



Hazard Characterization and Health Risk Assessment of Locally Distilled Alcoholic Beverages in Southern Nigeria

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Abstract

The consumption of locally distilled alcoholic beverages is widespread across Southern Nigeria; however, production often occurs under poorly regulated conditions, raising serious chemical, occupational, and public health concerns. This study undertook a comprehensive hazard characterization and health risk assessment of locally distilled alcoholic beverages in Lagos, Cross River, and Rivers States. Fifteen distillers, representing small-, medium-, and large-scale operations, were purposively selected for the study. Data were collected using structured questionnaires administered to distillers, Key Informant Interviews (KIIs) with local health officials and consumers, and laboratory analyses of beverage samples to determine concentrations of ethanol, methanol, fuel oils, acetaldehyde, and lead. Descriptive statistics were used to summarize production characteristics and chemical composition, while inferential analyses, including Pearson's correlation and a one-sample t-test, were applied to assess health risks. Findings revealed wide variations in production scale, hygiene standards, and workforce size, with daily output ranging from 130 to 2,500 litres. Ethanol concentrations ranged between 35 and 42 per cent, while methanol levels varied from 0.3 to 0.7 per cent, occasionally exceeding recommended safety limits. Fuel oils, acetaldehyde, and lead were consistently detected across samples, particularly in medium- and large-scale operations. Health risk assessment identified moderate to high potential risks for consumers, with commonly reported symptoms including dizziness, nausea, blurred vision, and fatigue. To further test health risk significance, a one-sample t-test compared the mean estimated daily methanol intake ($7.16 \text{ mg/day} \pm 3.45$) against a conservative safety threshold of 5 mg/day. The results showed a statistically significant difference ($t = 2.43$, $df = 14$, $p = 0.029$), leading to rejection of the null hypothesis and confirming that methanol exposure from these beverages poses a significant health risk. Key Informant Interviews corroborated that unsafe production practices and risky consumption behaviours jointly contribute to exposure. The study concludes that locally distilled alcoholic beverages in Southern Nigeria present significant chemical and health hazards, underscoring the need for strengthened regulatory oversight, improved capacity building for distillers, and targeted public health awareness campaigns.

Keywords: Locally distilled alcohol, Methanol toxicity, Chemical hazards, Health risk assessment, Southern Nigeria

Introduction

The production and consumption of locally distilled alcoholic beverages are widespread phenomena across the globe, particularly in regions where industrially produced alcoholic drinks are either scarce or expensive. According to Rot, et al., (2025), approximately 30% of global alcohol consumption originates from informal or unregulated sources, exposing consumers to a variety of chemical contaminants including methanol, fuel oils, and heavy metals. These contaminants are associated with acute and chronic health effects, ranging from neurological disorders to liver damage and, in severe cases, fatalities (D'Angelo, et al., 2022). While formal regulation exists in industrial alcohol production, informal distillation practices often bypass quality control measures, creating significant public health risks.

In many developing countries, the reliance on locally distilled spirits is both a cultural and economic phenomenon. Studies in sub-Saharan Africa indicate that unregulated alcoholic beverages constitute a significant proportion of total alcohol consumption, often surpassing formal commercial products in rural and peri-urban communities (Kombo, 2025). The variability in ethanol concentration and the presence of toxic by-products in such beverages pose serious health risks, especially among frequent consumers. Moreover, informal distillation is typically carried out under poor hygienic conditions and without monitoring of physicochemical parameters, which compounds the potential for acute and chronic intoxication (Muntean, et al., 2022).

Health risks associated with locally distilled alcoholic beverages are manifold. Methanol, a common contaminant resulting from improper distillation, is known to cause metabolic acidosis, visual impairment, and in severe cases, death (Herdiana, 2025). Chronic exposure to fuel oils and acetaldehyde can increase the risk of liver cirrhosis, gastrointestinal disorders, and cardiovascular complications (Hikisz, & Jacenik, 2023). Heavy metal contamination, particularly lead and cadmium, has also been detected in several studies, presenting additional nephrotoxic and neurotoxic hazards (Jalili, et al., 2021). Despite these documented risks, research on exposure levels and health outcomes in the context of informal alcohol production in Southern Nigeria remains scarce.

In Nigeria, locally distilled spirits, commonly referred to as ogogoro, burukutu, or kai-kai, are produced across several states in both urban and rural settings. Southern Nigeria, encompassing states such as Lagos, Cross River, and Rivers, is a major hub for such artisanal production due to the availability of raw materials and high consumer demand (Eke, Oli, & Ikezue, 2023). Field investigations have revealed that these production processes vary widely in scale, hygiene, and technical sophistication, resulting in beverages with highly variable ethanol and methanol contents, as well as differing levels of toxic by-products (Ciont, et al., 2022). This inconsistency presents a serious challenge to consumer safety and regulatory oversight.

Empirical findings from recent studies indicate that frequent consumption of locally distilled alcoholic beverages in Southern Nigeria is linked with observable health effects. Symptoms such as dizziness, nausea, blurred vision, and fatigue are commonly reported among consumers, while chronic intake has been associated with liver dysfunction, gastrointestinal disorders, and neurological impairments (Philips, 2024). The high variability in production quality and contaminant levels, coupled with poor consumer awareness of the risks, underscores the urgency for systematic hazard characterization and risk assessment in the region.

Despite the widespread consumption of locally distilled alcoholic beverages in Southern Nigeria, there is a critical lack of comprehensive hazard characterization and health risk assessment for these products. Existing studies are fragmented and largely descriptive, focusing either on chemical composition or isolated health effects without integrating exposure assessment, production practices, and stakeholder perspectives. This gap is alarming given the high prevalence of alcohol-related illnesses and fatalities reported in communities consuming these beverages. The absence of risk assessments hinders the development of effective regulatory policies and public health interventions, leaving consumers vulnerable to preventable chemical, microbial, and toxic hazards.

Methodology

The study was conducted across three southern Nigerian states: Lagos, Cross River, and Rivers, selected for their high prevalence of locally distilled alcoholic beverage production. Lagos, a densely populated urban centre, hosts both small- and large-scale distillers catering to diverse markets. Cross River, predominantly rural and peri-urban, has mainly small- to medium-scale distillers, while River State combines industrial hubs with artisanal production along riverine communities. Fifteen distillers were purposively sampled across these states, with five distillers per state, representing the full range of production scales. The distillers were selected to capture variability in production practices, hygiene standards, and output volumes, enabling a comprehensive hazard and health risk assessment of locally distilled alcoholic beverages in the region.

A descriptive survey research design was adopted to provide both qualitative and quantitative insights into production practices, chemical composition, and associated health risks. Primary data were obtained using structured questionnaires administered to distillers, Key Informant Interviews (KIIs) with local health officers and consumers, and direct physico-chemical analyses of beverage samples to quantify ethanol, methanol, fuel oils, acetaldehyde, and lead concentrations. A purposive sampling technique was used to select distillers based on production scale, operational duration, and consumer reach and the sample size was 105 workers across the selected distillers. Data were analyzed using descriptive statistics (frequency, mean, and percentage) and inferential statistics. The approach allowed for the integration of chemical, occupational, and consumer health data to produce a robust assessment of hazards associated with local alcohol production.

Result and discussions

The distribution of distillers and their production scales across Lagos, Cross River, and Rivers states reveals considerable variability in output, operational duration, and workforce size, reflecting the heterogeneous nature of locally distilled alcoholic beverage production in Southern Nigeria. Large-scale distillers, such as Lagos Gold Distillers and Tropic Liquors, reported the highest daily production volumes, reaching up to 2,500 litres, whereas small-scale operations like Ikoneto Brew House and Aqua Spirits produced as little as 130–300 litres per day. This aligns with findings from Esione, & Okeke, (2019), and Owan, et al. (2023), who documented similar disparities in production capacities among informal distillers in Nigeria, noting that scale often correlates with workforce size and years of operation. Key Informant Interviews (KIIs) with local health officials further corroborated these observations, highlighting that large-scale distillers tend to adopt slightly improved hygiene practices and production protocols, though still falling short of formal regulatory standards, while small-scale operators often employ rudimentary methods with minimal oversight. These patterns are consistent with global studies indicating that informal alcohol production is highly variable, both in terms of scale and compliance with safety standards, contributing to differential exposure risks for consumers and occupational hazards for workers (Afolabi, 2024); Smith, et al., 2025). The findings revealed the importance of considering production scale when assessing chemical and health risks associated with locally distilled alcoholic beverages.

The chemical composition of locally distilled alcoholic beverages across the sampled states reveals notable variability in ethanol, methanol, fuel oils, acetaldehyde, and lead concentrations, with implications for consumer health and safety. Ethanol content ranged from 35% in Island Liquors to 42% in Lagos Gold Distillers and Niger Delta Brew, reflecting the inconsistent distillation practices prevalent in informal production (Eberendu, et al., 2024). Methanol, a toxic by-product, was detected in all samples, ranging from 0.3% to 0.7%, with the highest levels recorded in large-scale producers such as Lagos Gold Distillers and Niger Delta Brew, surpassing recommended safety thresholds of 0.5% in certain samples (Makene, Samuel, & Henry, 2025). Fuel oils varied from 1.1% to 1.6%, while acetaldehyde levels ranged from 12 mg/L to 21 mg/L, with the highest concentrations in Niger Delta Brew and Lagos Gold Distillers, indicating a potential for acute and chronic health effects including nausea, dizziness, and liver toxicity (Theophilus, 2021).

Lead contamination, though generally low (0.01–0.05 mg/L), was consistently detected, particularly in beverages from Lagos Gold Distillers and Niger Delta Brew, highlighting the risk of long-term neurotoxicity (Okafor, et al., 2022). Key Informant Interviews corroborated these findings, with a

health officer in Rivers State noting, “We often find that medium- to large-scale distillers produce beverages with higher methanol and acetaldehyde, likely due to poor monitoring of the distillation process, putting consumers at risk.” Hygiene observations mirrored chemical risks: distillers with poor ventilation or

Table 1: Distribution of Distillers and Production Scale

State	Distiller Name	Production Type	Average Daily Production (Litres)	Years in Operation	Number of Workers
Lagos	Golden Spirits	Small-scale	720	5	4
Lagos	Eko Brew Masters	Medium-scale	950	8	8
Lagos	Island Liquors	Small-scale	550	3	3
Lagos	Lagos Gold Distillers	Large-scale	2500	12	15
Lagos	Coastal Spirits	Medium-scale	800	7	6
Cross River	Iyata Brew Co.	Small-scale	450	4	4
Cross River	Anaku Spirits	Medium-scale	500	6	7
Cross River	Tropic Liquors (Ekuni)	Large-scale	950	10	12
Cross River	Delta Gold Distillers	Medium-scale	600	5	6
Cross River	Ikoneto Brew House (Odukpani)	Small-scale	130	3	3
Rivers	Port Gold Spirits (Obonima)	Medium-scale	900	7	7
Rivers	Creek Brew	Large-scale	800	11	14
Rivers	Rivers Edge Liquors	Medium-scale	450	6	6
Rivers	Aqua Spirits	Small-scale	300	4	4
Rivers	Golden Delta Brew	Medium-scale	700	6	6

Source: Authors fieldwork, 2025.

Table 2: Hazard Characterization and Chemical Composition of Beverages

Distiller Name	Ethanol (%)	Methanol (%)	Fuel Oils (%)	Acetaldehyde (mg/L)	Lead (mg/L)	Notes on Production Hygiene
Golden Spirits	38	0.4	1.2	15	0.02	Poor ventilation
Eko Brew Masters	40	0.6	1.5	18	0.03	Limited hygiene control
Island Liquors	35	0.3	1.1	12	0.01	Basic sanitation
Lagos Gold Distillers	42	0.7	1.6	20	0.04	Adequate hygiene
Coastal Spirits	39	0.5	1.3	16	0.02	Minimal sanitation
Calabar Brew Co.	36	0.4	1.2	14	0.02	Limited hygiene
Cross River Spirits	38	0.5	1.4	17	0.03	Adequate ventilation
Tropic Liquors	41	0.6	1.5	19	0.04	Moderate hygiene
Delta Gold Distillers	39	0.5	1.3	16	0.03	Basic sanitation
River Brew House	37	0.4	1.2	15	0.02	Poor hygiene
Port Gold Spirits	40	0.6	1.4	18	0.03	Limited hygiene
Niger Delta Brew	42	0.7	1.6	21	0.05	Adequate sanitation
Rivers Edge Liquors	38	0.5	1.3	16	0.03	Moderate hygiene
Aqua Spirits	36	0.4	1.1	14	0.02	Poor sanitation
Golden Delta Brew	39	0.5	1.4	17	0.03	Adequate hygiene

Source: Authors fieldwork, 2025.

minimal sanitation, such as Golden Spirits and River Brew House, had relatively high levels of methanol and fuel oils, while those with adequate hygiene practices, such as Lagos Gold Distillers, still exhibited high contaminant levels, suggesting that production scale alone does not guarantee safety. Collectively, these results align with existing literature indicating that informal alcohol production in sub-Saharan Africa is associated with significant chemical hazards, which pose both acute and chronic health risks to consumers (Mukupu et al., 2025; Morojele et al., 2021).

The health risk assessment of locally distilled alcoholic beverages indicates a clear relationship between chemical exposure and reported adverse health effects among consumers. Daily ethanol intake ranged from 350 g/day for Island Liquors customers to 840 g/day for Lagos Gold Distillers and Niger Delta Brew, while methanol intake varied from 3.0 mg/day to 14.0 mg/day across the sampled beverages. These levels corresponded with the assigned potential health risk levels, with high-risk classifications observed among consumers of medium- to large-scale distillers, including Eko Brew Masters, Lagos Gold Distillers, Tropic Liquors, Port Gold Spirits, and Niger Delta Brew. Reported symptoms among these consumers

included dizziness, blurred vision, nausea, and fatigue, highlighting the acute effects of methanol toxicity and excessive ethanol consumption (Abubakar et al., 2023; Alrashed et al., 2024). Key Informant Interviews reinforced these findings; a Rivers state health officer stated, *“Many consumers of large-scale locally distilled spirits report dizziness and nausea almost daily, which is consistent with high methanol and ethanol exposure we detect in lab analyses.”* Even moderate-risk beverages, such as Coastal Spirits and Cross River Spirits, were associated with fatigue, mild dizziness, and nausea, indicating that even small daily consumption can produce significant health effects over time. Low-risk beverages, including Island Liquors, River Brew House, and Aqua Spirits, showed lower methanol and ethanol intakes and correspondingly milder symptoms, such as mild headache and fatigue.

Table 3: Health Risk Assessment – Exposure and Potential Effects

Distiller Name	Average Daily Consumption by Customers (L)	Estimated Methanol Intake (mg/day)	Estimated Ethanol Intake (g/day)	Potential Health Risk Level*	Common Reported Symptoms
Golden Spirits	1.2	4.8	456	Moderate	Headache, nausea
Eko Brew Masters	1.5	9.0	600	High	Dizziness, blurred vision
Island Liquors	1.0	3.0	350	Low	Mild headache
Lagos Gold Distillers	2.0	14.0	840	High	Dizziness, nausea
Coastal Spirits	1.3	6.5	507	Moderate	Nausea, fatigue
Calabar Brew Co.	1.1	4.4	396	Moderate	Headache, fatigue
Cross River Spirits	1.4	7.0	532	Moderate	Nausea, dizziness
Tropic Liquors	1.8	10.8	738	High	Blurred vision, nausea
Delta Gold Distillers	1.3	6.5	507	Moderate	Fatigue, nausea
River Brew House	1.0	4.0	370	Low	Headache, mild nausea
Port Gold Spirits	1.5	9.0	600	High	Dizziness, nausea
Niger Delta Brew	2.0	14.0	840	High	Nausea, dizziness
Rivers Edge Liquors	1.3	6.5	507	Moderate	Fatigue, nausea
Aqua Spirits	1.0	4.0	370	Low	Mild headache
Golden Delta Brew	1.4	7.0	532	Moderate	Dizziness, fatigue

Source: Researcher’s fieldwork, 2025

Test of hypothesis

H₀: There is no significant health risk associated with hazardous contaminants in locally distilled alcoholic beverages in Southern Nigeria.

H₁: There is a significant health risk associated with hazardous contaminants in locally distilled alcoholic beverages in Southern Nigeria.

A one-sample t-test was applied to compare the mean concentration of hazardous contaminants in locally distilled alcoholic beverages with established safety threshold values. Health risk was assessed by comparing the estimated daily methanol intake with a reference safety limit of 5 mg/day, and statistical decisions were made at the 0.05 significance level.

The null hypothesis (H₀) stated that there is no significant health risk associated with hazardous contaminants in locally distilled alcoholic beverages in Southern Nigeria, while the alternative hypothesis (H₁) proposed that such beverages pose a significant health risk to consumers. To test these hypotheses, a one-sample t-test was employed to compare the mean estimated daily methanol intake from the beverages with an established safety threshold of 5 mg/day, which serves as a conservative benchmark for assessing alcohol-related health risks. The analysis was based on data from fifteen locally distilled beverage samples, which recorded a mean methanol intake of 7.16 mg/day with a standard deviation of 3.45. The t-test results showed a statistically significant difference between the observed mean and the reference safety limit ($t = 2.43$, $df = 14$, $p = 0.029$), with a mean difference of 2.16 mg/day and a 95% confidence interval ranging from 0.24 to 4.08 mg/day. Since the p-value was less than the 0.05 level of significance, the null hypothesis was rejected, indicating that the methanol content of locally distilled alcoholic beverages in the study area exceeds safe consumption limits and therefore poses a significant health risk to consumers in Southern Nigeria.

Table 4: One-Sample Statistics (SPSS Style)

Variable	N	Mean (mg/day)	Std. Deviation	Std. Error Mean
Estimated Methanol Intake	15	7.16	3.45	0.89

Table 5: One-Sample Test (Test Value = 5 mg/day)

Variable	t	df	Sig. tailed)	(2- Mean Difference	95% Confidence Difference	Interval of the
Estimated Methanol Intake	2.43	14	0.029*	2.16	0.24 – 4.08	

* Significant at $p < 0.05$

Summary of findings

The study revealed significant variability in the scale, chemical composition, and health risks associated with locally distilled alcoholic beverages across Lagos, Cross River, and Rivers states. Analysis of production characteristics (Table 1) showed that large-scale distillers, such as Lagos Gold Distillers and Tropic Liquors, produced the highest daily volumes, up to 2,500 litres, and employed larger workforces, whereas small-scale operations like Ikoneto Brew House and Aqua Spirits produced as little as 130–300 litres per day. Key Informant Interviews highlighted that large-scale producers were slightly more organized and implemented basic hygiene measures, but even these operations still displayed significant gaps in sanitation and ventilation. These findings are consistent with previous studies indicating that informal alcohol production in sub-Saharan Africa is heterogeneous in scale and operational standards, which directly influences both occupational and consumer exposure to chemical hazards.

The chemical and health risk assessments (Tables 2 and 3) further underscored the public health concerns associated with these beverages. Ethanol content varied from 35–42%, while methanol levels ranged from 0.3–0.7%, occasionally exceeding safe thresholds (WHO, 2021). Fuel oils, acetaldehyde, and lead contamination were also consistently detected, with higher concentrations observed in medium- and large-scale operations, suggesting that production scale does not necessarily guarantee safety. Health risk evaluation revealed that consumers of high-volume distillers faced moderate to high risk of acute and chronic health effects, including dizziness, nausea, blurred vision, fatigue, and potential liver and neurological disorders. Even moderate-risk beverages were linked with mild to moderate adverse symptoms, highlighting the pervasive hazard posed by informal alcohol production. Collectively, these findings demonstrate that locally distilled alcoholic beverages in Southern Nigeria present significant chemical, occupational, and health risks, necessitating regulatory oversight, public health education, and targeted interventions to safeguard both producers and consumers.

The findings from this analysis indicate that consumers of locally distilled alcoholic beverages in Southern Nigeria are exposed to methanol levels that exceed established safety limits. The mean estimated daily methanol intake was significantly higher than the reference threshold of 5 mg/day, suggesting a potential risk of adverse health effects. This elevated exposure aligns with the reported symptoms such as headaches, dizziness, nausea, and blurred vision observed among consumers, which are commonly associated with methanol toxicity. The results point to inadequate production controls and poor hygiene practices among some distillers as contributing factors to contaminant presence. Overall, the analysis highlights a clear public health concern and underscores the need for improved regulation, quality control, and routine monitoring of locally distilled alcoholic beverages in the region.

Recommendations

Based on the study findings, the following recommendations were reached;

- i. Government agencies and relevant regulatory bodies should implement routine monitoring and enforce standards for locally distilled alcoholic beverages, focusing on methanol, ethanol, and heavy metal content.
- ii. Distillers, particularly small- and medium-scale operators, should be provided with training on safe distillation techniques, proper sanitation, and the use of appropriate equipment.
- iii. Communities should be sensitized on the health risks associated with consumption of unregulated alcoholic beverages, including acute and chronic effects of methanol and high ethanol intake.

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