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Influence of Different Sources of Sugar on the Production and Quality of Banana Peel Wine

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Abstract

Banana, a wonderfully sweet fruit with firm and creamy flesh that come prepackaged in a yellow jacket, available for harvest throughout the year, consists mainly of sugars and fibers which make it a source of immediate and slightly prolonged energy. When consumed, reduces depression, anemia, blood pressure, stroke risk, heartburns, ulcers, stress, constipation and diarrhea. It confers protection for eyesight, healthy bones, kidney malfunctions, morning sickness, itching and swelling, improves nerve functions as well as help people trying to give up smoking. The present study was carried for the evaluation of effect of different sources of sugar on production and quality analysis of banana peel wine by using two types of banana namely *Accuminata* and *Musa accuminata*. The pulp was maintained to 18.967±0.5°Bx and was inoculated with *Saccharomyces cerevisiae* for primary fermentation. The secondary fermentation was allowed till the 21st day. Wine was analyzed for chemical parameters such as TSS, acidity, specific gravity, alcohol content and pH at an every seven days interval. When compared to *Musa accuminata* (Rasthali) the *Accuminata* (Poovan) was effective in the production of wine. TSS varied from 14.1±0.05 °Bx to 10.234±0.05 °Bx in case of table sugar and also acidity from 0.79±0.01% to 0.886±0.01%, specific gravity from 1.082±0.01 to 4.068±0.02, pH ranges from 4.436±0.05 to 4.068±0.05 and alcohol content from 7.034±0.05% to 7.332±0.05% (v/v). In the jiggery used wine, TSS was ranged from 18.032±0.05 °Bx to 14.031±0.05°Bx, acidity from 0.58±0.01% to 0.70±0.01%, pH from 4.566±0.05 to 4.131±0.05, specific gravity from 1.026±0.01 to 0.76±0.01 and alcohol content obtained from 6.332±0.05% to 6.630±0.05 (v/v). In sucrose used wine, TSS was ranged from 17.766±0.05°Bx to 13.766±0.05°Bx, acidity from 0.622±0.01 to 0.881±0.01%, pH from 4.331±0.05 to 3.7±0.05, specific gravity from 1.070±0.01 to 0.943±0.01 and alcohol content from 7.330±0.05% to 7.966±0.05% (v/v). Sensory evaluation was also done with different types of consumers. The wine was accepted generally.

Key words: Anemia, TSS, specific gravity, *Accuminata* and *Musa accuminata*

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INTRODUCTION

Banana (*Musa sapientum*) is a fruit common in the tropics and is non-seasonal. It is readily available in Nigeria. Due to its high sugar content, it is preferable used in the production of wine (Robinson, 2006). Depending upon cultivar and ripeness, the flesh can vary in taste from starchy to sweet and texture from firm to mushy. Both skin and inner part could be eaten raw or cooked. Bananas flavour is due, amongst other chemicals, to isoamyl acetate which is one of the main constituents of banana oil. Wine is an alcoholic beverage typically made from fermented fruit juice. Any fruit with a good proportion of sugar can be used for wine production and the resulting wines are normally named after the fruit. Banana, apple, orange, pineapple, strawberries and coconut used to produce wine. The type of fruit wine to be produced dictates the fruit and strain of yeast to be involved (Alexander and Charpenter, 2004). The institution such as NIFOR (Nigerian Institute for oil palm research) have been involved in production of bottled palm wine using chemical preservatives poses potential dangers due to either toxicity or pro-toxicity (Idise and Izuagbe, 1988; Svans, 2008). Hence it becomes essential to search for means of producing wines devoid of chemical additives. Banana possesses desirable qualities such as high fiber-content which helps restore normal bowl action, stimulates the production of hemoglobin in the blood, contains potassium and has a low salt content which helps to lower blood pressure as well as control stroke and when consumed along with other fruits and vegetables and banana was also observed to be associated with reduced risk of colorectal cancer (Deneo-Pellegrini *et al*., 1996); and in women, breast cancer (Zhang, 2009) and renal cell carcinoma (Rashidkhani *et al.,* 2005). According to Uraih and Izuagbe (1990), eating banana as a regular diet can cut the risk of death caused by stroke as much as 40%. Fermentation of food for preservation, enhancement of nutritive values, improvement of flavour and

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preparation of beverages has been practiced probably since prehistoric times by people of nearly every civilization (Okafor, 2007; Sofos, 1993).

Home wine production has been practiced with various fruits such as apple, pear, strawberry, cherries, plum, pineapple and oranges (Fleet, 1993; Webb, 1984). Wines are healthful beverages that have been seen as a natural remedy for human illness from early days and are said to aid recovery during convalescent period (Jay, 1996 and Okafor, 2007). Fermentation processes are usually done by species of the yeast *Saccharomyces*, whereby the sugars in the fruit juice are converted into alcohol and organic acid, that later react to form aldehydes, esters and other chemical components (Watanabe and Shimazu, 1980). Fermentation could either be spontaneously mediated by natural flora of the fruit or controlled by introducing industrial strain of yeast to ferment the juice. Nowadays, the Nigeria people establish large plantations of banana and pineapple which are used mainly in the industries for the production of pineapple and banana juice, and for home consumption. A considerable part of these fruits is wasted during these processes. With the present government's policy on agriculture, more plantations are envisaged in the near future and this invariably, means producing lots of banana and pineapple wastes.

Wine is a product of alcoholic fermentation of the juice of any fruit mediated by yeast with a good proportion of jaggery. Wine is one of the most recognizable high value added products from fruits. Wine manufacture is challenging in which marketable product can be obtained, but the processes involved in its production are relatively straight forward (Amerine *et al*.,1980).

It is primarily the alcohol in wine that provides the calories. One gram of alcohol provides 7 kilocalories of energy (Carol Brannond, 2004). 8-18% of ethanol (%v / v) can inhibit bacteria, yeast and mould growth but effectiveness depends upon different physical and environmental factors (Sonia *et al*., 1992). There are many beneficial effects of wine consumption due to phenolics and alcohol in wine, which protects human body from free radical attack and increase HDL level in the body. In wines, alcohol is a macro nutrient and is an energy source, capable of providing calories for all essential biological activities of the human cells, energy for physical work and thermogenesis (Bisson, 1995). It consists of water, alcohol, pigments, esters, vitamins, carbohydrates, minerals, acids and tannins with medicinal and therapeutic value. Banana peel has 79.2g / 100g moisture, 0.83g / 100g protein, 0.78g / 100g fat 2.11g / 100 minerals, 1.72g / 100g fibers and 5.0g / 100g carbohydrates (Kotecha and Desai,1995). The present article deals with the effect of different sources of sugar on the production of wine using banana peel and quality analysis.

MATERIALS AND METHODS

Collection of raw material and must preparation

Banana varieties ('Rasthali' and 'Poovan') were collected from local market in Mannargudi, Thiruvarur (Dt), Tamil Nadu, India. The fruits were brought to the laboratory and washed with the good quality running tap water followed by de- mineralized water.

Preparation of banana juice

Preparation of must

Bananas were hand peeled after thorough washing. The juice was extracted by homogenizing the pulp in mixture / blender and mixing one part of pulp with two part of boiled water (pulp; water, 1:2).This was again diluted with equal proportion of water. To prevent browning and to inhibit unwanted micro flora the juice was added with 100mg / L of potassium metabisulfite. The juice was treated with pectinase enzyme at a concentration of 0.01% and held over night at room temperature (35°C) for clarification and for decreasing viscosity. The must so obtained contained low sugar and thus sugar was adjusted from 18°Brix by using table sugar. The must had pH of 3.98.

De- pectinazation of banana pulp using pectinase enzyme

Pectinase enzyme was added to the banana paste / pulp at a concentration of 0.0003% (w / v) and left for 5-6 hour incubation at 38°C,with occasional stirring.

Preparation of yeast culture medium

Activation of dry yeast

Two test tubes with 10 ml of distilled water in each and with a pinch of active dry yeast (*Saccharomyces cervisiae*) were incubated in between 24° C-27°C.

Preparation of yeast growth medium

200ml of growth medium was prepared with banana juice and distilled water (Brix=1). After wards, yeast extract- 0.5% and peptone -0.5% was added. Final pH was maintained in between 4.0-5.0 and the medium was sterilized at 15 lbs for 15 minutes and then cooled to 35-37°C and kept in a rotary shaker for 24 hours so as to facilitate the growth of yeast.

Treatments detail

Three treatments (Three sugar forms) were used and they are replicated thrice and evaluation was made for two verities of banana separately (*Acuminata* and *Musa acuminata*).

T_1: Peel extract + Sugar + Yeast
T_2: Peel extract + Jaggery + Yeast
T_3: Peel extract + sucrose + Yeast

Fermentation of banana juice

The banana peel extract was mixed with different forms of sugar such as table sugar, jaggery and sucrose respectively and was adjusted to 29° Brix. Three gram *Saccharomyces cerevisiae* was inoculated to 1 liter of above each combination. They were kept for three days to allow primary fermentation at 30° C then transferred into 2 liter glass bottles and were kept for secondary fermentation for 21 days. After that the wine was filtered and kept for aging in 750 ml long necked glass bottles at room temperature.

Analysis of physico chemical parameters

Physicochemical parameters such as TSS, acidity, specific gravity, alcohol content and pH were evaluated to check the quality of banana wine produced by using different source of sugar. The TSS content was determined using hand refectrometer. The pH was determined using, digital pH meter. The acidity was determined through titration. The alcohol content was determined by using hydrometer and the specific gravity was determined using a Brix hydrometer. Analysis was done at an interval of 7th day, 15th days followed by 7, 14 and 21st days (Ranganna, 2001).

Microbial analysis of fermented broth

Microbial analysis of each fermentation broth was made after 48 hours using pour plate method and nutrient agar, Mac Conkey agar and potato dextrose agar. The nutrient agar used was treated with fulcin to suppress fungal growth. Distinct colonies were picked for characterization from the culture plates, identification with the aid of Bergey s Manual of determinative Bacteriology (Holt *et al.,* 1994). Major groups of fungi were identified using the manual of Soil fungi (Gilman, 1957).

RESULTS AND DISCUSSIONS

In the present study the wine was produced by using two different banana varieties such as *Accuminata* (Rasthali) and *Musa accuminata* (Poovan), and the organisms used was *Saccharomyces cerevisiae*. Three different treatments were carried out for each banana separately.

T_1: Peel extract + Sugar +Yeast
T_2: Peel extract + Jaggery + Yeast
T_3: Peel extract +Sucrose + Yeast

Physicochemical analysis of fermented wine

The physicochemical analysis was made and following observation was recorded. There were changes in the physicochemical properties of banana wine produced with different sugar sources. Also the time determines the quality parameters.

Treatment: 1

Table 1a and b show the wine produced by both varieties of banana peel using table sugar. The production of wine was compared at 7 day interval (7,14 and 21st day). It was found that the variety *Musa accuminata* (Rasthali) banana effectively produced the wine on the 21st day of fermentation 8.534±0.05.The TSS shows a reducing rate and increase in acidity during aging of wine. Alcohol content was increased and thus the specific gravity and pH was decreased. In this treatment the wine colour was very pleasant, when compared to 'Rasthali' variety wine. Increase in values with increase in the period of fermentation was observed apparently due to increasing microbial load with period of fermentation. This result agrees with reports of Amerine and Kunkee (2002) and Okafor (2007). This could be due to microbial utilization of nutrients (primarily sugars) in the juice for metabolic activities with the evolution of CO_2 and heat. This result also agrees with reports of Uraih and Okafor (2007). The presence of high sugar content in banana peels, facilitate rapid metabolism the sugar anaerobically and produce large amount of ethanol. But they do not produce cellulolytic enzymes which are required for the degradation of cellulose present in the banana peels (Essien, *et al*., 2005).

Treatment:2

Fig. 1 a and b showed that the production of banana peel wine using the variety *Accuminata* ('Poovan') and *M. accuminata* ('Rasthali') with jaggery. Slightly by higher in the alcohol production on the 21st day of fermentation when compared to table sugar. It was found that (*Accuminata*) 'Poovan' banana peel produced moderate amount of wine on 21st of fermentation (7.8±0.05). However, the jaggery affected the colour of the wine, which is considered as the main drawback in the production of wine using jaggery. Wine is the product of alcoholic fermentation of the juice of any fruit mediated by yeast with a good proportion in the presence of jaggery. Wine is one of the most recognizable high value added products from fruits. Wine manufacture is challenging in which marketable product can be obtained, but the processes involved in its production are relatively straight forward (Amerine *et al*., 1980).

Treatment : 3

The treatment 3 showed that the varieties of banana peel wine produced reasonably good amount of wine using sucrose as a sugar source on 21st day of fermentation (8.1±0.05). The TSS showed a reducing rate and increase in acidity during the aging of wine. (Table 2 a & b).

Microbial analysis

Identification bacteria

At the beginning of the experiment, the microorganisms associated with banana peels infusion were determined by culturing samples of these three items in appropriate growth media. Ten microorganisms comprising 5 bacteria and 2 fungi were recovered from banana peel infusion. The microorganisms isolated in this study were largely been associated with materials from which they were recovered (Lgue, 1995; Prescott *et al*., 2008). The isolated bacteria were confirmed by Gram staining, motility test and various biochemical tests. The result is presented in table 4. The Both Gram(+)ve and Gram (-)ve and Rod and Cocci shaped bacteria were observed and identified which included *E.coli, Lactobacillus SP, Leuconostoc SP, Micrococcus SP, Bacillus SP* (Table 3).

Identification of fungi

The fungi were identified by wet mount technique. They were further confirmed by using the manual such as Manual of Soil Fungi (Gillman, 1957). The identified fungi were *Rhizopus spp* and *Mucor spp* (Table 4).

Table.1(a) Physiochemical properties of (variety 'Poovan' – *Accuminata*) banana peel wine produced using table sugar

Days	Chemical parameters				
	TSS (°Bx)	Acidity (%)	Alcohol 1%(v/v)	pH	Specific gravity
7th day	18.967± 0.5	0.79±0.01	7.034±0.05	4.436±0.05	1.082±0.01
14th day	14.1±0.05	0.886±0.01	7.332±0.05	4.068±0.05	0.92±0.02
21st day	10.234±0.05	0.918±0.01	8.534±0.05	3.8±0.05	0.84±0.01

Note: Values are expressed as Mean ± Standard Deviation.

Table.1(b) Physiochemical properties of (variety 'Rasthali' – *Musa accuminata*) banana peel wine produced using table sugar

Days	Chemical parameters				
	TSS(°Bx)	Acidity(%)	Alcohol 1% (v/v)	pH	Specific gravity
7th day	15.964±0.4	0.76±0.01	6.030±0.03	4.432±0.05	1.080±0.01
14th day	11.1±0.04	0.883±0.01	6.329±0.03	3.065±0.05	0.89±0.02
21st day	8.230±0.04	0.913±0.01	5.530±0.05	3.2±0.05	0.80±0.01

Note:Values are expressed as mean ± Standard Deviation.

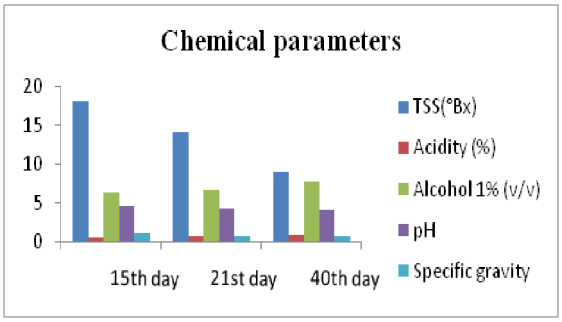

Fig.1(a) Physiochemical properties of (variety 'Poovan' – *Accuminata*) banana peel wine produced using Jaggery

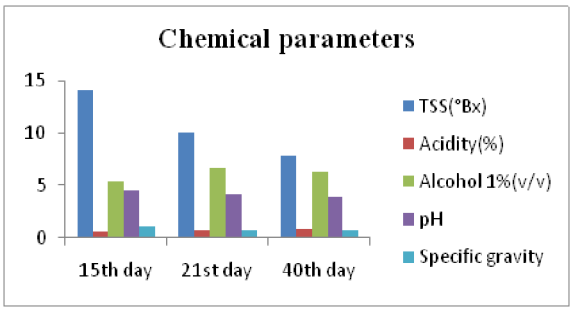

Fig.1 (b) Physiochemical properties of (variety 'Rasthali' – *Musa accuminata*) banana peel wine produced using table Jaggery

Table.3 (a) Physiochemical properties of (variety 'Poovan' – *Accuminata*) banana peel wine produced using sucrose

Days			Chemical parameters		
	TSS(°Bx)	Acidity %	Alcohol % (v/v)	pH	Specific gravity
17th day	17.766± 0.05	0.622± 0.01	7.330 ±0.05	4.331± 0.05	1.070± 0.01
20th day	13.766± 0.05	0.881± 0.01	7.966 ±0.05	3.7 ±0.05	0.943± 0.01
41st day	10.231± 0.05	0.920 ±0.01	8.1± 0.05	3.82 ±0.05	0.82± 0.01

Note: Values are expressed as mean± Standard Deviation.

Table.3(b). Physiochemical properties of (variety 'Rasthali' – *Musa accuminata*) banana peel wine produced using surcrose

Days			Chemical parameters		
	TSS (°Bx)	Acidity %	Alcohol % (v/v)	pH	Specific gravity
17th day	14.764 ±0.05	0.620± 0.01	7.328 ±0.05	4.329± 0.05	1.067± 0.01
20th day	10.763± 0.05	0.879 ±0.01	7.963± 0.05	3.4 ± 0.05	0.940± 0.01
41st day	7.230± 0.05	0.918 ±0.01	7.8± 0.05	3.79± 0.05	0.78 ± 0.01

Note:Values are expressed as mean ± Standard Deviation.

Table.4. Biochemical characters of isolated bacteria

S. No.	Test	*E.coli*	*Lactobacillus sp*	*Leuconostoc sp*	*micrococcus*	*Bacillus sp*
1	Colony morphology	rod	Rod	rod	cocci	Rod
2	Gram –staining	-	-	+	-	+
3	Motility test	+	-	-	+	-
4	Catalase test	+	+	-	+	+
5	Oxidase test	-	+	+	+	-
6	Triple sugar test	+	-	-	-	+
7	MR test	-	-	+	-	-
8	Urease test	-	+	+	-	-
9	VP test	+	+	-	+	-
10	Citrate utilization test	-	-	+	+	-
11	Indole test	+	-	+	N/A	-

Table.5. Isolated bacteria and fungi from fermented Banana wine

S. No.	Micro organisms Bacteria	Source Banana Waste
1	*E .coli*	+
2	*Lactobacillus sp*	+
3	*Leuconostoc sp*	+
4	*Micrococcus sp*	+
5	*Bacillus sp*	+
	Fungi	
1	*Rhizopus sp*	+
2	*Mucor sp*	+

Note: (+) Present (-) Absent

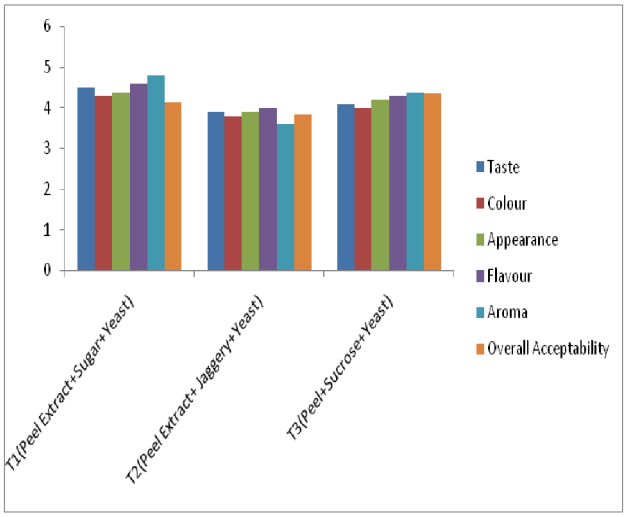

Fig.3. Mean score of wine using different sugar sources by Degustation

CONCLUSION

Due to its pleasant flavor and taste, Banana peel wine is even liked by the ladies and children's. So that the under-utilized banana peel can be utilized and also we will get health benefits, as our world is suffering with various health issues, it raises blood pressure and too many other problems. Drinking wine will reduce stress and lowers blood pressure. It was concluded that the Banana Peel Wine can be prepared by using three sources of sugar including Table sugar, Jaggery and Sucrose. They are qualified in physicochemical evaluation and also in the sensory evaluation and also the medicinal properties direct us to consume little amount of wine for many health problems. Thus it was accepted generally by the consumers. So I recommend this experiment for the fast growing world for its tension free future.

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