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EVALUATION OF WINE PRODUCED FROM BANANA JUICE

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ABSTRACT

Banana (*Musa sapientum*) has a long history in Nigeria as a staple food and seasonal crop with short shelf-life under the prevailing temperature and humidity conditions in tropical countries. Hence, there is rapid deterioration of ripe banana. Irrespective of its high consumption in Nigeria, decaying banana fruits are common in banana season. Fermenting banana juice is considered to be an attractive means of utilizing surplus and over-ripe bananas. Hence, this research is an attempt to produce wine using banana in order to reduce wastage associated with rapid deterioration of riped banana fruit. Ripe banana was bought, washed, peeled, sliced and boiled in hot water. The pulp obtained after boiling was filtered and ingredients including 3.5 kg of sugar, 30 ml of lemon juice, 5 g of of bakers yeast (*Saccharomyces cerevisiae*) in 10 litres of must. The mixture was thoroughly stirred and fermentation carried out for 14 days at 30^{o}C. There was increase in the yeast count starting from Day 2 of incubation, which reversed and started decreasing gradually after Day 4 to 4.9 x 10^{7} cfu/ml on Day 6 and 4.8 x 10^{7}cfu/ml on Day 8. The pH of the Banana wine produced at the end of fermentation decreased from 3.91 to 2.85, while the titrable acidity of the Banana wine increased progressively during the course of fermentation from 1.3 to 1.6. The total dissolved solids decreased with increasing length of fermentation of the juice from 2.5 to 0.5, while the total suspended solids increased from 1.33 to 2.2. The alcohol content of the wine increased with increase in fermentation period from 11 on Day 2 to 14 on Day 8. The result obtained from the sensory evaluation by ten panelist showed that the wine was liked. Banana wine production should be considered as a way of addressing unemployment, food security and economic recession, while further research should be conducted on safe and affordable method of preserving the wine locally.

KEYWORDS: *Wine, Production, Banana, Juice.*

INTRODUCTION

Banana (*Musa sapientum*) is an important staple starchy food in Nigeria good source of sugars and fibers, contents making it a good source of energy. The fruit has a long history in Nigeria as a staple food and seasonal crop with short shelf-life under the prevailing temperature and humidity conditions in tropical countries. It is a seasonal and highly perishable fruit, which can be available all year round. To forestall huge economic loss due to rapid deterioration of riped banana, production of banana juice from pulp of riped banana became a subject of research. Banana wine is a fruit wine made exclusively from banana (Blocker *et. al.*, 2001 and FAO, 2012).

Highly acceptable wines can be made from practically all fruits (Rajković, *et. al.*, 2007). Wine can be fermented with yeast that occurs naturally in grape and in other countries where grape is not emphasis is usually placed on other fruits for wine making. There are some soft fruits from both temperate and tropical regions whose pigment stability and flavor profiles match those of any wine from grapes. Wine is one of the most recognizable high value added products from fruits. It can also be used as a substrate for the manufacture of vinegar, a byproduct of wine manufacture.

Industrial banana wine manufacture is challenging due to high cost of equipment required for to carry out production, but the processes involved are relatively straight forward (Amerine *et. al.*, 1980). Reports on tropical fruit wines have been mainly on exotic species such as banana, pineapple, citrus, mango, pawpaw, apple and strawberries among others (Maldonado *et. al.*, 1975). Wine represents a safe and healthful beverage; it also provides calories and vitamins. During period when life was often strenuous, it offered relaxation and relief from pains (FAO, 2012).

The large quantity of bananas and plantains grown in Nigeria provides the potential for industrial production of wine. This in turn will improve banana farming economies by producing a marketable, value- added product, making banana to compete in the market, either as banana juice or as mixtures with other juices and eliminating the large environmental problem presented by banana waste (Lee *et. al.*, 2006).

This work therefore is aimed at quality evaluation of wine produced from banana. The objectives of the study include:

1. To produce wine from banana wine.
2. To estimate yeast colony, pH, titrable acidity, dissolved and total suspended solid in fermentation medium as fermentation progresses.
3. To evaluate the qualities of the wine produced from banana.

MATERIALS AND METHODS

Materials used for study were: stove, mixing bowl, weighing scale, plastic buckets, stainless pots and spoons, measuring cylinder, *Saccharomyces cerevisiae* (baker's yeast), earthen jars, lemon juice and fresh ripe banana were purchased at Ogbete Main Market Enugu in the month of January, 2011 and sent to the department of medical Microbiology of Enugu State University of Science & Technology where the production of wine from the juice and quality analysis were conducted.

The methods used in the production of banana wine in this study were adopted from Idise & Odum (2011**).**

Peeling and boiling the ripe Banana

The ripe uncontaminated banana was peeled into a sack. Five (5) kg of the peeled banana was put into a stainless metallic pot and 2.5 liter of water added. The banana was boiled at 100^{o}C while stirring with a firm long clean stainless spoon until the bananas can easily break when the spoon was passed through.

Filtering

While the banana pulp was still hot, filtration of the juice into a clean pot was carried out using a clean porous cloth.

Addition of other ingredients

After filtering, 3.5 kg of sugar, 30 ml of lemon juice, and 5 g of yeast were added into 10 liters of the juice, stirred thoroughly to ensure dissolution of the sugar and other ingredients added (Idise and Odum, 2011).

Fermenting and maturing

The must in a bucket with the added ingredients was covered and fermented at room temperature for 14 days. During the maturation period, a hole was made on top of the cover of the container to allow for aeration and prevent bubbling. A long thin plastic tube was inserted into this hole and the other end put in a bucket of clean water to prevent insect from

entering. After fermentation, the clear fermented liquid was filtered through a fine white and clean nylon cloth to remove all the remaining residues that have settled at the bottom of the bucket. The filtrate was tested for quality.

Analytical Assay

Sampling for yeast cell count, total suspended solids, total dissolved solids, titrable acidity, pH, and alcohol content were determined on bidaily bais (Day 0, 2, 4, 6, and 8) and results recorded. Day 0 is when fermentation has not started. Day 2 is 44 hours after fermentation and so on and so forth.

pH determination

The pH meter was standardized with buffer solution. The electrode of the pH meter was immersed in a glass beaker containing the sample and readings were obtained from the photo-detector of the pH meter.

Determination of Total Dissolved Solids (TDS)

A crucible was dried in the oven at 105^{o}C for 1 hour. It was placed in a dessicator after one hour and allowed to cool. The crucible was weighed. 20ml of the sample was filtered using 0.45 membrane filter paper. The filtrate was measured and poured into a weighed crucible. The crucible containing the filtrate was dried in the oven for 1 hour, removed and placed in dessicator to cool for 1 hour. The crucible containing the dried sample was re-weighed. The total dissolved solids were calculated.

Determination of Total Suspended Solids (TSS)

A crucible was dried in the oven at 120^{o}C for 30 minutes. It was placed in a dessicator for an hour to cool. The crucible was weighed and 20ml of the sample was filtered using 0.45 membrane litter paper. The filtrate was measured and poured into the crucible. The crucible containing the filtrate was dried in the oven for 1 hour after which the crucible was placed in dessicator and allowed to cool for 1 hour. The crucible containing the dried sample was re-weighed and the total dissolved solids calculated.

Titrable Acidity

To 200mls of boiling distilled water in a 500ml Erlenmeyer flask was added 1ml of a 1% phenolphthalein indicator. The solution was titrated with 0. 1M sodium hydroxide solution to a faint but definite pink colour; 5mls of the sample was titrated to a pink color with the 0. 1M

NaOH, using 3 drops of 1% phenolphthalein as indicator. The total acidity was expressed as lactic acid using the method described by Rajković *et. al.*(1989).

Alcohol Content

The refractometer method was used in determining the alcohol content. A clean applicator was used to place 2drops of the sample (must i.e., before fermentation) on the prism of the refractometer and the value (original gravity) of the refractive index taken. After fermentation, 2drops of the sample was applied on the prism of the refractometer and the value (total gravity) was taken. The refractive index of the sample was gotten on two days interval (Sullivan and Bradford, 2011).

Yeast cell count

Yeast cell count was determined using sterile Malt Extract Agar. The medium was prepared according to specification and sterilized in the autoclave at 12 1°c for 15 minutes. The medium was allowed to cool to 45^{o}C. The medium was made inhibitory to bacteria by adding streptomycin. One (1) ml of the fermenting wine was inoculated into labeled Petri dishes. The ready to pour bacteria inhibitory medium was aseptically poured into appropriate labeled Petri swirled on the bench to mix thoroughly. Plates were allowed to set then inverted and incubated at room temperature for 48 hours. Yeast cell count was conducted and result recorded (Sullivan and Bradford, 2011).

Organoleptic Evaluation of produced banana wine

A panel of ten undergraduate students and non academic staffs from College of Medicine, Enugu State University of Science & Technology were involved in the evaluation. They were to access the taste, color aroma and texture of the Banana wine produced at different fermentation periods. The panelists were familiar mostly with all the quality attribute of the wines. The ranking method that is rapid and allows the testing of samples at once was employed. Ranking was done using 5- point Hedonic scale ranging from strongly dislike (1) to strongly liked (5) (Lim *et. al.*, 2003).

RESULT

The result showed that yeast cell colony count rose from 4.5 x 10^7 on Day 0 of fermentation to 5.8 x 10^7 on Day 2 and started decreasing to from 5.8 x 10^7 on Day 2 to 5.0 x 10^7, 4.9 x 10^7 and 4.8 x 10^7 in Day 4, 6 and 7 respectively as shown in table 1.

Table 1: Yeast cell count during Banana musts fermentation (cfu/ml).

S/N	Must Fermentation period (in Days)	Yeast Cell Count (cfu/ml)
1.	0	4.5×10^7
2.	2	5.8×10^7
3.	4	5.0×10^7
4.	6	4.9×10^7
5.	8	4.8×10^7

Table 2: pH of the fermenting Banana Wine.

S/N	Must Fermentation period (Day)	pH
1.	0	3.91
2.	2	3.53
3.	4	3.2
4.	6	3.21
5.	8	2.85

Table 3: Titrable acidity of the fermenting Banana Wine (g/100ml).

S/N	Must Fermentation period (Day)	Titrable acidity
1.	0	1.30
2.	2	1.55
3.	4	1.57
4.	6	1.59
5.	8	1.60

Table 4: Total dissolved solids of fermenting Banana Wine (ppm).

S/N	Must Fermentation period (Day)	TDS (mg/mi)
1.	0	2.5
2.	2	2.0
3.	4	1.5
4.	6	1.0
5.	8	0.5

TDS: Total Dissolved Solid.

Table 5: Total suspended solids of fermenting wine (ppm).

S/N	Must Fermentation period (Day)	TSS (mg/ml)
1.	0	1.33
2.	2	8.8
3.	4	6.6
4.	6	4.4
5.	8	2.2

TSS: Total Suspended Solid.

Table 6: Alcohol content of the fermenting Banana wine (%).

S/N	Must Fermentation period (Day)	Alcoholic content (% v/v)
1.	0	-
2.	2	11.0
3.	4	12.1
4.	6	12.5
5.	8	14.3

Table 7: Sensory Evaluation of the fermenting must.

S/N	Organoleptic attribute of Produced Banana wine	Score
1.	Color	4
2.	Taste	5
3.	Aroma	4
4.	Texture	3
Overall Grade		**4**

Sensory scale used was the 5 point Hedonic scale.

5 – Strongly liked

4 – Liked

3 – Moderately liked

2 – Disliked

1 – Strongly disliked

DISCUSSION

The yeast cell count increased from 4.5 x 10^7 on Day 0 to 5.8 x 10^7 at Day 2. The count started decreasing from 5.8 x 10^7 on Day 2 to 5.0 x 10^7 on Day 4, 4.9 x 10^7 on Day 6 and 4.8 x 10^7 on Day 8. This observation was in agreement with that recorded by Makew (Unknown) in which the yeast cell count increased from 4.9 x 10^7 at 0^{th} hr to 5.1 x 10^7 at 48^{th} hr before decreasing to 4.8 x 10^7 at 168^{th} hr. The is in disagreement with that recorded in a study to estimate microbial population and investigate biochemical changes in fermenting finger millet in which increased total yeast cell count was reported (Usher and Chandra, 1996). This finding could be attributed to non production of alcohol during fermentation of the millet. The findings of this study suggests that as the percentage of alcohol production increases, yeast cell division decreases. This may be due to depletion of nutrients, accumulation of alcohol and change in pH.

Appearance of *Saccharomyces cerevisiae* at Day 4 and above during fermentation period agrees with the result obtained by Buzas *et. al.* (1989) in a study to ascertain the influence of pH on the growth and ethanol production of free and immobilized *Saccharomyces cerevisae*.

The result of the pH values in the experiment shows progressive decrease from 3.91, 3.53, 3.21, 2.87 to 2.85 on Day 0, 2, 4, 6, and 8 respectively. This showed that the wine became more acidic as fermentation progressed. The drop in pH also records the utilization of the sugar present in the must by the yeast. The finding from this study suggests that *S. cerevisiae* could strive under acidic pH (Akubor *et. al.*, 2003).

Results obtain in the study records that the alcohol content and titrable acidity increases with the period of fermentation. The result of the titrable acidity and alcohol content were recorded as 1.33g/100ml and 11% at 0hr to 1.60g/100rnl and 14% at 168hr respectively. Acid present in lemo juice added to the must may have contributed to the titer recorded in this study. The titrable acid obtained in this research This result conformed to that obtained in a study to determine the titrable acidity in white wine made from plantain in which there was gradual increase in the titrable acidity and the alcohol content in as fermentation progressed (Rajković *et. al.*, 1989). Wines, as a rule, contain less acids than must, and according to Regulations, titrable acidity is in the range of 4.0-8.0 g/dm expressed in tartaric acid, because a part of tartaric acid is deposited in the form of salts (tartar or argol) during alcohol fermentation (Rajković *et. al.*, 1989).

The total dissolved solids decreased as the fermentation period increased. At Day 0, 2, 4, 6, and Day 8, the dissolved solids and total suspended solid were: 2.5, 2.0, 1.5, 1.0, 5.0 mg/ml and 1.33, 8.8, 6.6, 4.4, 2.2 mg/ml respectively. This observation was similar to that obtained in a studies that estimated the proximate and mineral composition of locally produced pawpaw and banana wine and Vitamin C content of commercial orange juices respectively (Awe, *et. al.*, 2013 and Haddad, 1977). The study suggests that large amount of the soluble materials were precipitated by fermentation and fed upon by the fermenting yeast cells.

The result of the organoleptic evaluation of the banana wine produced showed that the penalists liked the color, strongly liked the taste, liked the aroma and moderately liked the texture. Based on the assessment, the banana wine was liked. Similar result was obtained in studies of wine produced from banana (Idise and Odum, 2011).

CONCLUSION

Banana wine has good flavor and aroma and high nutritional value. Its production could be a way of reducing economic losses due to rapid deterioration of ripe banana as the process is easy and does not require expertise and sophisticated equipment. Government through it

ministries, agencies and departments and other stakeholders involved in agriculture and commerce should consider banana wine production as a way of addressing unemployment, food security and economic recession, while further research should be conducted on safe method of preserving the wine locally.

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