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RESEARCH NOTE

Evaluation of Wine prepared from Sugarcane and Watermelon Juice

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ABSTRACT

Sugarcane (*Saccharum officinarum* L.) juice which contains high amount of sugar was used as a raw material and an attempt was made to prepare sugarcane wine blended with content fruits viz. watermelon (*Citrullus lanatus* Thunb.). Among the prrparation of sugarcane blended with watermelon juice, the concentration of 1:1 (v/v) maintained at total soluble solids (TSS) 30.3 °Brix, temperature 26 °C and pH 4.5 during fermentation, was found to be the best as it produced wine of alcohol percentage (9.6%), TSS (14.2 °Brix), titrable acidity (0.92%) and total reducing sugar (11.98%) with good flavour, colour and overall acceptability. Changes during maturation were also documented. Therefore, maturation storage yields high quality wine.

Keywords: Blend, fermentation, sugarcane, sugar, sensory evaluation, watermelon, wine

Cultivation of sugarcane estimates about 23.8 million hectares, in more than 90 countries, with a worldwide harvest of 1.69 billion tonnes (FAO, 2010). Brazil produced about 38 million tonnes of table sugar in 2010, while India produced 27 million, EU-27 countries 15 million, China 11 million, Thailand about 10 million, and United States over 7 million (FAO, 2011). In India, Uttar Pradesh is the largest producing state of sugarcane followed by Maharashtra, Orissa, Karnataka and Tamil Nadu. However, high post-harvest losses 32% (Lipinski, 2013) occur at various stages of marketing. The post-harvest losses not only reduce the availability of fruits but also results in increase in per unit cost of production and marketing affecting a member the producers (reduction in share in consumer's price) and consumers (reduced availability and higher prices). Thus, the overall objective of the present study was to develop strategies to reduce these losses.

Grapes have been used as the principal source of wine, since Assyrians during 3500 B.C. (Amerine *et al.*, 1980; Joshi, 1995; Modi, 2009) and later also from sugarcane juice (Espinoza *et al.*, 2005). Most of the wineries in the country or abroad commercially use grapes or other fruit juices to make wine. However, the idea of value addition in wine production from the blended fruit juice seems to have not been attempted so far. Accordingly, blended sugarcane juice having high sugar and watermelon juice having high antioxidant have been used could be used to prepare wine with acceptability, desirable colour and health benefit.

MATERIALS AND METHODS

Raw materials

Fresh sugarcane and watermelon were collected from the local market (Mohanpur, Nadia, West Bengal, India). Extractions of juice were carried out following: washing, peeling, cutting and crushing/ squeezing in their respective juice extractors, and then, filtered through strainers. The TSS value of the blended samples (sugarcane + watermelon at different concentrations) were taken using pocket refractometer and selecting only the sample mixtures near the optimum fermentation range (i.e. 27 – 30 °Brix). For preparation of blends, initially sugarcane juice (SJ) with 18 °Brix, was adjusted to 45 °Brix by adding sugar and was used as the stock sugarcane solution and mixed with watermelon juice (WJ) at different percentages i.e. SJ:WJ (3:7, 4:6 and 5:5 v/v), and brought the TSS to the desirable level for fermentation (Table 1). The working volumes of the samples were adjusted to 250 ml and pH 4.5 by adding citric acid.

Preparation of wine

The blended juice samples were inoculated with starter inoculum (Y_4), an unknown yeast *Saccharomyces cerevisiae* strain isolated from palm juice at 1.2 x 10^8 cells per ml @ 10% of the samples and kept in the incubation chamber at temperature (26±2) °C for fermentation.

Physico-chemical Analysis

After completion of fermentation (i.e. samples showing same °Brix consecutively for 2-3 days), the wine was subjected to analysis (fresh wine analysis) and the result was compared with those analysed after 6 months of maturation (storage). pH was measured by pH meter (Anon., 1995), titrable acidity as percentage citric acid by A.O.A.C. method (A.O.A.C., 1995), reducing sugar by Fehling's method (Ranganna, 2000) and alcohol by high-pressure liquid chromatography (HPLC). The HPLC was equipped with a quaternary pump, a manual injection valve and C-18 Column. The wine sample to be analysed was first distilled. Maintaining the temperature of the column at 25 °C, mobile phase, H_2O (HPLC grade), sample was injected at the flow rate of 1ml/ min followed by injection of 20 µl of distilled wine samples and the peaks were recorded with the corresponding retention time, for ethanol analysis (Sun *et al.,* 2003; Tomlins *et al.,* 1990).

Sensory evaluation

Sensory evaluation for colour, flavour and overall acceptability (OA) were carried out of a 5 point hedonic scale (Espinoza *et al.,* 2005; Tzeng *et al.,* 2009) ranging from "dislike very much" to "like very much". Out of 5 point hedonic scale, the score 3 and above were being selected as acceptable whereas below this level, the products were considered unacceptable by the panelists.

Statistical analysis

CRD (Completely Randomized Design, Single Factor ANNOVA)) following standard analysis method by IBM SPSS STATISTICS 19 software, was carried out on the observed data.

RESULTS AND DISCUSSION

Physico-chemical characteristics

Variations in TSS in various blends were recorded. Sugarcane juice (SJ) 30% + watermelon juice (WJ) 70% or sugarcane watermelon blended juice (SWBJ) 30%, (SJ) 40% + (WJ) 60% or SWBJ 40% and (SJ) 50% + (WJ) 50% or SWBJ 50% as 25 °Brix, 27 °Brix and 30.3 °Brix (Table 1). Blends with TSS of 25, 27 and 30-3 °B which were near the optimum fermentation range and were selected for fermentation. The amount of TSS utilized during the initial 7days fermentation, showed the highest utilization in SWBJ 30% (17.6 °Brix), and least in SWBJ 50% (16.1 °Brix) and SWBJ 40% (17.3 °Brix) in between. The TSS further decreased during 6 months of storage (Fig. 1) with SWBJ 50% content the highest TSS (9.26

Table 1: Changes in quality parameters of blended cane wine (temp. 26 °C, Initial pH 4.5 and fermentation period 7 days)

Watermelon (%)	Sugarcane juice (%)	After Fermentation						After 6 Month Storage			
		TSS (I)	pH (F)	TSS (F)	% Alcohol	TA	TRS	TSS (S)	% Alcohol (S)	TA (S)	TRS (S)
	50	30.3	3.7	14.2	9.6	0.92	11.98	9.2	12.4	0.78	8.5
	60	27	3.6	9.5	9.8	0.89	9.71	7.6	10.9	0.72	5.2
	70	25	3.5	7.5	9.9	0.75	8.09	5.8	10.8	0.62	4.3
SEm(±)		0.808	0.124	0.832	0.353	0.244	0.129	0.776	0.341	0.047	0.122
CD		2.54	NS	NS	NS	NS	0.41	2.44	NS	NS	0.39

NS= Non-significant

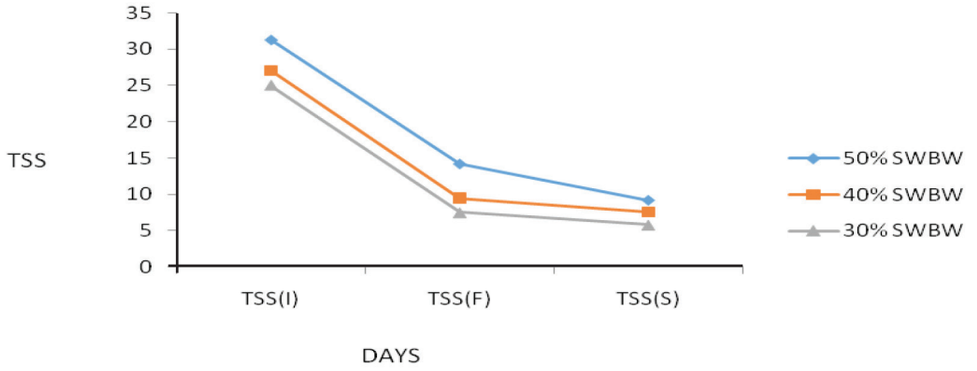

Fig. 1: Change in TSS after fermentation (7days) and after storage (180 days i.e. 6 month). TSS(I)=initial total soluble solids, TSS(F)=TSS after 7days fermentation and TSS(S)=TSS after 6 month storage

°Brix). It can therefore be concluded that higher TSS was utilized from SWBJ (16.1-17.65 °Brix) during fermentation as compared to the sugarcane juice (11.2 °Brix) as reported by Tzeng *et al.* (2009).

After 7 days of fermentation at optimum conditions, highest alcohol of 9.9% was produced in the must of SWBJ 30% and least (9.6%) at SWBJ 50%. Highest alcohol production in the initial 7 days fermentation occurred at pH 3.5 in SWBJ 30% and during storage at pH 3.7 in SWBW 50%. The titrable acidity (TA) decreased during storage of wine from 0.75 to 0.62 in SWBJ 30% and from 0.92 to 0.78 in SWBW 50%. Total reducing sugar (TRS) of the wine decreased during storage in SWBW 30% (from 8.09 to 4.3) and in SWBW 50% (11.98 to 8.5) which might be due to further utilisation of the remaining sugar by the fermenting yeast left and converting the sugar to ethanol and CO_2. The TRS content was significantly ($P<0.001$) related to the TSS and alcohol content of wine after preparation and after 6 months storage.

Lowering of pH from the initial 4.5 to 3.5-3.7 of the samples may probably be due to the formation of acetic acid as the pH was below 4 (Yan *et al.,* 2012). Reduced pH (3.5) of SWBJ 30% than SWBJ 50% (3.7) during initial fermentation, suggested faster or more fermentation. Higher initial alcohol fermentation of SWBJ 30% may be due to quicker growth of yeast, while lower initial fermentation in SWBJ 50% could be due to lesser growth of yeast / death of few yeast cells as a result of higher TSS content creating hypertonic media. Similarly, it was reported by that in spite of higher TSS, lower ethanol yield during fermentation and before storage was suggested to be due to occurrence of cell death, nutritional

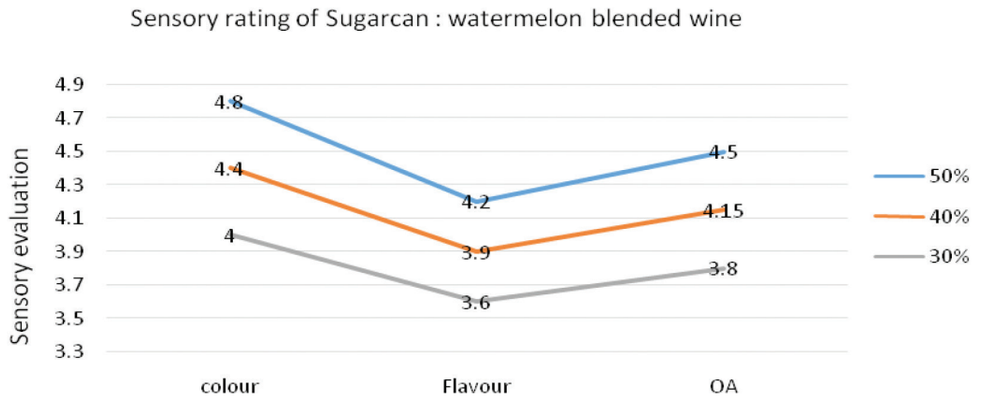

Fig. 2: Sensory rating for colour, flavour and overall acceptability of wine prepared from Sugarcane blending in watermelon at 30%, 40% and 50%; following

limitation or accumulation of some metabolites (Birol *et al.*, 1998; Phisalaphong *et al.*, 2006). After storage, a slight decrease in TSS during initial fermentation and increase in yeast count took place. SWBW 50% develops less hypertonic environment to undergo faster fermentation. It yielded higher alcohol (12.4%) than SWBJ 30% (10.8%) which could also be due to higher TSS (14.2 °Brix) against (7.5°Brix) of SWBJ 30%, TRS (11.98) against (8.09) of SWBJ 30% and pH (3.7) against (3.5) of SWBJ 30% is similar to the report by Wen (2001) where ethanol production during fermentation was more at pH above 3.5, which were favourable for fermentation. After 6 months of storage decrease in TSS, TRS and TA took place while increase in the alcohol suggested further fermentation of the remaining sugar by the yeast and converting it to ethanol and CO_2. The increase in ethanol production during storage was more in the higher percentage of sugarcane in the blending contrary to the fresh wine.

Sensory evaluation

From Fig. 2, SWBJ 50% showed the highest values of colour, flavour and overall acceptability as 4.8, 4.2 and 4.5, respectively while SWBJ 30% showed the least as (4, 3.6 and 3.8) according to the 5 point scale. The flavour of alcoholic beverages is due to numerous volatile and non-volatile compounds which confer the typical taste and odour of the beverage. The volatile compounds of wine perceived by the olfactory system are greatly dependent on the concentration of ethanol (Rothe and Schrodter, 1996).

When compared with the reported value of the unblended sugarcane wine (Tzeng *et al.*, 2009), the colour (3.8), flavor (3.5), overall acceptability (3.5) and alcohol percentage was higher in SWBJ (Fig. 2).

CONCLUSION

It is concluded that wine of good colour, flavor and overall acceptability can be prepared from sugarcane watermelon juice blended at 1:1 (v/v), TSS 30.3 ^{0}Brix, 26 °C and pH 4.5 during fermentation followed by storage.

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