



### Sweet Little Gabonese Palm Wine: A Neglected Alcohol

*Petit Vin de Paume gabonaise Doux : un alcool négligées*

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#### ABSTRACT

**BACKGROUND:** During the last ten years, consumption of palm wine, a popular traditional alcoholic beverage, seriously increases in Gabon. This sweet beverage seems to be the main alcohol and the most drunken in low socioeconomic population.

**OBJECTIVE:** To have an idea of its composition and toxicity, 21 samples of palm wine were collected in the country and analysed.

**METHODS:** Twenty-one palm wine samples were randomly selected from all over Gabon. Methanol and ethanol concentrations in the samples were measured by gas chromatography. Aromatic hydrocarbons were measured by selected ion monitoring mode in mass spectrometry. Delection of heavy metals was by standard techniques.

**RESULTS:** Gabonese palm wine contained ethanol at a mean concentration of about 60 g.L<sup>-1</sup>, i.e. 7.5° (volume %), volatile components such as alcohols, aldehydes, carboxylic acids and esters and trace metals. Trace metals were present at low concentrations below internationally recognized maximal limits for alcoholic beverages with less than 2 µg.L<sup>-1</sup> for cadmium, less than 10 µg.L<sup>-1</sup> for arsenic and for lead 15 samples with concentrations under 10 µg.L<sup>-1</sup> and the last six samples with concentrations between 11 and 61 µg.L<sup>-1</sup>. None of the searched aromatic or chlorinated solvents, indicative of refined fuel or industrial contamination, was detected.

**CONCLUSION:** For the parameters analyzed here, there seems to be no significant difference in constitution between Gabonese wine palm and others kind of palm wine produced in West Africa. This alcohol, need to be more considered by public health authorities and medical teams because of its health and economic consequences. *WAJM* 2009; 28(5): 291–294.

Keywords: Ethanol, palm wine, alcohol abuse, Gabon.

#### RÉSUMÉ

**CONTEXTE:** Au cours des dix dernières années, la consommation de vin de palme, une boisson alcoolisée traditionnelle populaire, sérieuse augmentation au Gabon. Cette boisson sucrée semble être l'alcool principale et la plus ivres dans la population socio-économique bas.

**OBJECTIF:** Pour avoir une idée de celui-ci composition et la toxicité, 21 échantillons de vin de palme ont été collectés dans le pays et analysés.

**MÉTHODES:** Vingt et un échantillons de vin de palme ont été choisis au hasard de tous les coins du Gabon. Le méthanol et l'éthanol à des concentrations dans les échantillons ont été mesurés par chromatographie en phase gazeuse. Hydrocarbures aromatiques ont été mesurés par le mode de surveillance d'ions sélectionnés en spectrométrie de masse. Delection de métaux lourds a été par des techniques standard.

**RÉSULTATS:** le vin de palme contenue gabonaise de l'éthanol à une concentration moyenne d'environ 60 g.L<sup>-1</sup>, soit 7,5 ° (% en volume), de composants volatils tels que les alcools, aldéhydes, acides carboxyliques et esters et les métaux traces. Métaux traces étaient présents à de faibles concentrations inférieures aux limites internationalement reconnues maximale pour les boissons alcooliques à moins de 2 µg.L<sup>-1</sup> pour le cadmium, moins de 10 µg.L<sup>-1</sup> pour l'arsenic et du plomb de 15 échantillons avec des concentrations de moins de 10 µg.L<sup>-1</sup> et les six derniers échantillons avec des concentrations comprises entre 11 et 61 µg.L<sup>-1</sup>. Aucun des cherché aromatiques ou chlorés, les solvants, les indicatifs de combustible raffiné ou contamination industrielle, a été détectée.

**CONCLUSION:** Pour les paramètres analysés ici, il semble y avoir aucune différence significative dans la constitution entre le vin de palme du Gabon et d'autres types de vin de palme produite en Afrique de l'Ouest. Cet alcool, ont besoin d'être plus considérée par les autorités de santé publique et des équipes médicales en raison de ses conséquences sanitaires et économiques. *WAJM* 2009; 28 (5): 291-294.

Mots-clés: éthanol, le vin de palme, l'abus d'alcool, au Gabon.

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Abbreviations: WHO, World health organisation; EEG, Electroencephalograms.

## INTRODUCTION

Palm wine is a whitish, effervescent, alcoholic beverage produced by the spontaneous yeast-lactic fermentation of the sugary sap of palm trees.<sup>1</sup> It is widely consumed in tropical regions where palms grow such as Asia, South America, Africa and.<sup>2</sup> more particularly in Gabon amongst all socioeconomic groups. In such areas, the beverage plays an important role in the culture of the people.<sup>2</sup> It is a popular traditional alcoholic beverage consumed by more than 10 million people in West Africa.<sup>3</sup> Most African countries have their own palm wine, including Gabon.

Today alcohol issues are causes of intense public health concern in both developed and developing countries. In poorer nations the adverse consequences of alcohol abuse may be beginning to threaten the health of these nations and their national development. In sub-Saharan Africa, except for South Africa, studies on alcohol use, and abuse are extremely rare.<sup>4</sup>

In Gabon as well as in Nigeria, consumption of various forms of alcoholic beverages is an important part of celebrated events.<sup>5</sup> For examples, the birth of a baby is an occasion for celebration with a generous supply of alcohol or the gods are appeased with a sprinkle of alcohol on the ground, wedding and other contractual arrangements cannot be sealed without the sharing of a drink. Conflicts are also resolved over a drink, as well as burial ceremonies are occasions for drinking and revelry.<sup>5</sup> While beer and other imported alcoholic drinks are expensive, traditional palm wine is common and relatively cheaper. Political, economic and cultural factors generally influence alcohol use and abuse.<sup>4</sup>

Important work has been done in West Africa, especially in Ghana and Nigeria during the last 20 years on various aspects of palm wine including its production and composition,<sup>6</sup> but to our knowledge no study on palm wine has been made or published in central Africa, especially in Gabon. The toxicity of Gabonese palm wine is unknown and may be underestimated by medical teams as well as its consequences on population health. This study was carried out to

appreciate the range of alcohol content in different samples of Gabonese palm wine and to search other substances that could be associated with acute or chronic toxicity of this beverage.

## MATERIALS AND METHODS

### *Palm wine samples*

Palm wine samples were randomly collected from different stores all over the country, where palm wine was generally conserved in various sizes of plastic or glass recipients. Each store represented a traditional and individual way of palm wine production from a town or a region. Twenty-one samples were obtained, representative of 21 towns located all over all over the country. For each sample, a volume of about four mL was put in a haemolysis glass tube. Each tube was capped with plastic cap, identified and then put in a larger plastic tube for safety transport at room temperature. It took about ten days to collect all the samples, and four days, to send them to laboratory, where they were stored at 4°C before analyses.

### *Analytic determinations*

Methanol and ethanol concentrations in the liquid phase of the samples were measured by gas chromatography with flame ionizing detection as described by others.<sup>7</sup> A few microliters of the samples were diluted in pure water and an internal standard was added before direct injection of the resulting solution in a PLOT capillary column (allowing direct injections of aqueous samples). Quantification was done by comparison with external calibration curves obtained with certified alcohol solutions treated and analysed by the same way. Materials used for this analysis were a CP-3800 chromatograph (Varian® inc.) and a RtQPLOT® column (30 m\* 0.32 mm i.d.) from Restek® company.

Analysis of the volatile fraction of the samples was performed by static head space, as described by other authors.<sup>2</sup> After an equilibration period of 30 minutes at 85°C, the analysis of the upper gaseous phase of air-tight enclosed aliquots of the samples (1 mL) was achieved by capillary gas chromatography hyphenated with ion trap mass spectrometry. Some aromatic hydro-

carbons (benzene, toluene and xylenes), and chlorinated solvents (trichloroethylene and tetrachloroethylene) were specifically monitored by selected ion monitoring mode in mass spectrometry. Detection limits were checked by similar analysis of aqueous solutions spiked with the monitored solvents. Materials used for these analysis were a CP-3800 chromatograph and Saturn 2200 ion trap (Varian® inc.) equipped with a Combipal® autosampler and a BP624 column (30 m\* 0.22 mm i.d.–d.f. = 1.2 µm) from Restek® company.

Two ml aliquots of the residual samples were finally digested by addition of concentrated ultra pure nitric acid and stored at ambient temperature for 48 hours (cold mineralization method derived from International Oenological Codex). Determinations of total lead, arsenic and cadmium concentrations were then performed by graphite furnace atomic absorption spectrometry. Quantification was done by external calibration. Material used for these analysis was a AA800 graphite furnace atomic absorption spectrometer (Varian® inc).

The choice of this analytical strategy was driven by the objectives of the study, the previously published results, and the small amount of sample that was available.

## RESULTS

Concentrations of ethanol were quite stable with figures between 50 and 69 g.L<sup>-1</sup> and a mean concentration of 59.9 g.L<sup>-1</sup>, *i.e.* 7.5° (volume %). No methanol was detected in any of the analysed samples. (Table 1).

In our samples the main volatile components were alcohols, aldehydes, carboxylic acids and esters. No unexpected constituent such as aromatic or chlorinated solvent, potentially indicative of a contamination by petroleum or other industrial products during the traditional production of palm wine, was detected. In all samples, trace metals were quantified at low concentrations below maximal limits internationally recognized for alcoholic beverages with less than two µg.L<sup>-1</sup> for cadmium, less than 10 µg.L<sup>-1</sup> for arsenic, and for lead 15 samples with con-

centrations under  $10 \mu\text{g.L}^{-1}$  and the last six samples with concentrations between 11 and  $61 \mu\text{g.L}^{-1}$  respectively. (Table 1). Other components of palm wine, such as volatile constituents or organic compounds, chemical basis of aroma and microorganisms (yeast and bacteria) were not individually identified and/or tested in our samples.

## DISCUSSION

Alcohol use and abuse is responsible for many diseases. According to recent studies by the World Health Organization, alcohol consumption is a leading contributor to chronic disease and recognized as a strong risk factor affecting health in developed countries such as the United States and Canada.<sup>8</sup>

The WHO global burden of disease project estimated that in developed countries alcohol was responsible for 9.2% burden of disease, behind tobacco (12.2%) and high blood pressure (10.9%).<sup>8</sup>

There are many kinds of palm wines especially in Africa, with various names. Palm wine contains many components such as a heavy suspension of fungi and bacteria, fermentation agents which give the palm wine a milky white flocculent appearance,<sup>9</sup> different kind of volatile constituents,<sup>6</sup> chemical basis for aroma,<sup>2</sup> mineral elements which may change from one production to an other and must of all alcohol. In developing countries, this beverage is one of the most drunk alcohol

and its production is essentially traditional in the most countries.

The analysis of Gabonese palm wine samples revealed some aspects of its composition, especially the identity and the concentration of alcohols. In all samples, concentrations of ethanol were homogenous in a range between 50 and  $69 \text{g.L}^{-1}$  and average concentration of  $59.9 \text{g.L}^{-1}$ , so  $7.5^\circ$  (percent of alcohol by volume). It was been previously reported that palm wine contained three to five percent of alcohol by volume<sup>4</sup> but other authors reports concentrations up to ten percent during fermentation.<sup>9,10</sup> Our samples were stored at room temperature during the collection and transport, which may explain a level of alcohol less than expected and probably related to an

**Table 1: Concentrations of Alcoholic Components and usual Toxic Substances in the 21 Palm Wine Samples.**

Sample No.	Ethanol Concentration (g/L)	Methanol Concentration (g/L)	Aromatic and Chlorinated Solvents Research	Total lead Concentration (g/L)	Total Cadmium Concentration (g/L)	Total Arsenic Concentration (g/L)
1	64	<0.05	Negative (< $1 \mu\text{g.L}^{-1}$ )	15	<2,0	<10
2	66	<0.05	Negative (< $1 \mu\text{g.L}^{-1}$ )	21	<2,0	<10
3	66	<0.05	Negative (< $1 \mu\text{g.L}^{-1}$ )	30	<2,0	<10
4	54	<0.05	Negative (< $1 \mu\text{g.L}^{-1}$ )	<10	<2,0	<10
5	58	<0.05	Negative (< $1 \mu\text{g.L}^{-1}$ )	<10	<2,0	<10
6	56	<0.05	Negative (< $1 \mu\text{g.L}^{-1}$ )	11	<2,0	<10
7	62	<0.05	Negative (< $1 \mu\text{g.L}^{-1}$ )	26	<2,0	<10
8	60	<0.05	Negative (< $1 \mu\text{g.L}^{-1}$ )	<10	<2,0	<10
9	60	<0.05	Negative (< $1 \mu\text{g.L}^{-1}$ )	<10	<2,0	<10
10	50	<0.05	Negative (< $1 \mu\text{g.L}^{-1}$ )	<10	<2,0	<10
11	59	<0.05	Negative (< $1 \mu\text{g.L}^{-1}$ )	<10	<2,0	<10
12	60	<0.05	Negative (< $1 \mu\text{g.L}^{-1}$ )	61	<2,0	<10
13	59	<0.05	Negative (< $1 \mu\text{g.L}^{-1}$ )	<10	<2,0	<10
14	58	<0.05	Negative (< $1 \mu\text{g.L}^{-1}$ )	<10	<2,0	<10
15	69	<0.05	Negative (< $1 \mu\text{g.L}^{-1}$ )	<10	<2,0	<10
16	57	<0.05	Negative (< $1 \mu\text{g.L}^{-1}$ )	<10	<2,0	<10
17	61	<0.05	Negative (< $1 \mu\text{g.L}^{-1}$ )	<10	<2,0	<10
18	57	<0.05	Negative (< $1 \mu\text{g.L}^{-1}$ )	<10	<2,0	<10
19	64	<0.05	Negative (< $1 \mu\text{g.L}^{-1}$ )	<10	<2,0	<10
20	58	<0.05	Negative (< $1 \mu\text{g.L}^{-1}$ )	<10	<2,0	<10
21	59	<0.05	Negative (< $1 \mu\text{g.L}^{-1}$ )	<10	<2,0	<10

ongoing fermentation, as often observed in West Africa. Ajibade *et al.* demonstrated that fresh sap was converted into palm wine in two stages: the production of alcohol and organic acids (mainly lactic acid) due to the activity of yeast and lactic acid bacteria respectively, then the conversion of alcohol into acetic acid with further lowering of the pH of the medium.<sup>10</sup>

We have shown that Gabonese palm wine can be considered as a real alcohol. According to other authors, the main components of volatiles in this kind of beverage are the acetates of higher alcohols, ethyl acetate and the ethyl esters of straight chain aliphatic C<sub>5</sub>–C<sub>6</sub> carboxylic acids as well as ethanol and higher alcohols and flavor volatile do not differ qualitatively from others conventional wines.<sup>6</sup> We have similar constituents in our samples, also similar to common alcoholic drinks. No unexpected constituent such as aromatic or chlorinated solvent, potentially indicative of wine contamination by petroleum or other industrial products was detected. Trace metals were at low concentration (Table 1), less than maximal limits accepted for alcoholic beverages according to the International Codex of Oenological Practices, respectively 200 µg.L<sup>-1</sup> for Arsenic, 150 µg.L<sup>-1</sup> for lead and 10 µg.L<sup>-1</sup> for cadmium.<sup>11</sup> However, Ukhun *et al.* showed that all metals analyzed in palm wine samples from Benin were either not detected or present at low levels in unprocessed samples but could be more important in bottled samples, suggesting a potentially important metal contamination during bottling.<sup>3</sup> In all depots visited during our collection process, palm wine was in various sizes of plastic or glass bottles, confirming the similarity between Gabonese palm wine and those made in West Africa.

While there is extensive literature on alcohol use and abuse in developed countries, the same cannot be said about developing countries.<sup>4</sup> However, a few have been reported mostly from West Africa. For example, in Ivory cost, Hamon showed that in patients with chronic intoxication from palm wine, abnormalities on electroencephalograms (EEG) were partly similar to those due to

alcoholism from brandy such as impairment in the ability to sustain attention.<sup>12, 13</sup> We should have more consideration for Palm wine intoxication as well as alcohol chronic intoxication in Gabon because of its increased consummation related to low price, encouraged by poverty during the last 10 years; but also in all producing countries all over Africa. Heavy drinking seems to be the norm, drinking moderately is often seen as a sign of weakness or an innate inability to «hold alcohol».<sup>5</sup> This way of thinking is part of many cultures in Africa as well as Gabon.

The onset of problems associated with heavy consumption of alcohol among African is often attributed to the western beverages,<sup>5</sup> neglecting the consumption of local alcohols including palm wine. The quantity of palm wine and the part of absolute alcohol consumed by a drinker is often very difficult to determine because of wide variety of sizes of recipients used to carry and serve it. Many indications – especially alcohol consumption including palm wine – show that the country may experience consequences of heavy drinking in the future. The toxicity of this beverage is actually unknown and only few tests have been done and/or reported in the literature, example is tests on its fungal components<sup>1</sup> or research of the effect of metaspulphite on palm wine alcohol. Effects of its use and abuse are not really known, even in West Africa where the most publications were done.

This study has shown that there is no significant difference in composition between Gabonese palm wine and those made in West Africa, irrespective of origin or technique of production. Gabonese palm wine is an alcohol drink such as industrial alcohol or wines, produced in developed countries, with probably the same effects on human body. More investigation should be done for a better understanding of consequences of palm wine on health.

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