Effect of dilution and maturation on physico-chemical and sensory quality of jamun (Black plum) wine

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Black plum or Jamun fruit [Syzygium cuminii (Linn.) Skeels] is relished for its sugar, acid and tannin content and is considered useful for curing diabetes, heart and liver troubles. The fruit has large amounts of anthocyanin and other nutrients of medicinal and therapeutic properties. To prepare jamun wine, the pulp was diluted with water in different proportions (1:0.5, 1:1 and 1:2). The diluted pulp was ameliorated with sugar (24°B), 100 ppm SO₂, 0.5% pectinase enzyme and DAHP (0.1%). The must was fermented with pure wine yeast Saccharomyces cerevisiae var. ellipsoideus (5% v/v) at 22±1°C. Jamun must prepared by dilution (1:2) gave better fermentation behaviour than the other two treatments. With the increase in dilution level, ethanol content and total esters increased while total soluble solids, titratable acidity, sugars and anthocyanin content decreased. All the wines were matured for a year and then, evaluated for various physico-chemicals and sensory quality characteristics. TSS of jamun wine of different dilutions ranged from 8.6 to 10°B. Jamun fruit wine of T₁ (1:0.5 dilution) had the highest acidity, reducing sugars, total phenols and anthocyanin contents, whereas ethanol content and total esters were found higher in T₃ (1:2 dilution). The ethanol content of wines of different treatments ranged from 9.9 to 11.8% (v/v) and the wine prepared from T₂ (1:1 dilution) was adjudged the best with respect to sensory qualities. On the basis of physico-chemical and sensory quality characteristics, jamun wine prepared by 1:1 dilution is considered best as table wine and maturation for a year improved the quality of wine considerably.

Keywords: Jamun, Black plum, Syzygium cuminii, Wine, Total phenols, Anthocyanin.

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Introduction

Syzygium cuminii (Linn.) Skeels, commonly known as Black plum and Jamun in Hindi, belongs to family Myrtaceae. It is an evergreen tropical minor fruit crop, native to India and Indonesia. The fruit is gaining popularity among the consumers due to its balanced sugar, acid and tannin content. It is generally consumed fresh and is known to have nutraceutical and therapeutic values. The fruit is an effective food remedy for curing diabetes, heart, bleeding piles and liver troubles because of its effect on the pancreas. Since the fruit is a very rich source of anthocyanin, it possesses antioxidant properties. Amongst different products that can be prepared from it, wine is one such product. Wine, an alcoholic beverage is prepared by fermenting the different fruit juices with appropriate processing and additions. The basic process of wine making involves the fermentation of grape juice or other fruits by Saccharomyces cerevisiae followed by maturation. However, the quality of wine is known to depend upon a number of factors like cultivars and their characteristics such as adequate sugar level, acid content, colour and aroma. Thick pulp, high acid and tannin contents of the jamun fruit affect its fermentation and hence, the quality of the final product. Different factors which affect the quality of wine include initial sugar concentration, addition of enzyme, yeast strains and various other variables. In earlier published works, jamun wine was prepared from commercial cultivars with 1:1 and 1:2 dilutions followed by fermentation as per the standard practice. However, there is no report on the preparation of wine from locally produced jamun, addition of nitrogen source and effect of maturation on quality of wine. Therefore, efforts were made to prepare a palatable wine from jamun fruit by diluting the pulp with water in different ratios and the results are presented in this communication.

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Materials and Methods

Raw materials
The jamun fruits were procured locally and converted into pulp and used for fermentation. Cane sugar used to ameliorate the must was procured from local market. KMS and di-ammonium hydrogen phosphate (DAHP) were of analytical grade. Pectinase enzyme used was manufactured by M/S Triton Chemicals, Mysore, India, under the brand name of ‘Pectinol’.

Wine yeast culture
Saccharomyces cerevisiae var. ellipsoideus strain UCD 595 used in the study was obtained from the department of Oenology and Viticulture (California Davis, USA). It was maintained on yeast malt extract agar medium and re-cultured after every three months or whenever needed from the stock yeast culture.

Must preparation
The jamun musts were prepared by diluting the pulp in 1:05, 1:1 and 1:2 ratio with water. Total soluble solids, DAHP, pectinol and SO2 as potassium metabisulphite (KMS) concentration were kept constant in all the treatments as per the method reported by Joshi (1997) 7. The initial TSS was raised to 24°B with sugar syrup 70°B, adding pectinol and di-ammonium hydrogen phosphate (DAHP) at the rate of 0.5 and 0.1%, respectively. To each treatment, 100 ppm SO2 in the form of KMS was also added.

Fermentation
Fermentation of all the treatments was carried out by the wine yeast Saccharomyces cerevisiae var. ellipsoideus (5% v/v) at 22±1°C. Flow sheet for the preparation of jamun wine is shown in Figure 1. During fermentation, reduction in °Brix was recorded every day. When fermentation was completed, siphoning was done and the wine was kept for maturation.

Analyses of fruit, must and wine

Physico-chemical analysis
Jamun fruits, must and wine were analysed for various physico-chemical characteristics as per the standard methods 13,14. TSS was measured using Erma hand refractometer (0 to 32°B), and corrected by applying the correction factor for the temperature variation 13. The titratable acidity (as per cent citric acid) was estimated by titrating a known aliquot of the sample against N/10 NaOH solution13. Reducing sugar was estimated with the Lane and Eynon method14 and ethanol was estimated by the colurimetric procedure 15. The total phenols or tannin contents in different fruit wines were determined by the Folin-Ciocalteu procedure 16. Total esters in wines were determined using a colourimeter as per the method given by Liberaty 17. Anthocyanins in wines were measured by adding 1 mL of wine to 16 mL of acidic methanol (containing 1% hydrochloric acid) and allowing the contents to stay overnight at 4°C. Thereafter, absorbance was recorded at 530 nm 18. Anthocyanin content was expressed in terms of absorbance units at 530 nm (A-530 nm) per ml of wine.

Sensory analysis
The sensory analysis of different wines was conducted by a panel of 10 judges. Chilled and coded samples of wine were given to the judges. They were asked to rinse their mouth with water before or in
between tasting the given sample. Each sample was evaluated for various quality attributes on the prescribed performa.

**Statistical analysis**

Completely Randomized Design (CRD) was used to analyze the data of quantitative estimation of physico-chemical characteristics, while the data pertaining to sensory quality were analyzed by Randomized Block Design (RBD).

**Results and Discussion**

**Physico-chemical characteristics of fruit pulp**

Jamun berries having a mean weight of (6.4 g) comprised of about 35% seed and 65% pulp with a seed to pulp ratio of 1:1.9 (Table 1). Total sugars in jamun fruit were 12.44%, while acidity was found to be 1.19%. However, Shukla et al. found these to range from 8.55 to 9.22% and 1.06 to 1.30%, respectively in different cultivars of jamun. The berries were found to be a good source of vitamin C (26.80 mg/100 g) and anthocyanins (191 mL/100 g), highlighting the nutritional significance of jamun fruits. Though the berries have quite high amount of TSS (16°B) to facilitate fermentation but also contain high acid (1.19%) and tannin (345mg/100g) contents. Shukla et al. have reported that high acidity and tannin content affect the rate of fermentation and finally, the quality of wine. To facilitate optimum fermentation, pulp was diluted with water in different proportions prior to must preparation.

**Changes in jamun must during fermentation**

During fermentation, the musts of T2 (1:1 dilution) and T3 (1:2 dilution) treatments witnessed a fast reduction in TSS, but after 144 hrs, it changed clearly with the flattening of curve (Figure 2). The highest reduction in TSS was observed in treatment T3 (1:2 dilution), whereas T1 (1:0.5 dilution) had the lowest reduction in TSS. The initial higher loss in TSS is attributed to the higher fermentability of musts of different treatments because of availability of more sugar and lesser ethyl alcohol in the medium but later decrease is attributed to the increased inhibitory effect of ethyl alcohol concentration. However, the changes were different in T1 (1:0.5 dilution) must. This may be because of lesser dilution of pulp resulting in must of higher consistency/thickness than the other of two treatments. Rate of fermentation showed an increase with increase in dilution level. Similar trend was observed in seabuckthorn wine.

**Physico-chemical characteristics of wine**

Perusal of data pertaining to the effect of dilution on various physico-chemical characteristics of jamun wines, revealed a significant reduction in TSS, titratable acidity, reducing sugars, total phenols and anthocyanin contents, while increase in ethanol content and total esters with increase in dilution level took place (Table 2). The TSS of different jamun wines ranged from 8.8 to 10.8°B. The wide variation in TSS of jamun wine is apparently related to the difference in fermentability of the must. It is also evident from the data (Table 2) that the titratable acidity ranged from 0.36 to 0.79 as % citric acid depending on the level of dilution employed. As the dilution level increased the fruit quantity decreased and hence, the acidity reduced (Table 2). Similar trends were also observed for reducing sugar and its highest content (5.0%) was observed in

<table>
<thead>
<tr>
<th>Table 1 — Physico-chemical characteristics of jamun fruit</th>
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<tbody>
<tr>
<td>Characteristics</td>
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<tr>
<td>Fruit weight (g)</td>
</tr>
<tr>
<td>Seed weight (g)</td>
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<tr>
<td>Pulp weight (g)</td>
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<tr>
<td>Seed to pulp ratio</td>
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<tr>
<td>TSS (°B)</td>
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<tr>
<td>Acidity (% citric acid)</td>
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<tr>
<td>Reducing sugars (%)</td>
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<tr>
<td>Total sugars (%)</td>
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<tr>
<td>Ascorbic acid (mg/100 g)</td>
</tr>
<tr>
<td>Anthocyanin (mL/100 g)</td>
</tr>
<tr>
<td>Phenols (as tannic acid mg/L)</td>
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</tbody>
</table>

*Each value is an average of 5 replicates*
T1 (1:0.5 dilution). The ethanol content of different treatments correlated with their respective rates of fermentation and was found in the range of 9.9 to 11.8 (v/v). Table wine contains alcohol content ranging from 7 to 14% (Ref. 6) and from this point of view wines of all the treatments fell within the category of table wines. Although the TSS (°B) of all the musts was kept at 24°B, the quantity of ethanol differed significantly amongst the treatments. The differences in composition of other nutrients in the respective musts22 and the conditions of fermentation i.e. anaerobic conditions23 might have contributed to these differences; moreover dilution might have its effect for ethanol content due to better fermentability of the diluted pulp. There are also significant differences for the total phenols among different wines. The highest (418 mg/L) quantity of total phenols were observed in treatment T1 (1:0.5 dilution) whereas, lowest (320 mg/L) were recorded in T3 (1:2 dilution). The variation in total phenols of wines is due to different dilutions employed. Similar results for variation in phenolic contents in jamun wine were also reported by various workers6, 9. Total esters were found highest (159.2 mg/L) in T3 (1:2 dilution) and lowest (148.1 mg/L) in T1 (1:0.5 dilution). Esters in general, have fruity and floral impact, characteristics that are important in sensory properties of wine. The amount of total esters in various wines normally ranged between 200 to 400 mg/L6,24. Like ethanol the esters formation on fermentation related characteristic and with higher dilution better fermentation might have resulted in higher total esters content.

During maturation of different wines (Table 3) for a period of 12 months, TSS reduced from an initial value of 9.93 to 9.20°B. Precipitation of soluble solids during interaction of various components might have contributed to a decreased TSS during maturation25. The reduction in titratable acidity was also found with maturation which may be due to the precipitation of different acids in terms of their respective salts6. The decrease in titratable acidity is desirable in wines from more acidic fruits during maturation as it increases the palatability of wine26. An increase in reducing sugar (3.9 to 4.3%) during maturation was observed in all the treatments (Table 3). The increasing trend of reducing sugar is apparently the result of hydrolysis of non-reducing sugar into reducing sugar during maturation6. It is significant from taste quality of wine point of view and is one of the desirable effects of maturation of wine. Decrease in ethanol content during maturation is apparently the result of interaction between alcohols and acids to form esters5,26. A slight decrease in total phenols concentration (366.0 to 360.3 mg/L) during maturation might be due to the susceptibility of phenolic constituents to degradation, condensation and polymerization, and subsequent precipitation27. An appreciable decrease in tannin contents has also been reported by Shukla et al9 in jamun wine after maturation of wine for six months. Wine esters are synthesized as a result of reaction between acids and alcohols. Wines esters also arise from ethanol by reaction with straight chain fatty acid precursors26. Jamun fruit is a rich source of anthocyanin and contributed its character to wine also. Jamun wine matured upto one year was still found rich in anthocyanin content that ranged between 59 mg/100 g T1 (1:0.5 dilution) to 35 mg/100 g T3 (1:2 dilution).

Sensory evaluation

The results on sensory analysis of jamun wine of different treatments (Table 4) show that there were

<table>
<thead>
<tr>
<th>TSS (°B)</th>
<th>Titratable acidity (% CA)</th>
<th>Reducing sugars (%)</th>
<th>Ethanol content (% v/v)</th>
<th>Total phenols (mg/L)</th>
<th>Total esters (mg/L)</th>
<th>Anthocyanin (mg/100 g)</th>
</tr>
</thead>
<tbody>
<tr>
<td>T1 (1:0.5 dilution)</td>
<td></td>
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<tr>
<td>10.8</td>
<td>0.79</td>
<td>5.0</td>
<td>9.9</td>
<td>418</td>
<td>148.1</td>
<td>61.0</td>
</tr>
<tr>
<td>T2 (1:1 dilution)</td>
<td></td>
<td></td>
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<td></td>
<td></td>
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<tr>
<td>10.2</td>
<td>0.53</td>
<td>4.1</td>
<td>10.4</td>
<td>360</td>
<td>155.3</td>
<td>42.5</td>
</tr>
<tr>
<td>T3 (1:2 dilution)</td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>8.8</td>
<td>0.36</td>
<td>2.5</td>
<td>11.8</td>
<td>320</td>
<td>159.2</td>
<td>37.5</td>
</tr>
<tr>
<td>CD p&lt;0.05</td>
<td></td>
<td>0.22</td>
<td>0.20</td>
<td>2.17</td>
<td>1.26</td>
<td>1.25</td>
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<table>
<thead>
<tr>
<th>Maturation period (months)</th>
<th>TSS (°B)</th>
<th>Titratable acidity (% CA)</th>
<th>Reducing sugars (%)</th>
<th>Ethanol content (% v/v)</th>
<th>Total phenols (mg/L)</th>
<th>Total esters (mg/L)</th>
<th>Anthocyanin (mg/100 g)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>9.93</td>
<td>0.56</td>
<td>4.5</td>
<td>10.1</td>
<td>366</td>
<td>154.2</td>
<td>47.0</td>
</tr>
<tr>
<td>12</td>
<td>9.20</td>
<td>0.52</td>
<td>4.3</td>
<td>10.5</td>
<td>360.33</td>
<td>157.6</td>
<td>45.0</td>
</tr>
</tbody>
</table>

| CD p<0.05 |                          | 0.16                | 0.18                | 1.77                  | 1.03                | 1.02                |
significant differences for different quality attributes. The wines fermented from must with lower dilutions (T1) scored lower sensory score compared to others with higher dilutions. Improper sugar: acid ratio and hazy brown appearance of the wine were among the major causes for the lower score given to these wines. The treatment T2 (1:1 dilution) was found superior to others mainly because of better appearance, colour, total acidity, sweetness, body and overall impression, except for volatile acidity, aroma and bitterness. Among the different treatments, sensory attributes differed significantly for different quality parameters.

Conclusion

It is concluded that the rate of fermentation increased with increase in dilution level due to the better fermentation conditions provided by the dilution of thick jamun pulp. On the basis of physicochemical and sensory quality characteristics, jamun wine of treatment T2 (1:1 dilution) was the best due to optimum TSS, acidity, ethanol content, appearance, colour, sweetness, body and overall impression. It gave balanced sugar, acid, tannins and ethanol content thus, found better for the preparation of jamun wine of acceptable quality characteristics. The maturation of wine for a year improved most of its characteristics.

References


