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Standardization and Nutritional Evaluation of Wood Apple Juice with Stabilizers

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Abstract *Limonia acidissima* (L.), wood-apple, is an underexploited and edible fruit of family Rutacae which can be consumed either in raw or ripe form. In the present work, we have attempted to prepare and standardize wood apple juice using stabilizer. Juices were prepared with different variations in sugar content (T_1, T_2, and T_3) and stabilizers (Ts_1 and Ts_2). Statistical analysis was done to find the significant difference in sensory parameters in different treatments. The results show that there is a significant difference at ($p>0.05$) between wood apple juice with and without stabilizer i.e. T_1, Ts_1 and Ts_2 for quality attributes of color/appearance, texture and taste. According to nutritional analysis TSS content varied from 11.7 ± 0.2 to 12.6 ± 0.10. Titrable acidity of the products varied from 0.40 ± 0.01 to 0.56 ± 0.01. The ascorbic acid content was 3.3 ± 0.03 mg in T_1 and 3.8 ± 0.20 mg in Ts_2 product. Total sugar content of developed products varied from 12.25 ± 0.98 to 12.43 ± 0.09. Non reducing sugars (%) content was highest in Ts_2 (11.38 ± 0.06) and lowest in T_1 (11.09 ± 0.21). The results showed that the developed wood apple juice of different combinations with respect to sugar and stabilizer is found to be acceptable by consumers with regard to overall acceptability.

Keywords Standardization, Nutritional evaluation, Wood apple juice, Stabilizers, Sugar content.

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Introduction

Wood apple *Limonia acidissima* Linn is the moderate size slow growing tree of family Rutaceae (Citrus family) with sharp strong spines. It belongs to monotypic genus Limonia, native to India, Pakistan, Srilanka and Southeast Asia east to Java. It is an ideal tree growing in wasteland. Its other common names in English include Elephant-apple, Monkey fruit, Curd fruit and Kath bel. This plant has medicinal importance and prescribed as traditional medicine for the treatment of various diseases (Kirtikar and Basu 1993). It is one of the very hardy fruit crops found all over the plains of Southern Maharashtra, West Bengal, Uttar Pradesh, Chhattisgarh, Karnataka and Madhya Pradesh. The wood apple is not under regular orcharding. However, plants are found as stray plant along the border of fields, roads, railway lines

and as a roadside tree, near villages and banks of the river. Wood apple is a small to moderate size, deciduous, glabrous tree with thorny branches reaching to a height of 10 metres with 0.6 metres to 1.6 meters girth (Troup 1921). The fruit tree can be grown even on saline, waste and neglected lands normally unsuitable for cultivation of other fruit trees.The tree also flourishes well in dry areas and is not affected by any serious pests or diseases due to its resistant nature to both biotic and abiotic stresses. It has a wide range of biological activities e.g. adaptogenic activity, for blood impurities, for jaundice and hepatoprotectent (Patil et al. 2004). *Limonia acidissima* Linn plant is related with number of traditional medicinal claims like liver disorder, ulcers, cut wounds, skin cancer, breast cancer, Anti-hyperglycemic and antioxidant activities(Qureshi et al.2010). However, some of these traditional medicinal claims are proved scientifically by scholars and researchers like breast cancer (Pradhan et al.2012),anti-hyperglycemic and antioxidant activities (Ilango and Chitra 2009), hypoglycemic effect (Khatib et al. 2010), lowered blood glucose concentration (Gupta et al. 2008), hepatoprotective activity (Ilango and Chitra 2009), wound healing activity (Chitra 2010). Through the literature survey, it has been investigated that fruits of *Limonia acidissima* Linn plant contains flavonoids, glycosides, saponins and tannins (Saima et al. 2000), some amount of coumarin (Adikaram et al. 2007) and tyramine derivatives (Parthasarathi et al. 1991, Rahman and Gray 2001). The unripe fruits contain 0.015% stigmasterol and seeds contain oil high in saturated fatty acids (Morton 1987).

The fruits are consumed as a 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 pre-cursor of vitamin-A which also contains significant amount of Vitamin-B such as riboflavin and thiamine and it had small quantities of ascorbic acid content (Poongodi et al. 2013). 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 diarrhoea and dysentery in folk medicines. It is effective treatment for hiccough, sore throat and diseases of the gums. The fruit is also used for curative properties, which makes it as one of the useful medicinal plants of India. Geda and Bokadia (1980) reported antimicrobial activity of essential oil extracted from wood apple fruits and noticed its effectiveness against 12 human pathogenic bacteria. Maiti and Mishra (2000) also reported presence of antivenom activity in wood apple fruits.

Table 1. Details of treatments employed during the development of wood apple juice.

Sl. No.	Ingredients	T_1	T_2	T_3
1.	Beal pulp (g)	25	25	25
2.	Sugar (g)	21	25	18
3.	Citric acid (g)	0.104	0.104	0.104
4.	Sodium benzoate (g)	0.1	0.1	0.1
5.	Water (ml)	210	210	210

The research on the wood apple juice with stabilizers and wood apple blended value added products are very scant. Keeping this in view, the present investigation was carried to develop and standardize wood apple juice and stabilize using stabilizer and the nutritional and sensory qualities of wood apple juice.

Materials and Methods

Collection of fruits

Well matured, ripened and sound fruits were used during this study. The fruits were procured from the local market, Shivamogga (Table 1).

Nutritional evaluation

Total soluble solids (TSS)

The TSS of wood apple juice of different combinations were measured using Digital Pocket Atago Hand Refractrometer (Model :PAL 3) and expressed as degree Brix (^{0}B) (Table 2, Figs. 1 and 2).

Acidity

Titrable acidity of wood apple juice of different combinations samples were determined by visual titra-

Table 2. Details of treatments employed during the development of wood apple juice with stabilizers.

Sl. No.	Ingredients	T_1	Ts_1	Ts_2
1.	Beal pulp (g)	25	25	25
2.	Sugar (g)	21	21	21
3.	Acacia (%)	–	1.5	–
4.	CMC (%)	–	–	0.4
5.	Citric acid (g)	0.104	0.104	0.104
6.	KMS (g)	0.1	0.1	1.2
7.	Water (ml)	210	210	210

tion method (Ranganna 1995).

Preparation of sample

Ten ml of sample was taken in a 100 ml beaker and a little quantity of distilled water was added to it. The mixture was boiled for 1 h frequently replacing the water which was lost due to evaporation. Then it was filtered using Whatman No. 4 filter paper and the filtrate was used for analysis.

Methodology of preparing wood apple juice

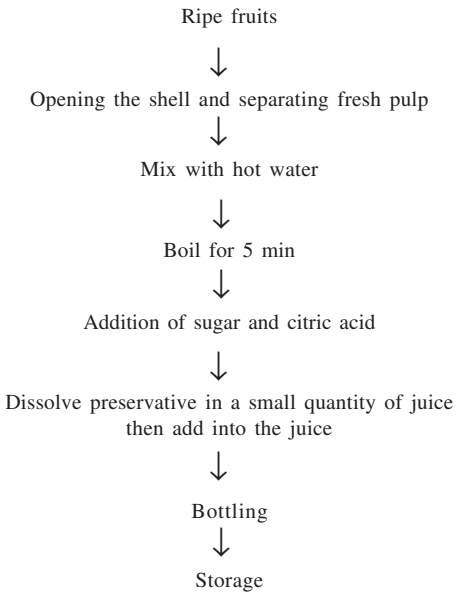

Fig. 1. Flow sheet for wood apple juice preparation.

Methodology of preparing wood apple juice with stabilizer

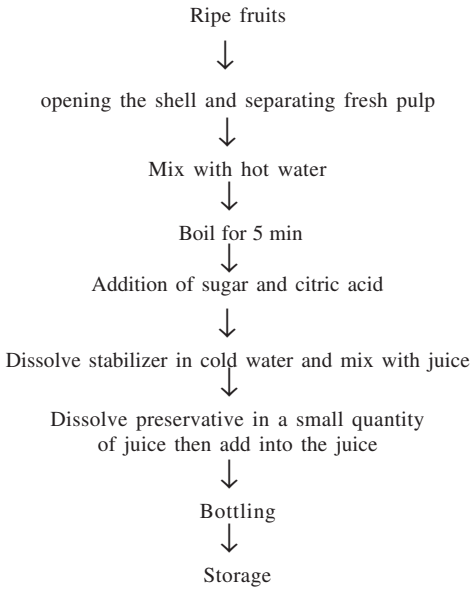

Fig. 2. Flow sheet for wood apple juice preparation with stabilizer.

Procedure

Ten ml of filtrate was taken in a conical flask and titrated against 0.1N NaOH solution using 1 or 2 drops of phenolphthalein indicator. Formation of pink color was recorded as the end point of filtration. Then, the acidity expressed as the percentage of an hydrous citric acid was calculated as follows :

Calculation

$$\text{Titrable acidity\%} = \frac{\text{Titre value} \times \text{N of NaOH} \times \text{Volume} \times \text{Equivalent} \times \text{Weight made up of citric acid}}{\text{Aliquot taken for titration} \times \text{Weight of sample}} \times 100$$

Ascorbic acid

Ascorbic acid of wood apple juice of different combinations were determined by 2, 6-dichlorophenol indophenols visual titration method (Ranganna 1995).

Preparation of 2, 6-dichlorophenol indophenols dye solution

In a beaker, 52 mg of 2, 6-dichlorophenol indophenols

dye and 42 mg of sodium bicarbonate were dissolved using 150 ml hot distilled water. Then, the volume was made upto 200 ml with distilled water.

Preparation of 4% oxalic acid

Fourty g of oxalic acid was dissolved in 900 ml distilled water. Then, the volume was made up to 1000 ml with distilled water.

Standard ascorbic acid

Fifty mg of L-ascorbic acid was dissolved in a small quantity of 4% oxalic acid in a 50 ml volumetric flask and the volume is made up to 50 ml with 4% oxalic acid. 10 ml of this stock solution was diluted to 100 ml using 4% oxalic acid. Therefore, the standard ascorbic acid contained 0.1 mg of ascorbic acid per ml of solution.

Standardization of dye

One ml of standard ascorbic acid solution and 5 ml of 4% oxalic acid were taken in a conical flask and titrated against the dye solution. The end point was light pink color which persisted for at least 5-10 seconds. The dye factor was then calculated as :

$$\text{Day factor} = 0.1 \,/\, \text{Titre value}$$

Preparation of sample

Ten ml of sample was taken in a 100 ml volumetric flask and 50 ml of 4% oxalic acid was added. The sample was thoroughly mixed and the volume was made up to the mark using 4% oxalic acid. The solution was filered using Whatman No. 4 filter paper and the filtrate was used for analysis.

Procedure

Ten ml of ascorbic acid extract was taken in a conical flask and titrated against the stadard dye solution. The end point was light pink color that persisted for 5-10 seconds.

Calculation

$$\text{Ascorbic acid, mg/100g} = \frac{\text{Titre value} \times \text{Dye factor} \times \text{Volume made up}}{\text{Volume taken for titration} \times \text{Weight of the sample}} \times 100$$

Sugars

Sugars present in wood apple juice of different combinations were estimated by following the method outlined earlier.

Preparation of sample

Ten ml of sample was blended with 80 ml distilled water in a 100 ml volumetric flask and the sample was neutralized with IN NaOH using phenolphthalein indicators. This solution was boiled gently for 1 h with occasional stirring. Boiling water was added to maintain the original level. It was cooled and transferred to 100 ml volumetric flask, volume was made up using distilled water and was also filtered through Whatman No. 4 filter paper. From this solution, 50 ml was pipetted out in to a 250 ml volumetric flask, 100 ml water and 2 ml lead acetate was added and was allowed to stand for 10 minutes. Then the excess lead was pre-cipitated by adding 1.8 ml potassium oxalate solution. It was made up to mark with distilled water and filtered through Whatman No. 4 filter paper and the filtrated was used for analysis.

Procedure

Ten ml of Fehling's solution (Fehling's No. 1 (25 ml) + Fehling's No. 2 (25 ml) with 25 to 50 ml of distilled water was taken in a conical flask, heated to boil and titrated against the filtrate sample using methylene blue as an indicator. The end point of titration was brick red color. The reducing sugar was calculated using equation.

Calculation

$$\text{Reducing sugar (\%)} = \frac{0.05 \times \text{Volume made up}}{\text{Titre value} \times \text{Weight of sample}} \times 100$$

Total sugars

Fifty ml of the filtrate (prepared for reducing sugar estimation) was hydrolyzed with 10 ml of 6 N HCl at room temperature for 24 h in250 ml volumetric flask. Add 4 drops of phenolphthalein indicator to hydrolyzed sample and was neutralized with 10% NaOH and the volume was made up to 250 ml with distilled water. Since all the sugars present in the sample were now converted to reducing sugars, estimation of reducing sugars in the aliquot as explained in the previous section gave the total sugar present.

Calculation

$$\text{Total sugar (\%)} = \frac{0.05 \times \text{Volume made up} \times 100}{\text{Titre value} \times 25 \times \text{Weight of sample}} \times 100$$

Non-reducing sugars

The non-reducing sugar contents of the wood apple juice of different combinations samples were determined by method of difference as :

Non-reducing sugars = Total sugars – Reducing sugars.

Sensory evaluation of jack fruit jam

Prepared wood apple juice of different combinations were evaluated by a panel of 10 judges for sensory attributes such as color appearance, texture, taste (aroma and sweetness) and overall acceptability in order to identify best one sample. Numerical scoring method with maximum 9 point hedonic scale (Lim 2011) was adopted for evaluating the products and the samples were ranked for quality parameters from higher to lower in descending order of acceptability.

Statistical analysis

The experimental data were analyzed as per the statistical design using the ARIS computer facility of College of Agriculture, Shivamogga to study the main treatment effects (Sundaraja et al. 1972). The limit of probability fixed for the test of significance was p=0.05.

Results and Discussion

Table 3 shows the average score obtained by the three wood apple juice products for color/appearance, texture, taste and overall acceptability.

Table 3. Organoleptic scores of Beal juice for various sensory attributes.

Treatments	Quality parameters			
	Color	Texture	Taste	Overall acceptability
T_1	8.1	8.1	8.2	8.3
T_2	5.3	5.4	5.1	4.6
T_3	4.9	4.5	4.1	4.3
Mean	6.1	6	5.8	5.7
F value	29.41	39.81	48.57	46.85
CD	1.052	0.856	0.884	0.938
P value	1.65×10^{-7}	8.84×10^{-9}	1.13×10^{-9}	1.66×10^{-9}
SEm	0.32	0.29	0.30	0.32

The product T_1 was found to be superior in all quality parameters that is color/appearance, texture, taste and over all acceptability. However the overall acceptability score of developed products varied from 4.3 to 8.30. T_1 was highly acceptable as compared to other products.

The results also show that there is a significant difference at (p>0.05) between different wood apple juice i.e. T_1, T_2, and T_3 for quality attributes of color/ appearance, texture and taste. Among the three treatments T_1 is selected for further investigation with stabilizers.

Table 4 shows the average score obtained by the three wood apple juice with stabilizers for color/appearance, texture, taste and overall acceptability.

The product T_1 was found to be superior in all quality parameters that is color/appearance, texture, taste and over all acceptability. However the overall acceptability score of developed products varied from 4.4 to 8.7. T_1 was highly acceptable as compared to other products.

The results also show that there is a significant difference at (p>0.05) between different wood apple juice i.e. T_1, Ts_1, and Ts_2 for quality attributes of color /appearance, texture and taste and overall acceptability.

Table 4. Organoleptic scores of wood apple juice with stabilizers for various sensory attributes.

Treatments	Quality parameters			
	Color	Texture	Taste	Overall acceptability
T_1	8.1	8.1	8.5	8.7
Ts_1	5.8	4.8	5.6	6.1
Ts_2	5.4	5.2	4.5	4.4
Mean	6.43	6.03	6.2	6.4
F value	14.73	27.28	36.71	46.21
CD	1.094	0.983	0.994	0.918
P value	4.71×10^{-5}	3.3×10^{-7}	1.99×10^{-8}	1.92×10^{-9}
SEm	0.379	0.340	0.344	0.318

Nutritional qualities of developed products are presented inTable 5. The TSS content varied from 11.7 ± 0.05 to 12.60 ± 0.10. According to Indian Standards, the TSS of juices should not be less than 10.0% (BIS-5861, 1993). Taking this standards in to consideration, the developed T_1, Ts_1 and Ts_2 had appreciable TSS levels in the present study.

Titrable acidity of the products varied from 0.40 ± 0.01 to 0.56 ± 0.01. However, the Ascorbic acid content was 2.07 ± 0.03 in Ts_1 and 4.56 ± 0.20 in Ts_2 product. Vitamin C is an antioxidant that protects the body against free radicals, strengthens immune system and keeps gums healthy (Umesh et al. 2010).

Total sugar content of developed samples varied from 12.25 ± 0.98 to 12.43 ± 0.09. Non-reducing sugars (%) content was highest in Ts_2 (11.38 ± 0.06) and lowest in T_1 (11.09 ± 0.21).

Table 5. Nutritional qualities of wood apple juice with stabilizers. Values are Mean ± SD.

Constituents	Treatments		
	T_1	Ts_1	TS_2
TSS (^{0}B)	11.7 ± 0.05	12.6 ± 0.10	11.7 ± 0.2
Titrable acidity (%)	0.50 ± 0.01	0.56 ± 0.01	0.40 ± 0.01
pH	3.2 ± 0.01	3.8 ± 0.01	3.9 ± 0.01
Ascorbic acid (mg/100g)	3.60 ± 0.10	2.07 ± 0.03	4.60 ± 0.20
Total sugar (%)	12.38 ± 0.11	12.25 ± 0.98	12.43 ± 0.09
Reducing sugar (%)	1.29 ± 0.12	1.10 ± 0.20	1.05 ± 0.05
Non reducing sugar (%)	11.09 ± 0.21	11.15 ±0.89	11.38 ± 0.06

Conclusion

The developed wood apple juice without stabilizer is found to be acceptable than the juice prepare with stabilizers. There was a significant difference between the different treatments and juice with stabilizers is not acceptable with respect to its color, taste, texture and overall acceptability.

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