Science Park Journals

Vol. 3(3), pp. 076-095, June 2019
ISSN ISSN 2315-6279
DOI: 10.14412/JARNR2019.095

Available online at http://www.scienceparkjournals.org/jarnr

Journal of Agricultural Research and Natural Resources

Full Length Research Paper

Physicochemical properties and acceptability of wine from fruit pulp of African Locust bean (*Parkia biglobosa)*

Beatrice O. Ifesan[*1],Bukola S. Owoeye[1], Olugbenga O. Awolu[1], Jumoke B. Olatujoye[1]

[1]Department of Food Science and Technology, Federal University of Technology Akure, Nigeria

Abstract: The fruit pulp of *Parkia biglobosa* is sweet to taste, indicating the presence of natural sugars and thus a potential energy source. However, the yellow dry powdery pulp of African locust bean seed is regarded as waste and can cause environmental pollution after the seeds are removed for production of condiment. This study sought to develop starter culture for wine from *Parkia biglobosa* (African locust bean) fruit pulp, evaluate the physicochemical properties of the wine during aerobic and anaerobic fermentation and consumer acceptability of the wine. The fruit pulp was sun dried for 5 days, separated from the seed and milled into flour. This was subjected to spontaneous fermentation and was found to contain yeast count (2.80×10^9 cfu/ml-3.90×10^9 cfu/ml, pH (7.58-4.36) and total soluble solid (TTA) (0.34-1.48) between 48 h-96 h. Yeasts isolated from the spontaneous fermentation, *Saccharomyces cerevisiae* and *Saccharomycodes ludwigii* were used as either single or multi-cultures to produce wine. This include; *Saccharomycodes ludwigii* (PWA), *Saccharomyces cerevisiae* (PWB), *Saccharomyces cerevisiae*+ *Saccharomycodes ludwigii* (PWC) and the control was the commercial *Saccharomyces cerevisiae.* The result of the physicochemical properties of the wine during aerobic fermentation revealed that the must had total soluble solids of 15.5 °Brix-16.0 °Brix, pH (3.58-3.98), TTA (0.44 g/100ml-0.64 g/100ml), specific gravity (1.020-1.058), alcohol content (5.8%-9.6%), reducing sugar (9.09 g/l-66.66 g/l, ash (4.70%-5.62%) and Vit C (4.05 mg/100g-6.96 mg/100g). After 2 weeks of anaerobic fermentation, it was observed that the control wine sample made from commercial yeast recorded values that were significantly higher than those wines made from yeast isolates in TSS, % ash and specific gravity, PWA had highest value for vitamin C, PWB was higher in reducing sugar while PWC possessed highest values in pH, TTA and alcohol. Considering the consumer acceptability, wine produced from PWA and PWB were found to

compete well with the control. This study is an indication that wine can be produced from *P*. *biglobosa* fruit pulp that is available locally and regarded as waste**.**

Keywords: African locust bean fruit pulp; *Saccharomyces* spp.; physicochemical properties

Introduction

The nature has supplies of different types of trees that produce fruits which are available seasonally and are wasted because they are produced in quantities that are in excess of consumption, storage facilities are poor or not available. African locust bean tree (*Parkia biglobosa*) grows over a wide range of agro-ecosystem and the roots, barks, leaves, stems, flowers, fruits, seeds have been found useful for medicinal purposes (Sacande & Clethero, 2007). The seeds of *P. biglobosa* are usually fermented to produce local condiment called 'iru or dawadawa' which are employed in cooking stew and soup. The fruit pods are used to produce an insecticide powder for treating crops. The fruit pulp of African locust bean tree is sweet to taste due to the presence of natural sugars (Akoma *et al*., 2001).The sweet yellow pulp contains a moisture content of 8.41%, protein 6.56%, fat 1.80%, crude fibre 11.75%, ash 4.18% and 67.30% carbohydrate. The sugar content was found to be 9.00 °Brix; total caroteniods, 49.17ug/ 100g and ascorbic acid of 191.20 mg/100g (Sacande & Clethero, 2007). Wine is the product of alcoholic fermentation of fruit juice from ripe grapes (*Vitis vinifera*) (Okafor, 1978). *Saccharomyces* spp. are usually employed in the production of wine where sugars in the fruit juice are converted into alcohol, organic acid, aldehydes, esters and other chemical components (Watanabe & Shimazu, 1980). It has been established that wines are beverages that are used as a natural remedy for treating illness, exhibited haematopoetic effect, served as immune booster and help to aid recovery during convalescent period (Okafor, 2007; Ajani *et al*., 2012). Health benefits of wines have been attributed to those of fruits from which they are derived (Jacob, 2001). Apart from water and milk, no other drinks have earned universal acceptance as wine (Shrikant *et al*., 2014). Various studies have explored different types of fruits for wine production which

include; plums wine (Kang *et al.*, 2008), banana wine (Obaedo & Ikenebomeh, 2009), cashew wine (Awe *et al*., 2013), watermelon-pawpaw wine (Adedeji & Oluwalana, 2013), raspberries (Cho *et al*., 2013) and pineapple-orange wine (Archibong *et al*., 2015). Over the centuries African locust bean seed is more utilized than the fruit pulp, despite its medicinal and nutrition values. The yellow dry powdery pulp is mostly wasted after the seeds are extracted for fermentation of "dawadawa" thereby leaving the pulp scattered which results into environmental pollution. However little or no information is available concerning the use of *P. biglobosa* fruit pulp as a substrate for wine production. This study sought to use yeasts isolated from spontaneous fermentation of African locust bean fruit pulp as starter culture to produce wine, investigate the physicochemical parameters of the wine during the aerobic and anaerobic fermentation and the sensory properties.

Materials and methods

Materials

Matured African locust bean (*Parkia biglobosa*) fruit pods were sourced locally from a farm in Okenne, Kogi State, North Central, Nigeria. Industrial dried yeast (*Saccharomyces cerevisiae*) was purchased from Pascal Scientific Laboratory, Akure, Ondo State, Nigeria. All chemicals used were of analytical grade.

Sample Preparation

Parkia biglobosa fruit pods were sorted to remove soil, dirt and foreign materials, sun-dried to a constant weight using a flat tray for 5 days and the fruit pulps were separated from the pods and seeds. The fruit pulp was milled into fine flour using a laboratory blender and the flour was kept in air-tight container at room temperature until use.

Spontaneous fermentation of African locust bean fruit pulp and isolation of yeast

About 50 g of the milled pulp was thoroughly mixed with 200 ml of potable water in a clean plastic container and covered for spontaneous fermentation between 28 ^{0}C -30 ^{0}C for 96 h in an incubator. Isolation and identification of yeast was done according to

the method of Mpofu *et al.* (2008). The yeasts selected based on dominance, morphological and biochemical characteristics (urease utilization, sugar fermentation, growth at different temperatures, assimilation of nitrogen compounds, growth on high concentration of glucose, acid formation and resistance to cycloheximide) were activated overnight in potato dextrose broth and harvested as described by Cardinal *et al.* (1997) in graduated sterilized eppendorf tubes of 5 ml using micro centrifuge (Sturat microfuge SRFCI 10000 x g) at 4000 x g for 1 min. After centrifugation the supernatant was decanted, washed with distilled water three times, sterile water was added and contents was kept in the refrigerator for use.

Activation of commercial yeast

The commercial *Saccharomyces cerevisiae* was activated by rehydration. About 5 g of yeast was dissolved in 35 ml of water inside a round bottom conical flask, placed in the water bath and allowed to stay for 15 min before inoculation (Ocbo & Ayernor, 2010).

Preparation of African locust bean fruit pulp syrup for controlled fermentation

Four separate 2 litre plastic jars used for fermentation were washed with 10% alcohol, rinsed thoroughly with distilled water and dried. About 50 g of the pulp was taken into each and 500 ml of distilled water was added respectively. The pulp and water were mixed vigorously while 75 g of sucrose was added to adjust total soluble solids (TSS) to 24 ^{0}Brix, pH was adjusted to 4.5 using citric acid and 0.2 g of sodium metabisulphite was added to inhibit the growth of unwanted microorganisms. This was pasteurized at 85 ^{0}C - 90 ^{0}C for 10 min inside water bath and allowed to cool at room temperature (Maragathan & Pannerselvam, 2011).

Aerobic and anaerobic fermentation of must from African locust bean fruit pulp

The must in each of the four plastic jars were seeded with 1 ml of the starter culture (10^{6} cfu/ml) isolated from spontaneous fermentation and labeled as PWA (fruit pulp + *Saccharomycodes ludwigii*), PWB (fruit pulp + *Saccharomyces cerevisiae),* PWC (fruit pulp + *Saccharomycodes ludwigii* +*Saccharomyces cerevisiae)* and the Control (fruit pulp + Commercial yeast*, S.erevisiae)*. All the

samples were subjected to aerobic fermentation at 28 ^{0}C±2 ^{0}C. While it was in progress the fermenting vessel were stirred intermittently for supply of oxygen (Maragathan & Pannerselvam, 2011). During the fermentation the fermenting must was drawn out for routine analysis, fermentation was terminated after 8 days and the must was sieved with sterile muslin cloth to remove the shaft and debris. After 8 days all the products of aerobic fermentation were subjected to secondary fermentation using an airlocked sterile plastic jars to prevent the entry of external oxygen into them and for the release of carbon dioxide developed during the fermentation. The total soluble solids of the fermenting must was adjusted to 24 ^{0}brix to provide additional fermentable substrate for the fermenting organisms (Omojasola & Ademuyiwa, 2003) and fermentation was allowed to continue for 14 days at (28 ^{o}C±2 ^{0}C) (Maragathan & Pannerselvam, 2011). The resulting wine was centrifuged, decanted into sterile bottles and pasteurized at 50 ^{0}C for 15 min. Wine samples were subjected to physicochemical tests after spontaneous and controlled aerobic and anaerobic fermentation.

Physicochemical analyses of *Parkia biglobosa* fruit pulp wine

Determination of specific gravity of *Parkia* fruit pulp wine

The specific gravity of the sample was determined using the pycnometer. The bottle was rinsed with sterile water and dried. The empty bottle was weighed and the mass was recorded as M_1. The bottle was emptied, rinsed, and filled with distilled water up to mark and weighed, with the mass recorded as M_2. The bottle was emptied and filled with each of the four samples respectively and weighed, with the mass recorded as M_3. The specific gravity was calculated (AOAC, 2005).

Table 1. pH, TTA and yeast count during spontaneous fermentation of *P. biglobosa* fruit pulp

Time of fermentation (h)	pH	TTA	Yeast count (cfu/ml)
0	ND	ND	ND
24	ND	ND	ND
48	7.58	0.34	2.8×10^9
72	6.40	1.48	3.5×10^9
96	4.36	1.35	3.9×10^9

Determination of total titratable acidity of fruit pulp wine

Five millilitre aliquot of the sample solution was taken and titrated against 0.1 N NaOH using phenolphthalein solutions as indicator. Titratable acidity was calculated as percent tartaric acid (AOAC, 2005).

Determination of pH of fruit pulp wine

The pH of the wine was determined using pH meter (ECO Testr PH 1). The glass electrode of the pH metre was dipped into 20 ml of the wine sample and allowed to stabilize for 3 min after which the reading was taken.

Determination of total soluble solids of fruit pulp wine

Total soluble solid (^{0}Brix) was measured with handheld Bellingham and Stanley refractometer at 20 ^{0}C. Two drops of sample were placed on the prism of the refractometer and the TSS reading was read directly and expressed as ^{0}Brix (AOAC, 2005).

Determination of alcohol content of fruit pulp wine

The alcohol by volume of the fermenting must and wine were determined by specific gravity method.

$$\% \text{ Alcohol} = \frac{\text{Original SG} - \text{Final SG}}{7.36} \times 1000 \quad \text{.....eqn.1}$$

Where SG is Specific gravity, 7.36 is a constant.

Determination of Vitamin C, reducing sugar and ash content of wine

Vitamin C content of the aqueous extract was determined using the method of Kirk & Sawyer (1991). About, 75 µl of DNPH (2 g dinitrophenyl hydrazine, 230 mg thiourea and 270 mg $CuSO_4.5H_2O$ in 100 ml of 5 M H_2SO_4) was added to 500 µl reaction mixture (300 µl of appropriate dilution of the wine with 100 µl of 13.3% trichloroacetic acid (TCA) and 100 µl water). The reaction mixture was subsequently incubated for 3 h at 37 °C, then 0.5 ml of 65% H_2SO_4 (v/v) was added to the medium and the absorbance was measured at 520 nm in the JENWAY UV–visible spectrophotometer. The vitamin C content of the wine was subsequently calculated using ascorbic acid as standard.

The reducing sugar of the fermented must and wines was estimated by Dinitrosalicyclic (DNS) method. About 0.1 ml of the sample was pipetted into test tube and made up to 3 ml with distilled water. About 3 ml of the DNS reagent was added and the contents was heated in a boiling water bath for 5 min while 1ml of 40% Rochelle salt solution was added after removing it from the water bath. The content was allowed to cool, and the absorbance was measure at 510 nm in the spectrophotometer. The ash content of wine was determined following AOAC (2005).

Sensory evaluation of fruit pulp wine

The sensory analysis was carried out on the produced *parkia* wine after 30 days of aging. The evaluation was done using a nine point hedonic scale ranging from like extremely (9) to dislike extremely (1) for taste, color aroma, clarity and overall acceptability (Solomakos *et al*., 2001).

Results and Discussion

Spontaneous fermentation of *Parkia biglobosa* fruit pulp

Gas bubbling and frothing was observed after 24 h of spontaneous fermentation of *Parkia biglobosa* fruit pulp until day four when the bubbling reduced and fermentation was terminated. Production of pleasant yeasty wine-like flavor was also observed during the fermentation period. The bubbling of gas was an indication that CO_2 was produced and can be attributed to the action of various natural microflora present on the fruit surfaces and the utensils used during fermentation (Vogel *et al*., 2002; Saeed *et al*., 2009). Several wild fruits have been fermented naturally; mapfura (*Sclerocarya birrea s*ubspecies *caffra*), hacha (*Parinari curatellifolia*) and mazhanje (*Uapaca kirkiana*) where similar trends were reported (Gadaga *et al.*, 1999). Table 1 shows the pH, total titratable acidity (TTA) and yeast counts of the spontaneously fermented fruit pulp. There was a reduction in pH values as the days of fermentation increased with values of 7.58 at 48 h to 4.36 at 96 h of fermentation. The pH value of this study is within the range obtained during

spontaneous fermentation of cocoa juice (Anvoh *et al*., 2010). The mean titratable acidity (TTA) ranged from 0.34 at 48 h to 1.35 at 96 h of fermentation, indicating an increase in the acidity of the must as fermentation progressed. Result revealed that there was no difference between the yeast counts (2.8×10^9 cfu/ml-3.9×10^9 cfu/ml) of the spontaneously fermented fruit pulp from 48 h to 96 h. Similar results were observed during spontaneous fermentation of Palmyra palm fruit pulp (Artnarong *et al*., 2014).

Biochemical characteristics of yeast isolates from spontaneous fermentation of *P. biglobosa* fruit pulp

Table 2. Biochemical characteristics of yeasts isolates from spontaneous fermentation of *P. biglobosa* fruit pulp

Isolate	Urease	Growth @ (° C) 25	30	35	37	42	Cycloheximide resistance	Ascospores development	Growth on 50% glucose	Ammonium sulphate	Acid production	Probable organisms
A	-	+	+	+	+	-	-	+	-	+	-	*Saccharomycodes ludwigii*
B	-	+	+	+	+	+	-	+	-	+	-	*Saccharomyces cerevisiae*
C	-	+	+	+	+	+	-	+	-	+	-	*Saccharomyces cerevisiae*
D	-	+	+	+	+	+	-	+	-	+	-	*Saccharomyces cerevisiae*
E	-	+	+	+	+	+	-	+	-	+	-	*Saccharomycodes ludwigii*
F	-	+	+	+	+	-	-	+	-	+	-	*Saccharomyces cerevisiae*

Table 2 shows that all the yeast isolates were not able to hydrolyze urea, did not grow in the presence of 0.1% cycloheximide and 50% glucose concentration, but assimilated ammonium sulphate and grew at different temperatures (25 ^{o}C, 30 ^{o}C, 37 ^{o}C and 42 ^{o}C). This is in agreement to previous findings by several authors who worked on isolation of yeasts from fermented local beverages (Demuyakor & Ohta, 1991; Abdel *et al*., 2015). Yeast isolated from spontaneous fermentation of *Parkia biglobosa* fruit pulp were identified by comparing with those of known taxa (Onions, Allsopp & Eggins, 2002), Bergeys manual of systematic bacteriology (Wood & Holzapfel, 1995) and comparing with the standard keys of yeasts (Barnett *et al*., 2002; Kurtzman & Fell, 2006). Isolates A and E were identified as *Saccharomycodes ludwigii*, while B, C and D were *Saccharomyces cerevisiae. Saccharomycodes ludwigii* have been isolated from spontaneous fermentation of pineapple juice and used as starter culture for the production pineapple wine (Chanprasartsuk *et al*., 2012). During the fermentation of Kombucha, a fermented tea in China, *Saccharomyces cerevisiae, Saccharomyces inconspius, Saccharomycodes ludwigii, Schizosaccharomyces pombe, Candida tropicalis, Candida krusei, Debaryomyces hansenii, Brettanomyces, Kloeckera* and *Zygosaccharomyces bailii* were isolated as the indigenous yeasts (Jayabalan *et al*., 2014).

Physicochemical properties of African locust bean fruit pulp during controlled aerobic fermentation

Table 3. Physicochemical properties of *Parkia* fruit wine pulp after aerobic fermentation

Parameters	PWA	PWB	PWC	CONTROL
pH	3.98±0.02[a]	3.82±0.01[a]	3.70± 0.02[b]	3.58±0.03[c]
TTA (g/100ml)	0.48±0.01[c]	0.64±0.02[a]	0.51±0.01[b]	0.44±0.01[d]
TSS (°Brix)	16.0±0.05[a]	16.0±0.03[a]	16.0±0.04[a]	15.5± 0.05[b]
% Ash	5.62±0.01[a]	4.82±0.00[b]	4.70±0.03[c]	5.60±0.02[a]
Reducing sugar (g/l)	26.38±0.02[b]	14.71±0.01[c]	9.09±0.01[d]	66.66±0.05[a]
Specific gravity	1.052±0.01[a]	1.058±0.00[a]	1.040±0.01[b]	1.020±0.01[c]
%Alcohol	6.02±0.01[c]	5.80±0.01[d]	7.02 ±0.01[b]	9.60±0.02[a]
Vit C (mg/100g)	6.87±0.07[b]	5.26±0.09[c]	6.96±0.08[a]	4.05±0.04[d]

Sample means with the same superscript along the column are not significantly different at P<0.05. **PWA** (Fruit pulp + *Saccharomycodes ludwigii*), **PWB** (Fruit pulp + *Saccharomyces cerevisiae*), **PWC** (Fruit pulp + *S.cerevisiae* + *S.ludwigii*), **CONTROL** (Fruit pulp + commercial (*Saccharomyces cerevisiae*)

Table 3 shows the physicochemical parameters measured at the 8th day of aerobic fermentation of the fruit pulp. After the 8 days of aerobic fermentation, it was observed that the total soluble solids of wine samples reduced from 24.0 ^{o}brix to 15.5 ^{o}brix in the control sample (fruit pulp + commercial yeast *S. cerevisiae*) which had the lowest value while PWA (fruit pulp + *Saccharomycodes ludwigii*); PWB (fruit pulp + *Saccharomyces cerevisiae*) and PWC (fruit pulp +*S*. *cerevisiae* +*S*. *ludwigii*) have the same value (16 ^{o}brix). The sugar consumption pattern of the commercial yeast was higher than those of indigenous yeasts isolated from the fruit pulp. Ezeronye (2004) reported the reduction of TSS in cashew apple juice from 24.0 ^{o}brix to 6.0 ^{o}brix after 14 days fermentation during cashew apple wine fermentation. The pH values of samples reduced from 4.5 at day 0 to 3.58 after 8 days of aerobic fermentation in the control sample and 3.70-3.98 in PWA, PWB and PWC. The decrease in the pH during fermentation may be explained by the production of organic acids from the utilization of sugars by the yeast for its growth. The trends of the pH value in this study is similar to that obtained by Chanprasartsuk *et al*. (2012) during pineapple wine fermentation using *Saccharomycodes ludwigii, Hanseniaspora* and commercial *Saccharomyces cerevisiae* as single and mixed starter cultures. The total titratable acidity (TTA) values were within 0.44 g/100 ml-0.60 g/100 ml compared to 0.35 g/100 ml at day 0. The increase in TTA during aerobic fermentation might be due to the production of acids by the microorganisms. Titratable acidity of wine is an important parameter which depends on the biochemical composition of fruit juice used and processing conditions (Singh *et al*., 2013). Citric, malic and tartaric acids are important acids present in wine that made up the total titrable acidity of wine sample. Previous researches reported both increase (0.51-3.30%) Chowdhery & Ray (2007) and decrease (1.07-0.52%) Vaidya *et al*. (2009) in TTA during production of wine from Jamun and kiwi fruit, respectively. Specific gravity of samples ranged from 1.020-1.052 at the 8th day of the aerobic fermentation. The pattern of the specific gravity values corresponds with the one obtained by Mbajiuka *et al.* (2015) during fermentations of pods of cocoa using palm wine yeast. This may explain the metabolic activities of the yeast during fermentation and production of alcohol, since alcohol is denser than water (Omojasola & Ademuyiwa, 2003). Results further showed that the control had the highest value of alcohol (9.6%), followed by PWC (7.02%), PWA (6.3%) and the lowest PWB (5.8%). The production and

variations in the alcohol contents may be attributed to the ability of each yeast strains to utilize sugars even in the presence of oxygen. The result of the study is in line with Alvarenga *et al.* (2011) where different yeast strains were used for fermentation of banana pulp to produce ethanol concentrations of 5.34% to 7.84% and that of Awe & Nnadoze (2015) where 5.5% alcohol was obtained from date palm fruit after 6 days of aerobic fermentation. The mean value of the reducing sugar include 26.38 g/l for PWA, PWB (14.71 g/l), PWC (9.09 g/l) and control 66.66 g/l. Reducing sugar is easily metabolized by yeast during fermentation and it decreases as fermentation progresses (Singh *et al*., 2013). Vitamin C content of the aerobically fermented fruit pulp was from 4.05 mg/100g-6.96 mg/100g.

Table 4. Physicochemical properties of anaerobically fermented *Parkia* wine

Parameters	PWA	PWB	PWC	CONTROL
pH	3.47±0.01^{c}	3.48±0.01^{c}	3.56± 0.01^{a}	3.50±0.01^{b}
TTA (g/100ml)	0.45±0.00^{c}	0.60±0.00^{b}	0.75±0.01^{a}	0.40±0.00^{d}
TSS (°brix)	19.5±0.01^{b}	18.0±0.23^{c}	13.7±0.65^{d}	21.0± 0.12^{a}
% Ash	8.69±0.00^{b}	1.04±0.00^{c}	0.03±0.05^{d}	10.24±0.00^{a}
Reducing Sugar (g/l)	29.04±0.01^{c}	36.01±0.01^{a}	31.60±0.01^{b}	23.75±0.01^{d}
Specific gravity	1.070±0.01^{a}	1.06±0.00^{b}	1.02±0.00^{c}	1.07±0.00^{a}
%Alcohol	3.07±0.01^{c}	4.36±0.01^{b}	8.57 ±0.01^{a}	3.00±0.01^{d}
Vit C (mg/100g)	5.89±1.00^{a}	4.62±0.9^{c}	5.24±1.8^{b}	4.32±0.4^{c}

Sample means with the same superscript along the column are not significantly different at P<0.05. **PWA** (Fruit pulp + *Saccharomycodes ludwigii*); **PWB** (Fruit pulp + *Saccharomyces cerevisiae*), **PWC** (Fruit pulp + *S.cerevisiae* + *S.ludwigii*); **CONTROL** (Fruit pulp + commercial (*Saccharomyces cerevisiae*)

Table 5. Sensory evaluation of wines from Parkia fruit pulp

Sample	Colour	Aroma	Taste	Clarity	Overall Acceptability
PWA	6.29±1.8[b]	6.86±1.7[a]	7.43±0.8[a]	7.43±1.3[b]	7.14±1.6[b]
PWB	8.43±0.5[a]	6.86±1.9[a]	7.29±1.3[a]	8.57±0.8[a]	8.57±0.5[a]
PWC	5.43±1.9[c]	5.14±2.3[b]	2.14±1.8[c]	5.71±2.9[c]	5.43±3.2[c]
Control	6.71±0.9[b]	5.29±2.4[b]	6.00±1.4[b]	7.00±1.6[b]	7.00±0.8[b]

Sample means with the same superscript along the column are not significantly different at P<0.05.

PWA (*parkia* wine + *Saccharomycodes ludwigii*), **PWB** (*parkia* wine + *Saccharomyces cerevisiae),* **PWC** (*parkia* wine + *S.cerevisiae* + *S.ludwigii*), **CONTROL** (*parkia* wine + commercial (*Saccharomyces cerevisiae*)

Physicochemical properties of *Parkia* pulp wine during anaerobic fermentation

After 2 weeks anaerobic fermentation, the fruit pulp wines were found to have reductions in pH (3.56-3.47), % alcohol (8.57%-3.00%) and Vit C (5.89 mg/100g-4.32 mg/100g), fluctuations in ash (0.03%-10.24%) and reducing sugar (23.75 g/l-36.01 g/l) while there were increases in values for TTA (0.40 g/100ml-0.75 g/100ml), TSS (13.70 °brix-21.0 °brix) and specific gravity (1.02-1.07). Wines produced in the present investigation recorded low pH values throughout the fermentation period which may be responsible for the microbiological stability of the wines. Similar observations have been reported for other tropical fruit wines such as banana wine

(Obaedo & Ikenebomeh, 2009), cashew wine (Awe *et al*., 2013) and pineapple-orange wine (Archibong *et al*., 2015). Reductions observed in ascorbic acid content of wine samples is expected as some of it might have been used up by yeast for enzymatic hydroxylation, glucose uptake together with excretion of ethanol (De & Okonofua, 2001). The TTA values ranged from 0.40 g/100ml - 0.75 g/100ml, and found to be within the specification (0.5-1.0%) for fruit wines (Singh *et al*., 1998). The result showed that there were reductions in the amount of reducing sugar during aerobic and anaerobic fermentations. The total soluble solids of wines in this work were found to reduce during fermentation but were higher than that reported for mahua wine (Singh *et al*., 1998). This may be due to the fact that the TSS of the fermenting must was adjusted to 24 ^{0}brix at the onset of anaerobic fermentation to provide additional fermentable substrate for the yeasts. Alcohol content of the *parkia* wine samples differ significantly, with 3.07% for PWA, PWB (4.36%), PWC (8.57%) and 3.00% for control. The variations in the alcohol content may be due to different species of yeast used for fermentation. A similar result was obtained from orange juice fermented with different yeast strains yielding 3.19% and 6.80% alcoholic contents (Okunowo *et al*., 2005). The high value recorded in sample PWC might be attributed to the synergistic efforts of the mixed cultures of *S. cerevisiae* and *S. ludwigii* to convert the sugars to ethanol.

Sensory evaluation of aged *parkia* fruit pulp wines

Sensory characteristics of *parkia* fruit pulp wine is shown on Table 4. The panelist scored the various wine samples on colour (5.43-8.43), aroma (5.14-6.86), taste (2.14-7.43), clarity (5.17-8.57) and overall acceptability (5.43-8.57). The result showed that parkia fruit pulp wine fermented with *Saccharomyces cerevisiae* isolated from spontaneous fermentation of the fruit pulp was scored significantly higher in all the sensory parameters than other wines including the control from baker's yeast. This may suggest that natural fermentation of the fruit pulp can be encouraged.

Conclusion

In this study, yeasts isolated from spontaneous fermentation of African locust bean fruit pulp were used as single or mixed starters for the production of fruit wines. Considering the physicochemical properties of the wine samples under aerobic and anaerobic

fermentation, *Saccharomyces cerevisiae* obtained from the fruit pulp was found to compete well with the commercial *S. cerevisiae*. Report from consumer acceptability test further showed that wine from the single culture of indigenous *S. cerevisiae* was preferred to the mixed indigenous cultures and the commercial *S. cerevisiae*. It is therefore suggested that fruit pulp from *P. biglobosa* can be employed in wine industry rather than been regarded as waste and constituting nuisance in the environment.

References

Abdel, M. E., Esra, A. M. and Warda, S.A. (2015). Isolation and identification of yeasts from the different stages of hulu-mur fermentation. *J. Microbiol*., **5**: 71-76.

Adedeji, T.O. and Oluwalana, I.B. (2013). Physicochemical, sensory and microbial analysis of wine produced from watermelon (*Citrullus lanatus*) and pawpaw (*Carica papaya*) blend. *Food Sci. Quality Man*, **19**: 123-125.

Ajani, R.A., Adeniran, M.K., Olabinri, B.M. and Ajani, A.J. (2012). *In Vivo* Assessment of Some Haematological and Biochemical Parameters in Normal Wistar Rats treated with Pineapple (*Ananas Comosus*) Wine. *Am. Int. J. Cont. Research,* 2: 141-146.

Akoma, O., Olawepo, O. and Ogunrinde, B.A. (2002). The production of `tsamiya winie' from *Tamarindus ladica*. *Nig. Food J*., 27:17-19.

Alvarenga, R.M., Mendonca, C.A., Silva, C. M. and Oliveira, S. (2011). Potential application of *Saccharomyces cerevisiae* strains for the fermentation of banana pulp. *Afr. J. Biotech.*, **10**: 3608-3615.

Anvoh, K.Y.B., Guehi, T.S., Beurgre, G.A.M., Kinimo, J.M. and Gnarkri, D. (2010). Comparison of biochemical changes during alcoholic fermentation of cocoa juice conducted by spontaneous and induced processes for the production of ethanol. *Afr. J. Food Agric. Nutr. Dev*., **10**: 2740-2754.

AOAC (2005). Official Methods of Analysis (22nd Edition). Association of Official Analytical Chemists Washington USA.

Archibong, E.J., Ezemba, C.C., Chukwujama, I.C. and Archibong, U.E. (2015). Production of wine from mixed fruits: Pineapple (*Ananas comosus*) and orange (*Citrus sinensis*) using yeast isolated from palm wine. *World J. Pharm. Sc*., 4: 126- 136.

Artnarong, S., Masniyom, P. and Maneesri, J. (2014). Isolation of yeast and acetic acid bacteria from Palmyra palm fruit pulp (*Borassus flabellifer*). *Int. Food Res. J.* 23, 1308-1314.

Awe, S. and Nnadoze, S.N (2015). Production and microbiological assessment of Date palm (*Phoenix dactylifera L*.) fruit wine. *British Microbiol. Res. J.* **8**: 480-488.

Awe, S., Sani, A., Eniola, K. I. T. and Kayode, R.M.O. (2013). Toxicological assessment of locally produced cashew wine. *IJRRAS*, 15: 121-125.

Barnett, J.A., Payne, R.W. and Yarrow, D. (2002). Yeast characteristics and identification 3rd ed. Cambridge University Press London; *pp*. 1139.

Cardinal, M.J., Meghrous, J., Laeronix, C. and Simard, R.E. (1997). Isolation of *Lactococcus lactis* strain producing inhibitory activity against Listeria. *Food Biotech,* 11: 129-146.

Chanprasartsuk, O., Pheanudomkitlert, K. and Toonwai, D. (2012). Pineapple wine fermentation with yeasts isolated from fruit as single and mixed starter cultures. *Asian J. Food Agro-industry*, **5**: 104-111.

Cho, J.Y., Jeong, J.H., Kim, J.Y., Kim, S.R., Kim, S.J., Lee, H.J., Lee, S.H., Park, K.H. and Moon, J.H. (2013). Change in the content of phenolic compounds and antioxidant activity during manufacturing of black raspberry (*Rubus coreanus* Miq.) wine. *Food Sc. Biotech.* 22: 1237–1244.

Chowdhury, P. and Ray, R.C. (2007). Fermentation of Jamun (*Syzgium cumini* L.) fruits to form red wine. *ASEAN Food J*, 14:15-23.

De, N. B. and Okonofua, P. E. (2001). Production of alcohol using the pulp of *Parkia biglobosa.* Bagalc J. Pure Apllied Sc, 1:40-42.

Demuyakor, B. and Ohta, Y. (1991). Characteristics of pito yeasts from Ghana. *Food Microbiol.,* 8: 183–193.

Ezeronye, O.U. (2004). Nutrient utilization profile of *Saccharomyces cerevisiae* from palm wine in tropical fruit fermentation. *Antonie van Leeuwenhoek*, 86: 235-240.

Gadaga, T.H., Mutukumira, A.N., Narvhus, J.A. and Feresu, S.B. (1999). A review of traditional fermented foods and beverages of Zimbabwe. *Int. J. Food. Microbiol.*, 53: 1-11.

Jacobs, F. (2001). Making wine from pineapple. Ihem Davis Press, Owerri.

Jayabalan, R., Malbasa, R.V., Loncar, E.S., Vitas. and Sathishkumar, M. (2014). A Review on Kombucha Tea—Microbiology, Composition, Fermentation, Beneficial Effects, Toxicity, and Tea Fungus. *Comprehensive Reviews in Food Science and Food Safety*, 13: 538-550.

Joshi, V.K. (1998). Fruit wines. Directorate of Extention Education, Dr. Y. S P University of Horticulture and Forestry, Nauni, Solan, India.

Kang, B.T., Kwon, D.H. Choi, W.J., Kim, S.H. and Park, D.C. (2008). Antioxidant and antiviral activities of polyphenolics in plum wine. *Korean Food Preser*. 15:891–896.

Kirk, R.S. and Sawyer R. (1991). Pearson's Composition and Analysis of Foods, 9th edn. Longman Scientific and Technical: Harlow, UK. pp. 530–574.

Kurtzman, C.P. and Fell, J.W. (2006). The yeasts, a taxonomic study, 6th. Elsevier Science B.V. Amsterdam, The Netherlands.

Maragatham, C. and Panneerselvam, A. (2011). Isolation, identification and characterization of wine yeast rotten papaya fruits for wine production. *Adv. Appl. Sc. Res.* 2: 98.

Mbajiuka, C.S., Ifediora, A.C., Onwuakor, C.E. and Nwokoji, L.I. (2015). Fermentation of pods of cocoa (*Theobroma cacao* L) using palm wine yeasts for the production of alcohol and biomass. *Am. J. Microbiological Res.* 3: 80-84.

Mpofu, A., Kock, J.L.F., Pretorious, E.E. and Pohl, C.H. (2008). Identification of yeasts isolated from Mukumbi, A Zimbabwean Traditional Wine. *J. Sustainable Dev. Afr*. 10: 88-102.

Obaedo, M.E. and Ikenebomeh, M. (2009). Microbiology and production of banana (*Musa sapientum*) wine. *Nig. J. Microbiol*. 23: 1890-1895.

Ocbo, F.C.K. and Ayernor, G.S. (2010). Production of alcohol from cassava flour hydrolysate. *J. Brew. Distill*. 1:15-21.

Okafor, J. C. (1987). Industrial Microbiology. University of Ife press Ltd. pp.413.

Okafor, N. (2007). Modern Industrial Microbiology and Biotechnology. Science Publishers. Enfield. pp. 263–308.

Okunowo, W.O., Okotore, R.O. and Osuntoki, A.A. (2005).The alcoholic fermentative efficiency of indigenous yeast strains of different origin on orange juice. *Afr. J. Biotechnol*. 4 1290-1296.

Omojasola, P. and Ademuyiwa, F.O. (2003). Some Characteristics of roselle wine produced from fermentation of *Hibiscus Sabdariffa* using *Saccharomyces cerevisiae*. *Nig J. Pure Appl. Sci.*, 18: 1401-1406.

Onions, A.H., Allsopp, D. and Eggins, H.O. (2002). Smith's Introduction to Industrial Mycology, 7th ed.

Sacande, M. and Clethero, C. (2007). *Parkia biglobosa (Jacq.) G. Don.* Millennium Seed Bank Project Kew. Seed Leaflet No 124.

Saeed, M.F., Anjum, T.., Zahoor, H.N. and Renman, S.U. (2009). Isolation and characterization of starter culture from spontaneous fermentation of sourdough. *Int. J.Agric. Biol*. 11: 329-332.

Shrikant B.S, Thakor, N.J. and Dwate, A.D. (2014). Fruit wine production: A Review: *J. Food Res. Tech*., 2: 93-100.

Singh, R., Mishra, B.K., Shukla, K.B., Jain, N.K., Sharma, K.C., Kumar, S., Kant, K. and Ranjan, J.K. (2013). Fermentation process for alcoholic beverage production from mahua (*Madhuca indica J. F. Mel*.) flower. *Academic Journals*. 12: 5771-5777.

Solomakos, N., Govaris, A., Koidis, P. and Botsoglou, N. (2008). The antimicrobial effect of thyme essential oil, nisin, and their combination against *Listeria monocytogenes* in minced beef during refrigerated storage. *Food Microbiol*., 25:120–127.

Vaidya, D., Vaidya, M., Sharma, S. and Ghanshayam, S. (2009). Enzymatic treatment for juice extraction and preparation and preliminary evaluation of kiwifruits wine. *Natural Product Radiance* 8: 386-391.

Watanabe, M. and Shimazu, G.H. (1980). Effect of yeast on botrytised wine making. *J. Ferment. Technol.* 58: 227-235.

Wood, B.J. and Holzapfel, W.H. (1995). The Lactic Acid Bacteria. The genera of Lactic Acid Bacteria, 1st edn. Chapman and Hall, London.

Table 1. pH, TTA and yeast count during spontaneous fermentation of *P. biglobosa* fruit pulp

Cite this article as:

Ifesan et al (2019). **Physicochemical properties and acceptability of wine from fruit pulp of African Locust bean (*Parkia biglobosa)***

JARNR 3(3).75-95
https://www.scopus.com/
https://scholar.google.com/
Submit your manuscript at: http://www.scienceparkjournals.org/jarnr/submit