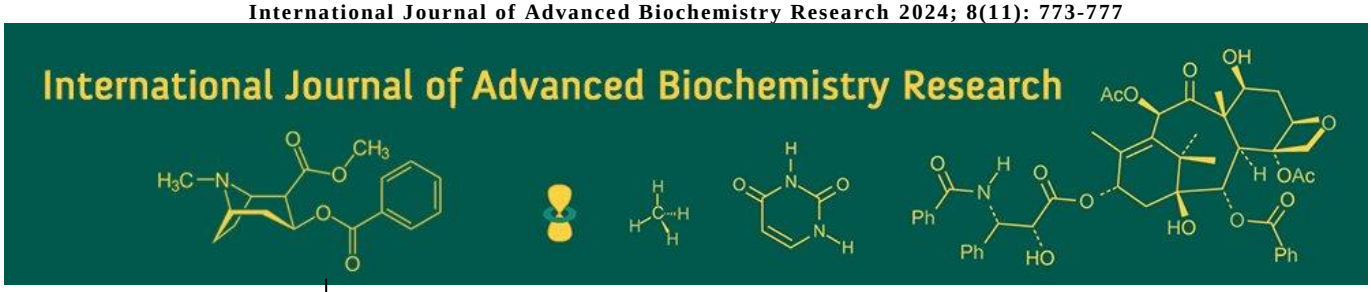

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Effect of different dilution levels and sugar concentration on bael wine preparation

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Abstract
The present investigation entitled "Effect of Different Dilution Levels And Sugar Concentration On Bael Wine Preparation" examine on chemical quality of wine and was conducted at Post Harvest Technology Laboratory, Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Akola, during the year 2022-23 Experiment was laid out in a Factorial Completely Randomized Design (FCRD) involving two main factors: dilution levels (1:2, 1:3, 1:4) and sugar concentrations (20°B, 22°B, 24°B). Wine samples were evaluated for chemical properties at two month intervals over a maturation period of seven months. Findings revealed that wine prepared from dilution of bael pulp with water in 1:3 ratio and maintaining sugar concentration in wine must at 22°B, exhibited significantly superior results in respect of total soluble solids (7.38°B), pH (3.40), titratable acidity (0.27%) and ethanol (10.66%).

Keywords: Bael wine, dilution levels, sugar concentration

Introduction
Bael (*Aegle marmelos* Correa) is an important indigenous fruit of India. It is of genus Aegle belonging to family Rutaceae. Widely distributed over India, Ceylon, Burma, Thailand, and Indochina, this subtropical tree is resistant, spiny, and grows slowly.

It is a fruit plant that is both nutritive and therapeutic, and it grows best in regions of the nation with limited water supplies. The fruit of this plant is high in carbohydrates, vitamin A and riboflavin. Alkaloids, coumarins, and steroids are among the chemical ingredients that have been identified and extracted from various portions of bael plants. Marmelosin, which ranges from (0.03-0.37%) depending on the species and location, is likely the therapeutically bioactive component of bael fruit, which is why bael is recognized as the cure-all for stomach disorders (Dixit and Dutt, 1932) [3]. Every component of the tree, including the stem, bark, roots, leaves, flowers, and fruit at various stages of maturation, has a purpose. Since ancient times, it has also been utilized to prepare a number of ayurvedic medications (Sharma *et al*., 2007) [4].

The beal fruit when ripens its colour changes from deep green to yellowish green in April or May, the fruit is ready to be harvested. Each fruit should be plucked separately to prevent the fruit from falling to the ground and splitting the shell, which could cause the fruit to rot in storage. When fruit is ripe, the stalk naturally separates from the fruit, signalling that the fruit is about to mature. In contrast to seedling trees, which bear fruit after 7-8 years, budded or grafted plants bear fruit 3–4 years after planting. A bael tree that is 12 to 15 years old yields 300–500 fruits, with each fruit weighing between 500g and 3000g. Yield varies greatly in bael varieties (Singh *et al*., 2014) [6].

The bael fruit is the healthiest fruits containing 61.5 g of moisture, 1.8 g of protein, 0.39 g of fat, 31.8 g of carbs, 1.7 g of minerals, 55 mg of carotene, 0.13 mg of thiamine, 1.19 mg of riboflavin, 1.1 mg of niacin and 8.0 mg of vitamin C per 100 g of edible portion, according to an analysis of the fruit (Gopalan *et al.*, 1985) [5]. There is no other fruit with as much riboflavin. The process of fermentation can be used to create innovative goods with altered physical, chemical, and sensory properties, particularly those related to flavour and nutritional value. Any beverage containing ethanol is considered alcoholic and since the bael fruit is not only rich in nutrients and medically significant but also holds great potential for commercial cultivation. Further research into this crop could promote widespread adoption, increasing awareness of its numerous health benefits.

Additionally, exploring innovative uses such as bael wine production as a post-harvest product could open new avenues for economic growth and broaden its appeal to consumers globally.

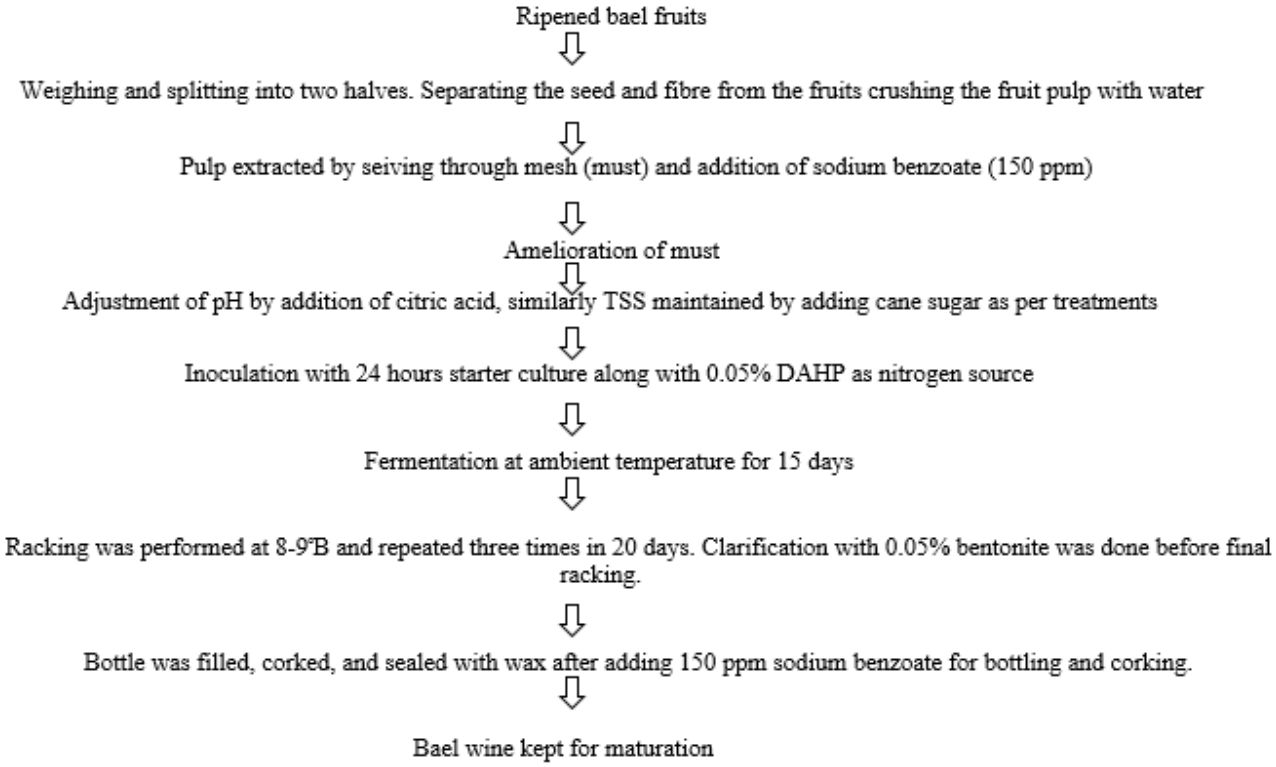
Materials and Methods

Fully matured and well-ripened bael fruits (*Aegle marmelos*) were procured from the Nagarjuna medicinal garden at Dr. Panjabrao Deshmukh Krishi Vidyapeeth (PDKV), Akola. The fresh fruits were brought to the Post-Harvest Technology Laboratory for analysis.

Laboratory experiment was conducted in Horticulture Section, College of Agriculture Akola in Factorial Completely Randomized Design (FCRD) with two factors: Factor A - Pulp dilution with water *viz*, D_1 (1:2), D_2 (1:3) and D_3 (1:4) and Factor B - Sugar concentration *viz*, T_1 (20°B), T_2 (22°B) and T_3 (24°B) with nine treatment combinations. Each treatment was replicated four times. The observation of fresh and seven months matured wine on TSS, pH, titratable acidity and Ethanol content were recorded.

The procedure for wine making was thus carried out with slight modification in general method described by (Joshi, 1995) [9]. The wine prepared from bael was analyzed for physico - chemical characteristics by standard methods described by A.O.A.C. (2000) [8]. The Total Soluble Solids (TSS) was determined by using Atagomake RX 1000 digital refractometer, pH of wine was determined with help of digital pH meter (Model 411). The method described by Ranganna (1979) [7] was adopted for the determination of titratable acidity of wine, in which one gram sample was diluted with 10 ml of distilled water and then filtered the solution. Then filtered solution was titrated against the standard NaOH (0.1N) solution, using phenolphthalein as an indicator. The appearance of light colour considered the end point of titration. Ethanol content of wine was estimated by using specific gravity method (Ranganna, 1979) [7]. This method provides an approximation of the alcohol content only. The method assumes that the difference in specific gravity before and after fermentation is due solely to the conversion of sugars before fermentation into alcohol after fermentation. The entire process of bael wine preparation is shown in below flow chart.

Flow chart for the preparation of bael fruit wine



Results and Discussion

Data in respect of TSS, pH, titratable acidity and ethanol content due to the effect of different dilution levels, sugar concentrations is presented in table 1 and their interaction were recorded at fresh and seven months maturated bael wine is shown in Table 2 and depicted in Fig 1a, 1b,1c and 1d.

Results

1. Effect of different dilution levels on TSS, pH, titratable acidity and ethanol content of bael wine

In fresh and 7 months matured bael wine, significantly minimum TSS (7.68 and 7.44°B, respectively), pH (3.30 and 3.43, respectively), titratable acidity (0.37 and 0.29%, respectively) and maximum ethanol content (10.48 and 10.61%, respectively) were recorded in treatment D_2 (1:3). However, there was significantly maximum TSS (8.33 and 8.08°B, respectively), pH (3.55 and 3.69, respectively), titratable acidity (0.59 and 0.50%, respectively) and significantly minimum ethanol content (9.88 and 9.98%, respectively) were recorded in treatment D_1 (1:2).

2. Effect of different sugar concentration on TSS, pH, titratable acidity and ethanol content of bael wine

In fresh and 7 months matured bael wine, significantly minimum TSS (7.91 and 7.65°B, respectively), pH (3.38 and 3.51, respectively), titratable acidity (0.44 and 0.35%, respectively) and maximum ethanol content (10.28 and 10.39%, respectively) were recorded in treatment T_2 (22°B).

However, there was, significantly maximum TSS (8.04 and 7.76°B, respectively), pH (3.43 and 3.56, respectively), titratable acidity (0.48 and 0.40%, respectively) and minimum ethanol content (10.17 and 10.28%, respectively) were recorded in treatment T_3 (24°B).

3. Interaction effect of different dilution levels and sugar concentration on TSS, pH, Titratable acidity and Ethanol content of bael wine: The interaction effect of different dilution levels and sugar concentration were found significant for fresh and 7 months matured wine. Significantly minimum TSS (7.62 and 7.38°B, respectively), pH (3.28 and 3.40, respectively), titratable acidity (0.35 and 0.27%, respectively) and maximum ethanol content (10.54 and 10.66%, respectively) were recorded in treatment D_2T_2. However, there were significantly maximum TSS (8.38 and 8.13°B, respectively), pH (3.57 and 3.71, respectively), titratable acidity (0.61 and 0.53%, respectively) and minimum ethanol content (9.82 and 9.92%, respectively) were recorded in treatment D_1T_3.

Table 1: Effects of levels of pulp dilution and sugar concentration on TSS, pH, titratable acidity and ethanol content of bael wine during maturation

Factors	TSS (°B)		pH		Titratable acidity (%)		Ethanol (%)	
	Fresh wine	7 months matured wine	Fresh wine	7 months matured wine	Fresh wine	7 months matured wine	Fresh wine	7 months matured wine
Factor A	Levels of Dilution (Pulp: Water)							
D_1 (1:2)	8.33	8.08	3.55	3.69	0.59	0.50	9.88	9.98
D_2 (1:3)	7.68	7.44	3.30	3.43	0.37	0.29	10.48	10.61
D_3 (1:4)	7.91	7.61	3.37	3.50	0.43	0.34	10.31	10.41
F Test	Sig	Sig	Sig	Sig	Sig	Sig	Sig	Sig
SE (m) ±	0.002	0.002	0.002	0.001	0.001	0.001	0.002	0.001
CD at 5%	0.007	0.005	0.005	0.003	0.004	0.003	0.006	0.003
Factor B	Sugar Concentration							
T_1 20°B)	7.97	7.72	3.41	3.54	0.47	0.38	10.22	10.34
T_2 (22°B)	7.91	7.65	3.38	3.51	0.44	0.35	10.28	10.39
T_3 (24°B)	8.04	7.76	3.43	3.56	0.48	0.40	10.17	10.28
F Test	Sig	Sig	Sig	Sig	Sig	Sig	Sig	Sig
SE (m) ±	0.002	0.002	0.002	0.001	0.001	0.001	0.002	0.001
CD at 5%	0.007	0.005	0.005	0.003	0.004	0.003	0.006	0.003

Table 2: Interaction effects of levels of pulp dilution and sugar concentration on TSS, pH, titratable acidity and ethanol content of bael wine during maturation

Interaction (D × T)	TSS (°B)		pH		Titratable acidity (%)		Ethanol (%)	
	Fresh wine	7 months matured wine	Fresh wine	7 Months Matured Wine	Fresh wine	7 Months Matured Wine	Fresh wine	7 Months Matured Wine
D_1 T_1	8.33	8.09	3.55	3.69	0.59	0.51	9.87	9.98
D_1 T_2	8.28	8.02	3.53	3.66	0.56	0.47	9.94	10.05
D_1 T_3	8.38	8.13	3.57	3.71	0.61	0.53	9.82	9.92
D_2 T_1	7.67	7.44	3.30	3.44	0.38	0.29	10.47	10.62
D_2 T_2	7.62	7.38	3.28	3.40	0.35	0.27	10.54	10.66
D_2 T_3	7.75	7.49	3.32	3.46	0.40	0.30	10.42	10.57
D_3 T_1	7.93	7.63	3.38	3.50	0.43	0.34	10.31	10.41
D_3 T_2	7.83	7.54	3.34	3.47	0.42	0.32	10.36	10.46
D_3 T_3	7.98	7.68	3.40	3.52	0.45	0.35	10.26	10.36
F Test	Sig	Sig	Sig	Sig	Sig	Sig	Sig	Sig
SE (m) ±	0.004	0.003	0.003	0.002	0.002	0.002	0.003	0.002
CD at 5%	0.012	0.009	0.008	0.005	0.006	0.006	0.010	0.005

Discussion

TSS

These results indicate that bael wine prepared using with a 1:3 dilution of pulp and 22 °B TSS (D_2T_2) showed a decreasing trend in TSS with maturation and achieved favorable levels for quality wine after 7 months of maturation. These findings are consistent with research by Joshi *et al*. (2012) [29] observed a decrease in TSS at different dilution levels with maturity of jamun wine, since as the dilution levels increased, total soluble solids content decreased. Panda *et al*., 2013 similarly found that TSS decreased from 20°Brix in must to 2.9°Brix in wine. The decrease in TSS from must to wine was indicative of the consumption of the sugar sources by the wine yeast to produce ethanol. The results are in conformity with Joshi *et al*., (2014) observed in mandarin wine that during maturation, there is decreasing trend in TSS of wine. Precipitation of soluble solids during interaction of various components might have resulted in a decrease of TSS.

pH

Change in pH of bael wine shows that pH increases with advancement of maturation time but the increase were meager upto 7th month of maturation. The increase in pH of bael wine during maturation could be attributed to precipitation of acids during fermentation. These findings are in close agreement with the findings of Kumar *et al*., (2011) [11] found that at lower dilution maximum pH was recorded with 1:2 dilution without DAHP (4.01). The decrease of pH was also associated with increase in dilution (Shukla *et al*. 1991) [12]. This might be due to formation of acids possibly as by-products as reported by Potty *et al*. (1978) [25], Vyas and Kochhar (1993) [13] and also due to production of certain organic acids as reported by Kulkarni *et al*. (1980) [14], Kumar *et al*., (2016) [1], Sharma and Joshi, (2003) [22] and Lokesh *et al*., (2014) [28].

Titratable acidity

From the above results it is apparent that, titratable acidity of bael wine decrease gradually as the maturation period

advances similar results were observed by Joshi *et al*. (2016) [1] observed higher titratable acidity in muskmelon wine prepared from 1:1 dilution of pulp compared to wine from 1:0.5 dilution. This higher acidity at 1:1 dilution correlated with better ferment ability of the must, as higher dilution reduced the pulp thickness, aiding in improved fermentation. Pawaskar *et al*., (2011) [15] recorded decreasing trend from 1.03 to 0.68 per cent with increase in dilution level. The decrease in acidity with increase in dilution levels are in accordance with the findings of Joshi *et al*., (1990) [16] in apricot and Taskar (2007) [17] in jamun wine. Similar results were also reported by Sharma and Joshi (2003) [27] in strawberry wine and Joshi *et al*., (2012) [29] in jamun wine. Lokesh *et al*., (2014) [28] observed decreasing trend of titratable acidity after fermentation and during ageing of jamun wine.

Ethanol

From the above results it is apparent that, increase in ethanol content of wine during maturation period is important for production of good quality bael wine. The ethanol content increase with advancement of maturation time might be due to auto-oxidation of ethyl alcohol. The above findings are in conformity with the findings of Joshi *et al*. (2016) [1] studied the effect of different variables (dilution of pulp and DAHP) on alcohol content in muskmelon wine. They found that the alcohol content ranged from 9.33% to 9.50% (v/v) with maturity of wine. Suresh *et al*., (2014) studied effect of sugar concentrations on the alcohol content of aonla wine the production of alcohol was very less in the first batch of fermentation with maximum and minimum alcohol concentrations between7.37 and 6.06 per cents respectively with 24oB TSS sugar syrup and 40oB TSS sugar syrup wines. However the alcohol concentrations had almost doubled in the second and third batches of fermentations. The alcohol contents were highest in the aonla wine prepared with 24oB TSS sugar syrup (7.37%, 12.06% and 13.98% in first, second and third batches of fermentation) which was significantly superior over other aonla wines prepared between 28oB and 40oBTSS sugar syrups, this could be due to the fact that the higher concentrations of sugar would have created high osmotic pressure on the yeast resulting in lesser alcohol production.

Conclusion

In the present study we have developed and evaluated the physic-chemical attributes of bael wine. Further bael fruits are seasonally available in tropical countries like India, in huge quantities during the summer (May-June). Due to its abundance of therapeutic qualities, bael has a lot of potential in the wine business. There is little work being done on bael wine. Therefore, a scientific method is needed to prepare wine from bael. There is little work being done on bael wine. Therefore, a scientific method is needed to prepare wine from bael. On this subject, merged information is also accessible. With the following goals in mind, an experiment is conducted to determine how sugar concentration and dilution affect the production of wine.

Reference

1. Joshi VK, Kumar V, Chauhan H, Tanwar B. Preparation and evaluation of muskmelon wine: Effect of dilution of pulp, DAHP, pectinesterase enzyme, and citric acid on physico-chemical and sensory quality characteristics. World J Biotechnol. 2016;1(2):56-63.
2. Joshi VK, Sharma R, Girdher A, Abrol GS. Effect of dilution and maturation on physico-chemical and sensory quality of jamun (Black plum) wine. 2012;222-227.
3. Dixit BBL, Dutt S. The constitution of marmelosin. J Indian Chem Soc. 1932;9:271-9.
4. Sharma PC, Bhatia V, Bansal N, Sharma A. A review on bael tree. Nat Prod Radiance. 2007;6(2):171-8.
5. Gopalan C, Rama Sastri BV, Balasubramanian SC. Nutritive value of Indian food. Hyderabad, India: I.C.M.R.; 1985.
6. Singh AK, Chaurasiya AK. Post-harvest management and value addition in bael (*Aegle marmelos* Corr.). Int J Interdiscip Multidiscip Stud. 2014;1(9):65-77.
7. Ranganna S. Manual of Analysis of Fruit and Vegetable Products. New Delhi: Tata McGraw-Hill Publishing Company Limited; c1979, p. 317-8.
8. AOAC International. Official methods of analysis of AOAC International. 17th Ed. AOAC International; c2000.
9. Joshi VK. General methods of wine preparation. In: Fruit wine. 1st Ed; c1995, p. 25-33.
10. Panda SK, Sahu UC, Behera SK, Ray RC. Bio-processing of bael [*Aegle marmelos* L.] fruits into wine with antioxidants. Food Biosci. 2014;5:34-41.
11. Kumar V, Goud PV, Babu JD, Reddy RS. Preparation and evaluation of custard apple wine: Effect of dilution of pulp on physico-chemical and sensory quality characteristics. Int J Food Ferment Technol. 2011;1(2):247-53.
12. Shukla KG, Joshi MC, Yadav S, Bisht NS. Jambal wine making: standardization of a methodology and screening of cultivars. J Food Sci Technol. 1991;28(3):142-144.
13. Vyas KK, Kochhar APS. Studies on cider and wine from culled apple fruit available in Himachal Pradesh. Indian Food Packer. 1993;47(4):15-21.
14. Kulkarni JH, Singh H, Chadha KL. Preliminary screening of mango varieties for wine making. J Food Sci Technol. 1980;17(5):218-220.
15. Pawaskar SP, Pawar CD, Bhuwad AV, Kasture MC, Pavhane SB, Tendulkar SS. Effect of different dilution and pH levels on quality of kokum (*Garcinia indica* Choisy) wine.
16. Joshi VK, Bhutani VP, Lal BB, Sharma RC. A method for preparation of wild apricot (chulli) wine. Ind Food Packer. 1990;44(5):50-5.
17. Taskar NV. Effect of different levels of DAHP, sulphur dioxide and dilution on yield and quality of jamun (Syzygium cumini L.) wine. M.Sc. (Agri.) thesis (Unpublished). Konkan Krishi Vidyapeeth, Dapoli, Dist. Ratnagiri (M.S.); c2007.
18. Suresh HL, Sreenivas KN, Thotad M, Ramakrishna BM, Shankarappa TH, Krishna HC. Fermentation extraction of aonla components into wine at varied levels of sugar concentrations. Environ Ecol. 2015;33(1A):203-207.
19. Rajvadya RR, Dalal SR, Deshmukh SD, Dhomane NJ. Effect of different levels of yeast and sugar concentrations on preparation of wine from bael. Int J Curr Microbiol App Sci. 2021;10(3):1817-1823.
20. Joshi VK, Sandhu N, Abrol GS. Effect of initial sugar concentration and SO2 content on the physico-chemical characteristics and sensory qualities of mandarin orange wine. Int J Food Ferment Technol. 2014;4(1):37-46.

21. Kumar V, Prakriti J, Goud PV, Bhasin JK. Effect of maturation on physico chemical and sensory quality characteristics of custard apple wine. Cogent Food & Agriculture. 2016;2:1180660.
22. Sharma S, Joshi VK. Effect of maturation on the physiochemical and sensory quality of strawberry wine. Journal of Scientific Research. 2003;62:601–608.
23. Lokesh K, Suresha GJ, Jagadeesh SL, Netravati. Influence of yeast levels and duration of anaerobic fermentation on physio- chemical and sensory qualities of jamun wine. The Asian Journal of Horticulture. 2014;9(1):76-78.
24. Joshi VK, Sharma R, Girdher A, Abrol GS. Effect of dilution and maturation on physio chemical and sensory quality of Jamun (Black plum) wine. Indian J. of Natural Products and Resources. 2012;3(2):222-227.
25. Potty VP, Joseph KV, Menon SK, Jayasankar NP. Processing and fermentation of coconut Toddy. J. Fd. Sc. Technol. 1978;15(2):31-33.
26. Kumar V, Jnawali P, Goud PV, Bhasin JK. Effect of maturation on physico-chemical and sensory quality characteristics of custard apple wine. Cogent Food Agric. 2016;2:1180660.
27. Sharma S, Joshi VK. Effect of maturation on the physiochemical and sensory quality of strawberry wine. J Sci Res. 2003;62:601-608.
28. Lokesh K, Suresha GJ, Jagadeesh SL, Netravati. Influence of yeast levels and duration of anaerobic fermentation on physico-chemical and sensory qualities of jamun wine. Asian J Hortic. 2014;9(1):76-78.
29. Joshi VK, Sharma R, Girdher A, Abrol GS. Effect of dilution and maturation on physico-chemical and sensory quality of jamun (Black plum) wine. Indian J Nat Prod Resour. 2012;3(2):222-7.
30. Potty VP, Joseph KV, Sethumadhava Menon K, Jayasankar NP. Processing and fermentation of coconut toddy. J Food Sci Technol. 1978;15(2):31-33.