

Organoleptic Analysis of Doughs Fermented with Yeasts From A Nigerian Palm Wine (*Elaeis guineensis*) and Certain Commercial Yeasts

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Abstract: Yeasts isolated from a freshly tapped palm wine obtained from Akure, Nigeria were identified as *Schizosaccharomyces pombe*, *Saccharomyces cerevisiae*, *Debaryomyces hansenii*, *Geotrichum lactis* and *Zygosaccharomyces rouxii*. Each of the isolates was used to ferment wheat flour dough and baked. Sensory analysis of the doughs was carried out on leavening, texture, aroma, taste and appearance. *Saccharomyces cerevisiae* performed best in leavening the dough while *Debaryomyces hansenii* produced doughs with the best taste and aroma. Appearances of the doughs made with all the isolated yeasts did not differ significantly ($P < 0.05$) from that of the dough that lacked yeast.

Key Words: A Nigerian palm wine, Yeasts, Sensory properties of dough.

INTRODUCTION

Palm wine is an alcoholic beverage produced by the natural fermentation of the sap of various palm trees. Among the palms used are coconut (*Cocos nucifera*), oil palm (*Elaeis guineensis*), date palm (*Phoenix clotifera*) and raphia palm (*Raphia hookeri*) [1]. The unfermented sap is a clean, sweet, colourless syrup containing about 10-12% (w/v) sugar, which is mainly sucrose [2]. Upon fermentation by the natural microflora, the level of this sugar decreases as it converts to alcohol and other products whereas the sap becomes milky white due to the increased microbial suspension resulting from the prolific growth of fermenting organisms [3].

Previous study on the microbiology of *Elaeis guineensis* have incriminated several bacteria and yeast flora to be involved in the fermentation process [2]. Ezenroye and Okerentugba [4] reported the genetically and physiologically different isolated yeasts from palm wine. These variants include nine species of *Saccharomyces cerevisiae*, three *Candida* species, one *Schizosaccharomyces* species and one *Kluyveromyces* species.

Literatures have shown that bakers have used palm wine as a cheap alternative dough-leavening agent. Palm wine is able to raise dough because it harbours many yeast species. However, fermented baked dough produced using palm wine as a substitute for baker's yeast is usually characterized by a sharp sour taste, pronounced palm wine flavour and short shelf life (Personal communication in 2007 with Kole, Kole bakery, Akure, Ondo State, Nigeria). This sour taste and short shelf life could be attributed to the large number of microbial flora, particularly the lactic acid bacteria present in palm wine [5] that produce metabolites undesirable for bread production.

Elaeis guineensis harbours many yeast species [2]. Although considerable amount of work has been done in characterizing the yeast strains present in palm wine, there are only few information available on the leavening ability of the yeasts. Also, the location or environment where the palm wine is can determine the exact type of yeasts present in the drink. Therefore, this work was designed to isolate and identify yeasts present in palm wine freshly tapped in Akure, Nigeria and determine the dough leavening ability of these yeasts. The organoleptic properties of the doughs made with these microbes were investigated.

MATERIALS AND METHODOLOGY

Microbial Analysis

A 1 mL aliquot of freshly tapped palm wine was aseptically collected from an Ijoka farm, Akure, Nigeria. The sample was serially diluted 100 folds after which 1 mL was pour-plated [6] in triplicate using PDA containing 0.1% (w/v) lactic acid. The plates were placed at $30^{\circ}\text{C} \pm 2^{\circ}\text{C}$ for 48 – 72 hours. After good growth of the colonies, distinct colonies were purified on fresh PDA by streaking. Each colony was confirmed to be yeast by examining it under a light microscope using oil immersion objective after staining with lactophenol-in-cotton-blue dye. Pure isolates were placed on PDA slants and stored at 4°C until needed.

The yeasts isolate were characterized based on their cultural characteristics (colony shapes, pigment, elevation, edge and surface appearance). Biochemical characterization of the isolates was done by testing for ability of the yeasts to ferment and assimilate sugars, utilize nitrate, form pellicle, spore, pseudomycelium and mycelium according to the methods of Harrigan, Olutiola *et al.*, Barnett *et al.* and Fawole & Oso [6-9].

Cultivation of Yeast Isolates for Dough Fermentation

The yeasts isolated were cultured separately at $25^{\circ}\text{C} \pm 2^{\circ}\text{C}$ in peptone broth medium containing 20% (w/v) glucose and lactic acid at concentration of 0.2% in 1 litre conical

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flask equipped with air locks. The set-up was agitated continuously for 72 hours in rotary shaker regulated at 150 rpm. After good growth was observed, the biomass concentrate for each yeast species was obtained by centrifuging it in an MSE centrifuge machine at $12,168 \times 10^3$ g for 10 min. The yeast concentrates were washed sufficiently with sterile distilled water after which they were resuspended in sterile distilled water. The same procedure was applied to the commercial yeasts (Saf-instant and STK Royal) used as controls.

Determination of Fermentative Ability of the Yeasts

All the yeast isolates were used to ferment dough in order to test their fermentative ability. Samples of dough were prepared as described by Cauvian and Young [10]. Each dough sample contained wheat, flour, salt, water, sugar and fat. All the ingredients were properly mixed. Each yeast isolate (1.41×10^9 CfU/mL) was used to ferment the dough. Baker's yeast (STK Royal and Saf- instant) were used separately as positive control yeasts to ferment the dough. Another set of dough formulation that did not contain any yeast sample was prepared as the negative control. The dough samples were left to ferment at room temperature at $37^\circ\text{C} \pm 2^\circ\text{C}$ for about 1 hour. The doughs were baked in an oven for 1 hr at 200°C .

Comparative Analysis of the Baked Dough Samples

The baked dough samples were subjected to sensory analyses by using panel of 26 enlightened judges to evaluate the following physical parameters namely: leavening, taste, texture, appearance and aroma. Five points grade was used in the analysis starting with Excellent =5, Very Good = 4, Good = 3, Satisfactory = 2 and Poor = 1.

Analysis of Data

All data obtained from sensory evaluation were subjected to statistical analysis by using Analysis of Variance and DUNCAN Multiple Range Test. Significance of variations in the analyzed data was tested at 95% confidence limit.

RESULTS AND DISCUSSION

Five morphologically different yeast strains namely *Schizosaccharomyces pombe*, *Debaryomyces hansenii*, *Geotrichum lactis*, *Saccharomyces cerevisiae* and *Zygosaccharomyces rouxii* were obtained from the freshly tapped palm wine (Table 1). The quantity and complexity of yeasts isolated from the palm wine used in this study is in agreement with the findings of Ezenronye and Okerentugba [4].

The complexity and variation in species of yeasts isolated is related to the fact that the yeasts originate from several sources such as the tapping container (which may retain some yeasts) and from the tapping environment. Furthermore, palm wine contains a high level of sucrose (10-12%). This high sugar level favours the growth of yeasts. It further gives credence to the general belief held in the early days of research that yeasts are found in sugary substances [11].

The organoleptic properties of doughs fermented with the various yeast isolates are presented in Figs. 1-5. The figures show that they compared well with doughs produced using commercial yeasts (Saf-instant and STK Royal) in all sensory attributes tested (leavening, texture, aroma, taste and appearance). All the isolates showed fermentative ability as depicted by their leavening activities (Fig. 1). Mean ratings of the leavening activities of the yeasts range between 2.33 (*Zygosaccharomyces rouxii*) and 2.83 (*Saccharomyces cerevisiae*). This corresponds to good leavening abilities on the sensory scale used at significant level of $P < 0.05$.

The analysis of variance (ANOVA) shows that one of the commercial yeasts (Saf-instant) did not differ significantly from *Schizosaccharomyces cerevisiae* and *Debaryomyces hansenii* ($P < 0.05$) in its leavening performance. The commercial yeasts STK Royal and Saf-instant had mean leavening activities of 2.70 and 2.40 respectively while the negative control (dough which lacked yeast) scored 2.29.

When compared with the negative control, the data showed that the isolated yeasts increased the size of doughs which they fermented considerably. This confirms the basis of using palm wine as a substitute for baker's yeast by some bakers. The result is supported by the abilities of the yeasts to ferment sugars especially glucose and fructose, the break down of which brings about the release of carbon dioxide that causes dough to rise. The highest leavening activity recorded for *S. cerevisiae* indicates that it is the best biological wheat dough leavener obtained in this work because it performed better than the two commercial yeasts used as controls. The result is in agreement with the findings of Somiari and Udoh [12] and Adenaike et al. [13] who reported that *Saccharomyces* species isolated from palm wine were found to be the best in leavening wheat dough.

The mean texture ratings obtained for the doughs fermented with the yeast isolates range between 2.84 (*S. cerevisiae*) and 2.14 (*Zygosaccharomyces rouxii*) (Fig. 2). This score range falls within good on the sensory scale used. The texture score recorded for *S. cerevisiae* followed the same

Table 1. Morphological and Biochemical Characteristics of the Yeasts Isolated from Palm Wine in Akure, Nigeria

S/No.	MORPHOLOGY							BIOCHEMICAL PROPERTIES: FERMENTATION/ASSIMILATION											Yeast Identity
	Cell Shape	Ascospore		Spore	Ps	My	Pe	Gl	Ga	Su	Fr	La	Ma	Ra	Ce	Xy	Ar	Mn	
		Present/Absent	Shape																
A	Cylindrical	ND	ND	+	-	-	+	FA	-A	FA	FA	--	-A	FA	-A	-A	--	FA	<i>Schizosaccharomyces pombe</i>
B	Oval	+	Oval	+	+	-	+	FA	FA	FA	FA	FA	-A	-A	-A	--	--	-A	<i>Debaryomyces hansenii</i>
C	Oval	+	Oval	+	-	+	+	FA	FA	-A	FA	FA	-A	-A	-A	-A	-A	FA	<i>Geotrichum lactis</i>
D	Oval	+	Oval	+	+	-	-	FA	FA	FA	FA	--	FA	FA	--	--	--	-A	<i>Saccharomyces cerevisiae</i>
E	Spherical	+	Oval	+	+	-	-	FA	FA	FA	FA	--	-A	FA	--	--	--	FA	<i>Zygosaccharomyces rouxii</i>

Keys: Ps: Pseudomycelium, My: Mycelium, Pe: Pellicle, Gl: Glucose, Ga: Galactose, Su: Sucrose, Fr: Fructose, La: Lactose, Ma: Maltose, Ra: Raffinose, Ce: Cellobiose, Xy: Xylose, Ar: Arabinose, Mn: Mannose, +: Positive or Present, -: Negative or Absent, FA: Fermentation and Assimilation, -A: Assimilation only, ND: Not Determined

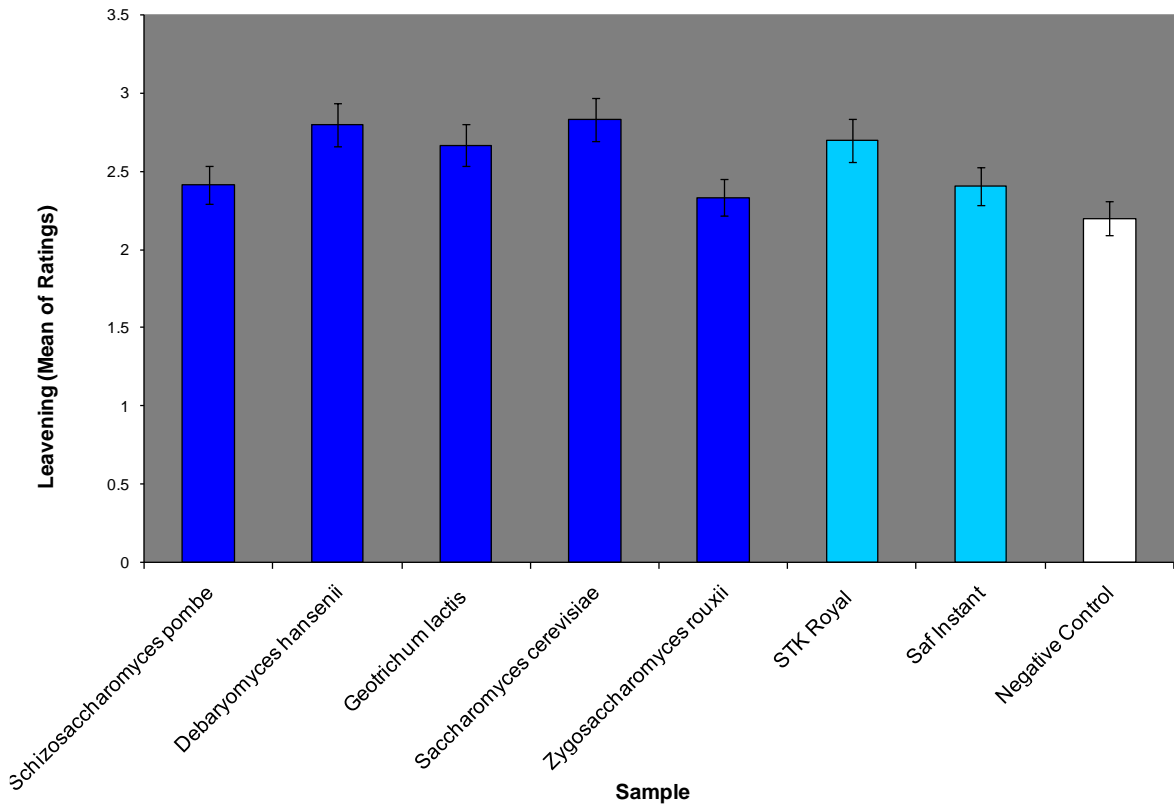


Fig. (1). Dough leavening activities of the various yeasts isolated from palm wine.

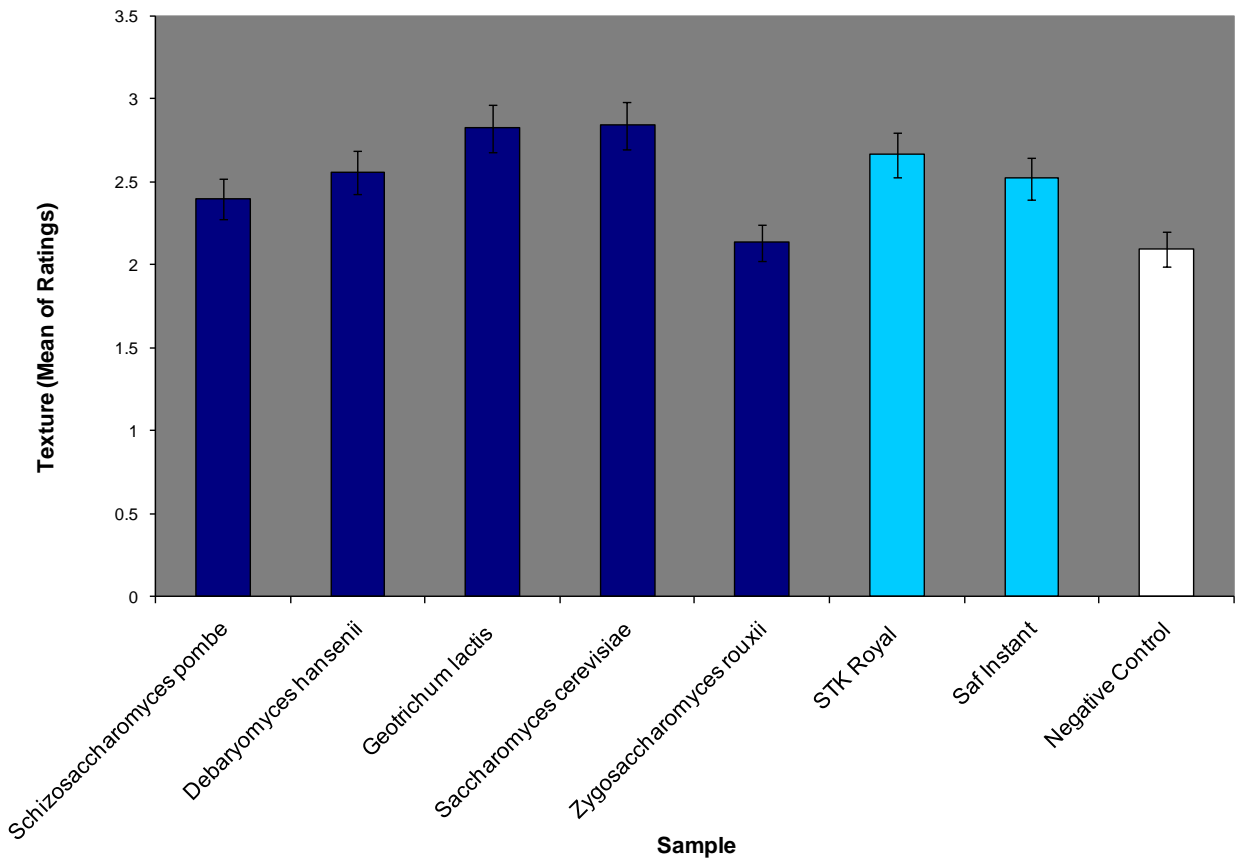


Fig. (2). Texture of baked doughs made with the various yeasts isolated from palm wine.

trend as its leavening activity since the highest texture score was obtained for it. Olorunfemi and Adetuyi [14] reported a similar finding. *Geotrichum lactis* had the next high score for texture (2.82) followed by *Debaryomyces hansenii* and *Schizosaccharomyces cerevisiae* at 2.56 and 2.40 ratings respectively. Generally, the texture ratings of doughs fermented with these yeasts are at very close range to their leavening activity ratings, thus suggesting that besides causing dough to rise, the yeasts have improved the texture of the doughs they fermented. This confirmed the statement of Corriher [15] that expansion of dough due to the carbon dioxide produced by yeasts leads to a characteristic porosity and texture of fermented baked dough. The low leavening activity and texture ratings of the negative control (dough which lacked yeast) confirms the effect of yeast on the fermented baked doughs.

Doughs fermented with the yeasts showed varying acceptance levels of aroma (Fig. 3). *Debaryomyces hansenii* produced dough with the best aroma (3.16). This was followed by *Saccharomyces cerevisiae*, *Schizosaccharomyces pombe*, *Zygosaccharomyces rouxii* and *Geotrichum lactis* with aroma ratings of 2.91, 2.80, 2.67 and 2.65 respectively. All the yeasts produced doughs with aroma ratings comparable with those of the commercial yeasts. The good and very good ratings of aroma indicate that the yeasts were able to produce compounds such as carbonyls, aldehydes and ketones that have imparted appealing flavours into the doughs.

The mean taste and appearance scores obtained for the dough fermented with the isolated yeasts and those of the commercial yeasts as well as the dough which lacked yeast range between 2.87 and 3.32 for taste and 2.76 and 3.17 for appearance (Figs. 4 and 5). The taste and appearance of the

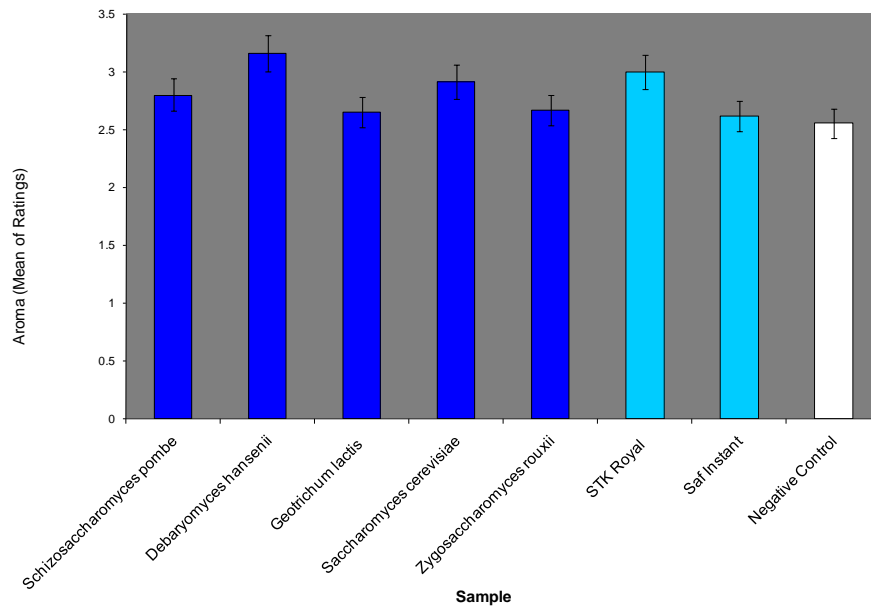


Fig. (3). Aroma of baked doughs made with the various yeasts isolated from palm wine.

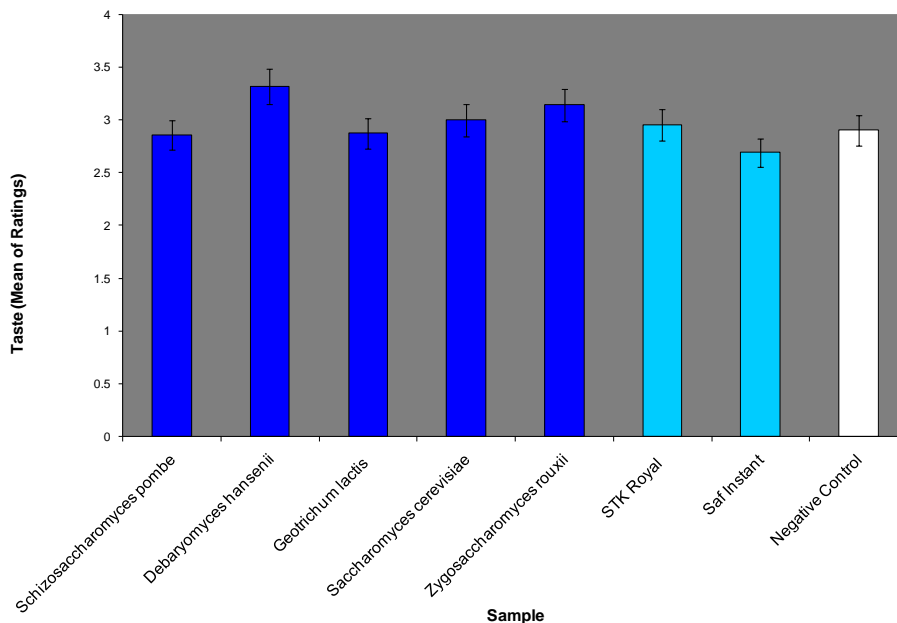


Fig. (4). Taste of baked doughs made with the various yeasts isolated from palm wine.

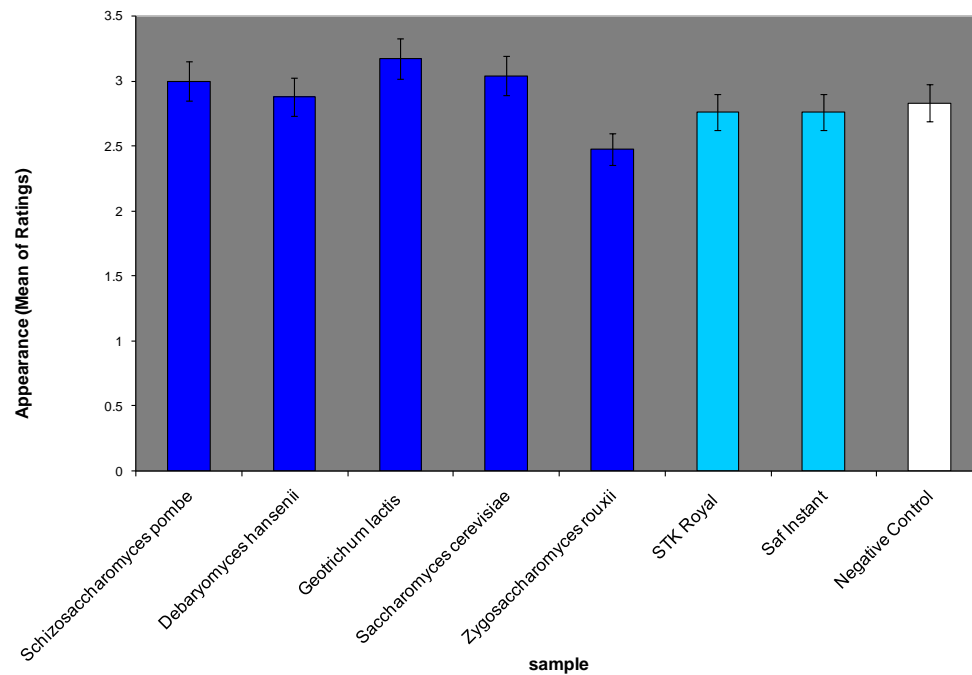


Fig. (5). Appearance of baked doughs made with the various yeasts isolated from palm wine.

positive control did not differ significantly from the negative control. This means that the appearance and tastes of fermented doughs after baking may not be totally dependent on yeast activity, rather on the ingredient formulation as all the dough samples contained the ingredients in equal proportion. Hence, the isolated yeasts produced doughs with acceptable sensory attributes of taste and appearance with no significant difference from the commercially available yeasts.

In conclusion, this work has shown that palm wine contains yeasts that can produce baked doughs with good sensory attributes that compares favourably with commercial yeasts used for baking. The yeasts isolated from palm wine have shown considerable leavening activity.

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