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Wine Production from Carambola (*Averrhoa carambola*) Juice Using *Saccharomyces cerevisiae*

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ABSTRACT

The fruit of Averrhoa Carambola L., is an attractive tropical fruit of the Oxalidaceae family. As most of the Carambola crops are consumed fresh, very few carambolas are processed. The physico-chemical characteristics of carambola fruit juice from unripened and ripened fruits were determined to assess the suitability of the fruit as raw material for wine production. The juice was analysed to determine pH, moisture content, total solids, the types of sugars, total sugars and vitamin C content. The fruit had a characteristic soft, fragile and thin skin, relatively few seeds and high water content (88.6% – 91.7%) which made its processing into a fruit juice fairly simple and easy. The analysis of the sugars showed sucrose as the predominant sugar present in both ripened and unripened fruit juice. Vitamin C content was substantially high (28- 40gm %). The total sugar content and pH were very low. Wine was produced from the ripened and unripened carambola fruit juice.The results indicated that sugar and yeast starter culture helped in increasing the alcohol content. Though sensory evaluation rated the Carambola wine quite acceptable as an alcoholic beverage, significant differences exist between the Carambola wine and the commercial grape wine particularly in taste and flavour.

KEY WORDS: *Carambola (Averrhoa carambola), Carambola juice wine.*

INTRODUCTION

The carambola (*Averrhoa carambola)*, more popularly known as star fruit, but also coromandel gooseberry, kamranga, or five finger, is a golden-yellow to green berry in colour. The carambola is a species of tree native to Indonesia, India, Sri Lanka, and Bangladesh and is popular throughout Southeast Asia, Trinidad, Malaysia and parts of East Asia. The fruits are ovate to ellipsoid, 2.5 to 5 inches (6 to 13 cm) in length, with 5 (rarely 4 or 6) prominent longitudinal ribs [12]. The skin is thin, light to dark yellow and smooth with a waxy cuticle. The flesh is light yellow to yellow, translucent, crisp and very juicy, without fiber. There may be up to 12 flat, thin brown seeds 0.25 – 0.5 inch long or none at all. Seeds lose viability in a few days after removal from fruit. Two carambola fruit varieties have been described: one, smaller in size with strong sour taste and the other, larger in size with mild sweet taste [20]. Several cultivars of the tree exist which are described as sweet types or sour types [3, 5]. The fruit is easily pureed to produce a thin yellow juice of ~6ºBrix and moderate acidity consisting primarily of oxalic acid. Single strength juice is weak, acidic and not very flavorful. Major products are a sweetened juice and a salted, fermented juice in the Orient [14].

The carambola fruit is an economically important commodity. Most carambola fruits are marketed in processed forms. It is edible and has numerous uses. The ripe fruit may be processed into fermented or unfermented drinks, preserves, jam or jelly, or eaten fresh as dessert [13]. The unripe fruit may also be eaten as a vegetable [13] In Southern China carambola fruits are preserved in thin packages and exported to other countries. The fruit is a potential source of pectin. The fruits are recommended for use as a febrifuge and especially effective against polydipsia [21]. The fruits have narcotic and emetic potentials which are exploited in infusion to alleviate asthma and various colics [9].

The objectives of this work are producing and characterizing the carambola fruit juice, studying the fermentation characteristics of the juice and production of wine using carambola fruit juice.

MATERIALS AND METHODS

Carambola fruits: Ripe and unripe undamaged Carambola fruits were harvested from a tree in Badlapur, Dist Thane. Maharashtra, India

Processing For the Fruits into Juice

The washed fruits (ripened and unripened) were cut into pieces and blended in a blender. The juice was strained

through a muslin cloth. 140 ml of the concentrated juice was diluted up to 1000 ml with Distilled water to make a solution of 14%. The extract was termed as the carambola fruit juice which was used for checking various parameters and preparing wine.

Characterization of Carambola Juice

The pH, moisture content, Total Solids, Total Sugars, Reducing Sugars and Vitamin C content of the fruit juice was determined. The pH was determined using a pH meter.

The moisture content was determined by placing 1gm of the cut fruit in a pre-weighed crucible. The crucible was placed in a hot air oven and dried till a constant weight was obtained.

The total solids were determined by filtering 10 ml of the juice through a pre-weighed Whatmann filter paper No. 1. The filtrate was taken in a pre-weighed crucible. The crucible and the filter paper were dried in a hot air oven till a constant weight was obtained.

The total sugars were found out by Cole's ferricyanide method [7]. The total reducing sugars were found out by DNSA method [17]. The Vitamin C content was found out using Dinitro phenyl hydrazine method (DNPH) method [26]. The total protein content was estimated by Folin and Lowery's method [15, 24].

Thin Layer Chromatography

The component sugars were determined by Thin Layer Chromatography. Water-extracted solution was used for the analysis. TLC Aluminum sheets (20X20 cm) Silica gel 60 F_{254} plates (Merck) were used. Standard solutions of glucose, fructose, sucrose, maltose and lactose in isopropanol (10%) were also spotted alongside the juice extract for identification. The plates were developed in a solvent system composed of ethyl acetate, isopropanol, water and pyridine (in a ratio of 26:14:7:2, respectively) by an ascending chromatography. They were dried and sprayed with a colour developing agent composed of 10% aniline in acetone, 10% diphenylamine in acetone and 85% orthophosphoric acid (in a ratio of 5:5:1, respectively). The plates were dried in oven at 100 ° C for 5-10 minutes for colour development and the retention factors calculated with reference to glucose (R_f).[10].

Wine Production

14% v/v juice was prepared in distilled water. The 100 ml juice was distributed in each flask. Sugar (dextrose) and yeast granules were added as per the table. The flasks were placed at room temperature for 21 days, after which the flasks where checked for alcohol content using Dichromate method of alcohol estimation [25]. The sets were carried out in duplicates.

RESULTS AND DISCUSSION

Tropical countries possess a wide diversity of fruits with many possibilities of commercial exploitation; some of them are considered exotic and rare. Major tropical fruits like mango [22] and banana [19] could enhance local or international markets by appropriate utilization processes and fermentation remains as a technological attempt of such utilization [18].

The carambola juice obtained was yellowish in colour. The physico-chemical characteristics of the fruit are shown in Table 2. The moisture content of the fruit was found to be 88.6% for unripened fruit while 91.7% for a ripened fruit. It is reported that the moisture content lies between 87 % to 90 %. The pH of the fruit juice was found to be slightly towards the acidic side. The total solids were found to be 0.042 gm for unripened fruit while for ripened fruit it was 0.036 gm.

Chemical parameters (Table 3) like Protein content, total sugar content, total reducing sugar content and ascorbic acid content was carried out. There was correspondingly low total sugar content. The fruit seems to be a good source of vitamin C. Consuming 100 g of the juice a day could supply the daily requirement of an individual [8].

Thin Layer Chromatography (TLC) was carried out to find the sugars present in the carambola juice. Table 4 shows the R_f of the standard sugars and the unknown sugars in the fruit extracts Comparing the R_fs of the unknown to the standard sugars, it was observed that the predominant sugar in the fruit juice is sucrose.

The data obtained generally indicated that the carambola fruits are suitable raw materials for wine production. The juice also contains fermentable sugars (sucrose) which could support the growth of ethanol fermenting microorganisms. The amounts of these sugars present, (Table 3) are however, too low for adequate alcohol production, to call the product a wine. Acceptable wine should contain a minimum alcohol concentration of 8% by volume [2]. This requires sugar content of about 10% w/v [4].

Most brewer's yeasts require a pH range of 4-6; and for adequate alcohol production to form a wine, the sugar content should be about 10%. The physico-chemical characteristics of the juice suggest the feasibility of modifying the juice

into a suitable *must* that could yield adequate amount of alcohol to form a wine. 14% carambola juice was taken for preparing the wine. The fermentation was allowed to be carried out for 21 days after which the alcohol content was estimated. The results indicated that sugar and yeast starter culture helped in increasing the alcohol content (Table 5). The addition of culture to the juice resulted in production of 1.05 mg/ml of alcohol in unripened fruit juice and 1.58 mg/ml of alcohol in ripened fruit juice. The alcohol content was quite less when no sugar or starter culture was added. Lewis and Grocizam **(**1989) reported the use of the sweet fruits in wine making in Surinam [13]. Whether the juice is modified or not before fermentation was not reported. However, some cultivars of carambola are said to have high carbohydrates (specifically glucose) content, [1, 6 and 16] and pH around 4, which make their processing into wine more feasible.

Table 1 Protocol for Wine Production

Sr. No	Parameter
1	Juice + 10 gm Sugar + Yeast Culture
2	Juice + Yeast Culture
3	Juice + 10 gm Sugar
4	Juice

Table 2 Physical Evaluation of *Averrhoa carambola* L. Fruit

Sr. No	Parameter	Observations	
		Unripened fruit	Ripened fruit
1	Fresh weight (gm)	26,77 gm	68.99 gm
2	Dry Weight (gm)	1.77 gm	2.78 gm
3	Moisture content %	88.6%	91.7%
4	Total Solids (gm)	0.042 gm	0.036 gm
5	pH	4.09	5.04

Table 3 Chemical Analysis Of *Averrhoa carambola* L. Fruit

Sr. No	Parameter	Observations	
		Unripened fruit	Ripe fruit
1	Total Protein content	31gm%	92gm%
2	Reducing sugars content	0.947gm%	1.122gm %
3	Total sugar content	1.25gm%	1.69gm%
4	Ascorbic acid content	39.50gm%	28.66gm%

Table 4 Rf of Standard Sugars and Unknown Sugars of The Carambola Juice

Sr. No	Sugar sample	R_f *
1	Lactose	0.26
2	Glucose	0.50
3	Fructose	0.53
4	Maltose	0.32
5	Sucrose	0.46
6	Unripened Fruit juice (sample 1)	0.46
7	Ripened Fruit juice (sample 2)	0.47

R_f* Retention factor: $\frac{\text{Distance traveled by the solute}}{\text{Distance traveled by the solvent}}$

Table 5 Amount of Alcohol Produced

Sr. No	Parameter	Observation	
		Unripened fruit	Ripe fruit
1	Juice + 10 gm Sugar + Yeast Culture	0.98 mg/ml	1.54mg/ml
2	Juice + Yeast Culture	1.05 mg/ml	1.58 mg/ml
3	Juice + 10 gm Sugar	0.35 mg/ml	0.76 mg/ml
4	Juice	0.36 mg/ml	0.41 mg/ml

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