Research Article

Determination of Trace Level Fatty Acids and Esters as a Quality Index of Liquors Produced by Distillation of Raffia Palm Wine by Local Distillers in Southern Nigeria using GC-MS

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Abstract

Alcoholic spirits are mostly imported in Nigeria but some locally distilled spirits called 'ogogoro'are also available. The quality and safety of ogogoro are not certified because they are crudely and remotely distilled away from the reach of the regulatory agencies. This work intends to investigate the quality of ogogoro by the analysis of trace level fatty acids. Two samples each of the locally distilled drink were collected from each of 3 districts that make up Rivers State. 501® which is a foreign spirit, was used as the standard control. These samples were analysed with Gas Chromatography-Mass Spectrometry (GC-MS). Results showed that 'ogogoro' was of good quality as they contain trace level fatty acids which were also present in the 501® sample as an index for quality. Also, no known alcohol contaminant was detected indicating that the spirits were not only of good quality but also safe for consumption.

Keywords: Alcohol, ogogoro, trace level fatty acids, spirits

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Introduction

An alcohol is an organic compound in which the hydroxyl functional group (-OH) is bound to a carbon atom. In particular, this carbon centre should be saturated, having single bonds to three other atoms [1].

The simple acyclic alcohols with general formula-$C_nH_{2n+1}OH$ are important class of alcohols of which ethanol (C_2H_5OH) is the type found in alcoholic beverages.

Methanol is the simplest form of alcohol with only one carbon atom and was formerly obtained by the distillation of wood and was called 'wood alcohol'. It has a boiling point of 64.7^0C.As little as 10ml is capable of causing permanent blindness and 30ml potentially fatal [2]. It is extremely toxic unlike ethanol with two carbon atoms.

Ethanol is the most commonly used alcohol and has been produced by human for millennia, in the form of fermented and distilled alcoholic beverages [3]. It is a clear liquid and has a boiling point of 78.4^0C. Because of legal and tax restrictions on alcohol consumption, ethanol destined for other uses is denatured with additives such as Bitrex and methanol [2].

Nigeria is one of the world's leading consumers of alcoholic beverages with an average of about 15 litres of pure alcohol per capita per annum [4].

Traditional alcoholic beverages have been consumed in Nigeria and other West African communities for centuries, and western commercial spirits, beers and wines have been available since pre-colonial days [5].

Alcohol holds a significant position in the nation's health and commerce sectors providing employment to thousands of Nigeria through its robust industry as well as posing a serious health risk and threat to the nation.

Alcohol has been associated with both positive and negative effects, with alcoholics and alcohol consumers believing that it helps to reduce stress, improve mood, enhance friendship, prevent some gastro-intestinal diseases and improve the body's general well-being [6].

The negative effects associated with consumption include but not limited to drunk driving with its antecedent road and vehicular mishaps, domestic violence, increase in social vices like prostitution, increase in crime rate etc and the health risks like cancer, stroke, diabetes, dementia and liver diseases [7]

Some of these effects could be acute or chronic depending whether the tolerable limit is exceeded in a single or cumulative consumption respectively.

For instance, cases of death following alcohol consumption in Benue State-Nigeria have been reported [8]. Also, some villagers in Agulu, Anaocha LGA of Anambra State-Nigeria have confirmed an unpublished report of the death of two middle-aged men following consumption of locally brewed alcohol in June 2012.

Alcohol is thought to be the cause of more than sixty diseases and conditions, accounting for 3.2% of all deaths and 4.0% of all disability adjusted life years (DALYs) in the year 2000, with considerable variation in consumption and related harm by region [7].

In many African countries, traditionally brewed alcoholic beverages are usually poorly monitored for strength and quality. This is because they are produced in remote villages and homes and are often out of reach of local governments and regulatory bodies.

Besides anecdotal evidence and limited results, there is no systematic information about the quality of unbranded alcoholic beverages in Nigeria by independent researchers available [9]. The detection of trace level of fatty acids and their esters in locally distilled liquor is seen an indication of product quality [10].

In this study, we intend determine the quality of locally produced alcoholic beverages known locally as ogogoro/shekpe sampled from Rivers State, Nigeria by analysis of trace level fatty acids.

Experimental

Materials and Methods

A volume of 100 mL of 2 samples of locally brewed gins were collected in universal bottle from three zones of River State, Nigeria. One bottle of 501® which is a foreign brew was also purchased as a standard.

Identification of the volatile constituents of the samples was carried out using Shimandzu Gas Chromatography–Mass Spectrometry (GC-MS) (Model QP2010 Plus, Japan).

The gas chromatograph was equipped with split injector and the carrier gas was helium. A capillary column (50 m x 0.25 mm i.e., 0.2 µm film thickness; Chrompack) coated with CP-Wax 57 CB was used. A gradient temperature programme was used for the GC. The temperature was first set at 60^{o}C for 5 minutes and was programmed to run from 60^{o}C to 140^{o}C at 5^{o}C/min. The temperature was then held at 140^{o}C for 3 minutes before ramping it up to 280^{o}C at 15^{o}C/min and was held at 280^{o}C for 10 minutes. Injections of 1 µl of the sample in a split mode were made at the temperature of 250^{o}C. The flow rate was 6.2 mL/min. For the MS conditions, the interface temperature was 250^{o}C, while the ion source temperature was 200^{o}C. Analysis was carried out on a full scan mode and ionisation method was electrospray in the negative mode. Identification was carried by matching with compound library of the MS.

Results and Discussion

Results

The analyzed local liquors were distilled from raffia palm wine which is plant derived nectar. The result obtained showed that known volatile contaminants such as methanol, benzene, toluene, acetaldehyde, propyl alcohol, n-butanol, amyl alcohol, etc. were not detected in the samples by the analytical method used. GC-MS is the most suitable method for the analysis of volatile compounds. It detected a total of 15 different compounds (Table1). On organoleptic properties, the six samples of local brew were clear colourless liquids with alcoholic taste and smell, while the 501® brand had clear brownish colour with alcoholic taste and smell.

Table 1 showing presence of different types of fatty acids and their esters in different samples

Volatile Constituents	S1	S2	S3	S4	S5	S6	Positive control (501®)
Palmitic acid	+	+	+	+	+	+	+
Oleic acid	+	+				+	+
cis-9-hexadecenal	+						
14-methyl-8-hexadecyn-1-ol	+	+	+	+			
9-hexadecenal		+					
Linoleic Acid		+	+	+	+	+	
6-octadecanoic acid			+	+			
7-hexadecenal			+				
Trilinolein				+			
9-octadecanoic acid					+		
9-octadecanoic acid-1,2,3-propanetriyl ester	+				+	+	+
Linoleic acid chloride					+	+	
Propylene glycol							+
9-eicosyne							+

+: present

Discussion

The GC-MS analysis detected a total of 15 different compounds 14 of which were trace level fatty acids, fatty acid esters and aldehydes from six local samples and one foreign sample (Table 1). The fifteenth one was propylene glycol, a humectant, which was detected from the foreign standard. Of the all the trace level fatty acids detected, only palmitic acid was present in all samples including the foreign distilled sample (501®).

Linoleic acid was present in all samples except samples S1 and S7. Linoleic acid chloride was present in samples S5 and S6 while octadecanoic acid ester was present in samples S5, S6 and S7. The positive control (501®) also contained 9-eicosyne which was not detected in any other sample which is used for flavour and fragrance.

Linoleic acid chloride which has not been reported as one of the volatile contaminants in alcoholic beverages was detected in some of the samples. The presence of linoleic acid chloride, which is a reagent for the laboratory synthesis of fatty acids, indicates contamination during processing. It can also be due to the use of impure flavouring compounds. However, to our knowledge, there is no available report in literature relating to the harmfulness of linoleic acid chloride to humans.

IARC monograph stated that most of these aliphatic fatty acids and esters are fermentation products. Generally, the straight chain C_8-C_{18} fatty acids are more in abundance. This is followed by octanoic and decanoic acids with a high concentration of palmitic acid in Scotch whisky [11]. The analysed samples fall in the category of Scotch whisky and this explains the presence of palmitic acid in all of the samples. 14-methyl-8-hexadecyn-1-ol which was detected in the first four samples is known to be of plant origin [12-13].

Alcohol is thought to be the cause of more than sixty diseases and conditions, accounting for 3.2% of all deaths and 4.0% of all disability adjusted life years (DALYs) in the year 2000, with considerable variation in consumption and related harm by region [7]. However, it is yet unclear whether alcohol alone or in combination with the various contaminants is responsible. For instance, alcohol increases the risk of cancer as a secondary carcinogen but benzene, one of its known contaminants is a known primary carcinogen [14].

Reported cases of death following consumption of adulterated alcoholic beverages in Tanzania, Central Africa Republic, Uganda and some Southern and Central African countries abound [15]. These adulterants (contaminants) include volatile organic contaminants like methanol, ethyl carbamate, ethyl acetate, toluene, benzene, cyclohexane, n-butanol, isobutanol, acetaldehyde, propanol, etc. [9]. Therefore the presence of synthetic reagent in finished product calls to question the quality of additives used in the production of locally distilled liquor and hence the safety of the products.

Considering that most of the fatty acids detected were also detected in the foreign standard which is regulated or reported in popular Scotch whisky [11], it could be said that the samples are of good quality based on the analysis of trace level acids. The presence of naturally derived fatty acids and volatile constituents added to the quality of the final product.

Conclusion

Although the production process of ‘ogogoro’ can be described as crude compared to contemporary methods and quality unregulated, from the result available to us, we can confidently conclude that the locally distilled liquor is of good quality and is not harmful to human when consumed in recommended quantity.

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