable Preservation Principles and Practices. International Book Distributing Co., Lucknow 1998, pp. 64-98.
11. Miller GL. Use of dinitro-salicylic acid reagent for determination of reducing sugar. Annual Chem 1972;31:426-428.
12. Ranganna S. Handbook of Analysis and Quality Control for Fruit and Vegetable Products. Tata McGraw–Hill Education Pvt. Ltd., New Delhi 2010, pp 47-56.
13. Harrigan WF, Mc-Cance ME. Laboratory Methods in Microbiology. Academic Press, London 1966, pp. 14-16.
14. Panse VS, Sukhatme PV. Statistical methods for Agricultural workers. Council of Agricultural Research, New Delhi 1985, pp. 152-174.
15. Kumar A, Deen B. Study on preparation and storage stability of wood apple RTS beverage. International Journal of Pure and Applied Bioscience 2017;5(6):879-886.
16. Manikanta HK. Standardization of juice extraction process and recipe for juice based beverages from guava fruits. M. Sc. (Hort.) Thesis 2005. Univ. Agric. Sci., Dharwad (India).
17. Upale, K. B. Studies on processing of jamun juice and its beverages. M. Sc.(Hort.) Thesis, 2005; Univ. Agric. Sci. Dharwad (India).
18. Chandana CS. Studies on extraction of wood apple (*Feronia Limonia* Swingle) pulp for value addition. M. Sc. (Hort.) Thesis 2016. Univ. Hort. Sci. Bagalkot (India).
19. Stadman ER. Non-enzymatic browning in fruit products; Effect of storage temperature on browning. Advances in Food Research 1948;1:325-372.
20. Verma S, Gehlot R, Singh R. Development and evaluation of bael (*Aegle marmelos* Correa.) beverages. Haryana Journal of Horticultural Sciences 2008;37(3-4):240-242.
21. Kumar A, Deen B. Studies on preparation and preservation of squash from wood apple (*Limonia acidissima* L.) fruits. International Journal of Chemical Studies 2018;6(1):1513-1516.
22. Paull JK. Fruit and Vegetable Technology Juice Processing. Noyes Data Corporation, New Jersy, London. Publishing Co. Inc. Westport, Connecticut 1979;2:213-232.
23. Singh V, Markam R, Uikey P, Shinde V. Study on the biochemical, sensory and microbial contamination of custard apple RTS beverage. HortFlora Research Spectrum 2013;2(3):202-207.