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Full Length Research

Quality acceptability of wine produced from fermented tiger nut drink fortified with coconut milk

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ABSTRACT: In some parts of the world, tiger nut (*Cyperus esculentus*) tubers are widely used as a healthy food for both human and animals due to nutritional, functional and medicinal properties of the crop. This study is designed to evaluate quality attributes and acceptability of fermented tiger nut drinks fortified with defatted coconut milk and date syrup. Milk was extracted from the sprouted tiger nut tubers, mixed with defatted coconut milk in ratio of 90:10, 80:20 and 70:30 respectively and date syrup was added to taste. Each sample was allowed to ferment for 24, 48 and 72 hours with the addition of 1 g of yeast (*Sacharomyces cerevisiae*). Sprouted and unfermented tiger nut milk without coconut milk and date syrup was taken to be control experiment. The results of physic-chemical properties of the drinks showed that temperature (23.7 – 30.5°C), pH (2.54 – 3.20), Brix (3 – 5°), specific gravity (0.86 – 1.05 g/cm^3), alcohol content (0.53 – 7.61%), iodine value (0.11 – 0.67), saponification value (20.89 – 68.86) and viscosity (780 mPa.S -1560 mPa.S). There was no microbial growth in all the samples for six months except A^{48} sample that had 1.00 cfu/g in week 4, 3.90 cfu/g in week 5 and 10.50 cfu/g in week 6. At $p \geq 0.05$ significant level, there was no significant difference in all the sensory attributes of most samples. Fermented tiger nut provides alternative drink with relatively low alcohol content compared to bottled wines in the market.

Keywords: Analysis, attribute, evaluate, fermentation, sample, wine.

INTRODUCTION

Tiger nut (*Cyperus esculentus*) milk could be regarded as imitation milk which is derived from tiger nut tubers and it is the most popular product from tiger nuts (Elom and Ming, 2017). This milk is known as *chufa de horchata*, *atadwe* and *kunu aya* in Spain, Ghana and Northern Nigeria respectively (Gambo and Dua, 2017). This imitation milk from tiger nut can be consumed ordinarily or combined with other liquid beverages. Tiger nut milk is a non alcoholic drink that is rich in nutrients (Nwobosi et al., 2013). However, it contains high quality energy, protein, minerals and vitamins, that are suitable for children, grownups and sport men but it is highly underutilized (Nyarko et al., 2011 and Sanchez – Zapata et al., 2013). Tiger nut milk prevents heart problems and thrombosis as well as activating blood circulation; it also helps in the prevention and treatment of urinary tract and bacterial infection hence, helps in the reduction of the risk of colon cancer (Elom and Ming, 2017; Adejuyitan et al., 2009).

Coconut milk is a white milky liquid extracted from the flesh of matured coconuts. It enhances weight loss, lowering cholesterol and it is well known in health care community as an alternative to diary milk (Lasekan and Abdulkarim, 2012). Coconut milk contains iron, magnesium, vitamin A, vitamin C, vitamin D, calcium, sodium and sugar and they are important in diets (Santosa et al., 2019).

Date fruits are good source of essential nutrients with much health potentials and benefits. The important quality parameters of date fruits to consumers are the appearance in terms of shape and color, physical condition like absence of defects, flavor and mouth feel and its nutritional values (Shahid et al., 2020). Date fruits are eaten either as dry or soft fruit and the juice could be extracted and boiled into concentrated form as syrup. Date fruits consist of easily digestible sugars such glucose, fructose and sucrose (Ezeh et al., 2014; Farahnaky et al., 2016).

The total energy value of tiger nut drink is due to its fat content and the milk can be fermented with starter cultures such as yoghurt starter culture as well as some *probiotics* to produce yoghurt and *probiotic* products respectively (Oyedepo and Odoje, 2014). Lactic and non lactic acid bacteria present in tiger nut enhances fermentation of the milk (Adejuyitan, 2011; Asante et al., 2014). During the fermentation process of tiger nuts, there is production of some quantity of ethanol due to microbial activities involved (Sanchez–Zapata et al., 2009). *Schizosarcharomyces pombe* and *Schizosarcharomyces boulderi* are the dominant yeasts in the production of traditionally fermented beverages, especially those derived from maize and millet while *Saccharomyces cervisiae* and *Carlbergensis* are the yeast involved in the production of beer (Shrikant et al., 2014).

Tiger nut has high post harvest looses, thus, processing of the crop increases its utilization. It is rich in fiber, vitamins and minerals (mainly Phosphorus and Potassium) and other beneficial plant compounds (Arafat et al., 2009). In view of nutritional and economic potentials of the nut, this work intends to add to its utilization as a food source by determining the quality acceptability of the wines produced from the fermented milk fortified with defatted coconut milk and sweetened with date syrup so as to reduce alcohol level for general consumption.

Figure 1. Dried tiger nut tubers.

Figure 2. Sprouted tiger nut tuber.

MATERIALS AND METHODS

Study area

The study was carried out in the Food Science and Technology laboratory, Bells University of Technology, Ota, Nigeria between October, 2019 and April, 2020.

Specimen collection

Fresh and good quality tiger nuts, coconuts, date fruits, sampling bottles, packaging bottles, white transparent bucket and jute bags were purchased from Ojuwoye Market, Mushin Lagos, Nigeria. The yeast (*Saccharomyces cerevisiea*), was purchased from Ojota chemical market, Ojota Lagos, Nigeria.

Methods

The selected dried tiger nuts (*Cyperus esculentus var. esculentus)* as shown in Figure 1 were steeped by soaking in potable water at room temperature between 27 and 30°C for 72 hours with constant changing of the water at 6 hours interval and soaked again into clean water to allow the tubers to absorb water. The tubers were thereafter rinsed and spread on a well washed and dried jute bag and kept in a cupboard to keep it away from light while the tubers were wetted at intervals; this was done as described by Abenaa and George, (2014). Sprouting was halted when the tubers busted and plumules came out as shown in Figure 2. Sorting and grading of the sprouted tiger nut was carried out manually. The sprouted tubers were washed with portable water to remove contaminants. They were then wet milled using attrition mill and sieved with muslin cloth. The filtrate was the expelled milk, the thick milk was then pasteurized at $72^{o}C$ for 15 minutes, and the pasteurized milk was allowed to cool to 45°C thereafter filled into sterilized Polyethylene terephthalate (PET) bottles. The coconut meat was grated and blended with hot water then sieved using muslin cloth. The resulted milk was defatted by refrigerating for 24 hours. The date fruits were opened to remove the stones and soaked in water at 60°C for 12 to 24 hours, then mashed with warm water and sieved using muslin cloth. The turbid date juice was concentrated by boiling and cooled.

Procedure for production of mild wine from fermented tiger milk fortified with coconut milk

This was carried out using modified method of Asagbra and Oyewole (2002) as shown in Figure 3. The sprouted tiger nut juice was portioned into four, the first portion was not fermented which was the control while the other three portions (90, 80 and 70% tiger nut milk) were fermented with the addition of 1 g of *Sacharomyces cerevisiae* (yeast) to each of the three portions. Defatted coconut milk at 10, 20 and 30% respectively was added to tiger nut milk; and date juice was also added as shown in blending ratio in Table 1. The first portion was fermented for 24 hours, the second for 48 hours and the third portion for 72 hours. The fermented drink was homogenized and the mixtures were separately pasteurized at 60°C for 30 minutes after filtration, cooled to 45°C, filled while still hot into sterilized PET bottles and labeled.

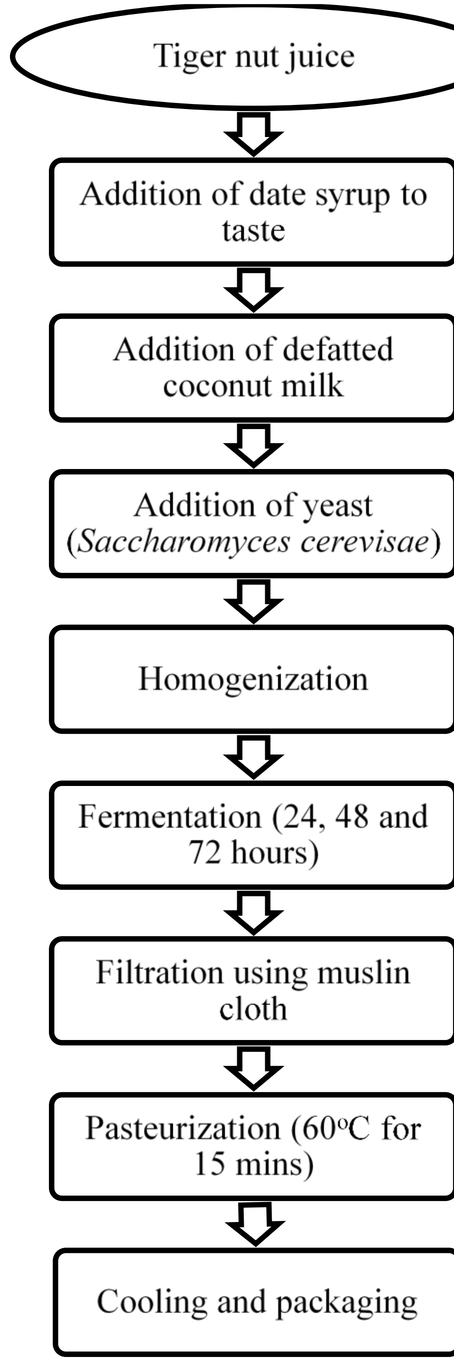

Figure 3. Flow chart for production of tiger nut wine from fermented drink (**Source:** Modified method of Asagbra and Oyewole, 2002).

Determination of physico–chemical properties

Specific gravity was determined using density bottle and a desicator as described by AOAC (2005). Temperature and pH was determined using the method described by AOAC (2005). Total sugar content was determined using a hand held refractometer of 0 to 40% brix range. Viscosity was determined using Brookfield rational viscometer; model NDJ- 5S, a method described by Chukwuma et al. (2010). The alcohol content of each sample was determined based on the specific gravity of the sample before and after fermentation. Saponification value was determined using an aldehyde – free potassium hydroxide as described by FSSAI (2012). Iodine value was determined using Hanus method as described by FSSAI (2012).

Microbial analysis

Each sample of tiger nut drink was serially diluted into 10^4 dilution factor and inoculations were made from dilution factor 10^4. The required quantity of nutrient agar was prepared during total plate count; Potato Dextrose agar was prepared during mould and yeast count; and Eosine Methylene Blue agar was prepared during coliform count according to the manufacturer's instructions in conical flasks, corked and sterilized at 121°C for 15 minutes. Each agar was allowed to cool down to about 45°C. Using pour plate method, 1 ml of sample was inoculated into labeled sterile plates in duplicate under aseptic condition using sterile pipette. All plate was allowed to set and incubated

Table 1. Blended ratios of tiger nut drink.

Fermented Time (hour)	% Milk		% Milk		% Milk		Date syrup	Yeast
	Tiger nut	Coconut	Tiger nut	Coconut	Tiger nut	Coconut		
24	90	10	80	20	70	30	To taste	1 g
48	90	10	80	20	70	30	To taste	1 g
72	90	10	80	20	70	30	To taste	1.g

Control was sprouted tiger nut milk.

at 37°C for 24 hours, thereafter, number of colonies were counted and results were calculated in cfu/g (Egbere et al., 2007).

Storage stability test

Each sample of equal volume of tiger nut drink was dispensed into five separate sampling bottles and labeled accordingly. The bottles were kept on the laboratory cupboard, and mould and yeast count were analyzed on each bottle weekly for six weeks using Potato Dextrose agar, and the number of colony was calculated in cfu/g.

Evaluation of sensory attributes

Consumer assessment of overall acceptability of the tiger nut drink was done according to Jimoh et al. (2020). Twenty staff of Yaba College of Technology, Lagos, Nigeria was chosen. These are regular consumer of juice and wine and randomly selected for the evaluation. There were ten samples and each sample was placed in separate identical, transparent and covered cup. The cups were coded as sample 1, 2, ... and 10 respectively and placed on a clean table. A questionnaire was designed and distributed among twenty respondents to score attributes namely color, taste, flavor, sharpness and general acceptability on a Hedonic scale of 9 points: 9 was like extremely, 8 like very much, 7 like moderately, 6 like slightly, 5 neither like nor dislike,4 dislike slightly, 3 dislike moderately, 2 dislike very much and 1 dislike extremely. Each of the samples was presented at different times to each of the respondents to avoid any bias in judgement. The responses were collated to compare the consumer preferences of the tiger nut drink.

RESULTS AND DISCUSSION

Results of physico-chemical properties of tiger nut wines

The results of the physico–chemical properties of the products are presented in Table 2. It was observed that the pH of the products ranged from 2.54 to 3.20 with C^{72} having the highest pH value compared to the control sample E which had the least Ph value of 2.54; this could be on the fact that control sample was not fermented. This result is closely related to the report given by Ike et al. (2017) who revealed that pH of milk produced from dried tiger nut ranged from 3.2 to 4.5 while that of fresh tiger nut ranged from 3.0 to 4.2. However, pH range of the fermented tiger nut wine produced fells within the range of most wines sold in the marked. The pH of red wine ranges from 3.0 and 3.6 while that of white wine ranged from 3.0 and 3.3 (Rita, 2009). Fermentation temperature ranged from 23.70 to 30.50°C with A^{24} having the highest value of 30.50°C. High temperature in A^{24} might likely be as a result of low proportion of coconut milk. The temperature of the wines produced was in line with statement of Reynolds et al. (2001) who stated that wines desirable fermentation temperatures vary for red and white wines; fermentation temperatures of red wine ranged from 20 to 30°C and that of white wine is at 15°C or below. However, higher temperatures is favorable in red wine to improve the extraction of color, phenolic, and tannins from the substrate, hence the aim of fermentation temperature control is to preserve compounds that contribute to aroma and flavor.

The brix content of the products ranged from 3º to 5º. A^{24}, A^{72} and C^{72} had the same brix content of 5º while C^{24} and A^{48} had the same brix content of 3°. However, A^{24} and A^{72} samples have high percentage proportion of tiger nut milk and this could be the reason for high brix content. The brix, which is an indication of the sugar level of the wine is in close range with the result reported by Eke-Ejiofor and Nnodim (2019), it was revealed that wine produced from tiger nut from day 1 to day 6 during fermentation ranged from 1.25 to 4°. However, the result of this study is comparable to the brix of wines obtained from the fermentation of tiger nut with granulated sugar as the sweetener for 24 hours, 48 hours and 72 hours which was given as 4, 3.8 and 3.5° respectively (Akinwale et al., 2020). This showed that aside from the sugar in the tiger nut milk, date syrup also added to the sugar present in the mixture, part of which was used up by the yeast in the fermentation process.

The importance of specific gravity is to determine the buoyancy of a substance which is a measure of the ability of the substance to float on a fluid. Water is used as a standard of comparison for liquids and solids while air is used for gases. It is also called relative density and those that contain carbon, oxygen and hydrogen only, have specific gravity that is less than one (John, 2014). Specific

Table 2. Physico–chemical analyses of tiger nut wine

Sample	Temp. (°C)	pH	Brix (º)	Spec. gravity (g/cm^3)	Alcohol (%)	Iodine value	Sap. value	Viscosity (mPa.S)
A^{24}	30.50	3.06	5.00	1.03	2.23	0.25	24.72	1560
B^{24}	25.90	3.11	4.00	1.02	3.41	0.58	23.64	1340
C^{24}	25.20	3.08	3.00	1.03	3.26	0.36	24.39	1140
A^{48}	25.20	3.12	3.00	1.03	2.89	0.50	20.89	900
B^{48}	24.00	3.18	4.00	1.05	0.53	0.56	22.89	1120
C^{48}	23.70	3.12	4.00	1.00	6.30	0.11	68.86	1400
A^{72}	25.60	3.18	5.00	0.86	3.54	0.63	28.39	780
B^{72}	24.00	3.06	4.00	1.01	4.86	0.67	24.44	1230
C^{72}	26.30	3.20	5.00	0.99	7.61	0.43	31.38	1010
E	24.30	2.54	5.00	1.05	Nil	2.68	27.04	1530

Legend: A^{24}: 90% 24h; B^{24}: 80% 24h; C^{24}: 70% 24h; A^{48}: 90% 48h; B^{48}: 80% 48h; C^{48}: 70% 48h; A^{72}: 90% 72h; B^{72}: 80% 72h; C^{72}: 70% 72h; E: Control (Sprouted unfermented tiger nut milk).

gravity of the products ranged from 0.86 to 1.05 g/cm^3 with B^{48} and E having the highest value while A^{72} having the least value. The fluctuation in specific gravity of samples could be as result of inclusion of date syrup. Result obtained in this work is comparable with the result of the study of Ike et al. (2017), where specific gravity of the wines obtained were 1.03, 1.05 and 1.07 g/cm^3 for the tiger nut milk fermented for 24, 36 and 48 hours respectively while that of the plain was 1.02 g/cm^3. Also, the specific gravity of the ice cream obtained using date syrup as sugar substitute ranged from 1.047 to 1.088 g/cm^3 (Tammam et al., 2014). Ohoke and Igwebike-Ossi (2017) revealed that wine produced from tiger nut using granulated sugar as sweetener had specific gravity of 0.9926, 0.9923 and 0.9919 g/cm^3 for 24, 48 and 72 hours fermentation respectively. The specific gravity of the products from most of dried and fresh tiger nut milk and “zobo” juice ranged from 1.02 to 1.07 g/cm^3 for dried tiger nut and 1.01 to1.06 g/cm^3 for the fresh tiger nut as reported by Baidya et al. (2016).

Percentage alcohol by volume of wines is between 7 to 16%, 10 to 14% in most bottled wines and that of sweet wines is between 15 to 22% (Rita, 2009). The percentage alcohol content of the products ranged from 0.53 to 7.61% compared to E which had no alcohol and this could be on the fact that is an unfermented sample. C^{72} had the highest percentage alcohol value of 7.61% while B^{48} had the least value of 0.53%. In comparison with the alcohol content of the wines in the study of Ohoke and Igwebike–Ossi (2017), their results stated that 4.30% for 24 hours, 8.86% for 48 hours and 12.97% for 72 hours fermentation using granulated sugar as sweeteners. The use of sugar could be the reason for the differences.

Iodine values of the wines of this study were in this order: $B^{72} > A^{72} > B^{24} > B^{48} > A^{48} > C^{72} > C^{24} > A^{24} > C^{48}$, ranging from 0.11 to 0.67 while that of the sprouted and unfermented milk without coconut milk and date syrup was 2.68. This result showed that the iodine values are less than 100 hence they are non drying oils and their degree of unsaturation is very low compared to that of the control of the study (Eke-Ejiofor and Allen, 2019). Saponification value ranged from 20.89 to 68.86, C^{48} had the highest while A^{48} had the least saponification value. This implies that 24 hour could likely be optimum fermentation time for the conversion of fat to alcohol and high percentage of coconut milk in C^{48} might enhances its high saponification value. Comparing the result with the findings of Abdulkadir and Jimoh (2013), they stated that the saponification value of palm oil according to SON and FDA is 191.324 mg KOH/1g of oil which showed that palm oil has long chain fatty acids with high molecular weight which are saturated. The saponification values of the wines of this study are low, this is an indication that the fatty acids present are of high molecular weight with short chain and they are unsaturated fatty acids (Ezeh et al., 2014).

Wines contain 84% water, 15% ethanol and 1% of minor compounds which are mainly sugar and glycerol (Ukwuru et al., 2008). Mouth feel of wine can be determined using viscosity measurements at the same time, ethanol alongside other compounds can be of significant effect on viscosity (Giri and Praveen, 2013). The higher the viscosity, the slower the leg developed and the slower the fall, hence the higher the alcohol or residual sugar present in the wine but the lower the viscosity, the faster the leg developed and faster the fall of the wine (Oladele and Aina, 2007). Viscosity value of tiger nut drink ranged from 780 to 1560 mPa.S. A^{24} had the highest viscosity value while A^{72} had the least value. Increased viscosity in A^{24} is a reflection of investigation reported by Eke-Ejiofor and Nnodim (2019) that tiger nut milk is characterized with high viscosity. However, in comparison with the results of viscosity of ice cream produced using date syrup as sugar substitute in the study of Tammam et al. (2014) which ranged from 24 to 314 mPa.S which showed that the viscosity of the wines from this study is high and appeared less viscous, hence, the wines are thin wines. Wine

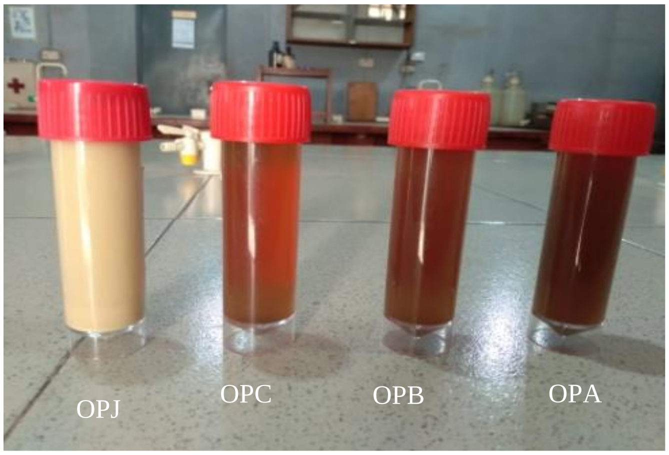

Figure 4. Wine fermented for 24 hours.

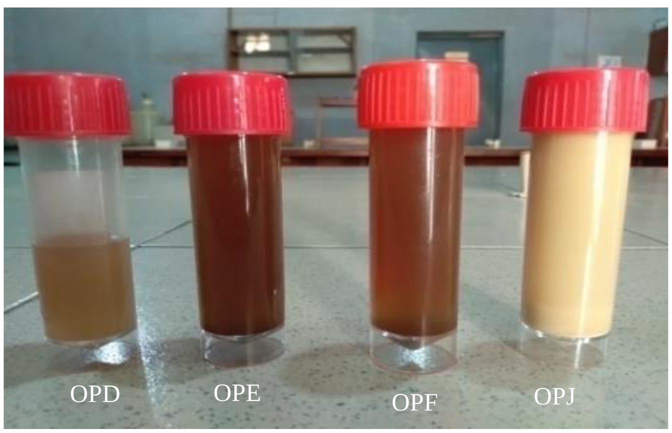

Figure 5. Wine fermented for 48 hours.

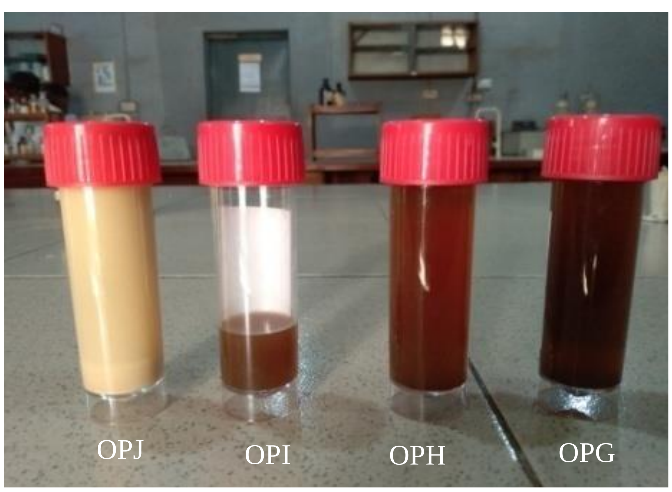

Figure 6. Wine fermented for 72 hours.

fermented for 24 hours, 48 hours and 72 hours are shown in Figure 4, 5, and 6 respectively.

Microbial analysis of tiger nut wines

The results for the microbial stability of fermented tiger nut drinks which were carried out weekly for six weeks as shown in Table 3 showed that all the products were stable throughout the six weeks. A^{48} and E had 1.00 x 10^5 and 2.00 x 10^5 cfu/g respectively on the fourth week, 3.90 x 10^5 and 11.50 x 10^5 cfu/g respectively on the fifth week and 10.50 x 10^5 and 25.50 x 10^5 cfu/g respectively on the sixth week. The increased value in the microbial count of sample E could be on the fact that is an unfermented sample. However, this microbial growth under ambient condition (30 to 34°C) showed that micro-organism increased over the weeks but within the limit of $<10^8$ cfu/g set as target in commercial guidelines for ready-to-drink soft drink products and less than 10^6 cfu/g for aerobic count in foods (Masia et al., 2020).

Effect of fermentation period on sensory evaluation of tiger nut wines

Table 4 presents the sensory evaluation results of the products. There was no significant difference in most sensory attributes of the products at 5% level of significance. The color, taste, flavor, sharpness and overall acceptability had mean score values that ranged from 2.09 to 3.25, 1.29 to 3.60, 2.00 to 3.30, 1.25 to 3.75 and 2.05 to 3.20 respectively. Based on the overall acceptability of the products, C^{24} had the highest mean score of 3.20 while A^{48} had the least mean score of 2.05.

From the results, colour of all the wines was generally accepted simply because it looks like the color of wine in the market. There was no significant difference in the color of A^{24}, B^{24}, C^{24}, B^{48}, C^{48}, A^{72}, B^{72} and C^{72} samples. Although, A^{48} came out in brown color which could likely be as a result of the colour of date syrup since it was added on the basis of taste. Taste and mouth feel of wines depends on alcohol and sugar level of the wine. There was no significant difference in the taste of A^{24}, B^{24}, C^{24}, B^{48}, C^{48}, A^{72}, B^{72} ans C^{72} samples. Sensory evaluation of the flavor revealed that there was no significant difference in A^{24}, B^{24}, C^{24}, A^{72} and B^{72} samples. More so, there was no significant difference in the flavor of A^{48}, B^{48}, C^{48} and C^{72} samples. The sharpness of the wine varied because of the difference in percentage alcohol content. At $p \geq 0.05$ significant level, there was no significant difference in the sharpness of A^{24}, B^{24}, C^{24}, B^{48}, C^{48}, B^{72}, and C^{72} samples. In the overall acceptability, there was no significant difference in A^{24}, B^{24}, C^{24}, B^{48}, A^{72}, B^{72} and C^{72} samples.

Table 3. Microbial stability of tiger nut wines.

Samples	Week 1 ($x10^5$ cfu/g)	Week 2 ($x10^5$ cfu/g)	Week 3 ($x10^5$ cfu/g)	Week 4 ($x10^5$ cfu/g)	Week 5 ($x10^5$ cfu/g)	Week 6 ($x10^5$ cfu/g)
A^{24}	TFTC	TFTC	TFTC	TFTC	TFTC	TFTC
B^{24}	TFTC	TFTC	TFTC	TFTC	TFTC	TFTC
C^{24}	TFTC	TFTC	TFTC	TFTC	TFTC	TFTC
A^{48}	TFTC	TFTC	TFTC	1.00	3.90	10.50
B^{48}	TFTC	TFTC	TFTC	TFTC	TFTC	TFTC
C^{48}	TFTC	TFTC	TFTC	TFTC	TFTC	TFTC
A^{72}	TFTC	TFTC	TFTC	TFTC	TFTC	TFTC
B^{72}	TFTC	TFTC	TFTC	TFTC	TFTC	TFTC
C^{72}	TFTC	TFTC	TFTC	TFTC	TFTC	TFTC
E	TFTC	TFTC	TFTC	2.00	11.50	25.50

TFTC: Too Few To Count. **Legend:** A^{24}: 90% 24h; B^{24}: 80% 24h; C^{24}: 70% 24h; A^{48}: 90% 48h; B^{48}: 80% 48h; C^{48}: 70% 48h; A^{72}: 90% 72h; B^{72}: 80% 72h; C^{72}: 70% 72h; E: Control (Sprouted unfermented tiger nut milk)

Table 4. Sensory evaluation of tiger nut wine**.**

Sample	Color	Taste	Flavour	Sharpness	Overall acceptability
A^{24}	$3.30^a±1.35$	$3.44^a±1.49$	$3.18^a±1.57$	$3.17^a±1.90$	$3.06^a±1.60$
B^{24}	$3.20^a±1.36$	$3.35^a±1.25$	$3.21^a±1.21$	$3.39^a±1.44$	$3.08^a±0.00$
C^{24}	$3.25^a±1.38$	$3.60^a±2.01$	$3.30^a±0.00$	$3.36^a±1.75$	$3.20^a±1.02$
A^{48}	$2.09^c±1.17$	$1.29^c±1.00$	$2.00^{bc}±1.70$	$1.25^{bc}±0.90$	$2.05^c±1.20$
B^{48}	$3.20^a±0.00$	$3.25^a±0.00$	$2.85^b±1.90$	$3.32^a±1.77$	$3.05^a±1.71$
C^{48}	$3.15^a±1.38$	$3.21^a±0.00$	$2.66^b±1.91$	$3.45^a±1.44$	$2.15^b±1.50$
A^{72}	$3.20^a±0.00$	$3.18^a±0.00$	$3.25^a±1.33$	$3.75^c±1.42$	$3.05^a±1.70$
B^{72}	$3.09^a±1.39$	$3.45^a±1.42$	$3.28^a±0.00$	$3.40^a±1.35$	$3.15^a±0.00$
C^{72}	$3.09^a±1.39$	$3.40^a±1.61$	$2.66^b±1.95$	$3.61^a±1.36$	$3.10^a±0.00$
E	$3.00^b±1.59$	$3.13^a±0.00$	$2.50^c±1.86$	$2.18^b±1.35$	$2.30^a±0.00$

Values are mean ± standard deviation of duplicate samples. Values with different superscripts within the same column are significantly different from each other ($p \geq 0.05$). **Legend:** A^{24}: 90% 24h; B^{24}: 80% 24h; C^{24}: 70% 24h; A^{48}: 90% 48h; B^{48}: 80% 48h; C^{48}: 70% 48h; A^{72}: 90% 72h; B^{72}: 80% 72h; C^{72}: 70% 72h; E: Control (Sprouted unfermented tiger nut milk).

Conclusion

Physico-chemical properties of the wines produced from fermented tiger nut milk fortified with defatted coconut milk such as temperature, pH, brix, specific gravity, alcohol, iodine, saponification and viscosity were determined and compared. The inclusion of date syrup enhances good sensory attributes and reduces the risk of diabetics associated with consumption of granulated sugar as sweeteners. The products were microbial stable for six weeks under ambient temperature. At p≥0.05 significant level, there was no significant difference in most of the wines produced. However, the colour and the taste of the wines have significant effect on consumer's perception. The alcohol content is less than 8% and it is therefore recommended for all ages.

CONFLICT OF INTEREST

The authors declare that they have no conflict of interest.

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