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Production of Wine from the Fermentation of Cherry by *Saccharomyces cerevisiae*

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Authors' contributions

This work was collaboratively conducted by all authors. Author MMA designed the study, performed fermentation experiments, and drafted the manuscript. Author BTT carried out statistical and microbiological analyses and assisted in antioxidant assays. Author ULS contributed to literature review, manuscript revision, and data interpretation. Author UA assisted in data collection and laboratory preparation. Author DHA conducted sensory evaluations and proximate analysis, while Author KHK supported literature review and manuscript editing. All authors reviewed and approved the final manuscript.

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ABSTRACT

Aims: This study investigated the fermentation potential and physicochemical characteristics of cherry wine produced using *Saccharomyces cerevisiae* isolated from naturally fermented palm wine, with comparisons drawn against standard values for fruit-based wines. The study also aimed

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to evaluate the yeast's sugar fermentation capability and the nutritional and antioxidant properties of the resulting cherry wine.

Study Design: A laboratory-based experimental design was adopted, incorporating statistical analyses to monitor microbial load, fermentation progress, and proximate composition changes over time.

Place and Duration of Study: Microbiology Laboratory, Kwara State University, Malete, Kwara State, Nigeria from March 2025 to April 2025.

Methodology: Fresh cherry fruits were procured from the Malete market in Kwara State, Nigeria, while yeast for fermentation was isolated from freshly tapped palm wine. Yeast isolation was conducted using Potato Dextrose Agar (PDA) prepared and sterilized under standard conditions, with isolates characterized morphologically, microscopically, and biochemically through sugar fermentation tests. Cherry fruits were washed, peeled, deseeded, blended, and treated with sodium metabisulfite before fermentation. A yeast starter culture of *Saccharomyces cerevisiae* was reactivated and inoculated into the prepared cherry must, supplemented with nutrients such as sugar, potassium phosphate, ammonium sulfate, citric acid, and magnesium sulfate. Fermentation was monitored daily for physicochemical changes, including pH, specific gravity, total soluble solids (°Brix), titratable acidity, and alcohol content. Proximate analyses of the final product measured moisture, ash, crude fiber, crude protein, and fat content. Microbiological safety was assessed by bacterial enumeration and coliform detection. Antioxidant properties of the cherry wine were evaluated DPPH free radical scavenging assay, hydrogen peroxide scavenging assay, ferric reducing antioxidant power (FRAP), and nitric oxide scavenging assay. Sensory evaluation was conducted comparing the fermented cherry wine with a commercial wine.

Results: The isolated *Saccharomyces cerevisiae* from palm wine demonstrated effective fermentation of cherry must, characterized by a progressive decline in specific gravity (from 1.085 to 1.070) and pH (from 3.5 to 3.1), alongside an increase in alcohol content from 0.31% to 6.32% v/v over 9 days. Total soluble solids decreased while titratable acidity showed a consistent decline. Microbiological analysis confirmed the absence of *Staphylococcus spp.*, *E. coli*, and coliforms, indicating the microbial safety of the wine. Proximate analysis showed that cherry wine had higher moisture and carbohydrate content but lower ash, protein, fat, and fiber compared to fresh cherry fruit. Antioxidant assays revealed moderate activity (50–58%) across DPPH, nitric oxide, FRAP, and hydrogen peroxide scavenging tests. Sensory evaluation showed that while the commercial wine was rated higher overall, the cherry wine received favorable scores in taste and aroma.

Conclusion: The study demonstrates that *Saccharomyces cerevisiae* isolated from palm wine effectively ferments cherry must into a safe, nutritious, and sensorially acceptable wine. The findings support the potential for local production of cherry wine with desirable quality attributes using native yeast isolates.

Keywords: Saccharomyces cerevisiae; cherry wine; palm wine; fermentation; physicochemical parameters; proximate composition; antioxidant activity; sensory evaluation; microbiological safety.

1. INTRODUCTION

Wine may be defined as the fermented juice of a plant product, typically a fruit, used as a beverage. For centuries, wines have been produced from a variety of plant materials, not just fruits (Legodi et al., 2022). Wine holds a significant cultural, artistic, and religious value and is often considered a nutritious, safe, and healthy drink (Inglis, 2021). With the increase in socioeconomic status, there has been a growing demand for health-oriented and nutraceutical foods (Boles et al., 2022). Wine contains several biologically active compounds, such as phenolics, acids, alcohols, and bioamines that offer numerous health benefits. Wine is produced through yeast fermentation, which converts sugars into ethanol and carbon dioxide, releasing heat in the process (Sun et al., 2020). A typical wine contains ethyl alcohol, sugars, acids, higher alcohols, tannins, aldehydes, esters, amino acids, minerals, vitamins, anthocyanins, and other minor constituents, including flavoring compounds (Shahrajabian & Sun, 2024). The production of wine from grapes, in particular, serves as a prime example of "value-added" processing, where raw food materials are converted into a finished product. Despite the reliance on modern microbiology and biochemistry in winemaking, traditional

techniques remain crucial in ensuring the production of high-quality wines (Kokkinomagoulos & Kandylis, 2023).

Wine is rich in powerful antioxidants, including resveratrol, epicatechin, catechin, and proanthocyanidins, which play a vital role in promoting health. Polyphenols in red wine, for example, help prevent unwanted clotting by maintaining flexibility in blood vessels (Buljeta et al., 2023). These antioxidants contribute to rejuvenating the skin, improving elasticity, and enhancing brightness. Additionally, red wines are rich in flavonoids, which have antiviral properties. Red wine also helps lower bad cholesterol levels, and resveratrol, found in grape skins, aids in regulating blood sugar levels, controlling cholesterol, and lowering systolic blood pressure (Čižmárová et al., 2023). Piceatannol, a compound derived from resveratrol, has been shown to reduce fat cells, contributing to weight management (Park et al., 2021). Furthermore, red wine has antibacterial properties, which can help treat stomach irritation and other digestive disorders. Regular and moderate consumption of red wine has also been associated with a reduced risk of certain types of cancers, including basal cell carcinoma, ovarian cancer, and prostate carcinoma (Wojtowicz, 2023).

Cherries, including both sweet and tart varieties, are widely enjoyed for their rich flavor and health benefits. These fruits are not only delicious but also packed with antioxidants, vitamins, and minerals. Cherries are known for their anti-inflammatory properties, which may help reduce the risk of chronic diseases such as heart disease and arthritis (Rippe, 2024; Colletti et al., 2025). They are also a good source of fiber, promoting digestion and gut health. Cherries are grown in many regions and can be enjoyed fresh, in savory and sweet dishes, or processed into juices, jams, and even alcoholic beverages such as cherry wine (Colletti et al., 2025). This study aimed to isolate and characterize yeast from palm wine and utilize it for the fermentation of cherry fruit must, followed by the analysis of the resulting wine's physicochemical, proximate, antioxidant and microbiological properties. The specific objectives of the study are to determine the Brix value, pH, titratable acidity, specific gravity, alcohol content, proximate composition, and antioxidant activity of the produced cherry wine.

2. MATERIALS AND METHODS

2.1 Description of the Study Area

The research site was located within the Microbiology laboratory at Kwara State University, with its address at Malete, Kwara State, Nigeria. Kwara State University Rd, Malete 241103, Kwara 1.1 km. Moro local government.

2.2 Sample Collection

The analysis involved obtaining Cherry fruits from the Malete market in Kwara State, Nigeria, while using freshly isolated yeast from palm wine.

2.3 Preparation of Media

Yeast isolation was performed on Potato Dextrose Agar (PDA) plates. The medium was prepared according to manufacturer instructions and sterilized at 121 °C for 15 minutes. Using sterile techniques, the medium was poured into sterile petri dishes and allowed to solidify.

2.4 Isolation Procedure of Yeast Cells

The palm wine used in this study was naturally fermented. Fresh palm wine was used as the source of yeast cells. A beaker was filled with vigorously mixed fresh palm wine and allowed to stand for 30 minutes. Using sterile micropipette, 1 mL of palm wine was aseptically collected from the top surface of the solution. Serial dilutions (10^{-1} to 10^{-4}) were prepared to obtain discrete yeast colonies. From each dilution, 0.1 ml aliquot was placed onto the surface of Potato Dextrose Agar (PDA) plates, spread evenly with a sterile glass spreader, and incubated at room temperature for 48 hours.

2.5 Macroscopic, Microscopic, and Biochemical Characterization of the Isolated Yeast

2.5.1 Sugar fermentation test of the isolated yeast from palm wine

For the sugar fermentation test of the isolated yeast from palm wine, sterile fermentation broths were prepared by adding 1% of each sugar, fructose, galactose, maltose, glucose, sucrose, and lactose to peptone water containing phenol red as a pH indicator and inverted Durham tubes to capture gas production. Each broth were

aseptically inoculated with 1 mL of a standardized yeast suspension and incubated at 30 ± 2°C for 48 hours. Fermentation was indicated by a color change from red to yellow due to acid production and by the presence of gas bubbles in the Durham tubes. This procedure was performed using a modified method of Ege et al. (2023).
The broths

2.5.2 Macroscopic observation

The macroscopic characteristics of the yeast colonies were examined by visual inspection after isolation. Observations focused on colony color, texture, elevation, and margin to assess the morphological features of the isolate.

2.5.3 Microscopic examination

A sterile dropping pipette was used to place a drop of lactophenol cotton blue solution onto a clean microscopic slide. Using a straight inoculating loop, yeast cells were carefully collected from the culture medium and transferred onto the drop of stain on the slide for microscopic examination. During the examination, a cover slip was placed over the slide preparation, allowing observation at ×40 magnification using a light microscope. Colonies that yielded positive results were sub-cultured by initial streaking onto the PDA medium and subsequently preserved as pure cultures on the same medium.

2.6 Must Preparation

The cherry fruits were initially washed with distilled water to eliminate surface contaminants. The outer skins were carefully peeled, and the seeds were manually removed. A total of 260 grams of the de-seeded fruits were then weighed and sliced into smaller portions using a sterile knife. The fruit pieces were blended and transferred into a sterile fermentation vessel, followed by the addition of 2.8 liters of distilled water to achieve the desired dilution. Subsequently, 2 grams of sodium metabisulphite ($Na_2S_2O_5$) were dissolved in 200 milliliters of water and added to the fruit must. The mixture was thoroughly stirred to ensure even distribution and then allowed to stand for 24 hours to facilitate proper sulfite action.

2.7 Preparation of *Saccharomyces cerevisiae* Reactivation

The yeast starter was prepared according to Song et al. (2024). The laboratory prepared potato dextrose agar containing chloramphenicol which served to stop bacterial growth. A newly prepared solidified PDA plate received the subcultured stock culture of *Saccharomyces cerevisiae* for 24h at room temperature.

2.8 Fermentation Process

Following a 24-hour pretreatment of the must with sodium metabisulphite ($Na_2S_2O_5$) to suppress undesirable microbial activity, the fermentation medium was prepared by mixing 3000 mL of must with 550 g of sugar dissolved in 250 mL of sterile distilled water heated to 37°C. To this mixture, 1 g each of potassium phosphate and ammonium sulfate, and 3 g of citric acid were added and thoroughly stirred to ensure uniform distribution. Subsequently, 2 g each of potassium phosphate, ammonium sulfate, and magnesium sulfate were incorporated. *Saccharomyces cerevisiae* cells were inoculated into the fermentation mixture at a concentration of approximately 1.5×10^8 CFU/mL, corresponding to a 0.5 McFarland standard. The inoculated medium was mixed thoroughly to ensure even distribution of the yeast cells. Fermentation was carried out over a period of nine days, during which key physicochemical parameters were monitored daily to assess fermentation dynamics.

2.9 Analysis of Physicochemical Parameters of the Wine

The wine type analysis includes measurements for pH value and titratable acidity and specific gravity (S.G), as well as total soluble solid (TSS), and percentage alcohol content.

2.9.1 Determination of pH

Using the method described by Ofoedu et al. (2021) cherry wine was measured using a digital pH meter after buffer-4 standardization

2.9.2 Percentage Alcoholic Content

An alcohol hydrometer was used to determine the alcoholic content of the wine. A hydrometer was allowed to float on the surface for reading measurement of liquid gravity at the point where the surface crosses**.** The assessment of the solution took place every 24 hours for nine days (Bowler et al., 2021).

2.9.3 BRIX Content Determination

The instrument used for this measurement was a refractometer. The author placed two drops of

the sample onto the prism face of the refractometer for reading acquisition (Jaywant et al., 2022).

2.9.4 Determination of Specific Gravity

Specific gravity was determined using a wine hydrometer (Kovačević et al., 2024).

2.9.5 Determination of Titratable Acidity (TTA)

The TTA was determined according to the method described by Ofoedu et al. (2022). A known volume of the wine sample (15 mL) was diluted with distilled water (10 mL) and then added to a conical flask, followed by the addition of 3 drops of 5% phenolphthalein as an indicator. The mixture was homogenized to ensure proper mixing and titrated with 0.1 N NaOH against a white background until the solution turned pink and retained its color. The TTA was expressed as % tartaric acid and calculated using the equation as follows: $\frac{V \times N \times 75}{V \times 1000} \times 100$

where *V* = milliliters of NaOH solution used for titration, *N* = normality of NaOH solution, and *v* = wine sample volume.

2.10 Microbiological Analysis

2.10.1 Enumeration of microorganisms from cherry wine produced

About 9 ml of normal saline was dispensed into each of ten capped tubes using a sterile 10 ml pipette, and the tubes were sterilized at 121 °C for 15 minutes in an autoclave. After sterilization, 1 ml of the cherry wine produced was subjected to a tenfold serial dilution from 10^{-2} to 10^{-10}, with thorough mixing at each step and discarding of 1 ml after the final dilution. Subsequently, 1 ml aliquots from the dilutions (10^{-1} to 10^{-10}) were aseptically transferred into sterile Petri dishes, and 20–25 ml of nutrient agar was added, swirled in both clockwise and anticlockwise directions for even distribution, and left to solidify for microbial enumeration using the pour plate method. For selective microbial counts, MacConkey agar was used for coliforms, Nutrient Agar for total aerobic plate count (TAPC), Eosin Methylene Blue (EMB) agar for *Escherichia coli*, Mannitol Salt Agar (MSA) for *Staphylococcus* spp, and Potato Dextrose Agar (PDA) for fungi. All bacterial plates were incubated at 37 °C for 24 hours, while the PDA plates were incubated at 25 °C for 48–72 hours to ensure consumer safety (Ikeh et al., 2021).

2.11 Proximate Composition

2.11.1 Determination of ash content

A clean crucible was weighed (W1) after drying in an oven. About 2 g of the sample was added to the crucible and weighed as W2. The crucible and its content were transferred into a muffle furnace set at 600°C for 4 hours until a gray color indicated complete ashing (Abdulrazaq & Bajepade, 2025). After cooling in a desiccator, the crucible was weighed as W3.

Ash content was calculated as: $\% ash = \frac{(W3-W1}{W2-W1} \times 100$

2.11.2 Determination of crude fiber

Following the methods of Abdulrazaq & Bajepade, (2025), 2 g of the sample (W1) was defatted with petroleum ether for 2 hours and boiled under reflux for 30 minutes with 200 mL of 1.25% H_2SO_4. It was filtered, washed until neutral, and boiled with 200 mL of 1.25% NaOH for 30 minutes. The residue was filtered, dried at 100°C, and incinerated in a muffle furnace at 600°C for 3 hours (Abdulrazaq & Bajepade, 2025). Crude fiber content was calculated as: % crude fiber = $\frac{W2-W3}{W1} \times 100$

2.11.3 Determination of moisture content

A clean crucible (W1) was weighed, and 2 g of the sample (W2) was added. The sample was dried in an oven at 105°C, cooled in a desiccator, and weighed as W3 (Akinboye et al., 2024). Moisture content was determined as: $\frac{W3-W1}{W2-W1} \times 100$

2.11.4 Determination of crude protein

Crude protein was determined using the method of Akinboye et al. (2024). A 2 g sample was digested with 25 mL of concentrated H_2SO_4, $CuSO_4$, and Na_2SO_4 catalysts at 80°C until a clear green solution was obtained. The digest was diluted to 250 mL, and the nitrogen content was determined.

2.11.5 Determination of crude fat

Using the Soxhlet extraction method (Abdulrazaq & Bajepade, 2025), 5 g of the sample was extracted with petroleum ether (40–60°C) for 6 hours. The extracted residue was dried and weighed to determine fat content.

2.11.6 Estimation of carbohydrate content

Carbohydrate content of the fermented foods was calculated by difference: The difference in value was taken as the percentage total carbohydrate content of the sample (Chileshe et al., 2020).

Calculated thus:% Carbohydrate content = 100 - (%protein + %moisture + %fat +%ash).

2.12 Determination of Antioxidant Activities of Cherry Wine

2.12.1 Hydrogen peroxide scavenging assay

The hydrogen peroxide (H_2O_2) scavenging activity of the Cherry Wine sample was evaluated using a modified method described by Yusuf-Salihu et al. (2025). A 40 mM solution of H_2O_2 was prepared in a phosphate buffer (pH 7.4), and its concentration was confirmed by measuring absorbance using a spectrophotometer. To assess antioxidant activity, 4 ml of Cherry Wine was mixed with 0.60 ml of the H_2O_2 solution. After incubation for 20 minutes at room temperature, the absorbance was measured at 610 nm against a blank solution consisting of phosphate buffer and H_2O_2. The percentage of hydrogen peroxide scavenging activity by the Cherry Wine was calculated using the following formula:

$$\%\ Hydrogen\ peroxide\ scavenging\ activity = \frac{OD\ Control - OD\ Test}{OD\ Control} \times 100$$

2.12.2 Ferric reducing activity

The ferric reducing antioxidant power (FRAP) of cherry wine was evaluated using gallic acid as the standard reference, following an adapted method from (Xiao et al., 2015; Yusuf-Salihu et al. 2025). The reaction mixture containing 2.5 mL phosphate buffer (200 mM, pH 6.6), 2.5 mL 1% potassium ferricyanide, and 1 mL cherry wine sample (or gallic acid standard) was incubated at 50°C for 20 minutes before rapid cooling. After adding 2.5 mL 10% trichloroacetic acid to stop the reaction, the mixture was centrifuged (3000 rpm, 10 minutes), and 2.5 mL supernatant was combined with 2.5 mL deionized water and 1 mL 0.1% ferric chloride for absorbance measurement at 700 nm using a BIOBASE BK-D590 spectrophotometer. The percentage ferric reducing activity was calculated by comparing the sample's absorbance against the gallic acid standard and blank (containing all reagents except sample), demonstrating the wine's electron-donating capacity relative to this established phenolic antioxidant benchmark. The percentage of ferric reducing activity was calculated using the formula: The reducing activity was calculated as follows:

$$\%\ Ferric\ reducing\ activity = \frac{OD\ Test - OD\ Control}{OD\ Test} \times 100$$

2.12.3 Nitric oxide scavenging assay

The nitric oxide (NO) scavenging activity of cherry wine was evaluated using a modified method described by Yusuf-Salihu et al. (2025). A 5 mM solution of sodium nitroprusside was prepared in phosphate-buffered saline (PBS, pH 7.4) to serve as the NO radical donor. One milliliter of the sodium nitroprusside solution was mixed with 1 ml of the cherry wine and incubated at 25 °C for 30 minutes under light to facilitate the generation of nitric oxide. After incubation, 2 ml of Griess reagent comprising 1% sulfanilamide, 2% phosphoric acid, and 0.1% N-(1-naphthyl) ethylenediamine dihydrochloride was added to the reaction mixture to detect nitrite, a stable end product of NO. The absorbance of the resulting chromophore was measured at 546 nm using a UV-Visible spectrophotometer (BIOBASE BK-D590). A control sample containing all reagents except the Cherry Wine was used as the blank. The percentage of nitric oxide scavenging activity was calculated using the formula:

$$\%\ Nitric\ oxide\ scavenging\ activity = \frac{OD\ Control - OD\ Test}{OD\ Control} \times 100$$

2.12.4 DPPH free radical scavenging assay

The antioxidant capacity of cherry wine was evaluated through DPPH (2,2-diphenyl-1-picrylhydrazyl) radical scavenging activity using ascorbic acid as the reference standard, following an adapted protocol from Yusuf-Salihu et al. (2025). The reaction mixture consisted of 4 mL of 1 mM methanolic DPPH solution combined with 1 mL of cherry wine extract, which was then incubated in darkness at room temperature for 30 minutes to prevent radical degradation and enable antioxidant-radical interaction. Absorbance was measured at 517 nm using a BIOBASE BK-D590 spectrophotometer, with a methanol-DPPH solution serving as the blank control. The percentage of DPPH radical

scavenging activity was calculated using the formula:

$$\% \text{ DPPH free radical scavenging activity} = \frac{OD\ Control - OD\ Test}{OD\ Control} \times 100$$

2.13 Sensory Evaluation

The sensory properties of the pasteurized cherry wine were evaluated by a panel of 10 semi-trained assessors (undergraduate students from Kwara State University, Malete, aged 22–30 years). A 9-point hedonic scale was used, where 1 = "dislike extremely" and 9 = "like extremely." Each panelist independently scored the sample for color, flavor, taste/aroma, and overall acceptability. To contextualize the results, the cherry wine was compared directly to a commercially available wine. This structured approach, adapted from Barbe et al. (2021), allowed for the assessment of relative preference and consumer acceptance.

2.13.1 Final filtration of cherry wine

After the completion of fermentation, the cherry wine was subjected to a final clarification step using a Pressure filter VINOFERM maxi 11 l complete. This process was employed to remove suspended solids, residual yeast cells, and other particulate matter, thereby enhancing the clarity and stability of the final product (Lillo et al., 2024).

2.14 Statistical Analysis

Data were analyzed using ANOVA, with significance set at $p < 0.05$. Mean separation was performed using Duncan's Multiple Range Test, and results were expressed as mean ± standard deviation (Chilikwazi et al., 2023).

3. RESULTS

3.1 Morphological, Microscopic, and Biochemical Characteristics of Isolated Yeast from Palm Wine

The yeast strain isolated from palm wine exhibited creamy-white, smooth colonies with entire margins when cultured on Potato Dextrose Agar (PDA). Microscopic examination revealed oval cells with multilateral budding, consistent with the morphology of *Saccharomyces cerevisiae*. Biochemical characterization using carbohydrate fermentation tests, as shown in Table 1, demonstrated positive reactions for fructose, galactose, maltose, sucrose, and glucose, while lactose was not fermented. Based on both morphological and biochemical characteristics, the isolate was presumptively identified as *Saccharomyces cerevisiae*. During wine fermentation, the number of microorganisms was monitored daily to track microbial dynamics and ensure consistency throughout the fermentation process.

3.2 Characteristics of the Product Wine during Fermentation

The characteristics of wine fermentation using *Saccharomyces cerevisiae* were shown in Table 2 over nine days. At 0 days, the wine had a specific gravity of 1.085, pH of 3.2, total soluble solids of 13 °Brix, an inoculum size of 1.5×10^{9}, alcoholic content of 0.31% v/v, and titratable acidity of 5.187 g/100 ml. By days 1–2, the specific gravity slightly increased to 1.088, pH rose to 3.5, total soluble solids decreased to 11 °Brix, inoculum size reduced to 2.1×on10^{8}, alcoholic content increased to 1.49% v/v, and titratable acidity dropped to 4.74 g/100 ml. In days 3–4, the specific gravity dropped to 1.084, pH returned to 3.2, total soluble solids slightly increased to 11.5 °Brix, inoculum size was 1.7×10^{8}, alcoholic content reached 2.97% v/v, and titratable acidity further declined to 4.51 g/100 ml. During days 5–6, specific gravity continued to decline to 1.080, pH slightly reduced to 3.1, total soluble solids dropped to 10 °Brix, inoculum size was 1.15×10^{8}, alcoholic content rose to 5.36% v/v, and titratable acidity decreased to 3.15 g/100 ml. Finally, by days 7–8, the specific gravity dropped to 1.070, pH remained at 3.1, total soluble solids stayed at 10 °Brix, inoculum size further declined to 1.10×10^{8}, alcoholic content peaked at 6.32% v/v, and titratable acidity reached its lowest at 3.10 g/100 ml.

3.3 Consumer Safety of Wine Produced

To ensure the microbial safety of the produced wine, daily microbial counts were conducted throughout the fermentation process using the pour plate method. Samples were taken aseptically each day, serially diluted, and plated on appropriate agar media to monitor microbial dynamics. Particular attention was given to the detection of potential pathogenic organisms. The final microbial testing revealed no presence of *Staphylococcus* spp., coliforms, or *Escherichia coli* (*E. coli*), as shown in Table 3, with all bacterial counts recorded at 0.00 CFU/mL. The

Table 1. Morphological and Biochemical Characteristics of the Isolated Yeast from Palm wine

Colony Morphology (Macroscopic and Microscopic)	Sugar Fermentation Test						Probable Organism
	Fructose	Galactose	Maltose	Glucose	Sucrose	Lactose	
The isolated yeast displayed creamy to off-white, smooth, raised colonies with entire margins on solid Potato dextrose agar, while microscopically, it appeared as oval and slight buds.	+	+	+	+	+	-	*Saccharomyces cerevisiae*

Table 2. The table demonstrates the product wine characteristics when fermenting with Cherry *Saccharomyces cerevisiae*

Days	Specific Gravity (kg/m^3)	pH	Total Soluble Solids (^{0}Brix)	Inoculum size	Alcoholic content (%v/v)	Titratable acidity (g/100ml)
0 day	1.085	3.2	**13**	1.5x 10^8	0.31	5.187
1-2	1.088	3.5	11	2.1x10^8	1.49	4.74
3-4	1.084	3.2	11.5	1.7x10^8	2.97	4.51
5-6	1.080	3.1	10	1.1510^8	5.36	3.15
7-8	1.070	3.1	10	1.10x10^8	6.32	3.10

Table 3. Consumer Safety of Wine Produced

Samples Site	Total *Staphylococcus* spp Count	Coliform Count	*E. coli* Count	Saccharomyces (CFU/ml x10^8)
Cherry Wine	0.00	0.00	0.00	1.10x10^8

examined *Saccharomyces* showed a total microbial count of 1.10 × 10^8 CFU/mL. These results confirm that the wine is free from harmful bacterial pathogens and safe for consumption.

3.4 Proximate Composition of Cherry Wine and Cherry Fruit

The proximate composition analysis revealed significant differences between cherry wine and fresh cherry fruit. Cherry wine had higher moisture content (90.27 g/l) and carbohydrate levels (7.18%), but contained lower ash (0.05%), protein (2.50%),The wine contained no detectable fat or fiber, in contrast to their presence in the fresh cherry fruit (3.477 ± 0.067% and 2.014 ± 0.004%, respectively); this difference is attributed to the removal of insoluble plant materials during juice extraction and clarification, the water insoluble nature of lipids, the inherently low lipid content of cherries, and the fact that *Saccharomyces cerevisiae* targets fermentable sugars rather than fats, with no lipid synthesis occurring at levels detectable by standard wine analysis methods. In contrast, the fresh cherry fruit showed higher values for ash (2.66%), protein (9.35%), fat (2.01%), and fiber (3.48%), but lower moisture (62.43 g/l) and carbohydrate content (2.66%).

3.5 Antioxidant Activities

Fig. 1 illustrates the antioxidant activities of cherry wine in comparison to standard antioxidants across four assays: DPPH, ferric reducing activity, nitric oxide scavenging, and H_2SO_2 inhibition. The cherry wine showed moderate antioxidant performance, with percentage activities ranging from approximately 50% to 58%, while the standard antioxidants consistently exhibited higher activities, ranging from about 70% to 82%. Among the tested parameters, the ferric reducing activity and nitric oxide scavenging showed the highest levels for both the cherry wine and the standards.

Table 4. Proximate composition of cherry wine and cherry fruit

Parameters	Cherry Wine	Cherry Fruit
Ash (%)	0.054±0.004	2.662±0.061
Carbohydrate (%)	7.175±0.016	2.662±0.061
Fibre	0.000	3.477±0.067
Fat (%)	0.000	2.014±0.004
Moisture (g/l)	90.272± 0.080	62.429±0.102
Protein (%)	2.500±0.068	9.348±0.112

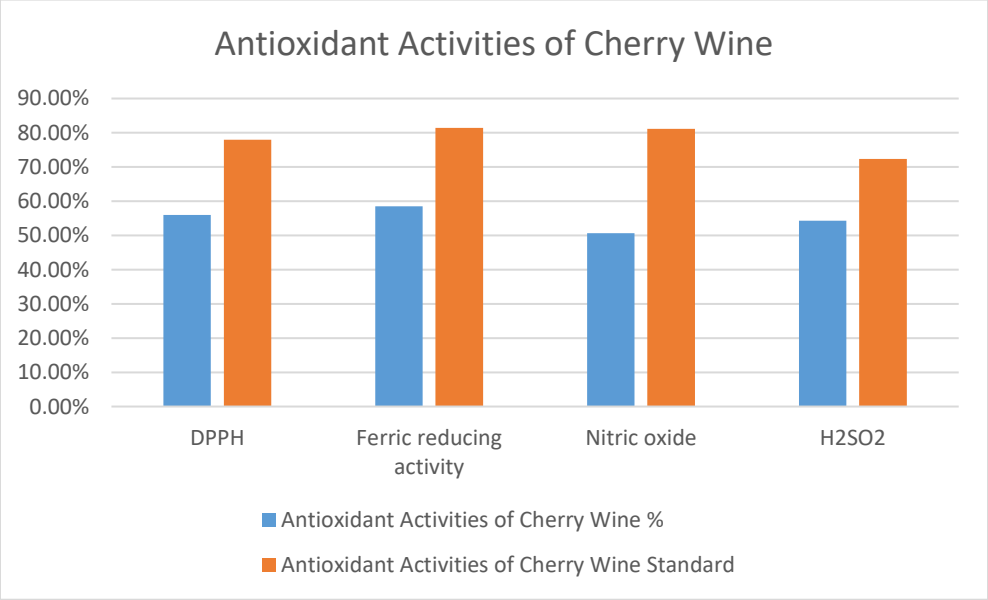


Fig. 1. Antioxidant Activities of Cherry Wine

Table 5. The sensory and organoleptic qualities of the product and commercial wine

Parameters	Product wine	Commercial wine
Colour	5.0	6.5
Flavour	5.2	6.2
Taste/aroma	5.3	5.1
General acceptability	5.2	5.9

3.6 Sensory and Organoleptic Qualities of Product and Commercial Wine

Most of the sensory and organoleptic evaluation parameters yielded higher ratings for the commercial wine compared to the cherry fruit wine. Participants ranked the commercial wine higher in terms of color, flavor, and overall acceptability, with scores of 5.0, 5.2 and 5.3 respectively. However, the cherry fruit wine received a slightly better rating than the commercial wine in the taste/aroma category (5.3 to 5.1), although its aroma was only slightly acceptable when compared to the more pleasant and refined aroma of the commercial wine. Overall, the commercial wine was rated more favorably across most parameters.

4. DISCUSSION

The yeast strain isolated from palm wine was identified as *Saccharomyces cerevisiae* based on its distinct morphological, microscopic, and biochemical characteristics. Colonies appeared creamy-white, smooth, and raised with entire margins on Potato Dextrose Agar, while microscopic examination showed oval-shaped cells with multilateral budding, typical of *S. cerevisiae*. Biochemical analysis revealed positive fermentation of fructose, galactose, maltose, sucrose, and glucose, but a negative result for lactose, consistent with known fermentation profiles of *S. cerevisiae*. These findings align with those of Abdulla *et al* (2022) and (2024) and Serra et al. (2025), who reported similar morphological features and sugar utilization patterns for *S. cerevisiae*. Additionally, the inability to ferment lactose further confirms the identity of the isolate, as *S. cerevisiae* lacks the necessary β-galactosidase enzyme, a finding also reported by Titilayo et al. (2022) in their study on indigenous yeasts from palm wine.

Specific gravity measurement decreased from 1.085 at day 0 to 1.070 during days 7–8, indicating a steady decline throughout fermentation. This drop reflects the effective metabolism of sugars into ethanol and carbon dioxide by *Saccharomyces cerevisiae*. A similar trend was documented by Akshayasri et al. (2024), who observed a consistent decrease in specific gravity during fruit wine fermentation, highlighting yeast-driven sugar utilization. The pH of the cherry wine fluctuated slightly but showed an overall decline from 3.5 on days 1–2 to 3.1 by days 5–8. This slight reduction in pH is primarily attributed to the production and accumulation of organic acids during microbial fermentation, which enhances microbial stability and contributes to product preservation, a trend similarly observed by Mercanti et al. (2024). Despite the expected increase in total acidity with acid production, the titratable acidity actually decreased from 5.187 g/100 mL at day 0 to 3.10 g/100 mL by the end of fermentation. This reduction is due to the conversion of certain organic acids into neutral metabolites during nine (9) days of fermentation. Such contrasting behavior has also been noted in studies like Yuan et al. (2024), where variations in acidity trends were linked to differences in fruit composition, yeast strain, and fermentation parameters. Meanwhile, the total soluble solids dropped from 13 °Brix to 10 °Brix, indicating effective sugar utilization by *S. cerevisiae*, which correlates with increasing alcohol content an observation supported by Vicente et al. (2022). The yeast population, initially 1.5×10^9 CFU/mL, declined to 1.10×10^8 CFU/mL by days 7–8, reflecting reduced viability due to ethanol stress and nutrient depletion, as also documented by Lairón-Peris et al. (2021). Alcohol content rose from 0.31% at day 0 to 6.32% by the end, confirming vigorous fermentation activity consistent with findings by Wang et al. (2020), who associated increasing ethanol levels with active yeast metabolism.

According to the National Agency for Food and Drug Administration and Control (NAFDAC) in Nigeria, all alcoholic beverages, including fruit wines, must meet strict microbiological safety standards to be deemed fit for human consumption. These standards require that finished products be free from harmful microbial contaminants such as *Staphylococcus spp.*, coliforms, and *Escherichia coli*, and must adhere to good manufacturing practices (GMP), sanitary

conditions, and proper fermentation protocols throughout production. In compliance with these regulatory requirements, the consumer safety assessment of the site-produced cherry wine demonstrated the complete absence of pathogenic bacteria. Microbiological analysis showed zero detectable counts (0.00 CFU/ml) of *Staphylococcus spp.*, coliforms, and *E. coli*, as presented in Table 3, indicating that the product meets NAFDAC's microbiological safety criteria for human consumption. Furthermore, the presence of *Saccharomyces* species at a viable count of 1.10×10^8 CFU/ml reflects an active and beneficial fermentation culture, which is characteristic of healthy wine production. These results are consistent with findings reported by Gebremichael et al. (2024) and Mishra et al. (2024), who highlighted that strict adherence to hygiene, fermentation control, and processing standards is important in ensuring the microbial safety and overall quality of fermented fruit-based beverages.

The proximate composition analysis demonstrated that fermentation significantly altered the nutritional profile of cherry fruit, with cherry wine exhibiting increased moisture (90.27 g/l) and carbohydrate (7.18%) content, while protein (2.50%), ash (0.05%), fat (0.00%), and fiber (0.00%) were markedly reduced. The increase in moisture is attributed to dilution from added water during must preparation, a common practice in fruit wine production (Ajogun et al., 2020). The higher carbohydrate content in wine compared to fresh fruit was likely due to the breakdown of complex polysaccharides into simpler fermentable sugars, some of which may not have been fully consumed by yeast before fermentation ended. The reduction in protein and fat is attributed to microbial metabolism and enzymatic degradation, as *Saccharomyces cerevisiae* utilizes available nutrients to support growth and ethanol production (Adebo et al., 2022). However, the disappearance of fiber in the final product is not due to microbial utilization, as yeast lacks the enzymatic capability to digest dietary fiber. Instead, the absence of fiber reflects its insoluble nature and removal during juice extraction, clarification, and filtration steps. This is consistent with the findings of Hampton et al. (2021), Li et al. (2021), and Pinto et al. (2022), who reported similar nutrient losses in fermented fruit beverages due to processing and fermentation procedures.

The antioxidant activities of cherry wine, as depicted in Fig. 1, were evaluated using four different assays: DPPH radical scavenging, ferric reducing activity, nitric oxide inhibition, and H_2SO_2 scavenging. Across all parameters, the cherry wine showed appreciable antioxidant activity, although consistently lower than that of the standard antioxidant reference. For instance, DPPH scavenging activity of the cherry wine was approximately 55%, while the standard showed around 78%, indicating a moderate free radical neutralizing capacity. Ferric reducing activity followed a similar pattern, with the wine scoring around 58% compared to over 80% for the standard, reflecting the presence of phenolic compounds with moderate electron-donating ability. Notably, the nitric oxide inhibition activity was lower (approximately 50%) compared to the standard's 82%, likely due to fewer nitric oxide-interacting phytochemicals present in the wine. The H_2SO_2 scavenging activity of the cherry wine was also moderate (around 53%), trailing the standard's 70%. These results suggest that while the cherry wine possesses natural antioxidant properties attributable to its phytochemical constituents, its efficacy remains lower than pure standard antioxidants. This pattern is consistent with findings by Tzachristas et al. (2020), Ofoedu et al. (2022), and Gil et al. (2023), who observed similar antioxidant performance in naturally fermented fruit wines, highlighting that unrefined matrices generally exhibit less potent activity than pure standards. Enhancement through fermentation optimization or formulation with other bioactive-rich ingredients could improve the functional value of cherry wine in health-promoting applications.

The sensory and organoleptic evaluation revealed that the commercial wine consistently scored higher across most parameters compared to the cherry fruit wine, as shown in Table 5. The commercial wine was rated superior in terms of colour (6.5 and 5.0), flavour (6.2 and 5.2), and general acceptability (5.9 and 5.2), suggesting a more refined sensory profile that aligns with consumer expectations. This may be due to enhanced processing techniques, stabilizers in commercial winemaking. Interestingly, the cherry fruit wine slightly outperformed the commercial counterpart in the taste/aroma parameter (5.3 and 5.1), indicating that the natural aroma profile of the cherry wine may be more appealing to some consumers, possibly due to the fresh fruit base and absence of synthetic additives. Similar findings were reported by Lucas, (2023), who noted that artisanal fruit wines sometimes offer distinct aromatic advantages despite scoring lower in overall acceptability due to limited

processing. Additionally, the relatively lower colour and flavour scores of the cherry wine could be attributed to pigment loss or subdued fermentation compounds, as highlighted by Bekris et al. (2024), who observed diminished sensory attributes in naturally fermented tropical wines. Overall, the commercial wine's superior sensory appeal underscores the importance of processing sophistication in enhancing consumer acceptance of fermented beverages.

5. CONCLUSIONS

Laboratory findings on cherry wine fermentation using isolated *Saccharomyces cerevisiae* from palm wine aligned with published research, confirming the yeast's active role as a fermentation agent. Fermentation indicators such as specific gravity, pH, °Brix, inoculum size, alcohol content, and titratable acidity showed expected changes driven by yeast metabolism. Microbiological analysis confirmed the product's safety, with no harmful bacteria detected and viable yeast counts maintained. Antioxidant assays including DPPH, nitric oxide inhibition, ferric reducing power, and hydrogen peroxide scavenging revealed moderate antioxidant activity, supporting the presence of functional phytochemicals. Although commercial wine scored higher in overall sensory evaluation, the cherry wine outperformed it in taste and aroma, indicating potential for further refinement and consumer acceptance in future product development.

DISCLAIMER (ARTIFICIAL INTELLIGENCE)

Author(s) hereby declare that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc) and text-to-image generators have been used during writing or editing of this manuscript.

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

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