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Study on Preparation and Storage Stability of Wood Apple RTS Beverage

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ABSTRACT

Study was investigated on the preparation of quality wood apple RTS beverage prepared from 10 per cent pulp, 13 per cent total soluble solids with 0.25 per cent acidity was found to be best during organoleptic quality. The manufactured RTS was bottled in sterilized glass bottles (200mL capacity) and stored at ambient temperature. The storage ability of RTS the TSS, acidity, reducing and total sugars and browning were increased, whereas ascorbic acid, non-reducing sugar and organoleptic quality was decreased with increased storage period, while microbial growth was first increased thereafter decreased. The microbial growth of RTS under the limit up to the end of storage period. Hence, the manufactured RTS was safe and suitable for consumption.

Key words: *Wood apple RTS, Storage Stability, Organoleptic Quality, Microbial Growth*

INTRODUCTION

Wood apple (*Limonia acidissima* L.) is one of the important, underutilized, former and indigenous fruit plants. It is also known by different vernacular names such as kainth, kath bel and elephant apple in different part of India. It is one of the very hardy fruit crops found all over the plains of Southern Maharashtra, West Bengal, Uttar Pradesh, Chhattisgarh and Madhya Pradesh. The wood apple is not under regular orcharding, however along the border of fields, roads, railway lines and as a roadside tree, near villages and banks of the river are the common places, where the plants are found as stray plant. The fruit tree can be grown even on saline, marginal lands, waste and neglected lands normally unsuitable for cultivation of other fruit trees. It is highly regarded as religious, cultural, nutritional and medicinal value fruit crop. The fruits are consuming as good source of juice during its harvesting season due to their low cost and thirst quenching ability. A homemade drink popularly known as "*Sarbat*" is prepared from the wood apple fruits. The wood apple pulp is a rich source of Beta carotene, a precursor of vitamin-A, which also contains significant amount of vitamins-B such as riboflavin and thiamine and it had small quantities of ascorbic acid content[23]. Fruits have high medicinal value and used in India as a liver and cardiac tonic, while unripe fruits are used as an astringent means of treating diarrhea and dysentery in folk medicines.

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It is effective treatment for hiccough, sore throat and diseases of the gums. Geda and Bokadia[10] reported antimicrobial activity of essential oil extracted from wood apple fruits and noticed its effectiveness against 12 human pathogenic bacteria. Maiti and Mishra[17] also reported presence of antivenom activity in wood apple fruits. Fruits are very well known for their medicinal properties due to its high nutritive value. Seeja *et al.*,[25] justified use of wood apple fruits by tribal people as a substitute for bael (*Aegle marmelos* Correa.) and *vice versa* due to the similar composition of leaf extracts to some extent. The chemical composition like TSS ranges from 10.67 to 14.33^0 Brix, acidity 1.04- 4.50 per cent and total sugars 4.08-4.47 per cent[13] The nutritional and chemical properties of fresh wood apple fruits showed that it contains 6.3 g protein, 15.6 g total carbohydrates, 72 per cent moisture, 4.16 per cent titratable acidity, 2.6 mg/100g vitamin-C, 235 mg/100g total phenol and 1412.55µg/g total antioxidant capacity[23]. Thus, large variability in physico-chemical characteristics of wood apple fruits provides an opportunity to select desirable types for commercial exploitation and plantation in waste and neglected lands.

The wood apple fruits are not consumed as fresh fruit due to high acidic and astringent taste. Although the medicinal and nutritive value is very high yet unfortunately there is not much demand of wood apple fruit either for fresh market or for processing, which may be due to poor awareness of consumers about its nutritive and medicinal importance of this underutilized fruits. However, it indicates that processing potential of wood apple fruits needs to be explored for commercialization of fruit. The present study would provide opportunity for commercial exploitation of the wood apple fruits and leads to the expansion of its cultivation on waste and neglected lands, marketing and processing in to quality products.

MATERIALS AND METHODS

The present experiment was carried out at post graduate laboratory of Department of Horticulture, College of Horticulture and Forestry, Narendra Deva University of Agriculture and Technology, Kumarganj, Faizabad (Uttar Pradesh) India. The fruits of wood apple were collected at ripening stage from Ratapur village of Milkipur Tehsil.

Extraction of pulp from wood apple fruits

The pulp extracted from ripe fruits of wood apple as per flow sheet showed in Fig-1. The wood apple pulp extracted by adding 3 fold water.

Chemical characteristics of wood apple pulp

The obtained data from analysed fruits regarding on chemical characteristics of wood apple pulp, which used for the preparation of wood apple RTS was presented in Table- 1.0.

Preparation of RTS

For formulation of recipes total soluble solids and total titratable acidity present in extracted pulp were first determined by hand refractometer and titration, respectively. Then calculation was done for sugar and acid present in the pulp as well as for remaining amount of sugar, citric acid, potassium metabisulphite and water required to prepare the finished RTS in different proportions according to desired recipes.

One liter of RTS of each recipe were prepared by mixing the calculated amount of pulp, sugar, citric acid and water in different proportions (recipes) then organoleptically evaluated by a panel of seven semi trained judges on a 9.0 Point Hedonic Rating Scale to find out the best one recipe of wood apple pulp, sugar and acidity content. Finally ten liter RTS was prepared with best recipe viz. 10 % fruit pulp, 13 % TSS, 0.25 % acidity and 70 ppm So_2. The technique used for making RTS is given in Fig 2.0. Prepared RTS was filled in sterilized bottles (200 mL capacity) by leaving 2cm head space and crown corked. Bottled RTS was pasteurized for 20 minutes in simmering water, cooled in air and stored at ambient temperature for further study and biochemical constituents in RTS were analyzed till the acceptability of the product.

Determine the proximate biochemical composition

Total soluble solids (TSS) were determined by hand refractometer (ERMA made) of 0-32 % ranges at room temperature. The reading was corrected at 20°C[24]. Total titratable acidity (% malic acid) content was analyzed, microbial contaminations and growth were determined and browning was recorded[24], while ascorbic acid content in the pulp and product according to the method of[2], and the determination procedure was followed as described The Fehling's 'A' and 'B' solutions[15] were used to estimate the sugars content adopting the procedure as suggested by Ranganna[24].

Organoleptic quality

Sensory evaluation offers the opportunity to obtain a complete analysis of the various properties of RTS as perceived by human sense. The organoleptic evaluation for assessing the sensory attributes like- colour, appearance, flavour, aroma, taste and texture of RTS was conducted by a panel of seven semi trained judges on 9.0 point Hedonic Rating scale[1].

Statistical analysis

During storage life study data were recorded at monthly interval on different parameters were subjected to statistical analysis using completely randomized design of analysis of variance[22] and results were interpreted at significance level of 5 per cent.

RESULTS AND DISCUSSION

Chemical characteristics of wood apple pulp

The data recorded on the chemical characteristics of wood apple pulp are showed in Table-1. The wood apple pulp extracted by adding 3 fold water was contained total soluble solids 6.00 per cent, titratable acidity 1.28 per cent, ascorbic acid 1.80 mg/ 100mL, reducing sugars 1.40 per cent, non-reducing sugar 2.45 per cent and total sugars 3.85 per cent, which affected the palatability and quality of processed RTS.

The wood apple RTS beverage manufactured from different amount of wood apple pulp and sugars are furnished in Table-2. The prepared RTS from recipe no.4 consisting 10 per cent wood apple pulp, 13 per cent TSS, 0.25 per cent acidity and 70 ppm SO_2 was found to be superior over rest recipes for preparation of quality palatable RTS followed by recipe no. 3 consisting 5 per cent pulp, 13 per cent TSS and 0.25 per cent acidity. However, there was no significant difference between recipe no. 4 and recipe no. 3.

Chemical changes during storage period

Data as embodied in table-3 clearly reflected that the total soluble solids of wood apple RTS gradually increased with storage period. An increase in total soluble solids content in RTS during storage period probably was due to the conversion of polysaccharides into sugars in the presence of organic acids. The results of present study are in close conformity to the findings of Nath *et al.,*[19] in ginger-kinnow squash, Tandon *et al.,*[30] in blended mango RTS, Swamy and Banik[29] in guava squash and Choudhary *et al.,*[5] in aonla squash.

The data portrayad in table-3 apparently indicated that per cent titratable acidity of RTS was increased gradually during storage period. Total pectic substances have been reported to increase the acidity in fruit products[6], hence degradation of pectin substances of pulp in to soluble solids might have contributed towards an increase in titrable acidity of RTS. The another reason for slight increase in titratable acidity might be due to formation of organic acids by the degradation of the ascorbic acid as it decreased with storage period of the beverage. This is in consonance with the findings of Pandey and Singh[21] in guava ready-to-serve beverage, Swamy and Banik[29] in guava squash, Ghanekar and Jain[11] in custard apple blend RTS and Balaji and Prasad[3] in kinnow-aonla blended RTS.

A perusal of data presented in table-1 indicated that the ascorbic acid content of RTS showed that content was decreased continuously during storage period. The reduction in ascorbic acid content of the beverage could be due to oxidation by trapped oxygen in glass bottles which results a formation of highly volatile and unstable dehydro ascorbic acid followed by further degradation to 2, 3- diketogulonic acid and finally to furfural compounds. Mapson *et al.,*[18] observed that oxidation due to temperature and greater catalytic activity of fructose in the catabolization of vitamin-C could be the reason for its decrease. The findings of present investigation matches with those as reported by Chalke *et al.,*[4] in RTS of fallen unripe mango fruits and Singh *et al.,*[27] in custard apple RTS beverage, Selvi *et al*.,[26] in guava-lime-ginger RTS beverage.

The data incorporated in table-3 indicated clearly the reducing and total sugars of the RTS were increased continuously throughout the entire period of storage in present investigation. The increase in reducing and total sugars content of RTS could be due to inversion of non-reducing sugar into reducing sugars as decreases in non-reducing sugar corresponded to increase in reducing sugars content. Hydrolysis of polysaccharides like pectin and starch could also be one of the reasons for increase in the sugars content. Similar observations were also observed by the several workers like Palaniswamy *et al.,*[20] in pulp and squash of mango, Deen and Singh[7] in karonda squash, Singh *et al*.,[27] in custard apple RTS and Deen and Kumar[7] in mango-ginger RTS.

It is evident from the observations for the non-reducing sugar of wood apple RTS, presented in table-3 that it was contrary to reducing and non-reducing sugar, the non-reducing sugar of RTS, decreased continuously throughout the entire period of storage which might be because of inversion. Similar observations were reported by Kumari and Sandal[14] in mango RTS, squash, Singh *et al.*[27] in custard apple RTS and Dubey *et al.*[9] in guava RTS.

Data furnished in table-3 showed that progressive increase in browning of RTS was observed in term of O.D. with the storage period in present finding. This could be mainly due to the non-enzymatic reaction (Millard reaction) such as reaction of organic acids with sugars or oxidation of phenol which leads to the formation of brown pigments. Stadman[28] reported that reduction in ascorbic acid content of the fruit product may be one of the possible reasons for browning of the product. The present investigation also support the contention that reduction in ascorbic acid content during storage of RTS corresponding an increase in browning. The browning was also reported in bael beverages[31], in karonda squash[8], in banana RTS[32] and in mango-ginger RTS[7]. These referred findings are in supports of present results.

Organoleptic quality determines the storage life of the RTS. In present investigation, organoleptic score of RTS was decreased gradually with storage period at ambient temperature showed in table-3. The acceptability of RTS was maintained up to 4th month of storage. Loss in organoleptic quality of RTS after certain period is obvious 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 in karonda squash[8], in custard apple RTS[27] and in mango-ginger blended RTS[7], these reported observations support the present findings.

Data with respect to microbial growth in RTS as illustrated in table-3 revealed the microbial growth of RTS was increased up to two month of storage at ambient temperature and thereafter, it showed continuously decreasing trend with storage period in RTS. The increase in microbial growth at first and second month may be due to some microbes present and contamination might occurred during processing. The decrease in microbial growth at later stage of storage might be due to increase in the content of sugar and acidity of product because sugar and higher acid possess preservative properties to reduce the microbial growth. The results reported by Li *et al.,*[16] and Goyal and Ojha[12] in orange juice and Singh *et al*.,[27] in custard apple Ready to Serve beverage are confirm the present findings. As reported by Ranganna[24] the microbial count should not exceed to 10^3 per mL of RTS. In present findings the microbial count had not exceeded this limit up till the RTS remained acceptable organoleptically.

Table 1: Chemical characteristics of wood apple pulp extracted with (1:3) water

S. No.	Chemical characteristics	Pulp (mean value)
1	Total soluble solids (%)	6.00
2	Acidity (%)	1.28
3	Ascorbic acid (mL/100 g)	1.80
4	Reducing sugars (%)	1.40
5	Non-reducing sugar (%)	2.45
6	Total sugars (%)	3.85

Table 2: Organoleptic quality of RTS prepared with different recipes

Treatments (Recipes No.)	Wood apple pulp (%)	TSS (%)	Acidity (%)	Organoleptic Quality	
				Score	Rating
1	5	12	0.25	7.30	Like Moderately
2	10	12	0.25	7.40	Like Moderately
3	5	13	0.25	8.14	Like Very Much
4	10	13	0.25	8.28	Like Very Much
5	5	14	0.25	7.25	Like Moderately
6	10	14	0.25	7.10	Like Moderately
SEm ±				0.12	
CD at 5%				0.37	

Table 3: Changes in biochemical during storage of wood apple RTS

Storage period (months)	TSS (%)	Acidity (%)	Vitamin- C (mL/100g)	Reducing sugars (%)	Non-reducing sugar (%)	Total sugars (%)	Browning (OD)	Microbial growth (X 10^3 cfu/mL)	Organoleptic quality	
									Score	Rating
0	13.00	0.25	0.18	0.13	11.77	11.90	0.14	0.390	8.30	LVM
1	13.20	0.29	0.17	0.55	11.53	12.08	0.16	0.421	8.15	LVM
2	13.80	0.33	0.16	1.12	11.27	12.39	0.17	0.538	7.80	LVM
3	14.35	0.38	0.14	1.60	11.12	12.72	0.20	0.401	7.60	LVM
4	14.85	0.42	0.12	2.17	10.98	13.15	0.23	0.381	7.30	LM
SEm ±	0.19	0.01	0.01	0.02	0.16	0.17	0.05	0.06	0.13	
CD at 5%	0.60	0.03	0.02	0.05	0.49	0.55	NS	0.15	0.40	

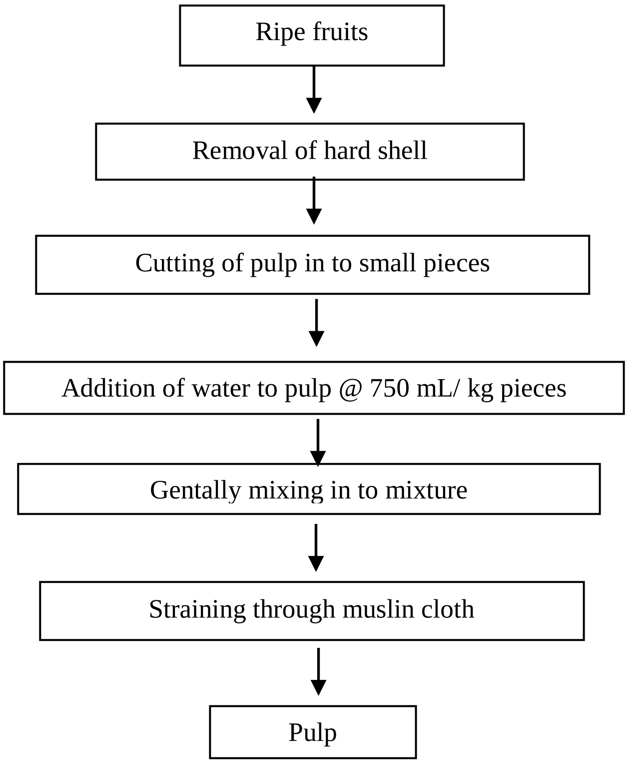

Fig. 1: Flow sheet for extraction of pulp from wood apple fruits

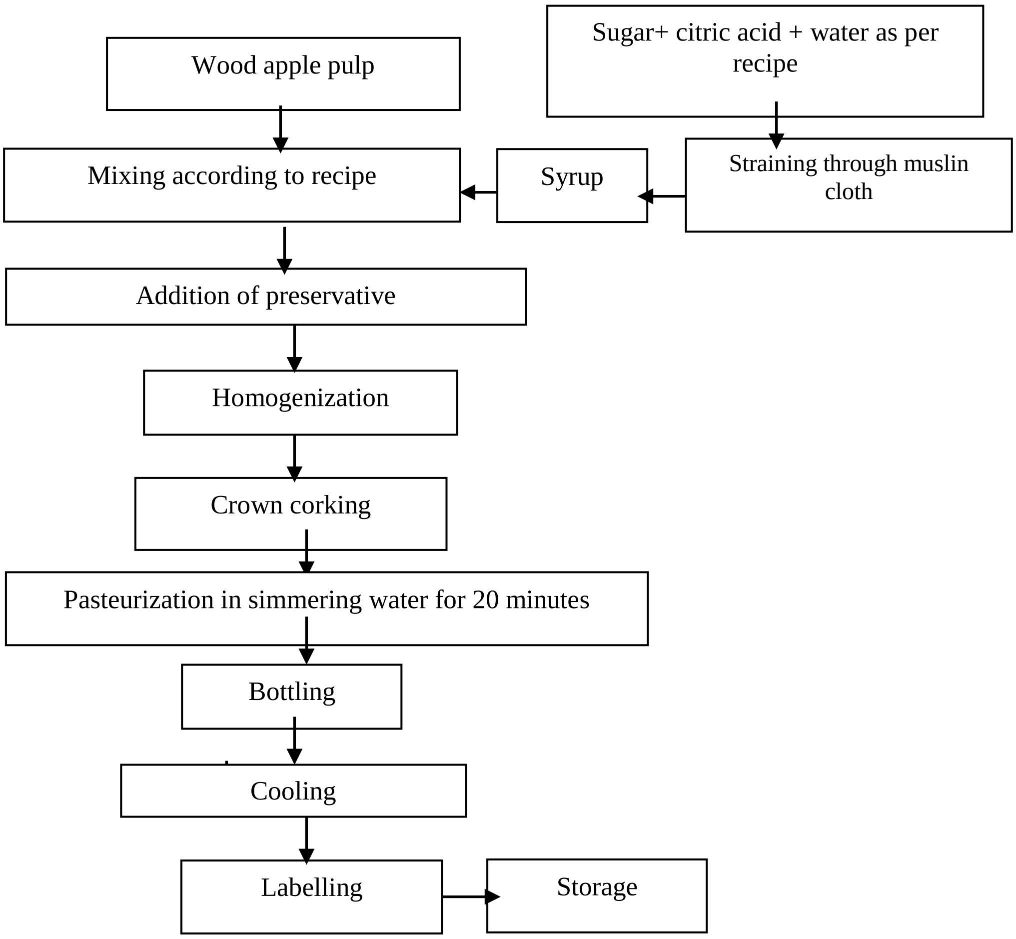

Fig. 2: Flow sheet for preparation of wood apple RTS

CONCLUSION

Results indicated that the wood apple pulp had sufficient amount of bio-chemical for providing nutrition and bioactive components to consumers. A recipe containing 10 per cent wood apple pulp, 13 per cent total soluble solids with 0.25 per cent acidity was found to be best for RTS making during evaluation of organoleptic quality.

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