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Full Length Research paper

Evaluation of Pineapple (*Ananas comosus*) as a Source for Wine Production: A Quality Assessment

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Pineapple (*Ananas comosus*) is the common name for a tropical plant with edible fruit, which is actually a multiple fruit, consisting of coalesced berries. The ratio of 1: 4 (pineapple must: sugar) was used to produce wine using recipes A to D. A contained only natural yeast; B contained natural yeast augmented with granulated sugar; C contained natural yeast augmented with baker's yeast and granulated sugar while D (control) contained granulated sugar and baker's yeast. Wines produced after 144 h of fermentation had average values of 3.44, 3.32, 3.46 and 3.50 for pH; 0.583, 0.627, 0.715 and 0.666 for optical density; 0.999, 1.003, 0.998 and 0.993 for specific gravity; 6.67, 6.69, 6.75 and 6.72 for total aerobic count (Log_{10} cfu/ml); 1.355, 1.355, 1.350 and 1.350 for % alcohol and 0.956, 1.246, 0.997 and 0.260 for %.titratable acidity for A to D respectively. The mean values for temperature and R_f were 30.5°c and 0.6 respectively. Malo-lactic fermentation after 48 h was evident. Taste testing showed very little differences in the wines with recipes A to C while statistical analyses at 95% confidence level showed no significant differences. The wine from the control had similar taste and characteristics with natural palm wine. Pineapple wine could thus, be produced for immediate consumption or preservation by refrigeration using recipes A to C. More research is still required to determine the shelf stability of the Pineapple wine.

Key words: Pineapple fermentation, sugar, wine, flavor, yeast.

INTRODUCTION

Pineapple (*Ananas Comosus)*, a leading member of the family *Bromeliaceae* comprises about 2,000 species mostly epiphytic and many strikingly ornamental and varies from nearly white to yellow in Color (Morton, 1987). It is an herbaceous perennial plant which grows to 1.0 to 1.5 m tall with 30 or more trough-shaped and pointed leaves, 30 cm long, surrounding a thick stem. It is a multiple fruit, forming what appears to be a single fleshy fruit. Pineapples contain good sugar proportion which makes it suitable for wine making (Adaikan and Ganesan, 2004).

Wine is an alcoholic beverage typically made of fermented fruit juice (Okafor, 2007). Any fruit with good proportion of sugar may be used in producing wine and the resultant wine is normally named after the fruit. The type of wine to be produced dictates the fruit and strain of yeast to be involved (Amerine and Kunkee, 2005). Preservatives used in wine making include sulphur-dioxide, potassium sorbate, sorbic acid and metabisulphides (Idise and Izuagbe, 1988). High concentration of these preservatives in wine, aside causing off odors, can induce lots of systemic disorderliness such as breathing problems in Asthmatic patients and gastrointestinal disturbances in allergic persons. The effects of bioaccumulation of these chemicals could further compound these situations (Okafor, 2007).

Fermentation is a process of extracting energy from the oxidation of organic compounds such as carbohydrates using an endogenous electron acceptor, usually pyruvate, an organic compound. Before fermentation takes place, one glucose molecule is broken down into two pyruvate molecules during glycolysis. Fermentation is important in anaerobic conditions when there is no oxidative phosphorylation to maintain the production of Adenosine tri-phosphate (ATP) by glycolysis. During

Table 1. The compositions of various fermenting vessels.

Vessel	Composition
A	1.5 liters of Pineapple slurry + 6.0 liters of water.
B	1.5 liters of Pineapple slurry + 6.0 liters of sugar solution.
C	1.5 liters of Pineapple + 6.0 liters of sugar solution + activated baker's yeast
D(control)	7.5 liters of sugar solution + activated baker's yeast

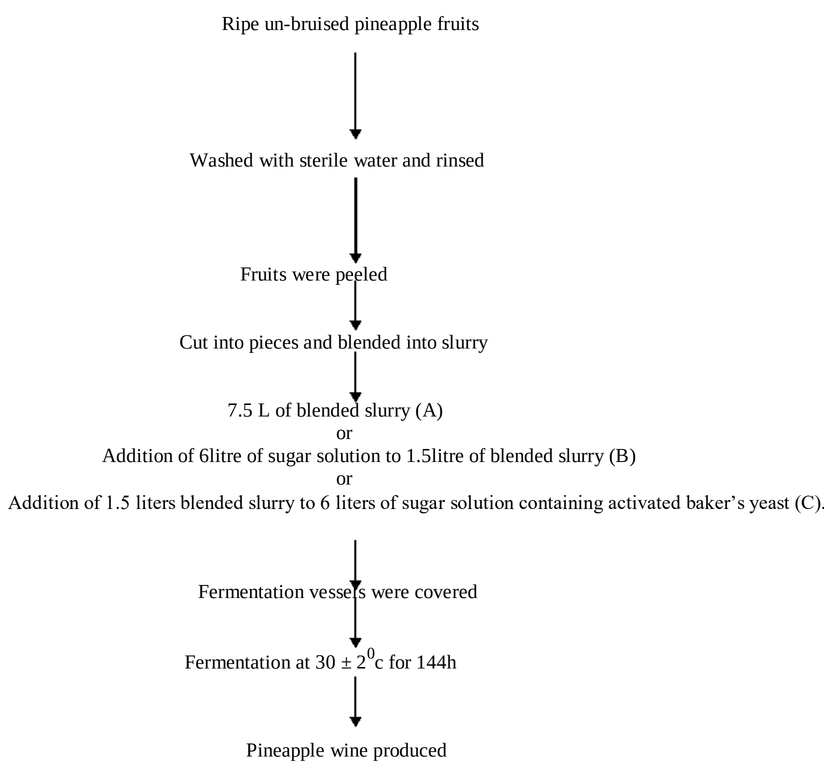

Figure 1. Flow chart of pineapple wine production.

alcoholic fermentation, usually carried out by yeasts, pyruvate is then converted into ethanol and carbon dioxide thus:

$$C_6H_{12}O_6 \rightarrow 2C_2H_5OH + 2CO_2.$$

During this process, the carboxylic carbon atom is released in the form of carbon-dioxide with the remaining components becoming acetaldehyde. The acetaldehyde in the absence of oxygen will then be further reduced by alcohol dehydrogenase to form ethanol along with carbon-dioxide (Robinson, 2006). This research was aimed at producing wine from pineapple for immediate consumption.

MATERIALS AND METHODS

Collection of materials: Sugar, baker's yeast and ripe un-bruised pineapple 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 analysis. These were washed with tap water in the laboratory and allowed to air dry.

Preparation of sugar solution

Clean water was boiled for five minutes and allowed to cool. One (1) teacup-full of granulated sugar was dissolved in one liter of water to obtain the sugar solution.

Preparation of must juice

This was carried in accordance with the method of Uraih (2003). The compositions of various fermenting vessels are presented in Table 1.

Fermentation of pineapple juice (must)

This was carried out using a modification of the method of Uraih (2003) using the flowchart in Figure 1.

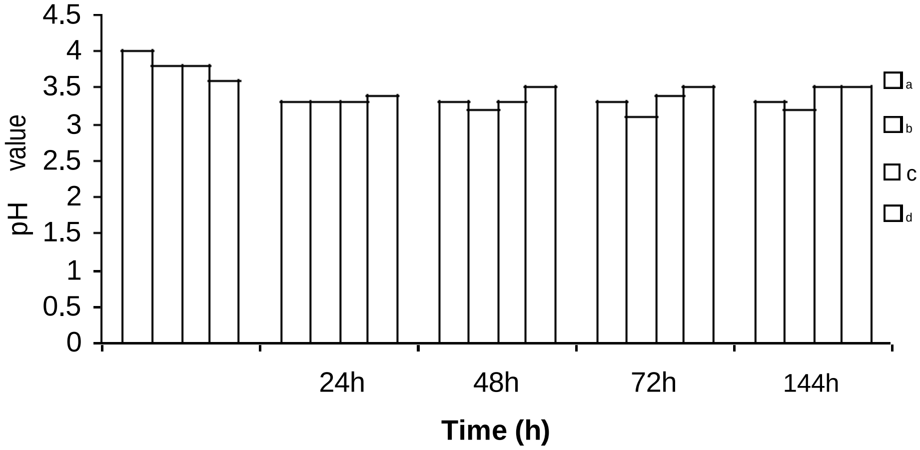

Figure 2. Changes in pH of pawpaw wine.

Fig 2 : Changes in pH of pawpaw wine

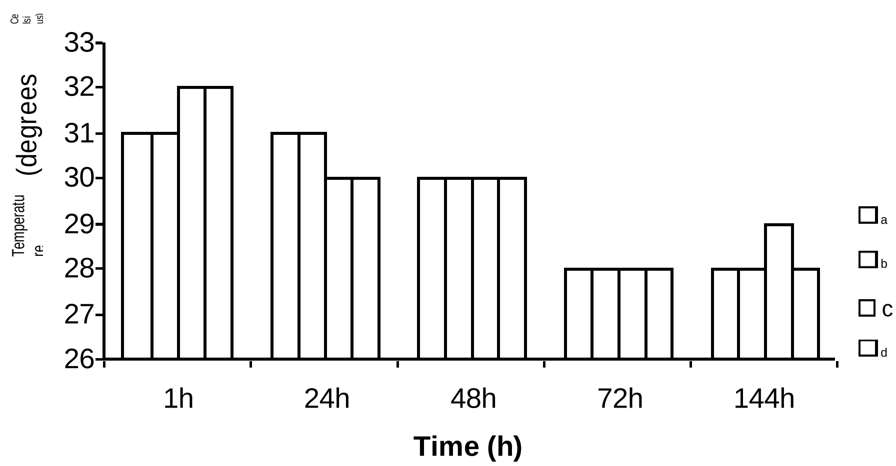

Figure 3. Changes in temperature of pawpaw wine.

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Determination of physico-chemical and microbial parameters

These were carried out in accordance with standard methods reported by Ogunkoye and Olubayo (1977), Harrigan and McCane (2001). 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 analysis

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

RESULTS

The pH values of the various wines presented in Figure 2 indicate a reduction after 24 h of fermentation and the values thereafter remained constant. The changes in temperature during orange wine production presented in Figure 3 showed a decrease from 1 to 24 h for recipes C and D and remained constant thereafter for C and increased for D while it decreased to 48 h for recipes A and B and remained constant thereafter. The highest value at 1h was observed for recipe C.

The optical density values presented in Figure 4 showed increases with period of fermentation for all the wines. The specific gravity values are presented in Figure 5. It was observed that there was a decrease from 1 to 72 h and an increase thereafter to 144 h of fermentation for the wines. The percentage alcohol represented in Figure 6 showed constant values till 48 h followed by a decrease

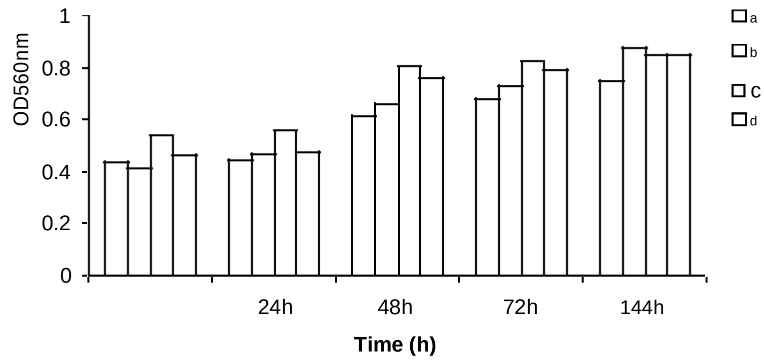
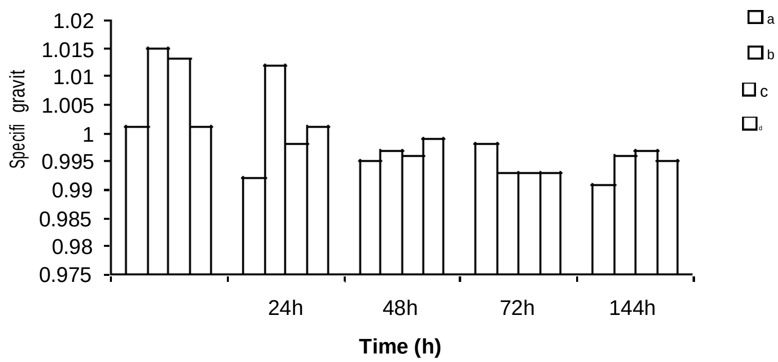


Figure 4. Changes in optical density of pawpaw wine.
Fig 4: Changes in optical density of pawpaw wine



FigureFig5. Changes5:Changesinspecificinspecificgravity gravityofpawpawofpawpawwine. wine

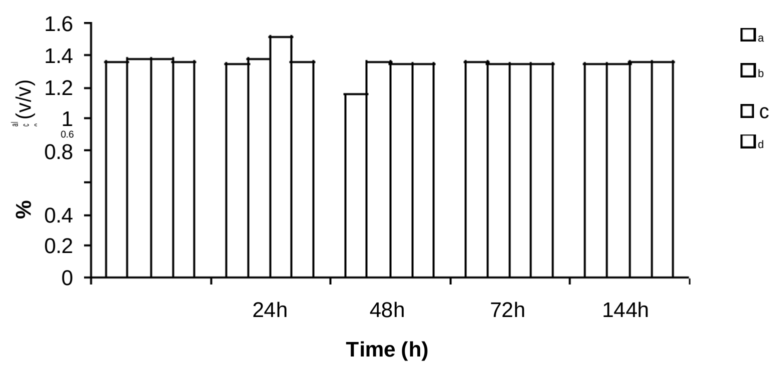


Figure 6. Changes in % alcohol of pawpaw wine.
Fig 6: Changes in % alcohol of pawpaw wine

at 72 h and an increase at 144 h for recipes A and B while constant values were observed for 1and 24 h followed by a decrease at 48 h which was constant till 144 h for recipes C and D.

The changes in % titratable acidity are presented in Figure 7. It was observed to increase with the period of fermentation supporting the occurrence of microbial succession with varying tolerance for the metabolic end products. The total aerobic counts are presented in Figure 8. It was observed to increase with the period of fermentation supporting the occurrence of microbial succession.

The average values of the tested parameters with period of fermentation presented in Table 2 indicate that there was no appreciable difference in recipes A to C.

The mean values R_f and retardation factor values are presented in Table 3. It was observed that the values indicate the presence of lactic acid in the fermentation

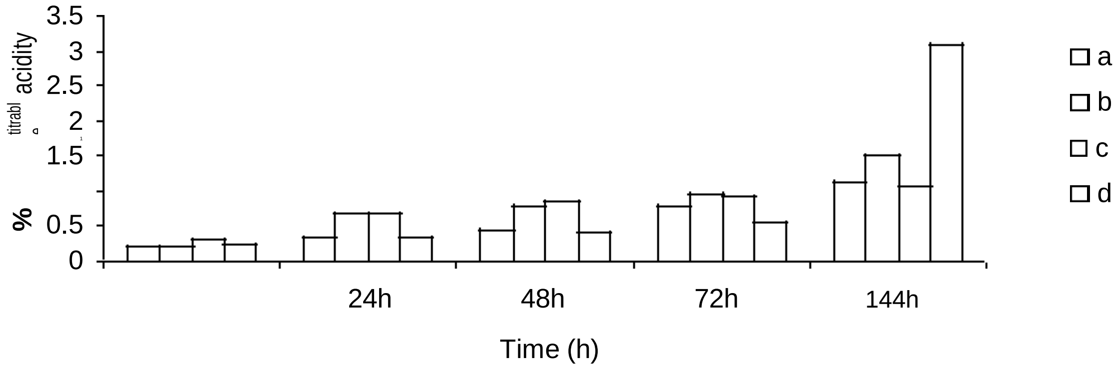


Figure 7. Changes in % titratable acidity of pawpaw wine during production.

Fig 7: Changes in % titratable acidity of pawpaw wine during

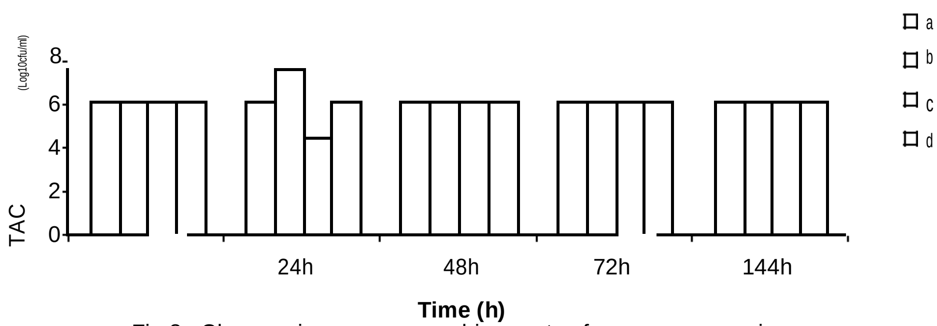


Fig 8 : Changes in aerobic counts of pawpaw wine
Figure 8. Changes in total aerobic counts of wine.

Figure 8. Changes in total aerobic counts of pawpaw wine.

Table 2. Mean values of three determinations.

Parameters	A	B	C	D
pH	3.44 ± 0.06	3.32 ± 0.14	3.46± 0.06	3.5 ± 0.14
Temperature	30.4 ± 0.46	30.6 ± 0.17	30.6± 0.46	30.6 ± 0.40
Optical density	0.582 ± 0.009	0.627 ± 0.025	0.715± 0.0023	0.666 ± 0.054
Specific gravity	0.999 ± 0.0006	1.003 ± 0.002	0.998± 0.002	0.993 ± 0.002
Total aerobic count (log_{10} cfu/ml)	6.67 ± 0.53	6.69 ± 0.052	6.75± 0.08	6.72 ± 0.28
Percentage alcohol (v/v)	1.355 ± 0.058	1.355 ± 0.006	1.35± 0.098	1.35 ± 0.058
Titratable acidity (%)	0.956 ± 0.019	1.246 ± 0.11	0.997± 0.0006	0.26 ± 0.023

medium at the end of 144 h.

The physically observable and taste changes in the wines with period of fermentation are presented in Table 4. It was observed that there were no appreciable changes in the pineapple wines of the different recipes.

DISCUSSION

The observed changes in the pH of the wines could be due to production of acids with period of fermentation probably arising from microbial succession. This result agrees with the reports of previous workers (Amerine and Kunkee, 2005; Okafor, 2007). The observed changes in the temperature of the wines could be due to microbial succession arising from microbial metabolic activities that made the fermentation medium favor the growth of certain organisms. These results agree with reports of previous workers (Idise and Izuagbe, 1985, 1988; Amerine and Kunkee, 2005; Okafor, 2007).

The observed changes in optical density with period of fermentation could be due to increase in microbial load arising from microbial succession with changes in fermentation end products. These results agree with reports of previous workers (Amerine and Kunkee, 2005; Robinson, 2006; Okafor, 2007).

Table 3. Mean R_f values of three determinations.

Variable	48 h	144 h
A Rfx (cm)	1.9 ±0.017	3 ±0.289
Rfy	0.47 ± 0.012	0.75 ± 0.017
B Rfx (cm)	1.5 ± 0.029	1.8 ± 0.023
Rfy	0.37 ± 0.046	0.45 ± 0.006
C Rfx (cm)	3.8 ± 0.346	2.6 ± 0.058
Rfy	0.95 ± 046	0.65 ± 0.075
D Rfx (cm)	1.95 ± 0.029	3.2± 0.19
Rfy	0.48 ± 0.023	0.82 ± 0.214

Table 4. Observed changes during pineapple wine fermentation

Parameters (h)	Color	Taste	Others
A 24	Pineapple	Slightly sweet	Foamy with whitish suspension
48	Pineapple	Sour	Frosty
72	Pineapple	Sour	Flocs
144	Pineapple	Sour	Flocs
B 24	Pineapple	Sweet	Foamy with more whitish suspension than A
48	Pineapple	Sour	Frosty.
72	Pineapple	Sour	Flocs.
144	Pineapple	Sour	Flocs.
C 24	Pineapple	Sweet	Frosty suspension
48	Pineapple	Sour	Sediments
72	Pineapple	Sour	Flocs
144	Pineapple	Sour	Flocs
D 24	Whitish	Sweet	Highly foamy
48	Whitish	Sour	Foamy
72	Whitish	Sour	Flocs
144	Whitish	Sour	Flocs with clear suspension

The observed changes in specific gravity, % alcohol (v/v) and total aerobic counts of the wines with period of fermentation support the occurrence of microbial apparently due to varying tolerance for metabolic end products. These results agree with reports of Idise and Izuagbe (1988), Robinson, (2006) and Okafor (2007). Rf values presented in Table 3 indicate the occurrence of malo-lactic fermentation. There were no appreciably observed changes in the taste of the wines with different recipes presented in Table 4 as well as the statistical analysis which showed no difference at 95% confidence level for f-test. These results agree with reports of Idise and Izuagbe (1988), Kunkee and Goswell (2002), Robinson, (2006) and Okafor (2007).

CONCLUSION AND RECOMMENDATIONS

Wines were produced from pineapple using its innate micro-organisms, granulated sugar and baker's yeast in varying proportions. There was evidence of Malo-lactic fermentation. The wines produced showed no appreciable differences in the tested parameters – pH, temperature, optical density, specific gravity, total aerobic counts, % alcohol (v/v) and % titratable acidity – taste-testing as well as statistically at 95% confidence level.

They could be consumed within 48 h. No chemical preservatives were required. However, there is the need for further research to ascertain the shelf life of the wines. Production of pineapple wine could be carried out using the flow chart.

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