International Scholars Journals

International Journal of Enology and Viticulture ISSN: 2756-3685 Vol. 12 (3), pp. 001-006, March, 2025. Available online at www.internationalscholarsjournals.org © International Scholars Journals

Full Length Research paper

The Potential of Banana (*Musa Sapientum*) as a Novel Source for Wine Production

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Accepted 10 December, 2024

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. Fermentation of banana must for 144 h was carried out using recipes A to D. Recipe A contained a mixture of banana must with natural yeast. A was enhanced with granulated sugar to obtain recipe B. Recipe C contained recipe A augmented with granulated sugar and bakers' yeast while recipe D (control) contained only granulated sugar solution and bakers' yeast. Wine produced had values that ranged from 31.4 ± 0.29 to 33.2 ± 0.12°C for temperature, 3.38 ± 0.017 to 3.54 ± 0.052 for pH, 0.999 ± 0.0085 to 1.02 ± 0.0058 for specific gravity, 0.586 ± 0.018 to 0.71 ± 0.017 for optical gravity, 1.37 ± 0.075 to 1.383 ± 0.152 for percentage (%) alcohol (v/v), 0.271 versus 0.012 to 1.348 ± 0.072 for percentage (%) titratable acidity, 8.2 ± 0.099 to 9.38 ± 0.283 for total aerobic counts and 3.5 ± 0.5 to 4.75 ± 0.1 for R_f. Malo-lactic fermentation after 48 h was evident. Taste testing showed very little differences in wines from recipes A to C. Statistical analyses of tested parameters at 95% confidence level showed no significant differences. The wine from the control was similar to natural palm wine in taste and characteristics. Wine could thus be produced from banana for immediate consumption, within 48 h, using the recipes A to C.

Key words: Banana, flora, fermentation, sugar, wine, flavor, yeast.

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 suitable for 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 can be eaten raw or cooked. Bananas' flavor 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 may be used for wine production and the resulting wines are normally named after the fruit hence banana, apple, orange, pineapple, strawberries and coconut may be 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). Wine production has not been a major market in Nigeria although institutions such as NIFOR (Nigerian Institute for oil palm research) have been involved in production of bottled palm wine using chemical preservatives. Bioaccumulation of chemical preservatives poses potential dangers due to either toxicity or pro-toxicity (Idise and Izuagbe, 1988; Svans, 2008). It is thus pertinent to search for means of producing wines devoid of chemical additives. Banana possesses desirable qualities - high fiber-content which helps restore normal

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Table 1. Composition of the recipes.

Recipe	Composition
A	1.5 L of fruit slurry + 6.0 L of water.
B	1.5 L of fruit slurry + 6.0 L of sugar solution.
C	1.5 L of fruit slurry + 6.0 L of sugar solution + bakers' yeast.
D	7.5 L of sugar solution + bakers' yeast.

Table 2. Changes in pH with period of fermentation.

Time (h)	A	B	C	D
1	4.3	4.2	4.1	4.0
24	3.4	3.3	3.4	3.4
48	3.3	3.2	3.4	3.5
72	3.4	3.1	3.4	3.4
144	3.3	3.1	3.4	3.3

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, banana was 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 by stroke as much as 40%. Thus, a wine produced from banana is a worthwhile venture. This study was aimed at small-scale wine production with desirable organoleptic properties from banana for immediate consumption without chemical preservatives.

MATERIALS AND METHODS

Collection of materials

Ripe banana fruits (*M. Sapientum*), sugar and baker's yeast were purchased from Abraka market in Delta State, Nigeria. The fruits were identified at the Botany Department of the Delta State University, Abraka prior to analyses. These were washed with tap water in the laboratory and allowed to air dry.

Preparation of sugar solution

Clean water was boiled for 5 min and allowed to cool. One (1) teacup-full of granulated sugar was dissolved in 1 L of water to obtain the sugar solution.

Preparation of must juice

The method of Uraih (2003) was employed.

Fermentation of orange juice (must)

This was carried out in duplicates according to the method of Uraih (2003) with some modifications (Table 1).

Determination of physico-chemical and microbial parameters

These were carried out in accordance with standard methods reported by Ogunkoye and Olubayo (1977), Kunkee and Amerine (2002), Cowan and Steel (2004) and Fawole and Oso (2008).

Organoleptic evaluation

This was carried out in accordance with the procedure reported by Maragatham and Panneerselvam (2011). The sensory evaluation was done using 8 judge panels after aging for 24 h. Observations recorded for color, clarity, body and taste on a 5 point scale with 5 points for excellent quality and 1 point for bad quality.

Statistical analyses

These were carried out using Microsoft excel 1995 to 2003 at 95% confidence level.

RESULTS AND DISCUSSION

The changes in pH of the banana wines during fermentation are presented in Table 2. It was observed that the pH values reduced with period of fermentation apparently due to the production of acids from the mixed fermentation as well as the microbes in a microbial succession. A malo-lactic fermentation is evident. This result agrees with reports of Robinson (2006) and Okafor (2007). The changes in optical density of the banana wines during fermentation are presented in Figure 1. Increases in values with period of fermentation were

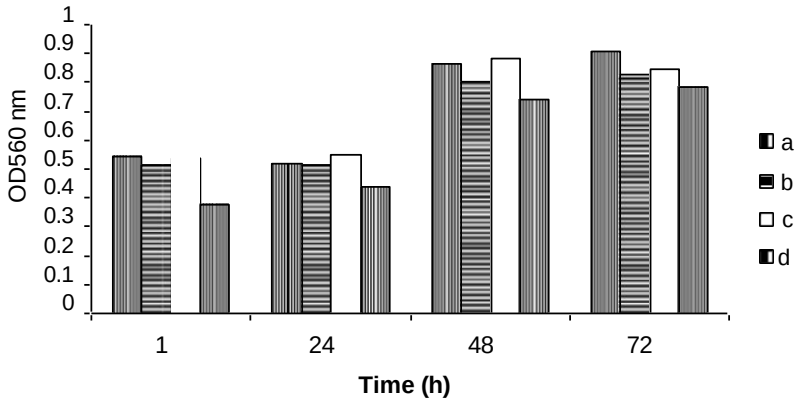

Figure 1. Changes in optical density of banana wine.

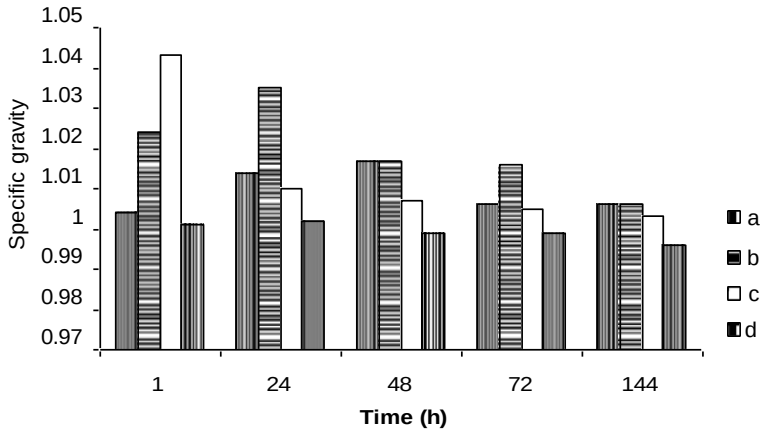

Figure 2. Changes in specific gravity of banana wine.

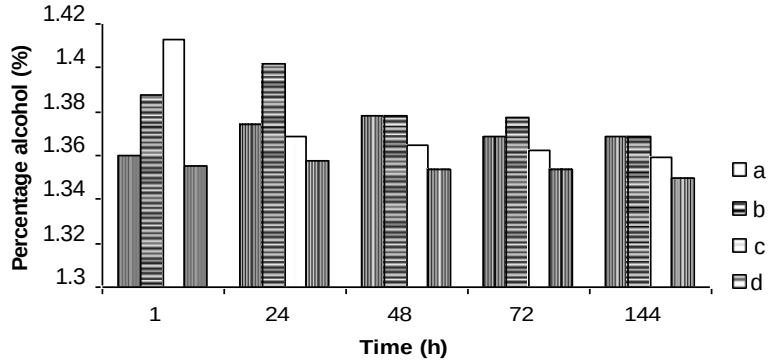

Figure 3. Changes in percentage (%) alcohol of banana wine.

observed apparently due to increasing microbial load with period of fermentation. This result agrees with reports of Amerine and Kunkee (2002) and Okafor (2007). The changes in specific gravity of the banana wines during fermentation are presented in Figure 2. It was observed that values decreased with period of fermentation. 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 agrees with reports of Uraih (2003) and Okafor (2007). The changes in percentage (%) alcohol (v/v) of the banana wines during fermentation are presented in Figure 3. It was observed

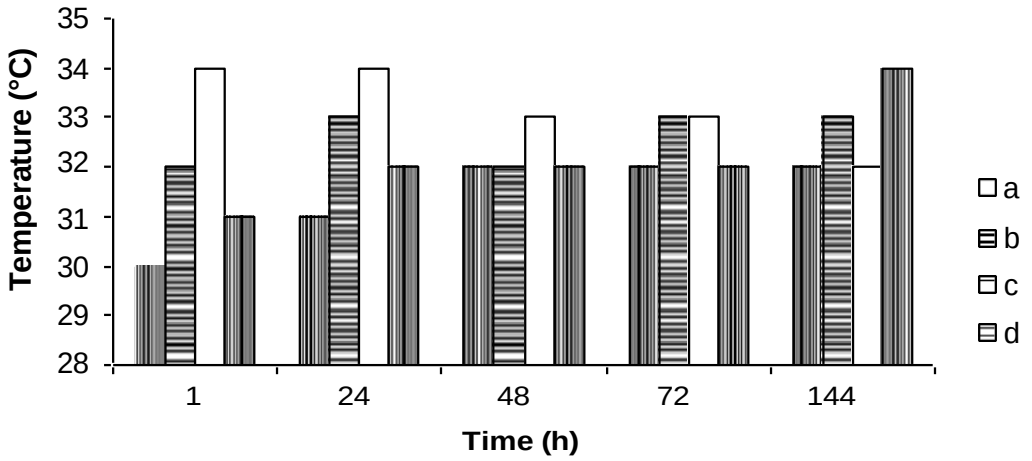

Figure 4. Changes in temperature of banana wine.

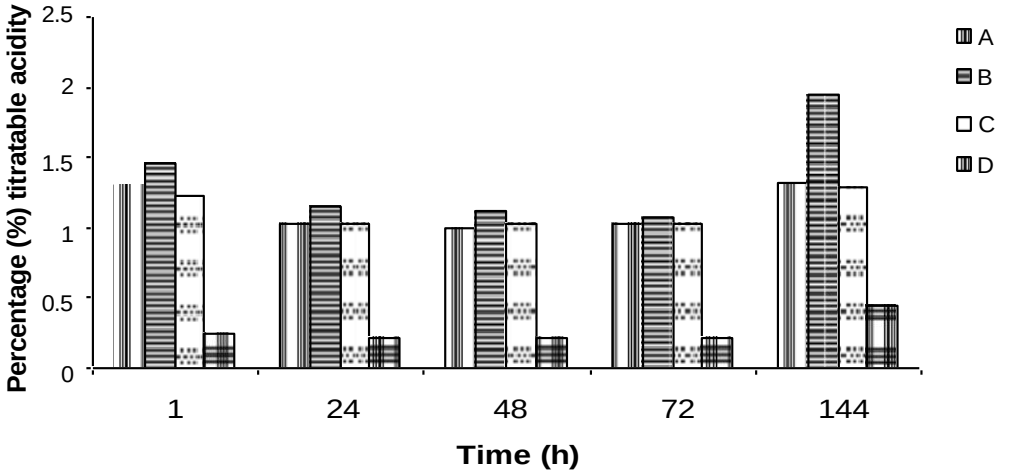

Figure 5. Changes in percentage (%) titratable acidity of banana wine.

that recipe C which was augmented with granulated sugar and bakers' yeast, within 1 h of fermentation had 1.413% compared to 1.360, 1.388 and 1.355% for recipes A, B and D respectively. This could be as a result of mixed fermentation by natural yeast and bakers' yeast. This result agrees with the reports of Wang et al. (2009).

The changes in temperature of the banana wines during fermentation are presented in Figure 4. It was observed that a mean temperature of 32.35°C was recorded from all the recipes. The observed mean temperature could be due to the heat generated during microbial metabolism. This result agrees with the reports of Okafor (2007). The changes in percentage (%) titratable acidity of the banana wines during fermentation are presented in Figure 5. It was observed that the titratable acidity of the recipes decreased up to 48 h of fermentation and thereafter increased with period of fermentation. This could be due to the presence of a malo-lactic fermentation arising from succession of the yeast cells by lactic acid bacteria after 48 h of fermentation. The presence of a malo-lactic fermentation is a desirable phenomenon in wine production due to the attendant buttery flavor. This result agrees with reports of Idise and Izuagbe (1988), Robinson (2006) and Okafor (2007). The changes in microbial load of the banana wines during fermentation are presented in Figure 6. It was observed that recipe C had higher microbial load than other recipes within 1 h of fermentation. This result supports those observed for Figures 4 and 5 and agrees with reports of Uraih (2003), Amerine and Kunkee (2002) and Okafor (2007). The average values of parameters of the various banana wines are presented in Table 3. Recipe B, which was the natural fermentation augmented with sugar produced wine with highest alcohol while

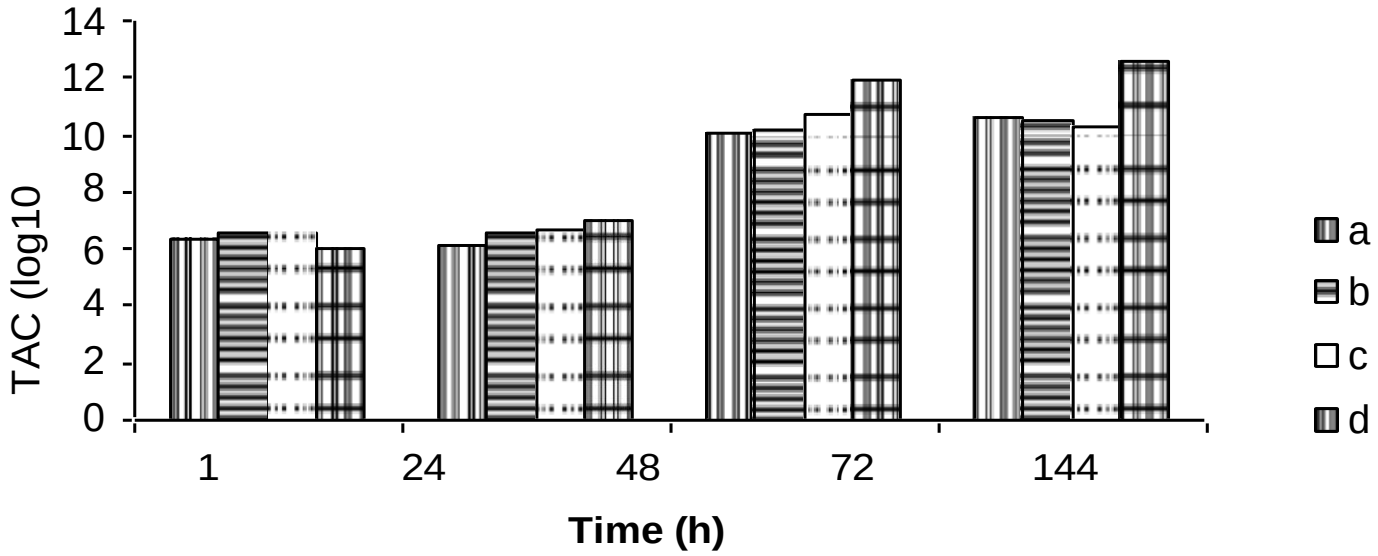

Figure 6. Changes in total aerobic counts of banana wine.

Table 3. Average values of parameters of the various banana wines.

Parameters	A	B	C	D
pH	3.5 ±0.029	3.38 ± 0.017	3.54 ± 0.052	3.52 ± 0.012
Temperature (°C)	31.4 ± 0.29	32.6 ± 0.17	33.2 ± 0.12	32.2 ± 0.35
Specific gravity	1.009 ± 0.0012	1.020 ± 0.0058	1.014 ± 0.0035	0.999 ± 0.0085
Optical density	0.710 ± 0.017	0.664 ± 0.057	0.704 ± 0.008	0.586 ± 0.018
Titratable acidity	1.33 ± 0.05	1.348 ± 0.072	1.115 ± 0.002	0.271 ± 0.012
Alcoholic content percentage (%) (v/v)	1.370 ± 0.075	1.383 ± 0.052	1.374 ± 0.152	1.354 ± 0.014
Microbial load cfu/ml	8.283 ± 0.099	8.20 ± 0.029	8.563 ± 0.126	9.38 ± 0.283
R_f values (cm)	4.75 ± 0.25	3.95 ± 0.65	3.5 ± 0.5	4.1 ± 0.1

Ho accepted as f-cal (0.083649) < f-crit (3.738892).

recipe D, which was sugar solution pitched with baker's yeast produced wine with the lowest percentage (%) alcohol.

The R_f values (cm) at 144 h of fermentation were within the reported values for lactic acid thus supporting the occurrence of a malo-lactic fermentation. Null hypothesis of significant difference was accepted as f-cal (0.83649) was less than f-crit (3.738892). These results agree with the reports of Ogunkoye and Olubayo (1977) and Idise and Izuagbe (1988). The changes in the physical and organoleptic properties of the various banana wines during fermentation are presented in Table 4. It was observed that while wines that received banana fruit must were creamy in color, the wine produced from sugar solution and baker's yeast had similar color and flavor with palm wine. This latter could form the basis for artificial palm wine production either on a small- or medium-scale. These results agree with reports by Idise and Izuagbe (1988), Uraih (2003) and Okafor (2007). The microcopy of yeast cells from the various recipes after 72 h of fermentation showed no significant differences between the yeast cells of the fermenting broths. It could be inferred that the wild yeast present in the banana wines could be of the same *Saccharomyces* species with the baker's yeast. These results are in agreement with the reports of Idise and Izuagbe (1985), Kunkee and Amerine (2002), Robinson (2006) and Okafor (2007).

CONCLUSION AND RECOMMENDATIONS

There is the possibility of banana wine production using various recipes and the flow chart in our homes for immediate consumption within 48 h without addition of chemical preservatives. There was evidence of Malo-lactic fermentation. The wines produced showed no

Table 4. Physical and organoleptic properties of the various banana wines.

Recipe	Time (h)	Sweetness	Color	Sediments	Frothing
	1	+	Cream	-	++
	24	-	Dirty cream	+	++
A	48	-	Dirty cream	+	+
	72	-	Dirty cream	+	-
	144	-	Cream	+	-
	1	++	Cream	-	++
	24	+	Dirty cream	+	++
B	48	-	Dirty cream	+	+
	72	-	Dirty cream	+	-
	144	-	Cream	+	-
	1	++	Cream	-	++
	24	+	Dirty cream	+	++
C	48	-	Dirty cream	+	+
	72	-	Dirty cream	+	-
	144	-	Cream	+	-
	1	++	Colorless	-	-
	24	+	White	-	-
D	48	-	White	-	-
	72	-	Colorless	+	-
	144	-	Colorless	+	-

appreciable differences in the tested parameters – pH, temperature, optical density, specific gravity, total aerobic counts, percentage (%) alcohol (v/v) and percentage (%) titratable acidity – taste-testing as well as statistically at 95% confidence level. However, there is the need for further research to ascertain the shelf life of the wines.

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