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EVALUATION OF SOURSOP WINE PRODUCED WITH BAKER'S YEAST (*Saccharomyces Cerevisae*)

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ABSTRACT

Soursop pulp was fermented for wine production using baker's yeast (S. cerevisiae) and the wine produced was evaluated using some wine quality parameters (pH, Titrable acidity (TA), specific gravity (SG) and alcohol content (AC). Sensory evaluation (preference test) was also carried out to determine how 20 panelist scored the wine on 9-point Hedonic scale using store bought table wine as control. Soursop was cleaned, peeled, pulped and strained. The thick pulp obtained was diluted (6kg pulp/20 litres) with potable water. Sugar (5kg/2litres), citric acid, sodium metabisulfite and yeast nutrient (food grade urea) were added (0.3g/litre) to make up the brew must. After sterilization (boiling) and cooling the must was inoculated with reconstituted baker's yeast (5%, /litre brew volume) and primary fermentation lasted for 11 days at 24^{0}C. The wine produced had alcohol content of 13.95%, pH of 3.35, titrable acidity of 0.81g/100ml and specific gravity of 0.9826 after 12 months ageing. When presented to 20 panelists for sensory evaluation using Don Morris white wine as control, soursop wine compared well with no significant preference ($P<0.05$) in aroma, taste and acceptability. There was however preference in the colour of the control.

INTRODUCTION

Wine, a fermented acid beverage (pH 3.5 and below) is made by alcoholic fermentation of juice of ripe grapes (*Vitis species*) modified by cellar treatments (Alias and Linden, 1999; Frazier and Westhoff, 1995; Amerine *et al.*, 1980; Amerine, 1981; Vine, 1979). Large number of other fruits are fermented for wine but wine produced from these fruits are referred to as fruit wine or specifically designated with the fruit name, for instance, orange wine, peach, banana, cherry wines. All wines are made by the basic process of extracting the fruit juice (grape/fruit), fermenting it with Saccharomyces yeast, drawing off the clear liquor and allowing it to mature. The wine yeast *(Saccharomyces sp)* convert sugars in the fruit juice to ethanol, carbondioxide and flavouring components with release of energy (Alian and Musenge, 1976; Frazier, 1967; Amerine and Singleton, 1977). Variations in the basic process give the different kinds of wine such as dry, sweet and sparkling wines.

Large variety of fruits are grown in Nigeria and tropical Africa but production is seasonal thus putting limitation on their availability throughout the year in the face of lack of appropriate processing/preservation methods. Akinyele and Keshinro, (1980) recommended that these fruits be processed at home or factory to make them available all year round. This will eliminate post-harvest losses and offer other advantages including value addition and employment.

Soursop or Guanabana (Spanish) (*Anona murricata L*) is an oval green-skinned tropical fruit with spiny protuberances and succulent white flesh. The fruits are harvested close to complete maturity and ripen very fast hence highly perishable. It has delicious flavour of strawberries; cinnamon, mango and pineapple into one. The edible pulp is pureed and strained to make juice drinks, custard, ice cream and so on. Soursop is good source of niacin, riboflavin, vitamin C and contains approximately 12% sugar (Bueso, 1980; Chan and Lee, 1975; Steven and Philip, 1980).

Production of soursop wine and its evaluation is a research towards preservation/utilization of tropical/subtropical fruits; minimization of food wastage and value addition. Soursop wine will create variety and add to development of Nigerian wine industry.

MATERIAL AND METHODS

Rippened soursop fruits were obtained from a market in Owerri West. Sugar and baker's yeast were purchased from Owerri main market Imo State. Citric acid, sodium etablisulfite, yeast nutrient (food grade urea) and other chemicals used were of analytical grade. Fermenters and other equipment were obtained from Department of Food Science and Technology laboratory/other laboratories in Imo State University Owerri.

Optimally rippend/wholesome fruits were washed and sterilized with 2% sodium metabisulfie solution before use in preparation of innoculum and production must.
Yeast innoculum was prepared 12 hours ahead of production at the rate of 4% production volume or 2.6 litres yeast innoculum for 20 litres production volume using baker's yeast at 5% (g/litre). Soursop pulp (780g) was prepared and diluted to 2.6 litres with potable water. Sugar (650g), yeast nutrient and sodium metabisulfite (0.6g each) were added and pH adjusted to 4.25 using citric acid. The must boiled and cooled to 38^0C was pitched with rehydrated active bakers' yeast. Pitching yeast was rehydrated by suspending 1g dried bakers' yeast (*Saccharomyces cerevisiae*) in 50ml distilled water at 38^0C for 15 mins. The yeast suspension was transferred into 200ml of the prepared soursop must at 38^0C and when active growth became obvious, evidenced by frothing/foaming, the yeast was transferred into the 2.6 litres innoculum preparation must at 38^0C and aerated by thorough mixing. This was allowed to ferment for 12 hrs before it was used as yeast innoculum for production brew.

For the production must, sterilized fruits were peeled and strained to obtain the pulp which was diluted at the rate of 6kg pulp in 20 litres using potable water. Sugar (5kg/20 liters) was added; citric acid was added until pH was adjusted to 4.25; sodium metabisulfile and yeast nutrient (0.2g/litre) were added and the must boiled to sterilize and then cooled to 38^0C before the innoculum (earlier prepared) was added in open primary fermenter (production must inoculation) and mixed thoroughly. When fermentation became well established (12 hours after inoculation) the brew was transferred into anaerobic fermenter fitted with

fermentation lock. The fermenting must was thoroughly stirred first at 6 hourly intervals then 12 hourly and finally 24 hourly intervals. Fermentation was at room temperature (24^0C) kept by spraying fermenter with cold water at 6 – 12 hourly intervals from day 2. Vigorous fermentation lasted for 11 days and fermented must was allowed to settle for 7 days and the "green"/"young" wine racked from sedimented yeast/pulp by siphoning from top. The cloudy green wine was placed back in an anaerobic fermenter with lock and allowed to clarify at refrigeration temperature (5^0C) by natural sedimentation/subsequent racking, first 3 times at 4 weeks, then 3 times at 3 months intervals.

The clarified wine was finally racked, bottled and pasteurized at 65^0C for 10 mins after 12 months aging/maturation from end of primary fermentation. Specific gravity (S.G), of fresh must, fermenting must and wine were measured using the method described by Pearson, (1976). Specific gravity bottle was cleaned, dried and the weighed, first when empty and then when filled with water and later when filled with must/wine samples. Specific gravity was calculated as weight of sample over weight of water. Alcohol content (AC) was determined from table with corresponding specific gravity and temperature (Pearson, 1976). Standard pH-meter was used for pH determinations.

Titrable acidity (T.A) was determined by acid-base titration method. Sample (15ml) was titrated against 0.1N sodium hydroxide solution using 3 drops of 5% phenolphthalein indicator. Titration was carried on by 1ml at a time until colour change (white to pink) persisted. Each ml of 0.1N sodium hydroxide is equivalent to 0.1% acidity as tartaric (Amerine *et al,* 1980; Vine, 1979).

Sensory evaluation (preference test) on the wine sample was carried out using nine-point Hedonic scale using Don Morris white wine (store bought) as control. Sample and control were served 20 panelists who scored their like and dislike on 9-point Hedonic scale with 1= dislike extremely, 5 = neither like nor dislike and 9 = like extremely. The mean scores received by control and sample were compared using t-test.

RESULTS AND DISCUSSION

Primary fermentation was completed within 11 days after which the characteristic gas production and foaming stopped. Acidity of fermenting must increased from 0.40g/100ml in the first day to 0.82g/100ml in the 11^{th} day while pH decreased from 4.25 to 3.35 within the period. Acidity of fermenting must is inversely proportional to pH, even though no direct relationship has been established between pH and total titrable acidity because of its varying buffer capacity (Austin, 1968). While pH is a measure of strength of acidity, total acidity accounts for the amount of acidity and is an expression of tartness, which is important in wine taste. Increase in acidity during must fermentation is as a result of production of organic acids and, it is necessary for wine quality/preservation (Amerine and Singleton,

1977; Amerine *et al.,* 1980). The final pH (3.43) is within the range for table wine (pH = 3.5 and below) (Amerine and Josylyn, 1970).

The soursop wine pH (3.35) increased to 3.43 after 12 months aging under refrigeration temperature (5^0C). Increase in pH during wine aging has been associated with malolactic fermentation which may occur naturally in aging wine at pH 3.0 and above. Low temperatures and low levels of free sulfur dioxide also encourage malolactic fermentation. Other conditions that encourage malolactic fermentation are low alcohol concentration and presence of lees sediments while aeration is a deterrent even though the organisms may be aerobic or micro-aerophilic (Amerine *et al.,* 1980; Vine, 1979). Benefits of malolactic fermentation in wine aging include reduce total acidity/increase in pH and mellowing of tartness.

There was steady increase in alcohol content from 0.00% in day 1 to 12.99% in day 10 while specific gravity (SG) decreased steadily. Rate of alcohol production was maximum between day 2 and day 8 while maximum percentage alcohol content was at day 10 and 11 during primary fermentation (Fig 1.). Nutrient depletion, increased acidity/toxicity of products (ethanol) and by products are responsible for reduced rate of products formation during fermentation. Most yeasts cannot tolerate alcohol toxicity above 12 – 15% (Frazier, 1967; Amerine *et al.,* 1980). During aging, alcohol content further increased to 13.95% and specific gravity dropped to 0.9826 due to gradual conversion of complex sugars to fermentable sugar and alcohol (Amerine *et al.,* 1980). Alcohol content of the wine (13.95%) was within the range of 10%-14% reported for table wines (Amerine and Josylyn, 1970: Amerine *et al.,* 1980).

Panelists' mean scores on colour were 8.2 for control and 6.0 for soursop wine sample. The colour of control was preferred by panelists and the mean score values showed significant difference at 95% confidence level (or $P < 0.05$). Wine colour is derived from fruit/juice composition and preserved from oxidation by antioxidants such as ascorbic acid and sulfur dioxide; and wine clarity is enhanced during aging by storage temperature, presence of protease enzymes and tannin. During aging peptides and polypeptides responsible for wine cloudiness form protein-tannin complex which settle out when wine stand for some time thereby making the wine clear, enhancing colour/appearance. Use of finning agents such as Isinglass, bentonite and others also enhance clarity. Panelists' mean scores on aroma were 6.1 and 7.6 for soursop wine and control. There was no significant ($P<0.05$) preference in aroma between soursop wine and control. Statiscal analysis also showed no significant ($P<0.05$) preference in taste and acceptability (Table 1).

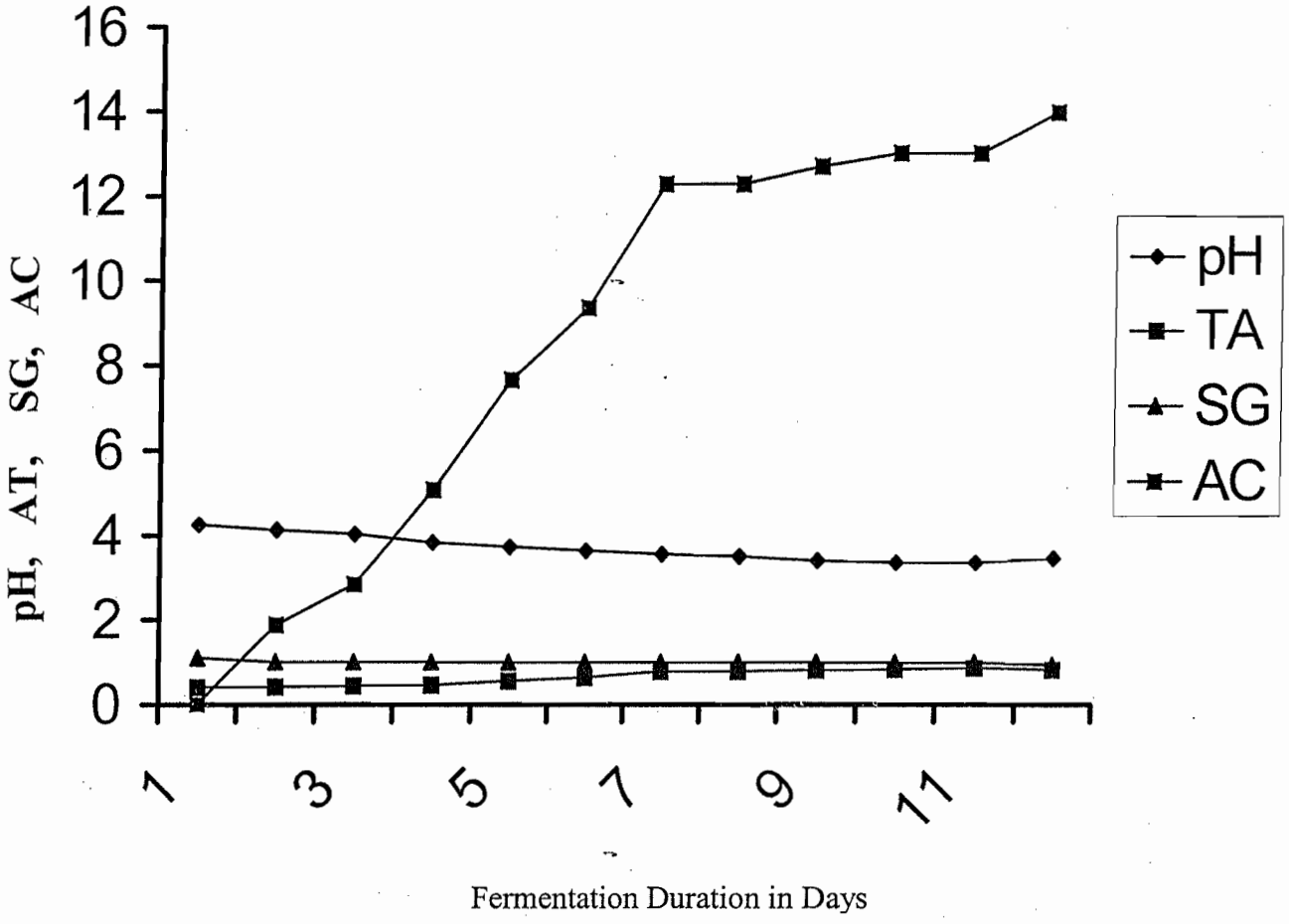

Fig. 1: pH, Specific gravity, (SG) Alcohol content, (AC) and Titrable acidity, (TA) of Fermenting Soursop Wine

Factors that influence wine quality and acceptability include composition of the fruit, yeast type, nature and quantity; cellar treatments including fermentation/storage temperatures during aging and so on (Vine, 1979; Amerine *et al.*, 1980). The fruit supplies yeast with substrates (sugars) and nutrients required for successful fermentation necessary for alcohol production/subsequent development of metabolites which contribute to wine quality. Sugars present in fruit must are glucose, fructose and sucrose. These are normal substrates for yeast fermentation. Deficiency in sugar requires sugar addition, a process known as amelioration (Amerine *et al.,* 1980). Most tropical fruits are deficient in sugar and require amelioration for good quality wine production (Amerine and Josylyn, 1970; Maldonado *et al.,* 1975; Steven and Philip, 1980; Bueso, 1980). Must sugar content is particularly important for alcohol content and wine taste. Fruit/must pH is also very important. Yeasts have optimum pH outside which they do not function well (Frazier, 1967). Organic acids such as citric acid

and tartaric acid; water/sugar syrup are used during amelioration to adjust must pH (Maldonado *et al.,* 1975; Amerine *et al.,* 1980; Alian and Musenge, 1977). Nitrogen, vitamins and mineral contents of fruits also influence wine quality directly, and through their influence on yeast performance. Yeast requires nitrogen source for growth and multiplication as well as micronutrient as yeast food (Austin, 1968). Polyphenols, tannins, colour pigments form skins/seeds also influence wine, colour, clarity, taste and acceptability.

Apart from conversion of sugars to alcohol, yeast growth influence formation of volatiles/aromatic molecules responsible for good wine bouquet. Yeast type and pitching rate affect fermentation and wine quality. Pure culture of strains of *Saccharomyces cereviiae var ellipsoideus* is used at the rate of 4% brew volume, (Frazier, 1967; Amerine, *et al.,* 1980; Vine, 1979). Reconstituted bakers yeast, *S. cerevisiae*, is also used. Inoculum of the starter culture is usually prepared to put the cells in very active growth phase prior to inoculation of production brew. Degree of aeration and temperature are other critical factors for good yeast performance and wine quality. Yeast fermentation is anaerobic but yeasts require dissolved oxygen for respiration. However, in the presence of excess oxygen, yeast cells, multiply at the expense of alcohol production. It is good practice to start fermentation with sufficient oxygen through aeration process, this ensures good yeast population/adequate pitching rate, and limit contact with oxygen afterwards. In the presence of oxygen, oxidation of colour pigments; ethanol and flavour constituents/aromatic metabolites occur as well as conversion of ethanol to acetic acid or wine to vinegar solution in the presence of acetobacter bacteria (Maldonado *et al.,* 1975). At lower temperatures, yeast cells tolerate higher alcohol levels and more odourous metabolites are produced. At higher temperatures evaporation/loss of volatiles and aromatics occurred and wine produced has better taste (Amerine *et al.,* 1980; Vine, 1979). Duration and temperature of aging greatly affects wine quality/characteristics (Amerine *et al.,* 1980). The young/green wine obtained at the end of primary fermentation was cloudy, harsh, rough tasting and fruity/yeasty smelling without pleasant wine bouquet. During aging/maturation yeast cells/suspended particles settled out and wine became clear. Chemical reactions such as malolactic fermentation. Slowly proceeded and resulted in disappearance of harshness, mellowing and development of wine bouquet (Amerine *et al,* 1980: Austin, 1968). Oxidation and formation of esters occur during aging. Duration is usually 12 months but can range from 90 days to as high as 25 years depending on type of wine. Aging dry white wine is usually 12 – 18 months in barrel (Vine, 1979). Wine blending is a cellar treatment aimed at improving wine(s). Blending improves wine colour, taste and aroma/bouquet. It can be done before or after wine polishing/fining or at the start of brew by mixing juice or must of various fruits(s).

Table 1: Panelists' mean scores for soursop wine and control

	Colour	Aroma	Taste	Acceptability
Soursop wine	6.0^a	6.1^a	6.1^a	6.2^a
Control	8.2^b	7.6^a	7.6^a	6.5^a

a, b, Any sample mean not followed by the same superscript is significantly different ($P<0.05$).

CONCLUSION

Soursop pulp diluted with potable water and ameliorated with sugar, citric acid and yeast nutrient, and fermented with reconstituted baker's yeast produced white table wine of alcoholic content 13.95%, pH = 3.35 and titratable acidity 0.82g/100ml. The aroma, taste and acceptability compared well with those of store bought white table wine while the colour, though less preferred to that of the store bought control, was scored 6.0 which corresponds to 'like' on a 9-point hedonic scale.

Soursop (*Anona muricata L*) used singly or in combination with other fruits can therefore be used in the production of wine of acceptable quality.

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