Journal of Pharmacognosy and Phytochemistry

Available online at www.phytojournal.com

E-ISSN: 2278-4136
P-ISSN: 2349-8234
JPP 2019; 8(1): 417-421
Received: 27-11-2018
Accepted: 29-12-2018

Dibofori-Orji AN
Department of Chemistry, Ignatius Ajuru University of Education, Port Harcourt, Rivers State, Nigeria

Ali ST
Department of Chemistry, Ignatius Ajuru University of Education, Port Harcourt, Rivers State, Nigeria

Correspondence
Dibofori-Orji AN
Department of Chemistry, Ignatius Ajuru University of Education, Port Harcourt, Rivers State, Nigeria

Physicochemical analysis of palm wine

Dibofori-Orji AN and Ali ST

Abstract
The physicochemical analysis of palm wine from three Local Government Areas of Rivers State: Eleme, Obio-Akpo and Etche were carried out at 0 hour, 24hours, 48hours and 72 hours. pH and electrical conductivity readings of the samples were determined by corning pH meter model 430 and DDS 307 conductivity meter, Total Dissolved Solids (TDS) by APHA standard methods. The TDS in all the samples of the palm wine increased from 500mg /l to 1260mgl^{-1}, 400mgl^{-1} to 1406mgl^{-1} and 600mgl^{-1} to1322mgl^{-1} for Eleme, Obio-Akpo and Etche LGAs respectively. The pH decreased progressively from 6.2 to 3.3, 6.4 to3.1 and 6.3 to3.2 in all the samples showing increase in acidity of the palm wines over the time. Electrical conductivity increased in all the samples from1000µScm^{-1} to 2520µScm^{-1}, 800µScm^{-1}to 2812µScm^{-1}and 1200µScm^{-1}to 2600µScm^{-1} respectively over the test period. The chloride concentrations of all the samples decreased from 700mg/l to 300mg/l, 400mg/l to180mg/l and 650mg/l to 300mg/l respectively. This is because of the increase in acidity since increase in acidity gives rise to decrease in alkalinity. The salinity is an attribute of the chloride concentration and as such decreased as the chloride concentration decreased. Meanwhile, the results showed very high chloride concentration, electrical conductivity and salinity for all the fresh palm wines. Palm wine from the areas of study showed presence of vitamin C in the mean values of: 0.0011 g/dm^3, 0.0012g/dm^3, 0.0014g/dm^3 for Eleme, Obio/Akpo and Etche LGAs respectively.

Keywords: Physicochemical, palm wine

Introduction
Palm wine is an alcoholic drink obtained from the saps of various species of palm trees. It is commonly consumed as a relaxation drink in many regions of Asia, Africa and South America. In Africa, palm wine is mainly got from oil palm such as the African oil palm (*Elaeis guineense*) and Raffia palms. Palm wine is of great importance in Nigeria during special ceremonies like; traditional marriages, coronation of kings, burial ceremonies, new yam festivals, child-naming ceremonies, community meetings, chieftaincy-title bestowment and many others. Palm wine tapping is a means of livelihood for quite a number of people in Nigeria. Wine market is usually early in the morning for fresh sales owing to the easy fermentation of the drink. The characteristics of palm wine is so unique that it has generated research interest to investigate the practical applications and industrial utilization (Nwachukwu *et al.*, 2006) [10]

The drink is so much valued such that in some occasions, no other drink is acceptable traditionally. Palm wine is tapped either from the young saps of a standing palm tree or by boring holes on the trunk of fallen palm trees. Palm wine from a standing palm tree has been found to be of better quality and more expensive than those from fallen trees. The drink is obtained fresh as a sweet whitish liquid which undergoes fermentation with time. Fermentation degrades the freshness of the drink and eventually turns it into vinegar over time. Fermentation is a metabolic process that consumes sugar in the absence of oxygen to produce alcohol and carbon (IV) oxide. *The overall equation of reaction is given as*; $C_6H_{12}O_6 \rightarrow 2\ C_2H_5OH + 2\ CO_2$. In anaerobic fermentation, a specie of anaerobic bacteria, including members of the family, Clostridium or Acetobacterium, can convert sugars to acetic acid directly without creating ethanol as an intermediate**.** This equation of reaction is given thus $C_6H_{12}O_6 \rightarrow 3\ CH_3COOH$. It occurs in yeast and bacteria, and also in oxygen-deficient cells. The science of fermentation is known as zymology.

This calls for a need of a reliable preservation method that can sustain the taste and contents of the wine even with regard to good health effect. Statistics has shown, according to Santiago and Ruiz (2014) that palm wine is consumed by over ten million Africans. It is an every-day drink and is preferred by many because of its natural contents.

The sugar contents of palm wine as documented by ok a for (1975) [11] are; sucrose, glucose, fructose, maltose, xylose and arabinose. These sugars are fermented by a number of yeasts (Ouoba, *et al.*, 2012) [12]. Pathogenic microorganisms like; Lactobacillus, Micrococcus,

Lieuconostoc, Klebsiella, Streptococcus, Racillus, Zymononas, Brevibacterium, Acetobacter and Sereratia are also found in Nigerian palm-wine and they are believed to have come from the water used by the tappers to dilute the drink (Amoa-Awua, *et al*., 2007) [1].

Different countries have different methods of tapping of palm wine. In Nigeria, most tappers climb palm trees with ropes made from either palm fronds or strong tree branches. It was noted that in Ghana incision of stem apex of felled palm is preferred, whereas in Nigeria excision of male or female inflorescence is carried out to initiate sap flow and is usually collected in plastic containers (Dalibard, 1999) [4]. Research has shown that Yeasts, Lactic Acid Bacteria (LAB) and Acetic Acid Bacteria (AAB) are the most common microorganisms in palm wine. *Saccharomyces cerevisiae* attracts major attention as it is mainly responsible for fermentation of sugar to alcohol (Amoa-Awua *et al.*, 2007) [1]. Record has it as the most widely studied eukaryotic model organisms in molecular and cell biology.

Palm wine has been taken over the years but much attention has not been paid to its contents especially in Nigeria. This work researched the physicochemical contents of palm wine to ascertain if it is truly good for health for a better health practice. The freshness of palm wine can be determined by measuring its pH and report shows that pH value of 5 indicates that the palm wine is within 24hrs of collection (Karamoko, *et al.*, 2012) [7]. To improve taste of palm wine during fermentation in south eastern region of Nigeria, the bark of *Sacoglottis gabonensis* can be added as a supplement to preserve the wine (Elijah *et al.*, 2010) [5]. The stem extract of *Sacoglottis gabonensis* is used in hipbaths in women after child delivery (Burkill, 1994) [3]. Lasekan *et al*, (2007) [8], identified that this stem bark, when added to palm-wine or gin prevents fever and eradicates body pains. Palm wine is a nutritionally rich medium for the growth of many organisms among which is yeast species. Activities of these yeasts convert the sugars in the palm wine into alcohol and carbon (IV) oxide. Ukwuru and Awah (2013) [14], researched that the physicochemical condition of palm wine is a function of the metabolic activities of the inherent yeasts in palm wine.

Materials and Methods

Materials

All reagents used in this research is of Analytical grade. Glass wares were sterilized. Instruments were calibrated before use.

Methods

Sampling and Sample Areas: 1litre each of fresh palm wine was collected in sterile sample containers from 30 palm wine tapers, 10 each from Eleme, Obio/Akpo and Etche LGAs of Rivers State of Nigeria. The wines were collected as fresh as they were brought down, placed in a cooler containing ice cubes at 4^{o}C and immediately taken to the laboratory for analysis.

The map below shows the Local Government Areas of sampling at numbers 07, 11 and 13.

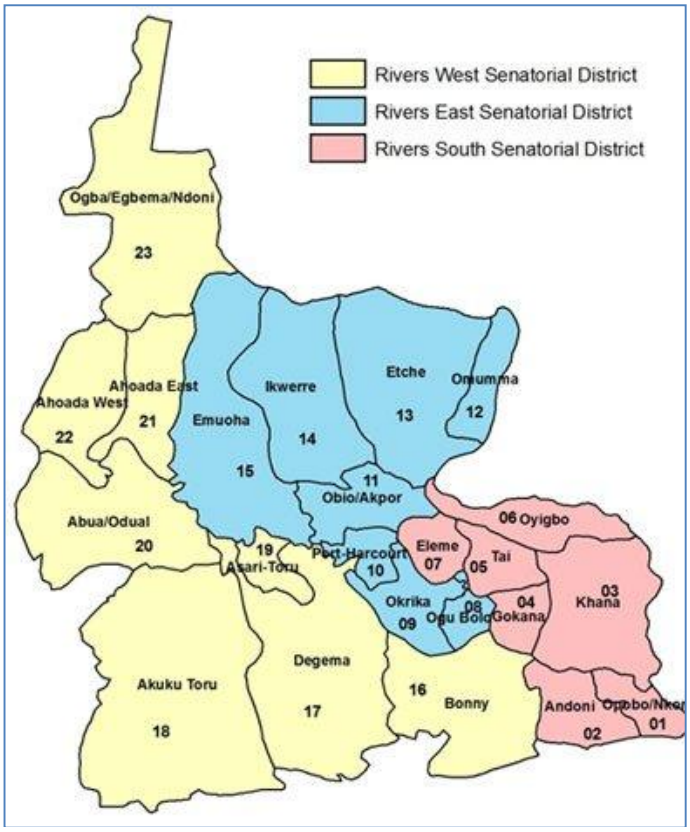

Fig 1: Rivers State Senatorial Distribution. Source: https://nigeriapostalcodes.com/rivers-state-post-codes-zip-codes.html

Experimental Procedures

pH and Electrical Conductivity: These were determined by corning pH meter model 430 and DDS 307 conductivity meter. pH meter was calibrated with buffers 4, 7 and 10.

Total Dissolved Solids: APHA standard methods (1995) was adopted.

Chloride Concentration: This was obtained by titration as follows: 100ml of palm wine was measured into a conical flask. 1ml of Potassium Chromate was added and stirred. This was titrated with silver nitrate solution with continuous stirring until slightest perceptible reddish coloration persisted. The methods were repeated for the palm wines from the three LGAs at 0hr, 24hrs, 48hrs and 72hrs.

Vitamin C: Redox titration was used to determine the concentration of vitamin C in palm wine obtained from three Local Government Areas of Rivers State. 0.1M Iodine solution was titrated against 250ml of palm wine in a conical flask with 1ml of starch indicator. The principle of the redox reaction was that ascorbic acid was oxidized to dehydroascorbic acid, while the iodine was reduced to iodide ions. ascorbic acid + $I_2 \rightarrow 2\ I^- +$ dehydroascorbic acid.
As a result of this reaction, the iodine formed was immediately reduced to iodide as long as there was any ascorbic acid present. Once all the ascorbic acid had been oxidized, the excess iodine was free to react with the starch indicator, forming the blue-black starch-iodine complex. This indicated the endpoint of the titration. This was done for the 30 samples of palm wines from the three LGAs and the mean values recorded.

Results and Discussion

Table 1: Mean Values (n=10) for Total dissolved Solids, pH, Electrical Conductivity, Chloride Concentration and Salinity of palm wines from three LGAs of Rivers State of Nigeria.

Sample identity	Total dissolved Solid (TDS) mall	pH	Electrical Chloride Conductivity (pScml a (mg/1)		Salinity (gmll)
At Ohr					
Eleme	500	6.	1000	700	1155
Obio/Akpo	400	6.	800	400	990
Etche ii 2This	600	6.	1200	650	1073
Eleme	1030	6.	1700	500	825
Obio/Akpo	660	5.	1320	300	495
Etche	825	5.	1600	400	660
At 431-irs					
Eleme	1196	5.	2380	230	500
Obio/Akpo	1054	4.	2000	210	346
Etche	1048	4.	2096	340	400
At 721113					
Eleme	1260	3.	2520	300	495
Obio/Akpo	1406	3.	2812	180	300
Etche	1322	3.	2600	300	495

Statistical Representations of Results

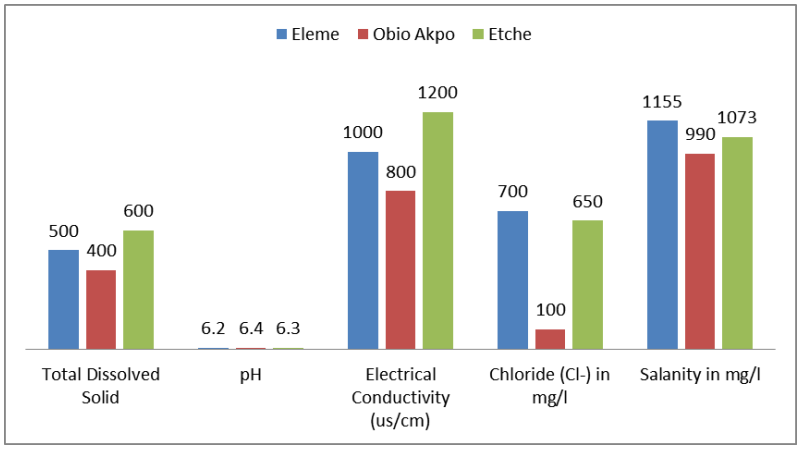

Fig 2: Physicochemical Analysis of Palm Wine at 0 hr.

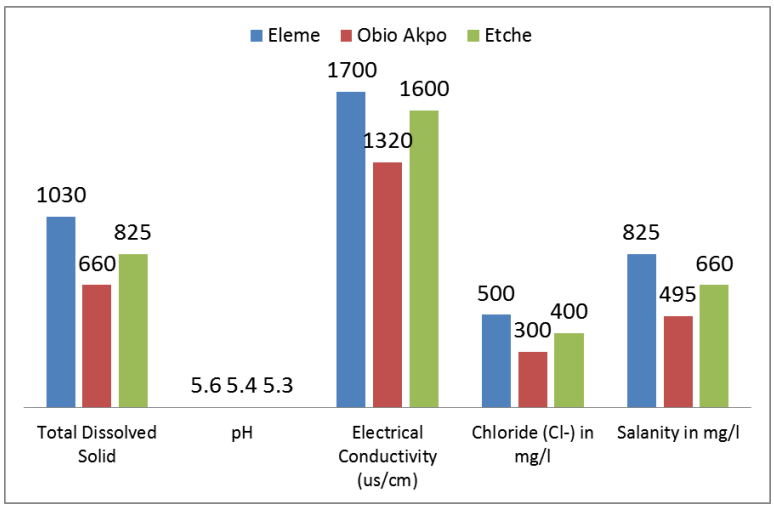

Fig 3: Physicochemical Analysis of Palm Wine at 24 hrs.

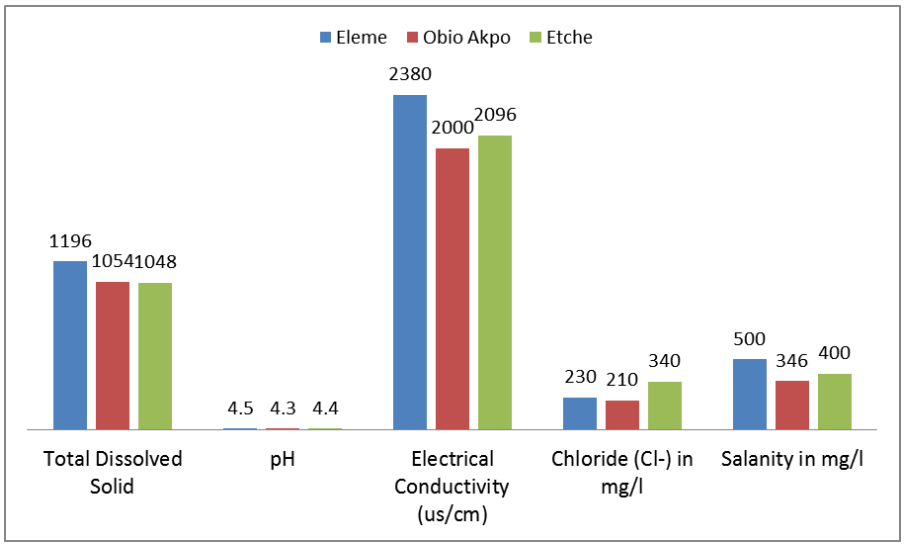

Fig 4: Physicochemical Analysis of Palm Wine at 48 hrs.

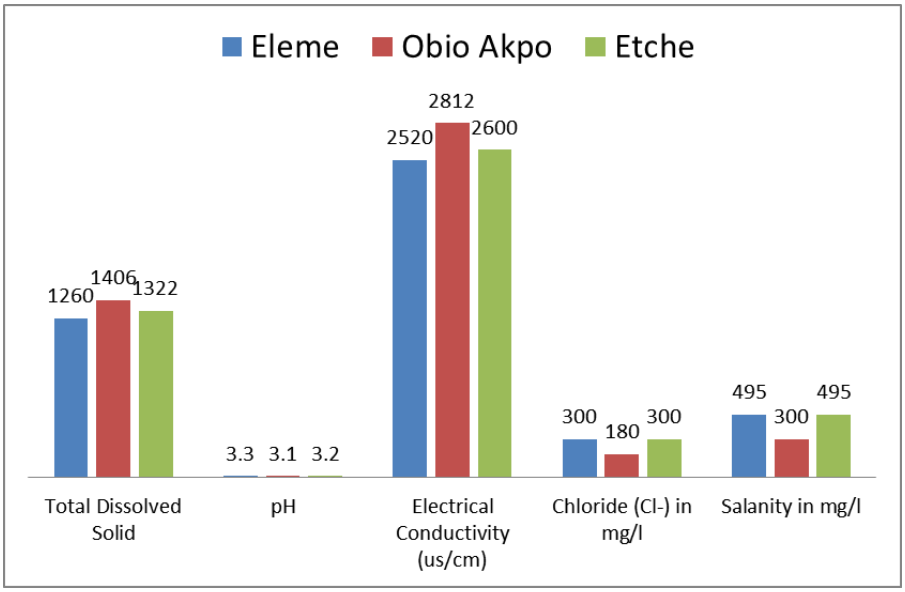

Fig 5: Physicochemical Analysis of Palm Wine at 72 hrs,

Table 2: Average Concentrations of Vitamin C in Fresh Palm WINE, n = 10

Local Government Areas of Research	ELEME	OBIO AKPO	ETCHE
Concentration of Ascorbic Acid present in g/dm^3	0.0011	0.0012	0.0014

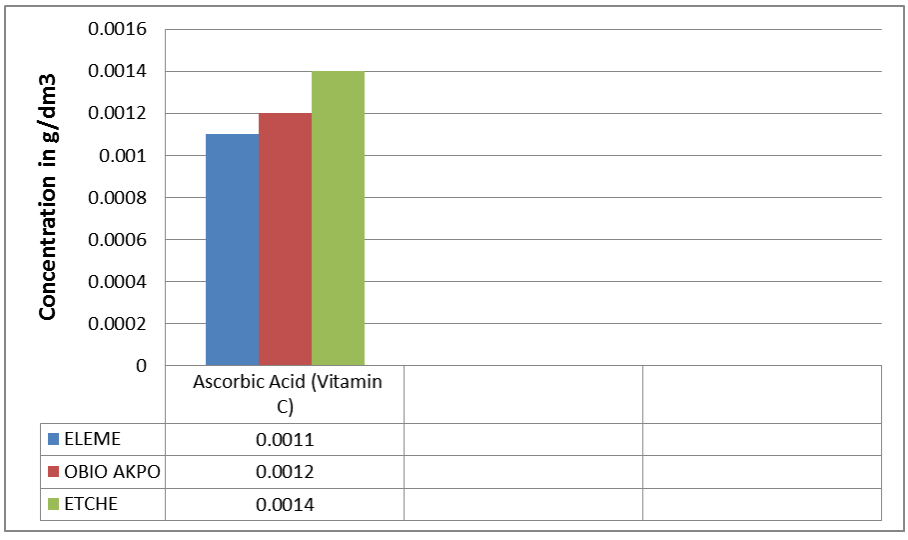

Fig 6: Mean Concentrations of Vitamin C in Palm wine

Discussion

The total dissolved solid in all the samples of the palm wine increased over time. This is as a result of formation of yeasts as time went by thereby increasing the dissolved solids. This is in agreement with Ukwuru and Awah (2013) [14] who reiterated that physicochemical condition of palm wine is a function of metabolic activities of the inherent yeasts in pale wine. The pH decreased progressively in all the samples showing increase in acidity of the palm wines over time. This was confirmed by testing the samples with blue litmus paper and it was discovered that the intensity of the red coloration increased over time. Karamoko *et al*., (2012) [7] reported a pH of 5 in palm wine after 24 hours. This is close to the figures (5.6, 5.4 and 5.3) respectively, obtained in this work. The Electrical conductivity increased in all the samples over the test period and this is because increase in acidity supports conductivity through increase in dissociated ions in the sample. The chloride concentration of all the samples decreased over time. This is because of the increase in acidity since increase in acidity gives rise to decrease in alkalinity. The salinity is an attribute of the chloride concentration and as such decreased as the chloride concentration decreased.

Meanwhile, the results showed very high chloride concentration, electrical conductivity and salinity for all the fresh palm wines. These concentrations are too high compared to the United States Environmental Protection Agency (USEPA) permissible limit of 250mg/l for chloride concentration (Manol and Avinash, 2012) [9] and the United States Public Health (USPH) recommended permissible limit of 300µm/cm for electrical conductivity (Jain *et al*, 2006) [6]. This may be harmful to the consumers. The nature of the soils where these palm trees are located may contribute to the chloride and salinity concentrations. Palm wines from the three areas of study contain vitamin C. This may be beneficial to the consumers.

Conclusion

Palm wines from the three LGAs of study in Rivers State showed increase in TDS, pH, Electrical conductivity but decrease in Chloride and Salinity concentrations over the time of study. This shows that palm wines from these areas may not be quite good to health after 24 – 36 hours subject to further studies. Furthermore, leaving the palm wines for more days after tapping before consumption even increases the danger associated to high acid content. Palm wines from the areas contain the antioxidant, Vitamin C. Vitamin C, on the other hand, helps in maintaining good health. In general, when served fresh, palm wine may be quite refreshing as it contains electrolytes and energy that may compare favorably with medically prepared (oral) drip.

Acknowledgment

The Authors wish to acknowledge the laboratory staff of the Department of Chemistry and the Management of Ignatius Ajuru University of Education for their technical and moral supports in course of this study.

References

1. Amoa-Awua WK, Sampson E, Tano-Debrah K. Growth of Yeasts, Lactic and Acetic Acid Bacteria in Palm Wine during Tapping and Fermentation from felled Oil Palm (*Elaeis guineensis*) in Ghana. Journal of Applied Microbiology. 2007; 102(2):599-606.
2. American Public Health Association (APHA). Standard Methods for Analysis. Washington D.C. USA, 1995.
3. Burkill HM. The useful plants of West Tropical Afric*a* 2nd Edition. Royal Botanic Gardens, Kew, United Kingdom, 1994, 648
4. Dalibard C. *O*verall View on the Tradition of Tapping Palm Trees and Prospects for Animal Production. Livestock Research for Rural, 1999.
5. Elijah AI, Ojimelukwe PC, Ekong US, Asamudo NU. Effect of Sacoglottis gabonensis and Alstonia boonei on the kinetics of Saccharomyces cerevisiae Isolated from Palm Wine. African Journal of Biotechnology. 2010, 9(35).https://nigeriapostalcodes.com/rivers-state-post-codes-zip-codes.html
6. Jain P, Sharma JD, Sohu D, Sharma P. Chemical Analysis of Drinking Water of Villages of Saanganer Tehsil, Jaipur District. International Journal of Environmental Science and Technology. 2006; 2(4):373-379.
7. Karamoko D, Djeni NT, N'guessan KF, Bouatenin KMJ, Dje KM. The Biochemical and Microbiological Quality of Palm Wine Samples Produced at Different Periods during Tapping and Changes Which Occur during their Storage. Journal of Food Control. 2012; 26(2):504-551.
8. Lasekan O, Buettner M, Christlbauer M. Investigation of The Retronasal Perception of Palm Wine (Elaeis guineensis) Aroma By Application of Sensory Analysis and Exhaled Odorant Measurement (Exom). African Journal for Food and Agricultural Nutrients Development. 2009; 9:793-813.
9. Manoj K, Avinash P. A Review of Permissible Limits of Drinking Water; Indian Journal of Occupational and Environmental Medicine, 2012, 16(1).
10. Nwachukwu I, Ibekwe V, Nwabueze R, Anyanwu B. Characterisation of palm wine yeast isolates for industrial utilization. African. Journal of Biotechnology. 2008; 5(9):1725-1728.
11. Okafor N. Preliminary Microbiological Studies on the Preservation of Palm Wine. Journal of Applied Bacterology Banner. 1975; 38(1):1-7.
12. Ouoba L, Kando C, Parkouda C, Sawadogo-Lingani H, Diawara B, Sutherland JP. Identification and Genotypic Diversity of Yeasts, Lactic Acid and Acetic Acid Bacteria. Journal of Applied Microbiology. 2012; 113:1428-1441.
13. Santiago-Urbina JA, Ruíz-Terán F. Microbiology and Biochemistry of Traditional Palm Wine Produced Around the World. Journal of Microbilogy. 2014; 1261-1269.
14. Ukwuru MU, Awah JI. Properties of Palm Wine Yeasts and its Performance in Wine Making. African Journal of Biotechnology. 2013; 12(19):2670-2677