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## Research Article

# Quality Characteristics of Wine Produced from Udara (*Chystophyllum albidum*) Extract Using Palm Wine Yeast and Baker's Yeast

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### ABSTRACT

This study evaluated wine production from "Udara" (*Chystophyllum albidum*) pulp using palm wine yeast and commercial baker's yeast. Palm wine yeasts were isolated from overnight palm wine, phenotypically characterized, and used alongside baker's yeast to ferment must prepared from fresh Udara pulp. The must was supplemented with sugar before fermentation. The data obtained were analyzed using analysis of variance (ANOVA) with SPSS. During the 14-day fermentation period, both yeast types showed similar fermentation dynamics. Total solids decreased from 20.54% to 6.24% in palm wine yeast-fermented must and from 20.76% to 6.83% in baker's yeast-fermented must. Specific gravity declined from 1.208 to 1.067 and from 1.205 to 1.091, respectively. Sugar content reduced markedly from 22.03% to 0.94% (palm wine yeast) and from 21.31% to 1.61% (baker's yeast). Conversely, titratable acidity and alcohol content increased during fermentation. Palm wine yeast fermentation showed increases from 0.43% to 1.54% (acidity) and 2.96% to 12.67% (alcohol), while baker's yeast recorded increases from 0.44% to 1.47% and 3.22% to 12.14%, respectively. Overall, no significant differences were observed between the two yeast types across most fermentation parameters. The findings indicate that palm wine yeast performs comparably to commercial baker's yeast and can be effectively utilized for Udara wine production.

**Keywords:** Fermentation; Palmwine; Udara; Wine; Yeast

**Citation:** Mbajiuka C.S. & Appeh, O.G. (2026). Quality Characteristics of Wine Produced from Udara (*Chystophyllum albidum*) Extract Using Palm Wine Yeast and Baker's Yeast. *Sahel Journal of Life Sciences FUDMA*, 4(2): 199-205. DOI: <https://doi.org/10.33003/sajols-2026-0402-21>

### INTRODUCTION

Wine production has long been a cornerstone of agricultural value addition, leveraging microbial fermentation to transform raw materials into economically significant beverages. Wines, no matter the fruit source, are recorded to be of tremendous health benefits in comparison with other alcoholic beverages (Asuk *et al.*, 2022) especially red wines which have beneficial effects on the heart. It does appear also that the beneficial effects of wines are similar to those of the fruits from which the wines were made (Gortges and Haubrich, 2015). Traditionally, grapes dominate global winemaking, but increasing interest in diversification has spurred

experimentation with non-conventional fruits, particularly in tropical regions where underutilized species offer untapped potential. Among these, *Udara* (syn. *Chystophyllum albidum*), a tropical fruit native to West Africa, stands out for its nutritional richness, aromatic profile, and high sugar content which are attributes that make it a promising candidate for fermentation into wine.

Many different fruits which are edible as food for man and animals are not fully utilized due to their limitation of poor storage (Ibeawuchi *et al.*, 2015). One of such useful under-utilized fruit in the "Udara" fruit. The Udara tree produces fruits of high value which contribute to the nutritional needs of many

and is rich in vitamin and minerals as well as phytochemicals all of which play important roles in the prevention of diseases like diabetes, cardiovascular ailments etc as well as in boosting the body immunity. The contribution of the Udara fruit, like those of many other nutrient rich fruits, is hampered by poor storage after harvest (Jimoh, 2014). Fermentation of underutilized fruits with palm wine yeast offers a viable channel to transform agricultural products into high-value alcoholic beverages. This process leverages the ability of indigenous yeast to efficiently convert the fruits' sugars into complex wines, effectively reducing post-harvest losses. The result is not only a unique product with distinctive sensory profiles but also an economic opportunity for small-scale producers. The selection of yeast strains is pivotal in determining the organoleptic and physicochemical qualities of wine. Commercial baker's yeast (*Saccharomyces cerevisiae*) is widely employed in modern fermentation due to its reliability, high ethanol tolerance, and consistent metabolic activity. In contrast, traditional palm wine yeast—often a consortium of wild microbes, including non-*Saccharomyces* species—imparts unique flavor complexities and regional character to fermented beverages. This study was thus aimed at producing and evaluating the quality of wine from "Nwannu" (a variety of sweet udara) using yeasts from isolated from palm wine.

## **MATERIALS AND METHODS**

### **Source of Materials**

The test fruits "Udara" were purchased from Umuahia Central Market, Orié Ugba Ibeku. The palm wine used in the work was procured, on arrangement, from a Tapper at Ariam Usaka, Ikwuano LGA, Abia State. The Bakers yeast used as control was purchased from a service store in Umuahia Town. One kilogramme (1kg) of ripened Udara fruits (*Chrysopyllum albidum*) were collected from sellers at the market and taken to the laboratory for use. The washed fruits were examined for spoilt and infested ones and those that were not completely ripped which were all removed while the "good" ones were reserved for the work. The fruits were washed in portions of portable water and allowed to drain dry. (Jimoh, *et al.*, 2014).

### **Isolation of yeast from palm wine**

A direct culture of palm wine samples was done on SDA plates and the grown yeasts were characterized and identified. The yeast of choice (*Saccharomyces cerevisiae*) was multiplied in broth culture and used for the wine production process.

### **Production of Wine**

The fruits were cut open, seeds removed and the pulp scooped out. The pulp was blended with a small amount of water (1:1 ratio) to facilitate extraction and the mixture filtered through sterilized muslin cloth to obtain clear juice. Five (5) ml of the palm wine yeast was added to 100 mL of the udara juice and fermentation was allowed to occur. Samples were taken at intervals and assessed for the wine quality.

### **Determination of Alcohol Content**

The alcohol content of the test samples was determined by distillation gravimetric method (Antia *et al.*, 2018).

### **Determination of Specific Gravity**

This was determined by the pycnometric gravimetric method. In this method, a clean dry pycnometric (specific gravity bottle), of 50ml capacity was weighed when it was empty (WA) and then filled with freshly distilled water up to the capillary of the stopper. The outside was mopped with a dry absorbent tissue (to remove water) and it was re-weighed (WW). The water was decanted and the bottle (Pycnometric) was dried without heating it (to avoid expansion). It was then filled with the test sample (juice, must wine) and again the outside was wiped clean. It was reweighed (WS). The specific gravity was determined as the ratio of the measured volume of the palm wine (volume of the pycnometric) to an equal volume of distilled water (also vol of the pycnometric) and calculated as follows:

$$\text{S.G. (g/cm}^3\text{)} = \frac{WS}{WW} \times \frac{WA}{WA}$$

W = Wt of empty S.G bottle

WS = wt of S.G bottle filled with sample

WW = Wt of S.G. bottle filled with distilled water

### **Determination of pH**

pH was determined instrumentally using an electronic pH meter as described by Jimoh *et al.* (2014). The pH meter was switched on and allowed for 10 minutes to equilibrate. It was calibrated with buffered solution of pH 7.0. To measure the pH of test samples, the sample was dispensed into a clean dry glass beaker (about 20-30mins) and the electrode (sensor) of the pH meter was dipped into the sample

taking care to ensure that the tip did not touch the side or bottom of the beaker. The pH value was read directly from the screen of the instrument when the figures became steady.

#### **Determination of Total Solids**

This was done gravimetrically using the method described by (Onwuka, 2018). Briefly, a measured quantity of the wine sample, 50ml, was put in a previously weighed clean evaporating dish and evaporated to dryness over a steam bath. The dish was allowed to dry in the oven at 100°C or 30mins (to remove residual moisture), cooled in a desiccator, and reweighed. By difference, the weight of dry solid in the sample was obtained and expressed as a percentage of the quantity of sample analysed. The formula below was used

$$\% \text{ Total solids} = \frac{W2-W1}{V} \times \frac{100}{1}$$

V = Vol of sample analysed

W1 = wt of empty evaporating dish

W2 = wt of dish + dry sample

#### **Determination of Sugar Content**

The sugar content of the test samples (fruit pulp, fermenting must, wine etc) was determined by the Anthrone colorimetric method (Antia *et al.*, 2018). Accordingly, a measured portion of the test sample (1g or 1ml) was put in a heat stable test tube and 6ml of the Anthrone reagent (freshly prepared) was added to it and it was boiled in a water bath for 10 minutes. Similarly, 1ml of standard sugar solution (glucose) was put in a separate test tube to serve as the standard while 1ml of distilled water was put in yet a different test tube to serve as control. Anthrone reagent (6ml) was added to each of the tubes and they were boiled as the sample was. In each case, the boiled tubes were cooled rapidly in cold water and their reactive absorbance were measured in a spectrophotometer at a wavelength of 660nm. The reagent blank was used to set the instrument at zero. The sugar content was calculated using the formula below

$$\% \text{ sugar} = \frac{100}{V} \times \frac{au}{as} \times C$$

Where;

V = volume of sample analysed

Au = absorbance of the test sample

As = absorbance of standard

C = concentration of standard

#### **Determination of Titratable Acidity**

Titratable acidity was determine using the alkaline titrimetric method (Saddler and Murphy, 2013). Accordingly, a measured volume of the sample (20mls) was dispensed into a clean dry 100ml conical flask and an equal volume of distilled water was added to it followed by three drops of phenolphthalein indicator solution. It was titrated against dilute sodium hydroxide solution (0.1m NaOH) to an endpoint marked by a pink colour which persisted beyond 15 seconds. The titrated acidity was calculated as shown below;

$$\% \text{ TTA} = \frac{100}{V} \times N \times \text{titre}$$

Where;

V = volume of sample analysed (20ml); N = concentration of titrant (0.1m alcohol)

#### **Data Analysis**

The experimental determination for all parameter was done in triplicates and the obtained data were subjected to statistical analysis of variance (ANOVA) using the statistical package for social sciences (SPSS) version 20 with Duncan Separation at 5%.

## **RESULTS**

Table 1 show variations in the pH of fermentation udara palm must for production of wine using palm wine yeast and commercial yeast. There was reduction in pH (showing increasing acidity) with fermentation time. Whereas both yeasts started with equal pH of 6.21 at the onset of the experiment, the drop in pH at the end of the experiment (15 days) was from 6.21 to 3.48 (43.96% decrease) in the palm yeast fermented must and from 6.21 to 3.69 (40.58% decrease) in the commercial yeast fermented must. In both musts, there was a steady increase in acid production as reflected in the increases in TTA from 0.43% to 1.54% in the palm wine yeast fermented must and from 0.44% to 147% in the commercial yeast fermented must (Table 2).

As shown in Table 3, there were significant changes in the total solids content of the fermenting udara wine must during the wine production process. Also, there were slight but significantly different (P<0.05) variations in the total solids of the must being fermented with the palm wine yeast compared with the normal commercial yeast used as control.

**Table 1: Changes in pH of fermenting Udara Pulp must during wine Production**

Sample	Days of Fermentation								
	0	1	3	5	7	9	11	13	15
PYC	6.21 <sup>a</sup> ±0.02	5.11 <sup>a</sup> ±0.05	4.97 <sup>a</sup> ±0.05	4.72 <sup>a</sup> ±0.04	4.40 <sup>a</sup> ±0.04	4.15 <sup>a</sup> ±0.2	3.90 <sup>a</sup> ±0.04	3.78 <sup>a</sup> ±0.01	3.48±0.09
CY	6.21 <sup>a</sup> ±0.03	5.07 <sup>a</sup> ±0.03	4.87 <sup>b</sup> ±0.03	4.67 <sup>b</sup> ±0.01	4.39 <sup>a</sup> ±0.04	3.90 <sup>b</sup> ±0.01	3.90 <sup>a</sup> ±0.04	3.81 <sup>a</sup> ±0.01	3.69 <sup>a</sup> ±0.03

Values show means of triplicate analysis ± standard Deviation

**Table 2: Changes in Total Titratable Acidity (TTA) of fermenting Udara pulp must during wine production**

Sample	Fermentation Period (Days)								
	0	1	3	5	7	9	11	13	15
PYC	0.43a±0.01	0.69a±0.03	0.81a±0.03	0.9a±0.03	0.97b±0.02	1.17a±0.01	1.29a±0.03	1.43a±0.06	1.54a±0.07
CY	0.44a±0.02	0.82a±0.02	0.82a±0.02	0.89a±0.01	1.03a±0.01	1.23a±0.02	1.23b±0.01	1.32b±0.04	1.47b±0.01

Values are means of triplicate analysis + standard deviation. Figures with different superscripts in the column are significant different (P<0.05).

**Table 3: Total Solids**

Sample	Fermentation time (days)								
	0	1	3	5	7	9	11	13	15
PYC	20.54 <sup>a</sup> ±0.50	17.8 <sup>b</sup> ±0.42	16.81 <sup>a</sup> ±0.34	14.82 <sup>a</sup> ±0.04	12.97 <sup>a</sup> ±0.13	10.97 <sup>a</sup> ±0.10	9.33b±0.10	7.93 <sup>b</sup> ±0.10	6.24 <sup>a</sup> ±0.05
CY	20.70 <sup>a</sup> ±0.09	18.35 <sup>a</sup> ±0.08	16.43 <sup>a</sup> ±0.20	14.70 <sup>a</sup> ±0.04	12.79 <sup>a</sup> ±0.08	10.91 <sup>a</sup> ±0.03	9.51±0.06	8.15 <sup>a</sup> ±0.01	6.82 <sup>b</sup> ±0.18

Values show means of triplicate analysis + standard deviation. Figures with different significant (abc) in the column are significantly different (P<0.05).

At the beginning of the fermentation process as well as at the end, there were no significant differences (P<0.05) between the densities of the musts being fermented by the two different yeasts, palm wine yeast and commercial yeast (Table 4).

**Table 4: Changes in Specific gravity of fermenting Udara pulp must during production of wine using palm wine yeast**

Sample	Fermentation time (days)								
	0	1	3	5	7	9	11	13	15
PYC	1.21a±0.09	1.19a±0.09	1.19a±0.00	1.18a±0.01	1.18a±0.00	1.15a±0.00	1.14b±0.00	1.10b±0.00	1.07a±0.02
CY	1.21a±0.00	1.19a±0.00	1.17a±0.00	1.17b±0.00	1.17b±0.00	1.15a±0.00	1.14a±0.00	1.11a±0.00	1.09a±0.01

Values show means of triplicate analysis + standard deviation. Figures with different superscripts in the column are significantly different (P<0.05).

In the must fermented by palm wine yeast, the sugar content reduced four 22.03% to 18.99%, after 24 hours of fermentation while that of the commercial yeast reduced from 21.31% to 18.81% after the same period of fermented showing no significant variations. However, the result show

significant drop in the sugar content in the fermenting must by palm wine yeast from the 9th day (8.80%) to the 15th day 0.94% all being lower than the values recorded for the commercial yeast fermented must of 9.23% to 1.01% within the same fermentation time.

**Table 5: Changes in Sugar content of fermenting Udara pulp must during production of wine using palm wine yeast**

Sample	Fermentation time (days)									
	0	1	3	5	7	9	11	13	15	
PYC	22.0 <sup>a</sup> ±0.09	18.9 <sup>a</sup> ±0.08	16.8 <sup>a</sup> ±0.11	13.1±0.09	11.6 <sup>a</sup> ±0.14	8.80 <sup>b</sup> ±0.14	6.34 <sup>b</sup> ±0.05	2.51 <sup>b</sup> ±0.17	0.94 <sup>a</sup> ±0.05	
CY	21.3 <sup>b</sup> ±0.30	18.8 <sup>b</sup> ±0.06	16.7±0.05	12.9 <sup>b</sup> ±0.01	11.5 <sup>a</sup> ±0.03	9.23 <sup>a</sup> ±0.01	6.87 <sup>a</sup> ±0.11	2.93 <sup>a</sup> ±0.15	1.01 <sup>a</sup> ±0.04	

Values show means of triplicate analysis + standard deviation. Figures with different superscripts in the column are significantly different (P<0.05).

**Table 6: Changes in Alcohol content of fermenting Udara pulp must during production of wine using palm wine yeast**

Sample	Fermentation time (days)									
	0	1	3	5	7	9	11	13	15	
PYC	0.00 <sup>a</sup> ±0.00	2.96 <sup>b</sup> ±0.80	4.29 <sup>b</sup> ±0.26	4.95 <sup>a</sup> ±0.08	5.15 <sup>b</sup> ±0.10	8.77 <sup>a</sup> ±0.25	10.8 <sup>b</sup> ±0.13	11.9 <sup>a</sup> ±0.05	12.7 <sup>a</sup> ±0.05	
CY	0.00 <sup>a</sup> ±0.00	3.22 <sup>a</sup> ±0.00	4.62 <sup>a</sup> ±0.07	5.06 <sup>a</sup> ±0.04	6.46 <sup>a</sup> ±0.04	9.06 <sup>a</sup> ±0.12	11.1 <sup>a</sup> ±0.19	11.5 <sup>b</sup> ±0.19	12.1 <sup>b</sup> ±0.16	

Values show means of triplicate analysis + standard deviation. Figures with different superscripts in the column are significantly different (P<0.05)

### DISCUSSION

The production of wine from Udara fruit represents a valuable approach to reducing post-harvest losses while creating products with potential health benefits. The findings of this study shows that Udara fruit is inherently acidic, as evidenced by its initial pH of 4.62 and titratable acidity of 0.85%. This is beneficial for wine production since it inhibits the growth of spoilage microbes while promoting the activity of acid-tolerant yeasts. The study of Ibeawuchi *et al.* (2015) reported that moderately acidic fruits are most suited for making wine.

The quality characteristics of Udara pulp juice prior to fermentation showed an initial sugar content of 6.38%, pH of 4.62, and titratable acidity of 0.85%. These values are close to those reported by Jimoh *et al.* (2014), on African star apple (*Chrysophyllum albidum*) fruits which had between 5-8% soluble sugars, confirming that supplementation is consistently necessary for wine production from this fruit. The pH value of 4.62 as obtained in this study is slightly higher than the range of 4.2-4.5 reported by Jimoh *et al.* (2014) for fresh Udara juice. The total solids content of 12.96% observed in this study compares favorably with values reported by Chukwu (2020), who recorded an initial total solid of 14%. This evenness suggests that Udara fruit, contains comparable levels of soluble components. Variations in the observed values in contrast to ther studies may be attributed to the difference in fruit variety and geographical location.

This reduction in pH value from 6.21 to 3.48 (43.96% reduction) for palm wine yeast-fermented must and to 3.69 (40.58% reduction) for commercial yeast-fermented must is consistent with several investigations on tropical fruit

wines. The study of Emenogu (2022) observed similar pH drops from 5.3 to 3.3 and 3.4, respectively, when soursop (*Annona muricata*) was fermented for 14 days using baker's yeast and palm wine yeast. In their investigation of date and honey wines fermented using yeasts originating from palm wine, Ugboogu *et al.* (2025) found similar fermentation patterns, with pH gradually declining as fermentation progressed. Similar pH ranges (3.2–3.8) for acceptable fruit wines were reported by Antia *et al.* (2018). The slightly lower pH attained by palm wine yeast in towards as the fermentation period increased suggests that mixed indigenous yeast cultures may produce more acidic wines than single-strain commercial cultures. The generation of organic acids, specifically succinic acid, acetic acid, and lactic acid, as metabolic byproducts of yeast activity which is typical of alcoholic fermentation, could have resulted to this decrease in pH. According to Gortges and Haubrich (2015), yeasts produce a variety of organic acids during fermentation in addition to ethanol, which influences the resulting wine's acidity and flavor profile.

The titratable acidity (TTA) increases from 0.43% to 1.54% (palm wine yeast) and 0.44% to 1.47% (commercial yeast) over 15 days (Table 3) demonstrate progressive acid accumulation during fermentation. These values compare favourably with the work of Ugboogu *et al.* (2025), who reported that different palm wine yeast isolates exhibited varying TTA-producing potentials in date wine fermentations. Patel *et al.* (2021) reported titratable acidity of 0.657% for mango wine fermented with *Saccharomyces cerevisiae*. This value is considerably lower than the 1.47-1.54% achieved in the present study, highlighting the influence of fruit substrate on final wine acidity.

In the palm wine yeast fermentation, the sugar level decreased from 22.03% to 0.94% (95.7% usage), and in commercial yeast fermentation, it decreased from 21.31% to 1.01% (95.3% utilization), indicating effective substrate conversion. These usage rates are comparable to the 95–97% sugar consumption for date wines fermented with palm wine yeasts reported by Ugbogu *et al.* (2025). This study's slightly higher effective sugar utilization by palm wine yeast (95.7% vs. 95.3%) is consistent with research by Emenogu (2022), who found that palm wine yeast produced 12.8% alcohol yield from soursop as opposed to 11.2% for baker's yeast, indicating more thorough sugar conversion.

A final alcohol concentration of 12.67% and 12.14% was recorded by the palm wine yeast and commercial yeast respectively which represents successful fermentations Emenogu (2022) reported remarkably similar values for soursop wine with a 12.8% alcohol for palm wine yeast-fermented wine and 11.2% for baker's yeast-fermented wine. The consistency between these studies, strongly validates the finding that palm wine yeast consistently produces slightly higher alcohol yields than commercial baker's yeast across different fruit substrates. Ugbogu *et al.* (2025) reported alcohol contents ranging from 7.54% to 12.24% depending on substrate composition (date-to-honey ratio) and yeast strain used. According to Umar *et al.* (2013), different yeast strains have different levels of ethanol tolerance and production capacity; under ideal circumstances, some strains can produce up to 15% ethanol.

Over the course of the fermentation process, the total solids content consistently decreased from 20.54% to 6.24% in the palm wine yeast-fermented must and from 20.70% to 6.82% in the commercial yeast-fermented must. The reduction in total solids reflects the utilization of soluble components, particularly sugars, by the fermenting yeasts. The palm wine yeast may have been more effective at using the available substrates, as seen by the somewhat lower final total solids in the palm wine yeast-fermented must (6.24%) compared to commercial yeast (6.82%).

The drop in sugar, especially in the first 24 hours (from 22.03% to 18.99% for palm wine yeast and 21.31% to 18.81% for commercial yeast), is a sign of active and effective fermentation by the yeast. The sugar concentrations of the palm wine yeast-fermented must were consistently lower than those of the commercial yeast-fermented must starting on day 9, reaching 0.94% as opposed to 1.01% on day 15. In comparison to the single strain of commercial baker's yeast, the metabolic variety of the mixed

yeast culture may be reflected in the palm wine yeast's somewhat more effective sugar utilization.

## CONCLUSION

The findings of this research work observed that palm wine yeast isolates performed credibly well in the fermentation of the udara pulp must for wine production. Comparatively, both yeast appeared to have similar fermentation dynamics (progressive pH decline, TTA increase, sugar reduction, specific gravity decrease, and alcohol accumulation). Generally, both yeasts performed well and their products (wine) had approximately the same quality characteristics such as same level of alcohol (12-13% by volume). The successful fermentation of Udara fruit must by both yeast types demonstrated that this indigenous fruit can be effectively utilized for value-added product development, addressing the significant post-harvest losses that characterize this seasonal fruit.

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