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Assessment of physicochemical characters of traditional "koutoukou" from different raw materials

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Abstract

This study aimed to identify the chemical characters of traditional "koutoukou" from different raw materials to propose ways of increasing their commercial value. The investigations concerned a traditional "koutoukou" from palm wine (KTK_{PW}), sugar cane (KTK_{SC}) and sugar water yeast added (KTK_{SWY}).The yield of the "koutoukou" manufacturing, alcoholic Strength by Volume, methanol, higher alcohols and heavy metals was determined. The results showed that heavy metal concentrations of traditional "koutoukou" are higher than those present in the industrial "koutoukou". The data vary from 3.70 mg/L to 20.47 mg/L (copper), from 0.05 mg / L to 0.07mg/L (iron) and from 0.16 to 0.36 mg/L (lead). In the industrial "koutoukou", the only metal detected is copper with a value of 1.24 mg/L. lower in the standard (2 mg/L). The alcoholic strength by volume (ASV) is lower for the KTK_{SC} (15.58 % vol.) and KTK_{SWY} (33.38 % vol.) compared to those of KTK_{PW} (42.47% vol.) and KTK_{IND} (50.46% vol.). Propanol-1was obtained in the KTK_{PW}. All these results show the toxicity of this beverage that could cause health problems to consumers.

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Introduction

"Koutoukou" (KTK) is a traditional brandy introduced in Côte d'Ivoire from Ghana since 1940 (Amany 1990). The use of this liquor was perpetuated in the ceremonies of worship to ancestors, funerals, rituals, libations, marriages and in the manufacture of traditional therapeutic beverages. Thus, KTK is one of the most consumed alcoholic beverages in Ivory Coast because of the availability of raw materials, its socio-cultural character and its relatively low cost compared to alcoholic beverages from industrial production (Yao *et al.* 2011;. Assoumanou *et al*, 2011). This alcoholic beverage is used in traditional medicine as a preferred solvent for traditional practitioners (Hamon *et al*., 2002) for making many therapeutic solutions. It would facilitate the spread of active units either from leaves, roots or bark immersed in this drink that are responsible for the therapeutic action (Yao *et al*., 2011).

The traditional producing of KTK would be practiced in unsound hygienic conditions, uncontrolled temperature and time, causing high toxicity of the product (Gnagne, 1990). The Ivorian government has banned the traditional production and marketing of drink in favor of industrial production of beverages. But the impoverishment of social classes will favor the proliferation of that traditional liquor that represents a potential danger to consuming populations (Yao, 2009). Moreover, many poisonings linked to the consumption of KTK were found in recent years in Ivory Coast (Gnagne, 1990, AIP, 2015).

Despite its high consumption by the population (Amany, 1990, Camara *et al*., 2008; Yao, 2009), KTK would be unsuitable because of its poor quality (Yao *et al*., 2011). In addition, the traditional KTK would be most related to clinical and para-clinical abnormalities in black African. (Camara *et al*., 2004; Yao *et al*., 2011). Studies on the KTK by Dano *et al*, 1988 and Camara (1998) reveal the presence of highly toxic element in the KTK. so, faced with these facts, the Ivorian government decided to lift the ban, in order to improve the production and marketing of local brandy (Hamon et camara, 1999; Tehoua *et al*., 2011).

However, the chemical composition of KTK could vary according to technical production and the nature of raw materials used. The objective of this study was to evaluate the quality of that liquor produced from various raw materials such as palm wine, water-sugar-yeast and sugar cane juice traditionally manufactured.

Material and methods

Material

The material consists of artisanal KTK produced from palm wine (KTK_{PW}), water-sugar-yeast (KTK_{SWY}) and sugar cane juice (KTK_{SC}). The artisanal KTK was compared to industry KTK (KTK_{IND}), which served as a control.

Methods

Manufacturing "koutoukou" from palm wine

Eighty (80) liters of palm wine decanted in sealed cans, were submitted to alcoholic fermentation for 15 days. After fermentation, the wine is filtered and distilled in a traditional still at an unknown temperature to provide 20 L of "false KTK". At this "false KTK" is added 20 L filtered and unfermented palm wine. The resulting mixture was distilled again under the same conditions as the first distillation to give the "real KTK" (Fig. 1).

Manufacturing "koutoukou" from the water-sugar-yeast mixture

Ten (10) kg of row sugar were stirred into 10 liters of water. To that mixture, 250 g of yeast (*Saccharomyces cerevisiae*) and 80 L of water were added. The resulting mixture was stored in sealed cans and submitted to alcoholic fermentation for 15 days. The fermented mixture is filtered and distilled to give "KTK" (Fig. 2).

Manufacturing "koutoukou" from the sugar cane juice

Sugar cane stalks were pressed to obtain juice. The mixture (bagasse + juice) were stirred into 10 L of water and then 250 g yeast (*Saccharomyces cerevisiae*) were added.

The resulting mixture was stored in sealed cans and underwent alcoholic fermentation for 15 days. The fermented mixture was filtered and distilled to give "KTK" (Fig. 3).

Determination of Physicochemical parameters

The yield of the koutoukou manufacturing was determined by the method of Boulal *et al.,* (2013). The Alcoholic Strength by Volume, methanol, higher alcohols and heavy metals were obtained by the method of OIV (2012).

Statistical analysis

The Data were subjected to an analysis of variance (ANOVA) using the software SPSS 20.0 software. Mean and standard deviation were calculated and, when F-values were significant at the P≤ 0.05 level. The mean difference was separated using the Newman keul's test.

Results

The "koutoukou" yield

The "koutoukou" from sugar-water-yeast mixture (KTK_{SWY}) and sugar cane juice (KTK_{SC}) have high yields respectively to 75% and 62.5% compared to the KTK_{PW} (25%) (Table 1).

Table 1. The yield of "koutoukou" according to row materials.

	KTK_{CS}	KTK_{SWY}	KTK_{PW}
Yield (%)	62,5	75,0	25,0

KTK_{PW}: "koutoukou" from palm wine; KTK_{SC}: "koutoukou" from sugar cane; KTK_{SWY}:. "koutoukou" from sugar water yeast added.

Alcoholic strength by volume content (ASV)

Statistical analysis showed a significant difference between of the 4 types of "koutoukou**"** (Table 2) .The KTK_{IND} has a higher ASV (50.5%vol) than the other type of "koutoukou" with respectively 42.5%vol , 33.4% and 15.6%vol for the KTK_{PW}, the KTK_{SWP}, and KTK_{SC}**.**

Heavy metals contents

The copper appears in all type of "koutoukou". The amount of copper is higher in the KTK_{SC} and KTK_{SWY} respectively to 20.48 mg/L and 19.36 mg/L. There is a difference significant for all types of "koutoukou".

Iron only appears in the KTK_{SC} and KTK_{PW} with the content respectively to 0.08 mg/L and 0.06 mg/L. There is no statistical difference between the four types of "koutoukou".

Table 2. The alcoholic strength by volume content of the 4 type of "koutoukou".

	KTK_{IND}	KTK_{SC}	KTK_{SWY}	KTK_{PW}
ASVC (% Vol)	$50,5 \pm 0,45^{a}$	$15,6 \pm 1,15^{d}$	$33,4 \pm 1,45^{c}$	$42,5\ b \pm 1,13^{b}$

Averages followed by the same tiny letter in the same line are not significantly different

KTK_{PW}: "koutoukou" from palm wine; KTK_{SC}: "koutoukou" from sugar cane; KTK_{SWY}:. "koutoukou" from sugar water yeast added; KTK_{IND} : industrial "koutoukou".

Lead appears in the KTK_{SC} and KTK_{PW} with the content respectively to 0.37 mg/L and 0.16 mg/L .there is a significant difference between KTK_{SC} and KTK_{PW} (Table 3).

Methanol and higher alcohols content

No trace of methanol was detected in all type of "koutoukou". However, there is a presence of propanol-1 in the KTK_{PW} (Table 4).

Discussion

The yield of KTK_{PW} is very low compared to the KTK_{SC} and KTK_{SWY}. These high yields of KTK_{SWY} and KTK_{SC} could be explained by the unique distillation underwent by their raw materials. These results are consistent with information gathered from various producers who show a preference for sugar water added yeast for the KTK production due to its high yield (oral communication).

The Alcoholic Strength by Volume (ASV) of KTK_{IND} is the highest, followed by KTK_{PW}; KTK_{SWY} and KTK_{CS}. Nonetheless, all these drinks obtained have a ASV minimum of 15% vol turning them "spirits" in compliance with CEE Regulation.

Table 3. Heavy metals content in different type of "koutoukou".

	KTK_{IND}	KTK_{SC}	KTK_{SWY}	KTK_{PW}	Norm
Copper (mg/L)	$1,24^{d} \pm 0,01$	$20,48^{a} \pm 0,08$	$19,36^{b} \pm 0,10$	$3,70^{c} \pm 0,05$	2
Iron (mg/L)	-	$0,08^{a} \pm 0,04$	-	$0,06^{a} \pm 0,07$	0,2
Lead (mg/L)	-	$0,37^{b} \pm 0,19$	-	$0,16^{ab} \pm 0,15$	0,2

Averages followed by the same tiny letter in the same line are not significantly different

KTK_{PW}: "koutoukou" from palm wine; KTK_{SC}: "koutoukou" from sugar cane; KTK_{SWY}:. "koutoukou" from sugar water yeast added; KTK_{IND} : industrial "koutoukou".

These results are similar to those found by Zakpaa *et al.,* (2009). These reported ASV ranging from 20.5 to 20.8% vol in "akpeteshie" (Ghanaian liquor). The high ASV of KTK_{PW} and the KTK_{IND} indicate the presence of a high amount of ethanol. These results are similar to those found by Hamon and Camara (1999) and Camara *et al.,* (1997). The first authors found a 45.5% vol whereas the latter have obtained 46% vol in the brandy palm samples produced and clandestinely sold in Côte d'Ivoire.

This ASV difference would be justified by the unsimilarity of row materials and of the traditional manufacturing process used for the production of these "koutoukou" compared to the KTK_{IND}. These handicrafts produced "koutoukou" are made with no measuring equipment and control of the final product. Indeed, the double distillation carried out for the production of the KTK_{PW} and $_{IND}KTK$ would have an ethanol concentration effect.

Table 4. Identification of methanol and higher alcohols in different type of "koutoukou".

	KTK_{IND}	KTK_{SC}	KTK_{SWY}	KTK_{PW}
Méthanol	A	A	A	A
Propanol-1	A	A	A	P

A: Absence P: Présence

KTK_{PW}: "koutoukou" from palm wine; KTK_{SC}: "koutoukou" from sugar cane; KTK_{SWY}:. "koutoukou" from sugar water yeast added; KTK_{IND} : industrial "koutoukou".

The different samples of "koutoukou" contain no amount of methanol. These results are opposed to those obtained by Camara *et al.,* (1997) who got 1% methanol in palm wine brandy. The absence of methanol in our samples would be due to the application by producers of new production mechanism such as the "head-tail" operations. In fact, this operation consist in not considering the first jets (distillates) "head" and the last jets "tail" of distillation. However, the only higher alcohol detected in KTK_{PW} is propanol-1. These results are consistent with those of Camara *et al.,* (1997).

These last have proved the presence of higher alcohols such as propanol-1 in samples of palm wine based "koutoukou" produced in Côte d'Ivoire.

The presence of propanol would prove that certain parameters of the manufacturing conditions such as temperature, fermentation and the distillation time would not be totally controlled. All the "koutoukou" samples except the KTK_{IND}, contain a quantity of heavy metals that do not meet quality standards.

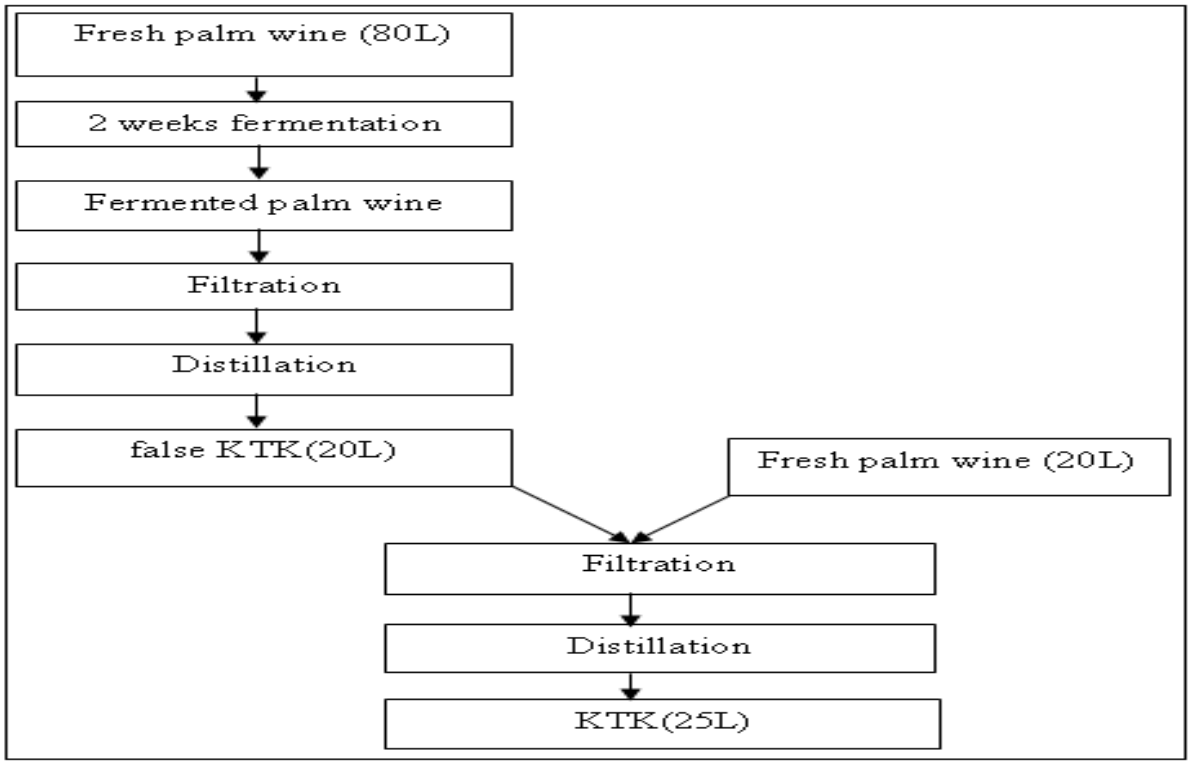

Fig. 1. Manufacturing diagram of "Koutoukou" from palm wine.

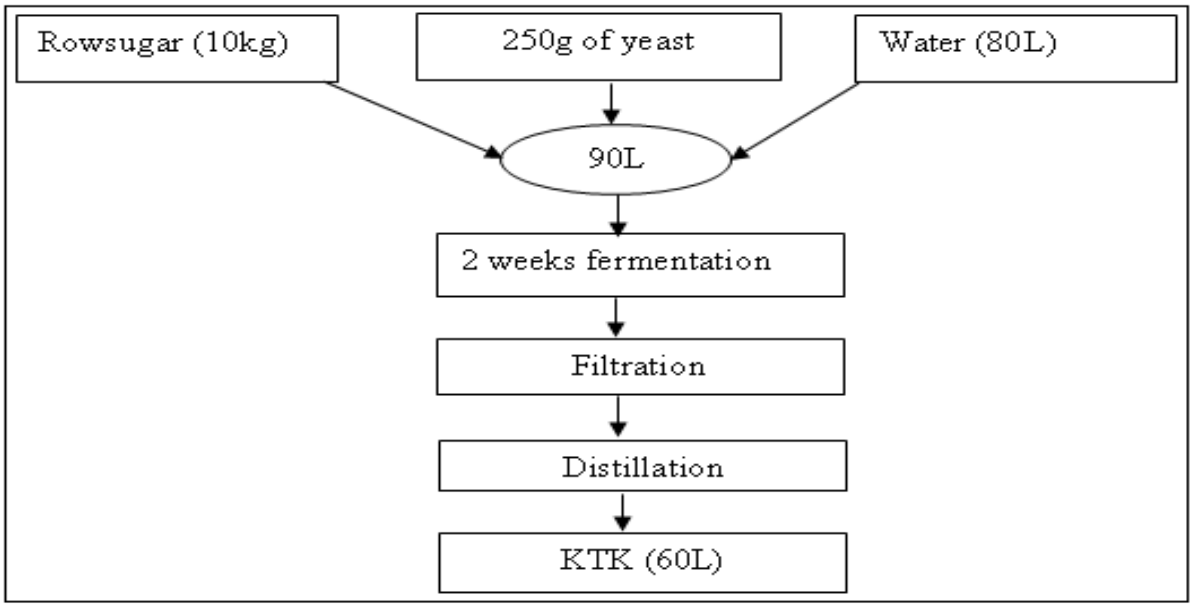

Fig. 2. Manufacturing diagram of "koutoukou" from the water-sugar-yeast mixture.

The notable presence of copper in all the "koutoukou" is largely above the permissible limit (1mg/L) set by the International Organization of Vine and Wine (OIV, 2012). These quantities would be explained by their distillation materials (copper still) under high temperature.

In addition, the strong copper levels in the KTK_{CS} would come from the sugar cane contamination by the soil, entailed by pesticides used during the sugar cane production.

Only the KTK_{CS} and KTK_{SWY} contain iron even if these levels remain below the standard, which sets the level of iron in water and drinks to 0.2 mg / L.

This could derive from boiling rust. Indeed, this metal (iron) gets weakened during repeated boilings and could be the likely source of iron found in the KTK. Moreover, all KTK samples do not contain cadmium. These results are consistent with the work of Woldemariam and Chandravanshi (2011). They have found cadmium concentrations in the Ethiopian wine. The lack of this trace element would prove that no step in the manufacturing process seem to expose the KTK to any cadmium contamination.

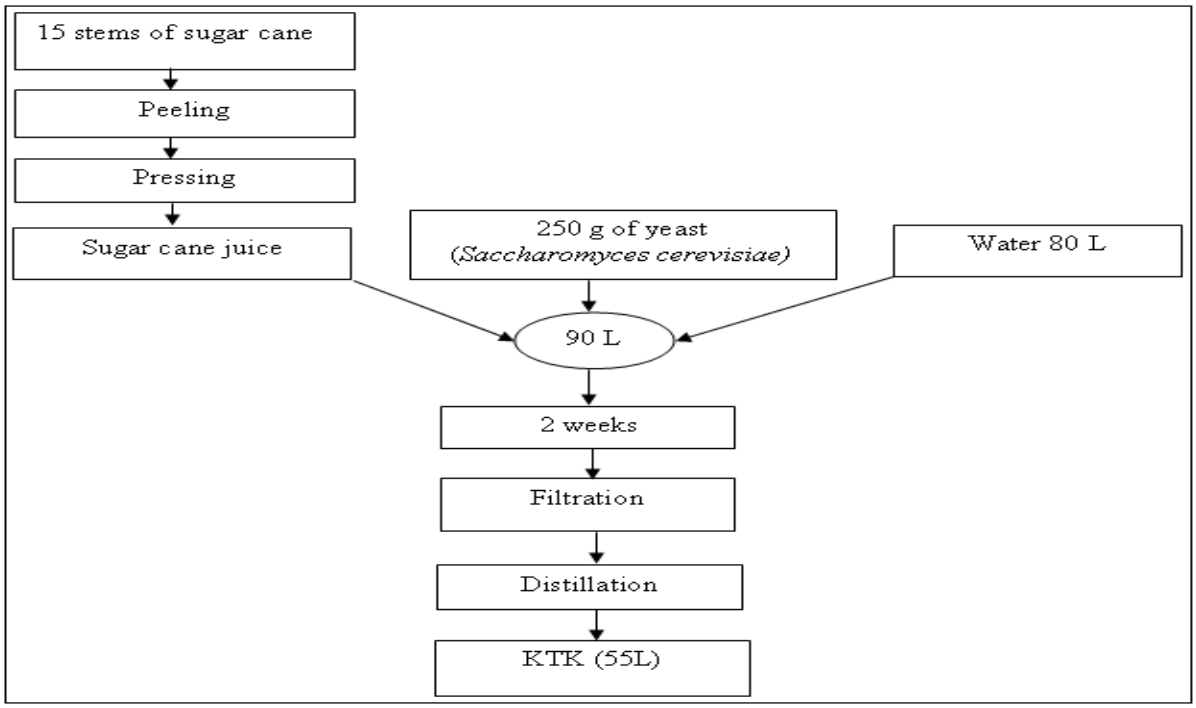

Fig. 3. Manufacturing diagram of "koutoukou" from the sugar cane juice.

Concerning the lead, the KTK_{CS} contains an amount greater than the standard of 0.2 mg/L allowed for spirits, liquor and brandy. This result is consistent with the work of Woldemariam and Chandravanshi (2011). They have reported lead levels of 0.31 mg/L in the Ethiopian wine. The presence of lead in that KTK would be justified by the non mastery of the manufacturing process. In addition, the sugar cane used to producing KTK would have been contaminated by the lead during its transport and storage prior to use for making the koutoukou.

Conclusion

The KTK_{CS}, KTK_{SWY} and KTK_{PW} is not of good quality compared to the KTK_{IND}. It also shows The ASV of KTK_{PW} is higher than the KTK_{SWY} and KTK_{CS}. Also, the poor quality of this drink is linked to its traditional manufacturing processes and materials. So, the danger of consumption lies in the relative presence of ethanol homologous, higher alcohol and higher concentrations of heavy metals. This could possibly contribute to the deleterious effects of the homemade KTK.

References

Agence Ivoirienne Presse (AIP). 2015. Côte d'Ivoire – Un mort et 12 intoxiqués après consommation de koutoukou (*Boisson frelatée*), visité le 12/07/2015.
www.aip.ci

Amany KA. 1990. Etude d'une eau-de-vie traditionnelle : le Koutoukou. *Thèse de doctorat de Pharmacie*, Université de Cocody, Abidjan, 118p.

Assoumanou MG, Saka DH, Akpona SA, 2011.Réponse glycémique induite par quatre boissons alcoolisées locales du Bénin chez des sujets adultes jeunes sains. International Journal of Biological Chemical. Sciences **5(3),** 1153-1164.
http://dx.doi.org/10.4314/ijbcs.v5i3.72244

Boulal A, Benbrahim Z, Benali B, LadjelS, 2013**.** Etude comparative de rendement de la production d'éthanol de deux variétés de dattes communes de faible valeur commerciale (Tinaceur et Aghmou) de Sud - Ouest de l'Algérie. Revue des Energies Renouvelables **16(3),** 539-550.

Camara PA, Yao KM, Adou KF. 2004**.** Etude préliminaire des effets d'une prise unique de Koutoukou sur le niveau de vigilance et émotionnel de l'Homme. Revue Internationale Sciences de la Vie et de la Terre **4(1),** 99-113.

Camara PA, Yao KM, Adou KF, Bakou NF. 2008.Approche épidémiologique de la consommation des boissons alcooliques en Côte d'Ivoire. Revue Internationale des Sciences et Technologie **12,** 157-171.

Camara PA. 1998. Effets de l'intoxication aiguë et chronique au koutoukou (eau-de-vie traditionnelle africaine) pour le fonctionnement cérébral de l'homme.Thèse de Doctorat d'Etat ès-Sciences (option :Neurosciences et Pharmacopée Africaine), Université de Cocody-Abidjan, 118 p.

Camara PA, Hamon JF, Piongaï M. 1997**.** Analyse quantitative et qualitative d'une eau-de-vie traditionnelle (le koutoukou)*:* étude préliminaire. Afrique Biomédicale **2(1),** 133-140.

Dano SD, Kouadio LP, Macia R. 1988**.** Identification et dosage du méthanol et des alcools supérieurs dans le koutoukou. Afrique Pharmarcie, 25 p

Gnagne A. 1990**.**Quand l'alcool tue la femme,Week-end Magazine, 24-26.

Hamon J, Camara P. 1999**.**Toxicité des distillats de vin de palme approche bromatologiques et clinique. InKabaro Note ; **1(2),** 133-140.

Hamon JF, Camara PA, Adou KF. 2002.Gouts et habitudes en matière de consommation d'alcool dans le sud et le centre-nord de la Côte d'Ivoire : enquête sur 3428 sujets. Revue sciences et technique de l'ENS d'Abidjan, 12p.

Organisation Internationale de la Vigne du Vin (OIV). 2012**.** Recueil des méthodes internationales d'analyses des vins et des moûts. 8ème Assemblée générale, Tbilissi - Georgie, 596 p.

Tehoua L, Datte YJ, Offoumou AM. 2011. Alcoolisation chronique des rats (Rattusnorvegicus) de souche Wistar à une eau-de-vie traditionnelle produit en Côte d'Ivoire (koutoukou). Journal of applied biosciences **41,** 2772-2779.

Woldemariam DM, Chandravanshi BS. 2011**.** Concentration levels of essential and non-essential elements in selected ethiopian wines. Chemical Society of Ethiopia **25(2),** 169-180. http://dx.doi.org/10.4314/bcse.v25i2.65852

Yao KM, Adou KF, Camara PA, Bakou NF, Tako NA, Seri B. 2011.Effets comparés de l'alcoolisation aiguë au Koutoukou de vin de palme (boisson alcoolique artisanale) et au Pastis 45 (boisson alcoolique industrielle) sur la mémorisation, chez l'homme. International Journal Biological Chemical Sciences **5(3),** 1073-1081.

Yao K. 2009**.** Approche épidémiologique de la consommation d'alcool en côte d'ivoire et évaluation des effets de l'alcoolisation (aiguë et chronique) au koutoukou (eau-de-vie de vin de palme) sur le fonctionnement cérébral des consommateurs. Thèse de doctorat en Physiologie Animale, Université de Cocody-Abidjan, 151 p.

Zakpaa HD, Mak-Mensah EE, Avio OA. 2010**.** Effect of storage conditions on the shelf life of locally distilled liquor (Akpeteshie).African Journal of Biotechnology **9(10),** 1499-1509. http://dx.doi.org/10.5897/AJB09.1001