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Full Length Research Paper

Evaluation of chemical and fermentation parameters during the preparation of wine from berry (*Maesobotyra standii*)

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A milky red wine was produced from locally sourced berry (*Maesobotyra standii*) in Abraka, Delta State, Nigeria using innate wild yeast (*Saccharomyces cerevisiae)* augmented with baker's yeast activated with 2, 5 and 10% (w/v) sugar solutions in activated yeast: fruit extract ratios of 1:2 and 1:3. It was observed that there was an inverse proportional relationship between percentage (%) titratable acidity and pH as well as for specific gravity (SG) and percentage (%) alcohol for 48 h after which both SG and % alcohol increased. Diauxic growth and malo-lactic fermentation were observed. Total aerobic counts followed same trend as for % alcohol. pH, % titratable acidity, specific gravity, % alcohol and total aerobic counts at 72 h fermentation ranged from 4.85 - 5.85, 0.955 - 1.152, 0.956 - 1.141, 0.54 - 2.62 and 0.95 - 185 x 10^3 cfu/ml, respectively. The baker's yeast activated with 5% (w/v) granulated sugar was most suitable for home or commercial berry wine production which gave wine with lower alcohol-content (1.84%, v/v alcohol) using 1:2 activated baker's yeast : fruit extract ratio; it gave wine with slightly higher alcohol-content (2.62%, v/v alcohol) with 1:3 baker's yeast : fruit extract ratio. Thus portable and/or commercial wine can be produced from berry (*M. standii*) with baker's yeast activated with 5% (w/v) granulated sugar.

Key words: Berry wine, sugar, baker's yeast, malo-lactic, fermentation.

INTRODUCTION

Wine making is gardening of a sort with selected yeasts being the seeds. They need nutrients in the form of sugar and all the elements associated with life. Selection of a good seed ensures a good wine (Anon, 2008b). Wild yeasts are found in almost all fruits but generally produce wine inferior in flavor and of lower alcohol content than wines produced with selected strains of yeast (Anon, 2008a).

Wine can be made from grapes, fruits and berries (Armstrong, 2004; Anon, 2007). Any small, fleshy fruit is popularly called a berry, especially if it is edible (Encyclopaedia Britannica, 2009). However, irrespective of the starting materials, there must be fermentation to produce alcohol and if the alcohol-content is relatively low, the result is wine. Various types of wines abound depending on the clarity and alcohol-content (Anon, 2008a, b, c, d). There can be a secondary fermentation, malo-lactic, when malic acid is broken down to lactic acid and carbon dioxide which imparts additional flavor, often 'buttery' to the wine (Todd, 1999; Anon, 2008d).

Berries, which are grape-like fruit clusters, belong to the family Euphorbiaceae and Genus Maesobotyra. They grow wildly throughout the seasons with white flavors but produce fruits between April and June, which is the onset of the rainy season. On maturation, the fruits are bright red containing fleshy edible pulp with red seed. The fruit is ovoid or ellipsoidal in shape with pointed styles about one centimeter long and broad. The genus is found to extend from South-western Nigeria to Zaire (Keay, 1989). It is known by different names in different tribes; 'oshushu' (Urhobo) and 'osunsun' (Ika).

Various berries have been used in wine making. With few exceptions, the more the fruits used in wine making, the fruitier the taste (Anon, 2008a). The amount of sugar

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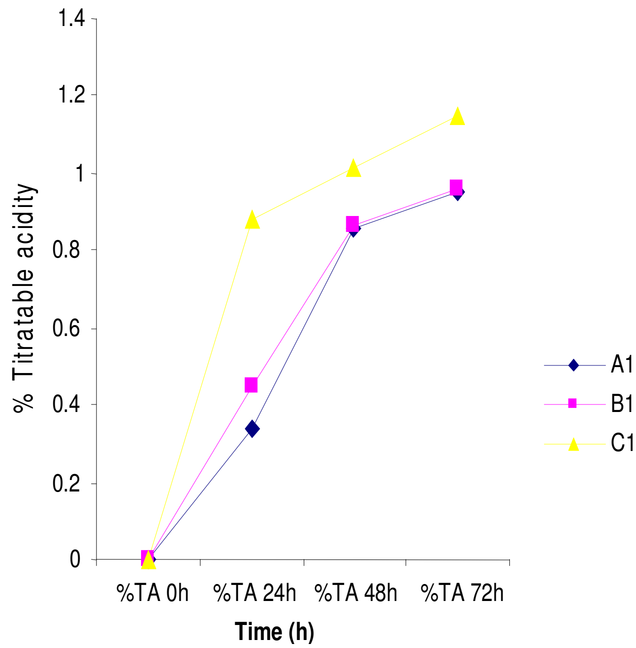

Figure 1a. Changes in % titratable acidity with fermentation of 2, 5 and 10% (w/v) sugar solutions (A1, B1 and C1, respectively), mixed with the juice at a ratio of 1:2.

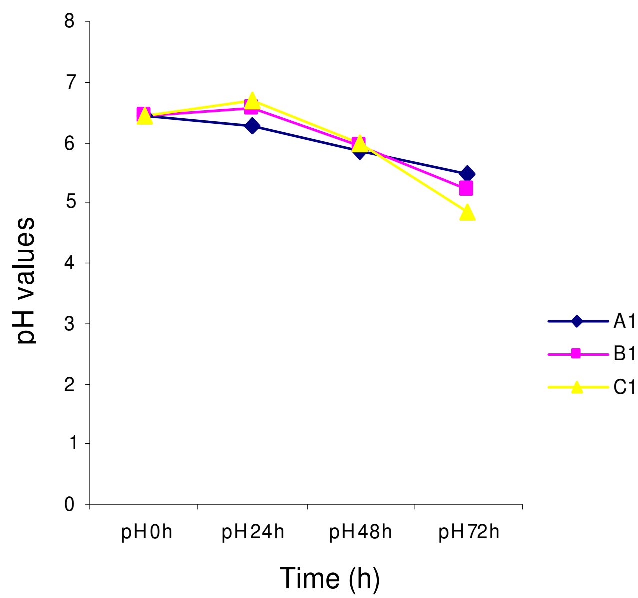

Figure 1b. Changes in pH with fermentation of 2, 5 and 10% (w/v) sugar solutions (A1, B1 and C1, respectively), mixed with the juice at a ratio of 1:2.

added depends on the amount naturally present. Tartness, usually caused by acid, could be produced by tannin, pectin or simply a natural flavor. These are usually removed by precipitation during wine maturation. They often affect the clarity of the wine (Armstrong, 2004).

The berry contains soluble carbohydrate (glucose and fructose) which enables it serve as food, energizer and can be used for the production of wine (Keay, 1989). It contains inherent yeasts of the genus *Saccharomyces* just as have been reported for various wild plants (Dias et al., 2006). The current study was aimed at the use of the berry in home and/or commercial wine production.

MATERIALS AND METHODS

Collection of berries, sugar and yeast

The berries, granulated sugar and baker's yeast (*Saccharomyces cerevisiae*) (Levure Instantance, 500 g net wt., Made in China) were purchased from Abraka main market, Abraka, Delta State, Nigeria. The berries were washed with sterile distilled water, crushed to extract the juice with a pestle in a 1 l plastic bowl. The pestle and plastic bowl were previously washed with detergent ('Omo') and sterilized by washing in 95% ethanol, placed in an inverted position and allowed to dry. The juice was stored at 4°C until required.

Preparation of the berry wine

Using three sterile 250 ml flasks, 2, 5 and 10% (w/v) sugar solutions, denoted as A, B and C respectively, were prepared to activate the baker's yeast. The activated yeast was mixed with the juice at ratios of 1:2 and 1:3 to give A1, B1, C1 and A2, B2, C2, respectively. Each flask was mixed properly by hand agitation, covered properly with a stopper that has a tube covered with cotton wool to release the carbon-dioxide that would be produced during the fermentation. pH, retention factor (R_f), specific gravity (SG), % titratable acidity (%TA) and total aerobic mesophilic counts (TAC) and % alcohol (w/v) were determined at 1, 24, 48 and 72 h for the fermenting broths.

Determination of pH, R_f, % alcohol, specific gravity, % titratable acidity and TAC

pH was determined using a Mettler pH meter that was standardized in accordance with the manufacturer's instructions. The R_f values, % alcohol, specific gravity and % titratable acidity were carried out using the methods reported by Ogunkoye and Olubayo (1977). The TAC were carried out using the pour plate method reported by Cowan and Steel (2004).

RESULTS

The results of berry wine prepared from baker's yeast activated with 2, 5 and 10% (w/v) sugar solutions in activated yeast: fruit extract ratio of 1:2 is presented in Figure 1 while wine prepared from activated yeast: fruit extract ratio of 1:3 is presented in Figure 2. It was observed that there was an inverse proportional relationship between % titratable acidity and pH (Figures 1a, b, 2a and b) as well as for specific gravity and % alcohol for 48 h after which both SG and % alcohol increased (Figures 1c, d, 2c and d). The total aerobic counts observed the same trend with % alcohol (Figures 1e and 2e). It was observed that the 5% (w/v) sugar activated yeast produced wines with higher % alcohol-contents. The wine produced using 1:3 activated yeast: fruit extract ratio possessed the highest% alcohol-content of 2.62.

The results of the wine prepared from activated yeast: fruit extract ratios of 1:2 and 1:3 are presented in Figures 3 - 5 for 2, 5

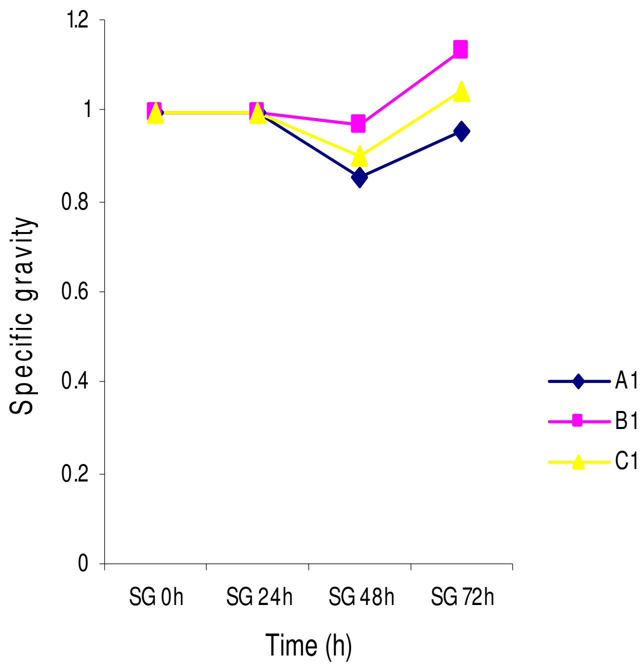

Figure 1c. Changes in specific gravity with fermentation of 2, 5 and 10% (w/v) sugar solutions (A1, B1 and C1, respectively), mixed with the juice at a ratio of 1:2.

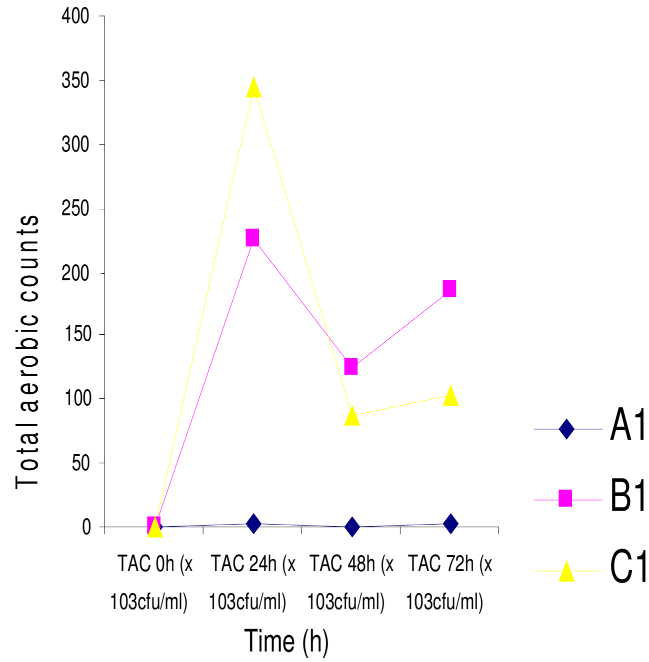

Figure 1e. Changes in total aerobic counts with fermentation of 2, 5 and 10% (w/v) sugar solutions (A1, B1 and C1, respectively), mixed with the juice at a ratio of 1:2.

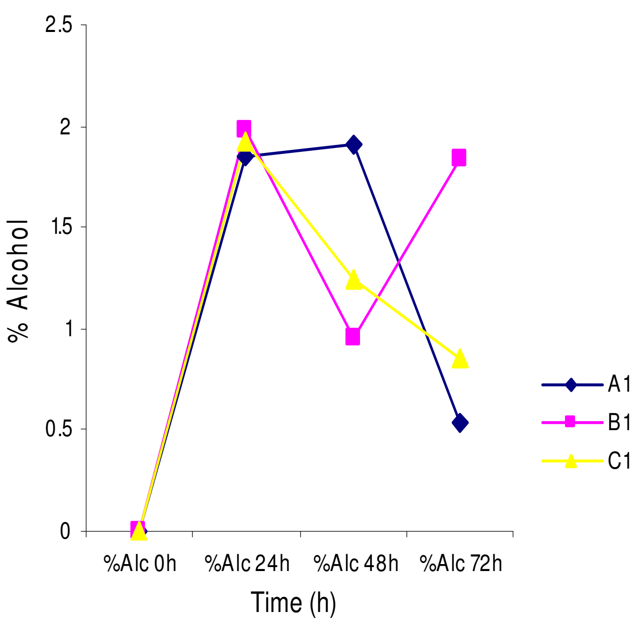

Figure 1d. Changes in % alcohol with fermentation of 2, 5 and 10% (w/v) sugar solutions (A1, B1 and C1, respectively), mixed with the juice at a ratio of 1:2.

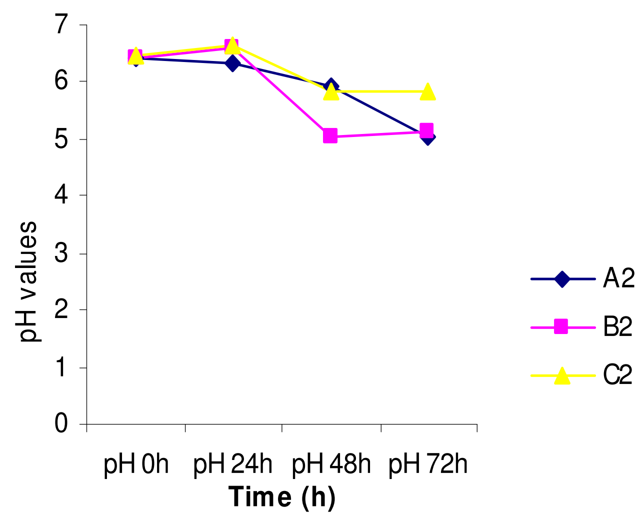

Figure 2a. Changes in % titratable acidity with fermentation of 2, 5 and 10% (w/v) sugar solutions (A2, B2 and C2, respectively), mixed with the juice at a ratio of 1:3.

and 10% (w/v) sugar respectively. It was observed that the wines produced from the 1:3 activated yeast: fruit extract ratios possessed higher values with the wine produced from 5% (w/v) activated yeast possessing highest value of 2.62. Diauxic growth was observed to take place after 48 h of fermentation as both alcohol and total aerobic counts increased (Figures 1c, d, e, 2c, d, e, 3b, c, d, 4c, d, e, 5c, d and e). A malo-lactic fermentation was observed to take place after 48 h as shown in the R_f values in Table 1.

DISCUSSION

The inverse relationship observed between pH and %

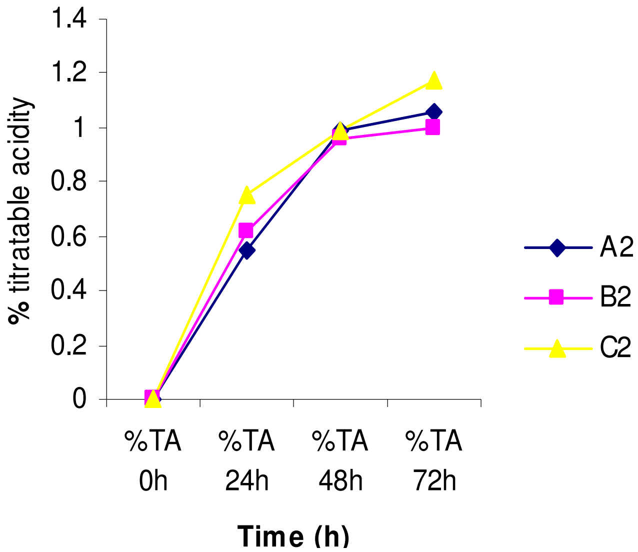

Figure 2b. Changes in pH with fermentation of 2, 5 and 10% (w/v) sugar solutions (A2, B2 and C2, respectively), mixed with the juice at a ratio of 1:3.

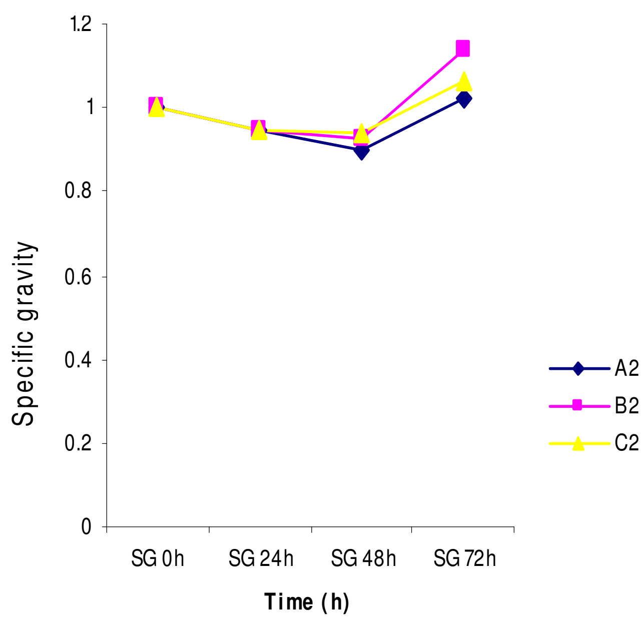

Figure 2c. Changes in specific gravity with fermentation of 2, 5 and 10% (w/v) sugar solutions (A2, B2 and C2, respectively), mixed with the juice at a ratio of 1:3.

titratable acidity and specific gravity and % alcohol in Figures 1 and 2 conforms to the reports of previous studies (Armstrong, 2004; Dias et al., 2006).

The increase in total aerobic counts, % alcohol and % titratable acidity after a decline phase observed in all the Figures indicate a diauxic growth. Diauxic growth observed could be due to the presence of sucrose in the fruit. Sucrose, a disaccharide, is made up of a molecule

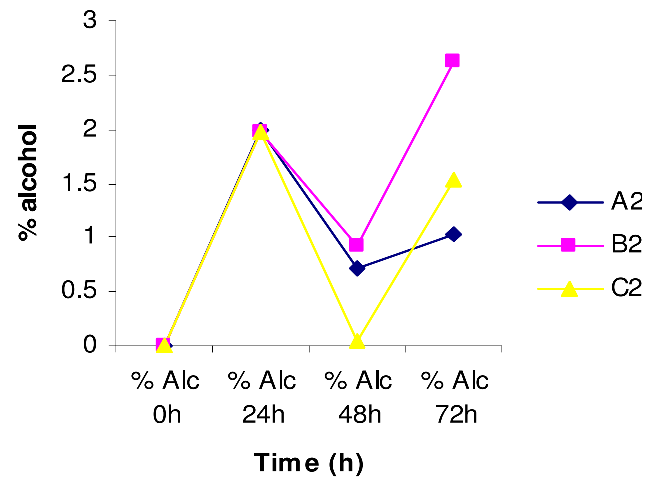

Figure 2d. Changes in % alcohol with fermentation of 2, 5 and 10% (w/v) sugar solutions (A2, B2 and C2, respectively), mixed with the juice at a ratio of 1:3.

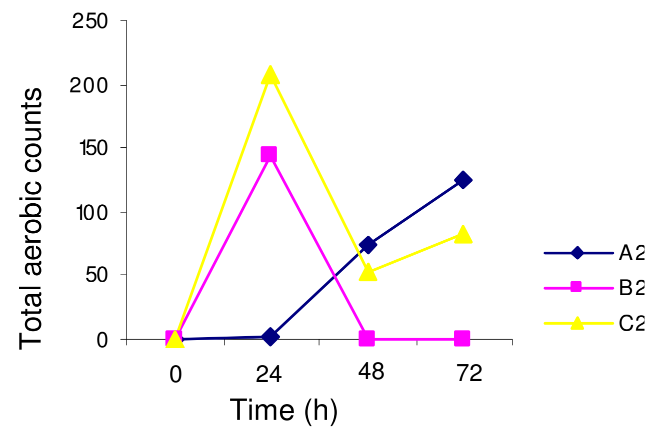

Figure 2e. Changes in total aerobic counts with fermentation of 2, 5 and 10% (w/v) sugar solutions (A2, B2 and C2, respectively), mixed with the juice at a ratio of 1:3.

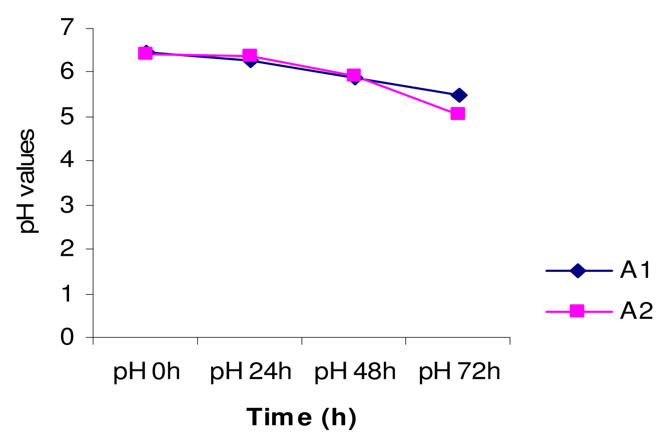

Figure 3a. Changes in pH with fermentation of 2% (w/v) sugar solutions, mixed with the juice at a ratio of 1:2 and 1:3 (A1 and A2, respectively).

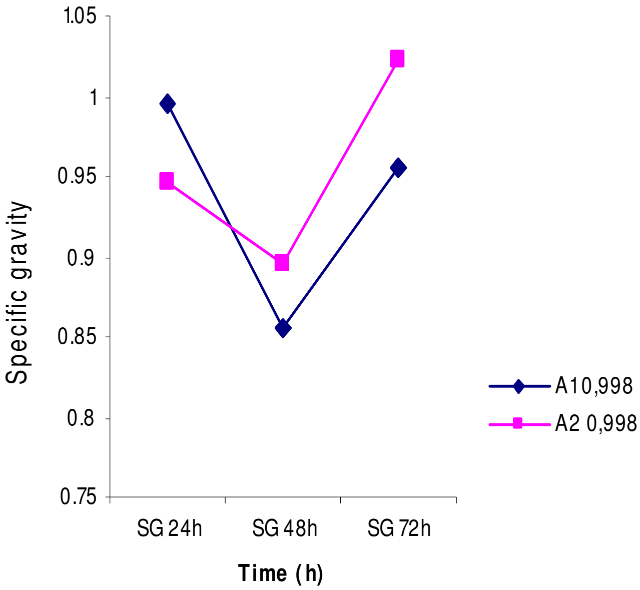

Figure 3b. Changes in specific gravity with fermentation of 2% (w/v) sugar solutions, mixed with the juice at a ratio of 1:2 and 1:3 (A1 and A2, respectively).

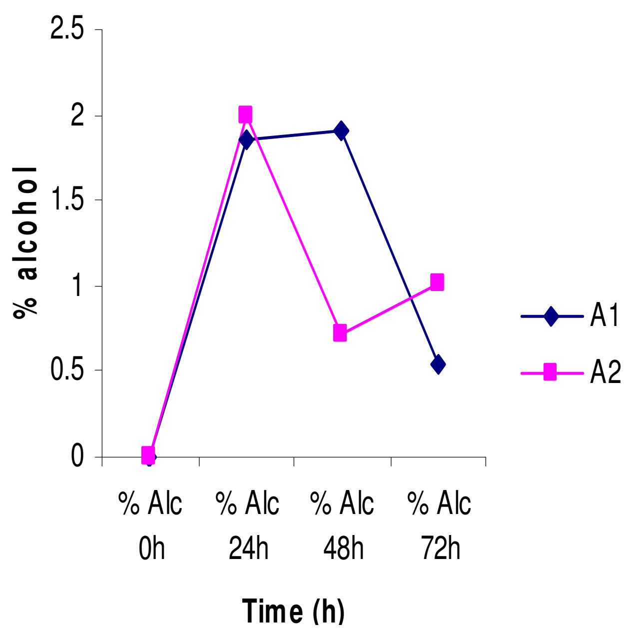

Figure 3c. Changes in % alcohol with fermentation of 2% (w/v) sugar solutions, mixed with the juice at a ratio of 1:2 and 1:3 (A1 and A2, respectively).

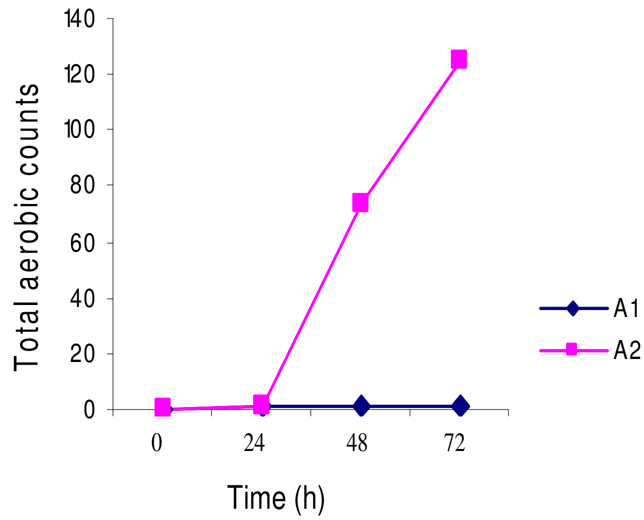

Figure 3d. Changes in total aerobic counts with fermentation of 2% (w/v) sugar solutions, mixed with the juice at a ratio of 1:2 and 1:3 (A1 and A2, respectively).

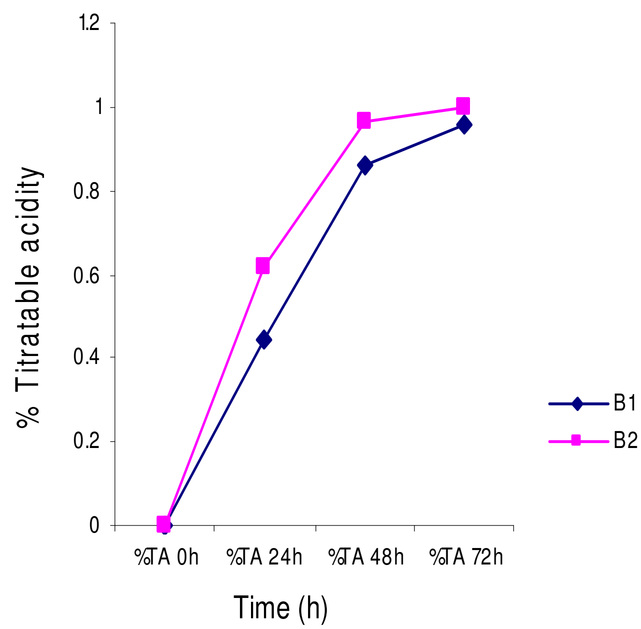

Figure 4a. Changes in % titratable acidity with fermentation of 5% (w/v) sugar solutions, mixed with the juice at a ratio of 1:2 and 1:3 (B1 and B2, respectively).

of glucose and a molecule of fructose. In the presence of two sources of metabolizable nutrients, an organism usually utilizes the most readily available source to exhaustion and thereafter utilizes the second thereby resulting in a log phase following a death phase (Precott et al., 2008). This is in agreement with reports of previous studies (Dias et al., 2006).

The higher values observed for wines produced from 1:3 ratio of activated yeast: fruit extract indicate the ready availability of the required growth nutrients at this dilution. This conforms to reports of previous studies which support the determination of optimal conditions for microbial actions in food production processes (Anon, 2008a, b, c, d; Precott et al., 2008).

The observed R_f values indicate the presence of a malo-lactic fermentation. This reportedly imparts a

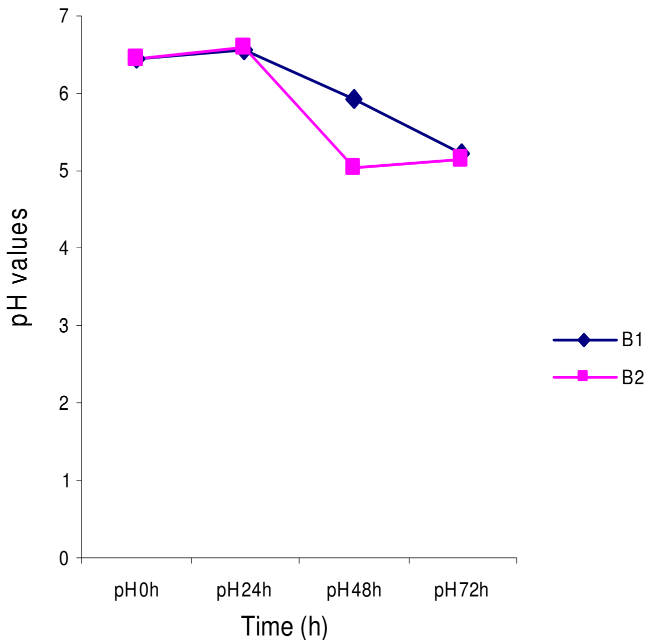

Figure 4b. Changes in pH with fermentation of 5% (w/v) sugar solutions, mixed with the juice at a ratio of 1:2 and 1:3 (B1 and B2, respectively).

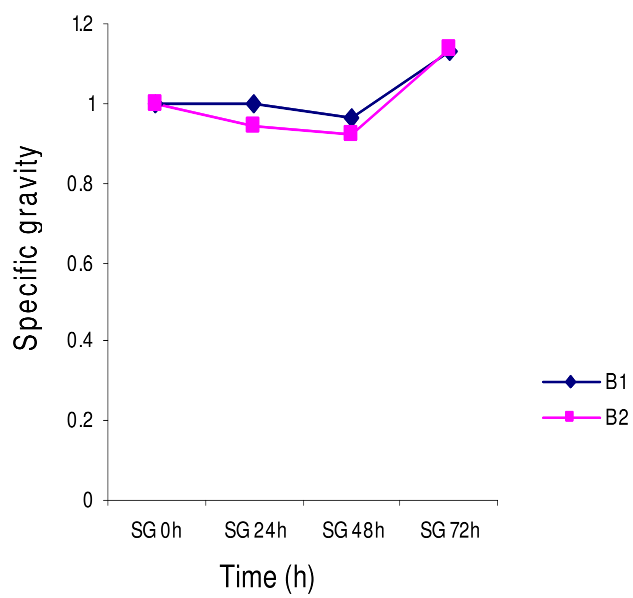

Figure 4c. Changes in specific gravity with fermentation of 5% (w/v) sugar solutions, mixed with the juice at a ratio of 1:2 and 1:3 (B1 and B2, respectively).

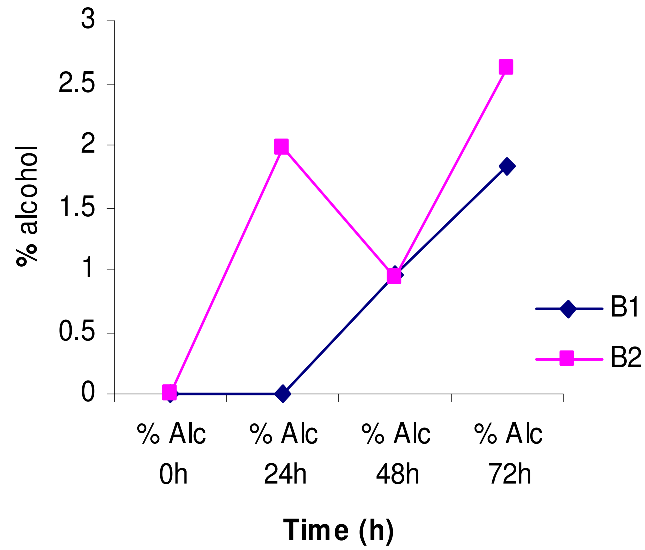

Figure 4d. Changes in % alcohol with fermentation of 5% (w/v) sugar solutions, mixed with the juice at a ratio of 1:2 and 1:3 (B1 and B2, respectively).

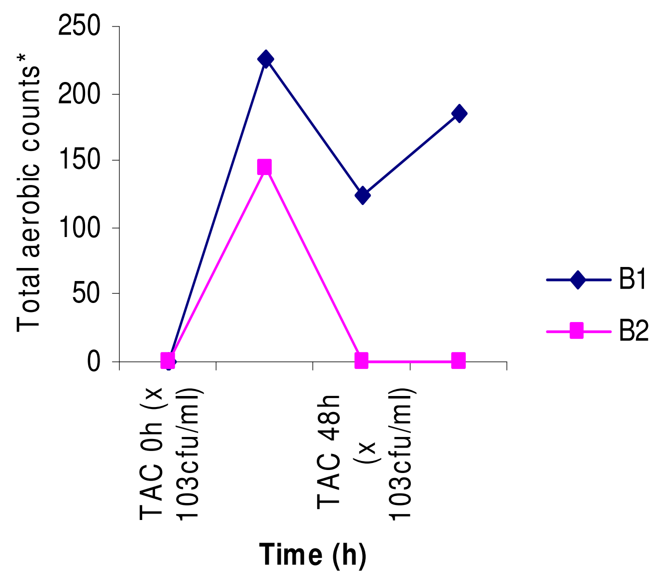

Figure 4e. Changes in total aerobic counts with fermentation of 5% (w/v) sugar solutions, mixed with the juice at a ratio of 1:2 and 1:3 (B1 and B2, respectively).

desirable flavor often 'buttery' to the wine during maturation. This is in agreement with reports of previous studies (Armstrong, 2004; Dias et al., 2006; Anon, 2008b; Prescott et al., 2008). The alcoholic fragrance was stronger in B2 than B1 presumably due to the higher alcoholic content. This is in agreement with the report of Anon (2008b).

In conclusion, a red, milky slightly alcoholic wine was produced from locally sourced berry (*Maesobotyra standii*) augmenting with Baker's yeast activated with various concentrations of granulated sugar. The baker's yeast activated with 5% (w/v) granulated sugar is most suitable for home or commercial berry wine production. A wine with lower alcohol-content (1.84%, v/v alcohol) could be made using 1:2 activated baker's yeast: fruit extract ratio while wine with slightly higher alcoholic

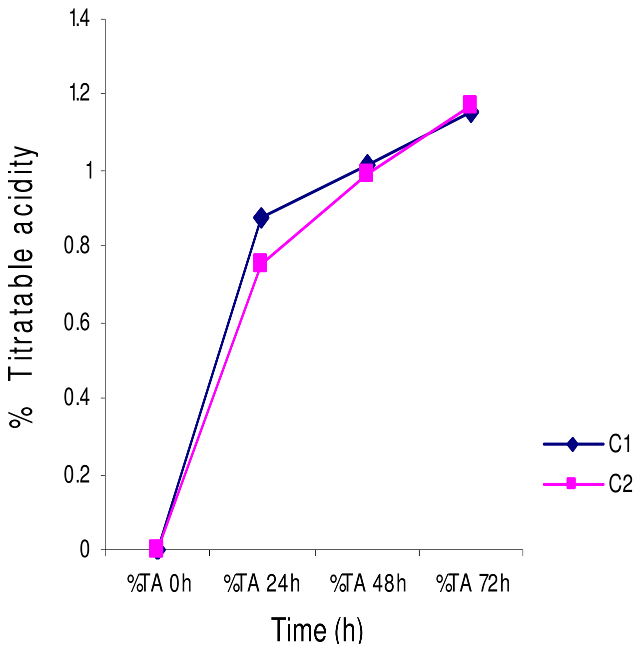

Figure 5a. Changes in % titratable acidity with fermentation of 10% (w/v) sugar solutions, mixed with the juice at a ratio of 1:2 and 1:3 (C1 and C2, respectively).

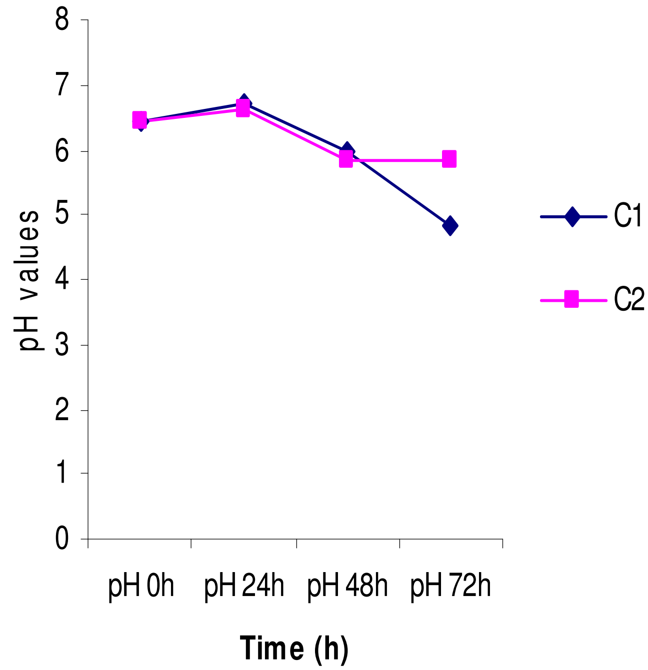

Figure 5b. Changes in pH with fermentation of 10% (w/v) sugar solutions, mixed with the juice at a ratio of 1:2 and 1:3 (C1 and C2, respectively).

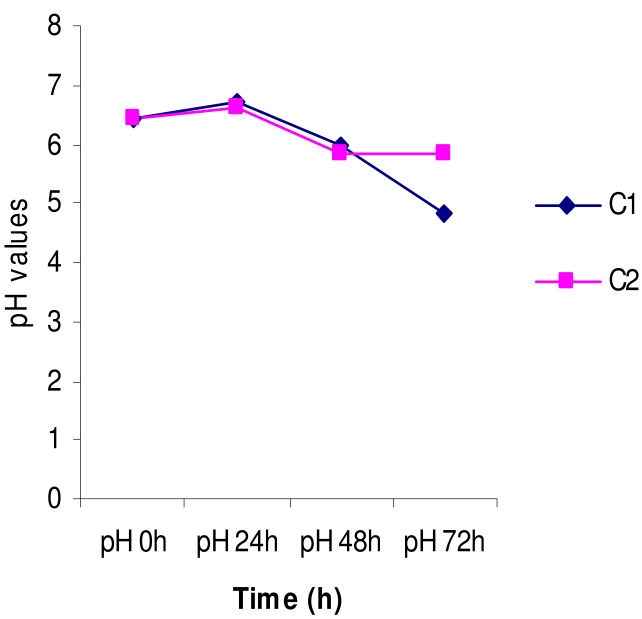

Figure 5b. Changes in pH with fermentation of 10% (w/v) sugar solutions, mixed with the juice at a ratio of 1:2 and 1:3 (C1 and C2, respectively).

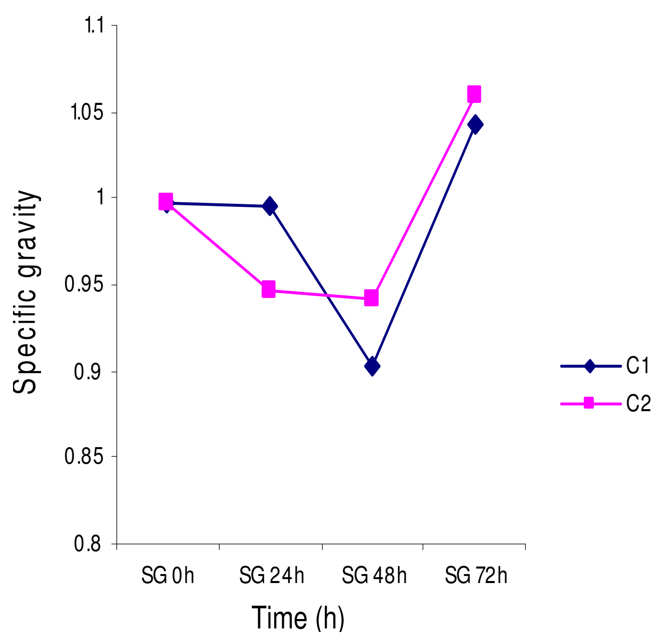

Figure 5c. Changes in specific gravity with fermentation of 10% (w/v) sugar solutions, mixed with the juice at a ratio of 1:2 and 1:3 (C1 and C2, respectively).

content (2.62% v/v alcohol) could be produced with 1:3 baker's yeast: fruit extract ratio. A diauxic growth was observed apparently due to presence of two growth nutrients. A malo-lactic fermentation was also observed which reportedly imparts a desirable 'buttery' flavor on the wine during maturation. Thus portable and/or commercial wine can be produced from berry (*M. standii*) with baker's yeast activated with 5% (w/v) granulated sugar.

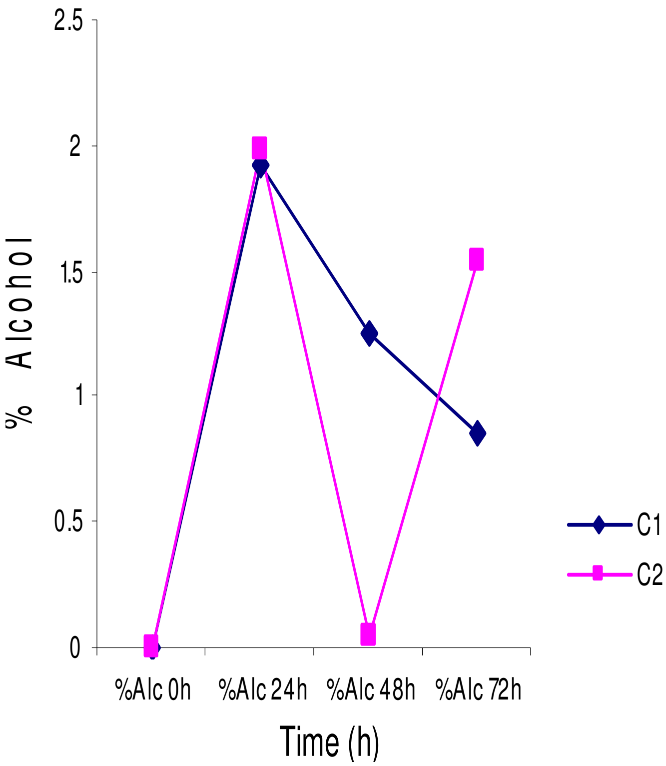

Figure 5d. Changes in % alcohol with fermentation of 10% (w/v) sugar solutions, mixed with the juice at a ratio of 1:2 and 1:3 (C1 and C2, respectively).

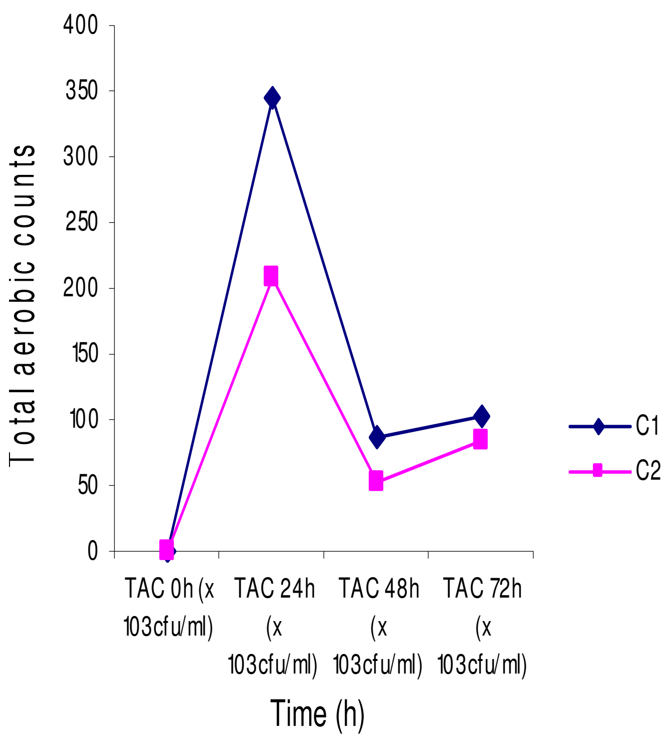

Figure 5e. Changes in % total aerobic counts with fermentation of 10% (w/v) sugar solutions, mixed with the juice at a ratio of 1:2 and 1:3 (C1 and C2, respectively).

Table 1. R_f values of wine at 48 h fermentation.

Wine	R_f value at 48 h
A1	0.51
B1	0.51
C1	0.52
A2	0.52
B2	0.51
C2	0.53

A1 = 2% (w/v) sugar activated yeast in a 1:2 yeast : fruit extract ratio; B1 = 5% (w/v) sugar activated yeast in a 1:2 yeast : fruit extract ratio; C1 = 10% (w/v) sugar activated yeast in a 1:2 yeast : fruit extract ratio; A2 = 2% (w/v) sugar activated yeast in a 1:3 yeast : fruit extract ratio; B2 = 5% (w/v) sugar activated yeast in a 1:3 yeast : fruit extract ratio; C2 = 10% (w/v) sugar activated yeast in a 1:2 yeast : fruit extract ratio.

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