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Influence of yeast levels and duration of anaerobic fermentation on physico-chemical and sensory qualities of jamun wine

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ABSTRACT : Jamun (*Syzygium cumini* L.) fruits were utilized to prepare organoletpically acceptable wine. The wine was prepared using different levels (0.2, 0.25 and 0.3 g/l) of yeast (*Saccharomyces cerevisiae* var. *ellipsoideus*) and fermented for 7, 14 and 21 days in anaerobic condition after 1 day of aerobic fermentation. TSS and PH of the *must* were ameliorated to 240B and 3.2, respectively and juice was used as *must.* The analysis for ethanol (6.32 %), tannin (1.79 %) and wine recovery (76.39 %) showed maximum in the treatment T_3 (yeast 0.2 g/l and 21 days of anaerobic fermentation). Sensory evaluation of the prepared wine revealed that the same treatment T_3 recording the total score of 15 out of 20.0 by the semi trained sensory panel. The treatment T_3 recorded maximum score for appearance (1.7 out of 2), colour (1.68 out of 2), aroma and bouquet (3.75 out of 4), body (1.58 out of 2) and flavor (1.69 out of 2).

KEY WORDS : Jamun, Anaerobic fermentation, Yeast, Wine, Sensory evaluation

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Jamun (*Syzygium cumini* L.) is an important unexploited indigenous fruit of the tropics belongs to the family Myrtaceae. Fruits are a very rich source of antioxidant and have numerous health benefits. The fruit and the seed contain a biochemical called 'jamboline'.

Fruit wines are un-distilled alcoholic beverages which are nutritive, more tasty and mild stimulants. Wine is a food with a flavor like fresh fruit which could be stored and transported. Many tropical and subtropical fruits can be utilized for making wine with lot of health benefits, the method also helps in reduction of postharvest losses during the production seasons. Similarly, wine can be prepared from anthocyanin rich jamun fruits and the prepared wine was comparable with grape wine (Chowdhury and Ray, 2007). Shukla *et al.* (1991) standardized the methodology and also screened cultivars to prepare wine from jamun fruits. The pectinase enzyme was used for juice extraction and the wine was prepared from the pulp with 1:1 dilution yielded organoleptically acceptable wine from jamun fruits (Joshi *et al.*, 2012). The quality of the wine significantly influenced by the varying conditions especially the level of yeast inoculation and number of days for fermentation. Hence, in the present study, the wine was prepared from highly seasonal (May to June) and deteriorating (shelf life of 1-2 days) jamun fruits with different yeast levels (*S. cerevisiae* var. *ellipsoideus*) and the duration of anaerobic fermentation (7, 14 and 21 days). The prepared wine was analyzed for physicochemical and sensory qualities.

RESEARCH METHODS

The study on wine preparation from jamun fruit was carried out in the laboratory of Department of Post Harvest Technology, K.R.C. College of Horticulture (University of Horticultural Sciences, Bagalkot), Arabhavi, Belgaum district of Karnataka during the period from 2011 to 2012. Ripe fruits were brought from the orchard of Fruits Science Department K.R.C. College of Horticulture, Arabhavi. They were washed thoroughly in water to remove the dirt and foreign materials adhering to the fruits. The washed fruits were squeezed to extract the pulp. To separate seeds and skin, the extract was

filtered through a clean muslin cloth to obtain juice.

Wine yeast *S. cerevisiae,* Actiflore EM-890 is rehydrated according to the manufacturer's recommendation before inoculation. The flow chart for the preparation of wine is furnished in Fig. A.

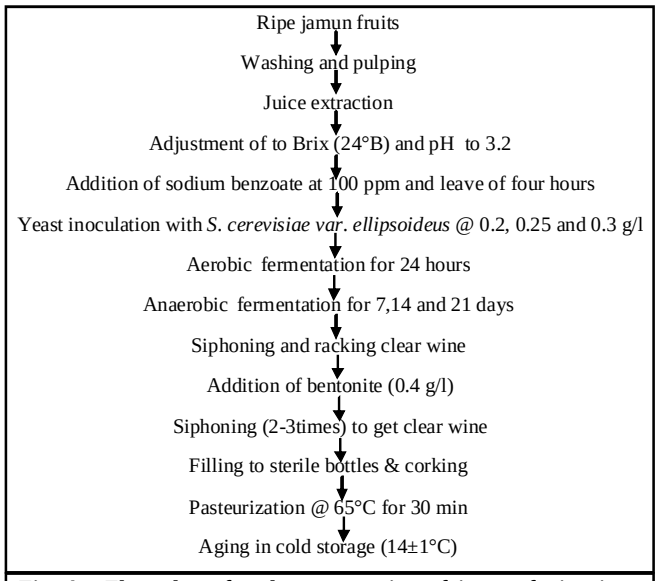

Fig. A : Flow chart for the preparation of jamun fruit wine

The treatments consisted of *S. cerevisiae* var. *ellipsoideus* was inoculated at 0.20 and fermented for 7 days (T_1), 14 days (T_2) and 21 days (T_3). The yeast level of 0.25 fermented for 7 days (T_4), 14 days (T_5) and 21 days (T_6). The same strain at level 0.30 g/l and fermented for aerobically for 7 (T_7), 14 (T_8) and 21 days (T_9). For each treatment three replications ware maintained and the results were statistically analyzed using Completely Randomized Design.

Wine was analyzed for different physiochemical by following the standard procedure (Ranganna, 1977) for fresh wine and after three and six months of aging. Sensory evaluation was also carried out by serving the chilled and coded samples kept randomly by a group of five trained panel using a twenty point scale (Amerine *et al.*, 1972). The scale mainly based on the appearance (0-2), colour (0-2), aroma and bouquae (0-4), acidity (0-2), sweetness (0-2), body (0-2), flavor (0-2), astringency (0-2) and overall acceptability (0-2). The wine was graded according to the score card *viz.*, 17-20 wines with outstanding characteristics and no marked defect; 13-16 wines of commercial acceptability; 09-12 wines of commercial acceptability but with a noticeable defect; 05-09 standard wines with neither an outstanding character nor defect; and 01- 04 completely unacceptable wines.

RESEARCH FINDINGS AND DISCUSSION

The physico-chemical parameters of jamun wine are presented in Table 1 and 2. There was a significant difference recorded with respect to TSS. At three and six months of aging, the treatment T_3 documented the lowest TSS of 11.03 and 10.94 ^{0}B, respectively. The difference in TSS may be due to effect of different levels of yeast and duration of anaerobic respiration. Decreasing trend in TSS was observed during ageing. Effect of different levels of inoculums on the chemical composition and sensory properties of sapota wine were studied by Honde and Adsule (1998) and reported that, total soluble solids in sapota wine ranged between 8.91 and 9.37 ^{0}Brix.

The mean pH of fresh wine and aged wines indicated an increasing trend. Treatment T_3 recorded a pH of 3.22 in fresh wine and increased to 3.28 and 3.32 during 3 and 6 months, respectively, during storage. Similar observations of increasing trend in pH after fermentation and during aging have been recorded in guava wine (Shankar *et al.*, 2004). Increase in pH was due to reduction in acidity through precipitation of potassium tartrate salts from wine or due to enhanced synthesis of esters from ethyl alcohol and volatile acids. The changes in the pH were not correlated with the changes in total acidity because of the buffering capacity of the wines and the relative amount of various acids influencing the acidity (Shankar *et al.*, 2004). Shukla *et al.* (1991) analysed the pH of the wine samples prepared from different varieties of jambal fruit and the pH of these wines ranged from 3.50 to 3.40. Attri *et al.* (1994) opined that sand pear based wine had a pH of 3.99.

The wines that have undergone 21 days anaerobic fermentation showed lower residual sugars whereas, those underwent 7 days anaerobic fermentation exhibited higher sugar levels. In the fresh wine, T_3 recorded the lowest total sugar of 11.09 per cent and it continued to record a comparatively low sugar throughout the aging. Several studies have recorded similar sugar content in the wines. Kotecha (2010) recorded total residual sugar of 4.30 per cent in pomegranate wine to 7.17 per cent in banana wine.

The titratable acids in all the samples decreased after fermentation and during aging. The lowest acidity of 0.27 per cent was found in T_3. At three and six months of aging, the lowest acidity of 0.24 and 0.19 per cent was found in the treatment T_3, respectively. The decrease in the acidity during aging might be due to combination of acids with alcohol to form esters which adds aroma to the wine during aging (Shankar *et al.*, 2004). The titratable acidity is an important parameter used to measure the quality of wine (Olasupo and Obayori, 2003). The ideal acidity in the wine is dependent on the style and preferences of the consumer. Nevertheless, the acceptable range for total acidity in most wines is between 0.55 to 0.85%.

Tannins were found to be non significant among the treatments and also showed the decreasing trend during aging. Treatment T_3 recorded the highest per cent of tannins in fresh (1.95), at three months (1.83) and at six months (1.79) of aging.

Table 1 : Effect of yeast levels and duration of anaerobic fermentation on TSS(^{0}B), pH, reducing sugar(%), non reducing sugar(%) and total sugars(%) in jamun wine

Treatments	TSS (^{0}B)			pH			Reducing sugar (%)			Non Reducing sugar (%)			Total sugar (%)		
	Fresh wine	Ageing		Fresh wine	Ageing		Fresh wine	Ageing		Fresh wine	Ageing		Fresh wine	Ageing	
		3MS	6MS		3MS	6MS		3MS	6MS		3MS	6MS		3MS	6MS
T_1	14.48	14.19	14.11	3.31	3.35	3.38	9.91	9.58	9.41	4.97	4.91	4.85	14.24	14.06	13.96
T_2	13.46	13.16	13.02	3.30	3.32	3.39	8.04	7.93	7.86	4.33	4.30	4.28	13.01	12.97	12.91
T_3	11.21	11.03	10.94	3.41	3.49	3.52	7.36	7.03	6.91	3.43	3.38	3.30	11.09	10.96	10.63
T_4	14.28	14.15	14.07	3.29	3.31	3.36	9.50	9.46	9.38	4.94	4.83	4.71	14.01	13.96	13.90
T_5	13.64	13.53	13.43	3.22	3.28	3.32	8.28	8.16	8.04	4.53	4.45	4.32	13.24	13.16	13.09
T_6	11.34	11.20	10.98	3.37	3.39	3.44	7.49	7.12	7.04	3.51	3.44	3.34	11.14	11.03	10.71
T_7	14.32	14.17	14.06	3.31	3.34	3.39	9.48	9.31	9.03	4.74	4.63	4.52	14.06	14.04	13.94
T_8	13.92	13.72	13.49	3.25	3.29	3.33	8.92	8.47	8.08	4.58	4.48	4.38	13.68	13.54	13.76
T_9	11.46	11.24	11.02	3.32	3.36	3.42	7.78	7.28	7.12	3.60	3.47	3.38	11.21	11.06	10.97
Mean	13.13	12.93	12.79	3.31	3.35	3.39	8.55	8.26	8.09	4.30	4.49	4.56	12.85	12.75	12.65
S.E.±	0.41	0.51	0.47	0.08	0.10	0.09	0.16	0.28	0.27	0.28	0.25	0.27	052	0.51	0.62
C.D. (P=0.05)	1.29	1.56	1.49	NS	NS	NS	0.51	0.87	0.84	0.88	0.81	0.85	1.64	1.56	1.91

NS=Non-significant

Table 2 : Effect of yeast levels and duration of anaerobic fermentation on titratable acidity (%), tannin (%), colour (OD), ethyl alcohol (%) and wine recovery (%) in jamun wine

Treatments	Titratable acidity (%)			Tannin (%)			Colour (OD)			Ethyl alcohol (%)			Wine recovery (%)
	Fresh wine	Ageing		Fresh wine	Ageing		Fresh wine	Ageing		Fresh wine	Ageing		
		3MS	6MS		3MS	6MS		3MS	6MS		3MS	6MS	
T_1	0.35	0.31	0.28	1.49	1.46	1.37	1.30	1.28	1.26	4.39	4.43	4.49	74.10
T_2	0.37	0.34	0.31	1.42	1.40	1.36	1.35	1.33	1.30	5.11	5.16	5.21	74.29
T_3	0.27	0.24	0.19	1.95	1.83	1.79	1.45	1.41	1.38	6.25	6.29	6.32	76.39
T_4	0.39	0.36	0.33	1.50	1.39	1.37	1.31	1.28	1.25	4.94	4.97	5.06	72.16
T_5	0.46	0.41	0.35	1.29	1.21	1.16	1.36	1.33	1.30	5.51	5.54	5.59	73.36
T_6	0.28	0.25	0.21	1.81	1.77	1.72	1.43	1.40	1.36	5.95	5.98	6.03	76.18
T_7	0.46	0.42	0.38	1.43	1.39	1.37	1.34	1.31	1.29	4.89	4.94	4.97	73.36
T_8	0.41	0.39	0.34	1.54	1.51	1.49	1.37	1.34	1.31	5.61	5.64	5.69	74.65
T_9	0.29	0.26	0.23	1.72	1.69	1.63	1.39	1.35	1.33	5.69	5.73	5.76	76.09
Mean	0.36	0.33	0.29	1.57	1.51	1.47	1.36	1.33	1.30	5.31	5.35	5.40	74.50
S.E.±	0.20	0.23	0.22	0.19	0.16	0.12	0.08	0.06	0.05	0.22	0.33	0.29	1.69
C.D. (P=0.01)	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS

NS=Non-significant

There was a decrease in the per cent of tannins was observed in all the treatments. This may be due to complexing of tannins with protein and polymerization takes place. The per cent of tannins may vary in the treatments depending upon the type of wine, yeast, fermentation conditions, containers and the maturation period was observed in litchi wine (Singh and Preetinder, 2009).

Colour (OD value) was also found non significant among the treatments. Treatment T_3 recorded significantly higher OD value in fresh wine (1.45), three (1.41) and six (1.38) months of aging. The change in colour of wine made from guavas at different stages of maturity was attributed to variation in the pigmentation of fruits (Anderson and Badrie, 2005). Joshi *et al.* (2005) observed a variation in the colour intensity of wine made from peach cultivars where in the higher colour intensity was recorded in cv. Red heaven (OD of 0.19) and lower in cv. Stark Early Gaint (OD of 0.86) which is attributed to the variation in pulp colour.

Comparatively higher ethyl alcohol were noted in T_3 (6.25%), T_6 (5.95%) and T_9 (5.69%) indicating positive effect of increase in the duration of anaerobic fermentation on conversion of sugars in to alcohol. The variation in alcohol production depends on several factors such as, initial sugar content, initial pH, amount of by product formed, temperature maintained during fermentation, amount of quality sugar, pH maintained during fermentation and alcohol tolerance limits of the yeasts could cause variation in the alcohol production (Thippesha *et al.*, 1997). During aging, the alcohol level increased slightly in most of the treatments. This increase might be due to very slow fermentation that might have occurred during aging.

Wine recovery was found non significant among the treatments. The high percentage of wine recovery 76.39 was noticed in T_3. The 21 days of anaerobic fermentation resulted in more wine recovery due to increased number of days of anaerobic fermentation and more sugar is converted into alcohol.

The overall acceptability was non significantly higher (14.51 and 15.30) in T_3 followed by T_6 (14. 45 and 15.24) and T_9 (14.30 and 15.21) at three and six months after aging. Appearance, colour, aroma, taste and subtle taste factors such as flavor of wine constitute the quality (Sharma, 2000 and Joshi *et al.*, 2006) reported that aroma and taste of wines is very complex and depend on a number of factors such as cultivars, agricultural land, vinification practices, fermentation and maturation. Incidentally, all the treatments received 21 days of anaerobic fermentation resulted in organoleptically better wine as compared to 7 and 14 days. The parameters *viz.*, colour, appearance, body and astringency did not show any significant differences under both three and six months of aging. Aroma and bouquet and flavour were found to be better in the treatment T_8. The treatment T_3 resulted in more astringent (1.28, 1.35 out of 2.00) wine. This may be due to the presence of more tannins (1.83, 1.79%). Lower phenolic compounds account for that flavor while larger polyphenols constitute to bitterness and astringency. The wine aged for six months found to be better organoleptically, as compared to three months old aged wine (Fig. 1). This may be due to complexicity of tannins and protein polymerization takes place during maturation which results in smoothing of taste (Joshi *et al.*, 2005).

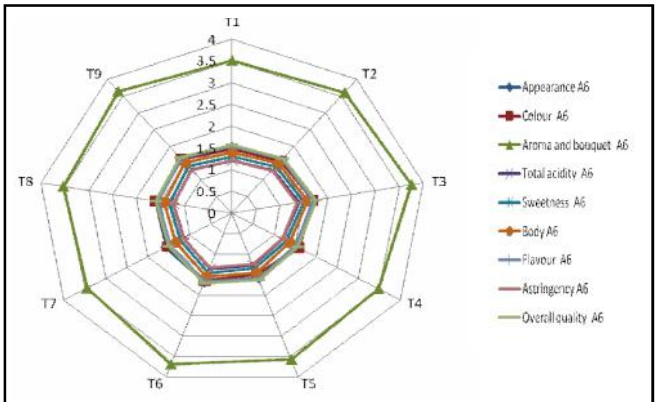

Fig. 1 : Effect of different yeast levels and duration of anaerobic fermentation on sensory qualities after six months of aging in jamun fruit wine

During maturation, the complex chemical reactions involving sugar, acid and phenolic compounds in wines can alter the aroma, colour, mouth feel and taste of the wine in a way that is more pleasing to the taste (Pawar, 2010). Reports of improvement in sensory quality due to aging have also been recorded in strawberry wine (Somesh *et al.*, 2009) and guava wine (Shankar *et al.*, 2004).

In conclusion, the physico-chemical and sensory qualities of jamun wine affected by the level of yeast and duration of fermentation. The wine prepared with 0.2 g/l and fermented for 21 days resulted in better organoleptic qualities.

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