

## Ethanol Concentration and Standard Drink Equivalent of Locally Brewed Alcoholic Drinks in Vwang district, Jos South Local Government Area, Plateau State, Nigeria

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### Abstract:

**Background:** The harmful effect of alcohol use is a well-documented subject globally. However, little is known about the ethanol concentration of locally brewed alcoholic drinks in rural communities in Nigeria. The aim of this study was to determine the types of alcoholic drinks, their ethanol concentration and Standard Drink equivalent of the various locally brewed alcoholic drinks in Vwang District, Central Nigeria

**Materials and Methods:** This was a descriptive cross-sectional study where samples of alcoholic drinks were taken from all the commercial brewing houses across the four wards of Vwang District. Determination of ethanol content of the brews was based on the standards of the Association of Official Analytical Chemists (AOAC). The concentration of alcohol (ethanol) determined was converted to standard units by multiplying the amount of ethanol by volume (one litre) by the constant 0.789

**Results:** The six locally brewed drinks sampled from the brewing houses were: Achas, Pyata, Nzokokok, Rokrok, Rwagwakya and Zandi and the mean ethanol concentration and Standard Drink (SD) equivalent of one litre of the drinks was found to be: 2.78% (2.19 SD), 5.24% (4.13 SD), 5.02% (3.96 SD), 3.23% (2.54 SD), 5.58% (4.40 SD) and 6.34% (5.01 SD) respectively.

**Conclusion:** The study found that the ethanol concentration of locally brewed alcoholic drinks in Vwang District ranged between 2.78 – 6.34%. When converted to Standard Drinks, a litre of the drinks would be approximately 2.19 – 5.02 standard drinks. There was no difference in the cost per volume based on the standard drink equivalent of the drink. This calls for standardization of methods of preparation of these drinks, labelling, and community awareness creation about the alcoholic content and the dangers of harmful alcohol use.

**Key Word:** Ethanol concentration, Standard drink, Locally brewed, alcoholic drinks

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### I. Introduction

Harmful alcohol use is a global public health problem causing about 3 million deaths per year and accounting for about 5.5% of all deaths.<sup>1</sup> In addition, it is implicated in more than 200 different disease conditions resulting in diverse health, social and economic consequences.<sup>1</sup> The drinking pattern in Africa is heterogeneous as characterised by abstinence in some parts of North Africa, to heavy drinking in the Sub-Saharan.<sup>2,3</sup> The identification of Africa as a progressive market led to heavy investments by global brewers resulting in increased alcohol production and promotion in the region.<sup>4</sup> Even though recent reports show that alcohol consumption in the African region has remained stable, the greatest burden of alcohol-related deaths and disability are found in Africa.<sup>5</sup> In addition, the prevalence of heavy episodic drinking (HED) (defined as 60 or more grams of pure alcohol on at least one occasion at least once per month) has remained high in some parts of sub-Saharan Africa.<sup>5</sup>

Typically, alcohol consumed can be classified as recorded or unrecorded.<sup>6</sup> Recorded alcohol is an alcoholic drink that is recorded in official statistics while unrecorded alcohol is consumed alcoholic beverage that is unaccounted for in official statistics of alcohol sales or taxation and as such produced, distributed and sold outside formal government channels.<sup>6</sup> An important example of unrecorded alcohol is homemade alcohol beverages from fermented products like millet, rice and maize which are consumed in communities or homes.<sup>6</sup> Unrecorded alcohol constitutes an important threat to global health.<sup>7</sup>

About 30% of alcohol consumed in Africa is unrecorded and this poses a challenge owing to poorly implemented alcohol policies and regulation.<sup>7,8</sup> Deaths and hospitalisation linked to home-brewed alcohol have previously been reported in Kenya.<sup>9</sup> Those that consume unrecorded alcohol are at greater risk owing to unknown contaminants and impurities.<sup>3</sup> This has led to attempts at unravelling the characteristics of unrecorded alcohol in countries like Nigeria, Kenya and Zimbabwe.<sup>10,11,12</sup> Therefore, the first step in curtailing the menace of unrecorded alcoholic beverages is an in-depth knowledge of their properties and types for any geographical area or context.

Locally brewed alcoholic drinks can be categorized into three broad groups: Fermented drinks, such as *Burukutu* produced from maize and *Pito* from millet or guinea corn, palm wine tapped from raffia and palm oil trees and gin-like distillates such as *Ogogoro*, *Kinkana*, *Kai* and *Apetesi*.<sup>13</sup>

The effects of harmful alcohol use have been documented by researchers however, little is known regarding the process of fermentation and alcoholic content of locally brewed alcoholic drinks in rural communities.<sup>14,15,16,17</sup> The aim of this study was to determine the types as well as the ethanol concentration of the locally brewed alcohol drinks in Vwang district, Central Nigeria. This will aid in determining the amount of Standard Drink (SD) for each alcohol beverage type. This information will enable a determination of the potential harm associated with such drinks and allow comparison of the ethanol concentration in the local drinks with those obtained in other communities. Results from this study will be a tool for advocacy and for instituting behavioural change communication programs for the reduction of harmful alcohol use. This is in line with Sustainable Development Goal 3.5.<sup>18</sup>

## **II. Material And Methods**

### **Study Area**

The study was conducted in Vwang District of Jos-South Local Government area of Plateau State, Nigeria which has its headquarters in Bukuru at 9°48'00"N 8°52'00"E. It has an area of 510 km<sup>2</sup> and a population of 306,716 at the 2006 census.<sup>19</sup> It is a rural agrarian community and the major language spoken in this region is Berom. The study was conducted among the local alcoholic beverage brewing houses in Vwang District using a cross-sectional study design. There are fourteen brewing houses all together located in Vwang District.

### **Study population, Sampling and Data collection**

The study population consisted of all brewing houses in Vwang district and total population sampling was done by taking samples of all the different types of alcoholic drinks brewed in all the 14 brewing houses. Information was obtained from the brewer or seller at the point of sample collection on the types of drinks produced, the cereals used, method of production, the number of days it takes for the drink to be ready for sale, the types of receptacles used in selling the drinks, measuring their volumes and the cost per volume using an interviewer-administered key informant interview. Three consecutive samples, one week apart, of the brews produced in the selected brewing houses, were obtained in empty portable water bottles between 6:00 – 7:00 am and placed in ice packs before transport for laboratory analysis. Data collection commenced in October and completed in November 2018.

### **Determination of Ethanol Content**

Determination of ethanol content of the brews was based on the standards of the Association of Official Analytical Chemists (AOAC 942.06). Twenty millilitres of the sample was measured into a distillation flask and 150 ml of distilled water added. About 100 ml of the distillate was collected and allowed to cool at 20<sup>0</sup> C. The specific gravity of the distillate was determined using AOAC 945.06. The alcohol content (% v/v) was determined using the specific gravity and reading it off the Ethanol Quadruple Bulk Table 7.

### **Standard Drink Equivalent**

The concentration of alcohol (ethanol) determined was converted to standard units by multiplying the amount of ethanol by volume (one litre) by the constant 0.789.<sup>20</sup>

### Data analysis

Data was analysed using a Microsoft excel spreadsheet. The means and standard deviations of the ethanol concentration of the locally brewed alcoholic drinks were tabulated.

### Ethical Approval

Ethical approval was obtained from the Jos University Teaching Hospital Human Research Ethics Committee.

## III. Result

### Brewing Methods

The study area consists of four wards namely; Turu, Chugwi, Tya and Fwil. There were 14 brewing houses, labelled, A – N. Brewing sites A – E are located in Turu, sites F – H in Chugwi, sites I – L in Tya while site M and N in Fwil. There were six locally brewed drinks in these brewing houses: *Achas*, *Pyata*, *Nzokokok*, *Rokrok*, *Rwagakya* and *Zandi*. Two brewing houses (D and E) made *Achas*; six (B,C, F,H, K and J) *Pyata*; one (N) *Nzokokok*; eight (C,G,I,J,K,L,M and N) *Rokrok*; three (C,G and M) *Rwagakya* and three made (A,F and I) *Zandi*. Table 1. The serving containers for drinks consist of the ‘*Ci*’ (Calabash) which measures one litre by volume and the ‘*Langa*’, a small paint bucket, which is four litres.

*Achas* is produced from millet, guinea corn, *tamba* (finger millet) and *acha* (fonio) cereals and has a period of production of between four to five days. The production process consists of malting, mashing, boiling and the addition of a fermenter (a stock from remnants from an old alcohol brew). *Pyata* is produced essentially from millet alone over a period of five to seven days. The production process consists of malting, mashing, boiling and the addition of a fermenter. *Nzokokok* is made using millet, sweet potatoes and *tamba* over a two-day period. It does not go through the process of malting. However, it is mashed, boiled and a fermenter added. *Rokrok* is made from millet, sweet potatoes and *tamba*. However, some brewers also add maize, guinea corn and malted rice. It takes two days to produce but in one brewing home, where there was malting, it took five days. *Rokrok* is usually not malted but simply mashed and in some instances, strained. *Rokrok* is boiled but no fermenter is added. *Rwagakya* is produced from millet, potatoes and *tamba* over a period of two to four days. It is not malted but mashed, boiled and a fermenter added. *Zandi* is produced from red guinea corn over a period of five to six days. It undergoes malting, mashing, the addition of a grain bill, boiling and then the addition of a fermenter. All the drinks are produced using aluminium pots. Malting is done by soaking the grains in a drum except for *Zandi* where polyethene grain bags are used.

### Mean PH, specific gravity and ethanol concentration

The mean PH, specific gravity and ethanol concentration of the drinks were found to be: 3.78, 1.02 and 2.78% for *Achas*; 4.07, 1.02 and 5.24% for *Pyata*; 3.91, 1.02 and 5.02% for *Nzokokok*; 3.79, 1.04 and 3.23% for *Rokrok*; 4.10, 1.02 and 5.58% for *Rwagakya* and 3.46, 1.00 and 6.34% for *Zandi*. Table 2. When the mean concentration of the drinks per volume was converted to the number of standard units, the lowest was a ‘*Ci*’ (1 L) of *achas* which is 1.41 standard units while a ‘*Langa*’ (4 L) of *achas* is 5.64. Similarly, the drink per volume with the highest number of standard units, a ‘*Ci*’ of *rwagakya* is 5.83 standard units and the ‘*Langa*’ of *rwagakya* 23.30 standard units. Table 3.

### Cost of drink

All the drinks in the brewing houses, irrespective of their standard drink equivalence were sold at ₦50:00 per litre. (At the time the study was done, USD: NGN = 1:363)

## IV. Discussion

The study showed that the mean ethanol concentration of the locally produced alcoholic drinks in the Vwang district was between 2.78% and 6.34%. The term *Burukutu* in Vwang and several settings is most times used as the generic name for any locally produced alcoholic drink and most communities have more than one type of drink named in their local languages.

The findings in this study agree with those from an earlier study which found the alcoholic content of fermented drinks in Nigeria to range between 3% - 6% ABV.<sup>21</sup> It is also within the limits of that reported for *Burukutu* in north-central Nigeria where the mean concentration was found to be 5.7%.<sup>22</sup> In Ghana, the mean alcohol concentration of *Burukutu* was found to be 4.76%<sup>26</sup> and the mean ethanol content of Busaa, a cereal-based fermented beer was 4%.<sup>23</sup> Traditional beers in Tanzania had an ethanol concentration ranging between 2 – 8%.<sup>24</sup>

Some studies have found higher alcoholic concentration in locally brewed drinks by fermentation. In a study in Wukari, Nigeria the concentration of ethanol in locally brewed drinks was between 8.69 – 10.29%.<sup>25</sup> The ethanol concentration in Ibadan was found to be less than that found in this study.<sup>26</sup>

The variance in our results compared to other studies may be as a result of the difference in the fermentable sugars in the cereals used, as ethanol content from sorghum-based locally produced alcoholic drinks is higher than that produced from millet which is in turn higher than that produced from maize.<sup>22,25</sup> It may also be as a result of the differences in the methods of production of the alcoholic drinks as the details in the methods of production in the other studies are not mentioned. It is worthy of note however that almost all the studies used the AOAC method to determine the ethanol concentration in their drinks.

Converting a litre of the mean alcoholic concentration of the locally produced drinks in our study to standard drinks gave a range of 2.19 – 5.01 units. Several regions in the world have stipulated guidelines on the value of a standard drink. Some guidelines have stipulated that men should not take more than 21 standard drinks per week and women, not more than 14.<sup>27</sup> This can thus be applied to the individual locally brewed drinks in the community thus: men should not take more than 9 Calabashes ('Ci') per week while women should not take more than 7 Calabashes for the low concentration drinks. For the high concentration drinks, men should not take more than 4 Calabashes per week while women should not take more than 3 Calabashes.

There should be on-going enlightenment in the community regarding the volume of the Calabash and other serving containers and the concept of the unit of alcohol and the association of alcohol to some disease entities as an individual may take more than one drink. Binge drinking, the intake of large amounts of alcohol within a short duration or drinking to get drunk, would for the locally produced alcohol mean that men should not take more than four Calabashes (4 L) per sitting for the low concentrated drinks and about one and a half to two Calabashes for the high concentration drinks. Women should also not take more than 3 Calabashes for the low concentration drinks and one to one-fifth Calabashes for the high concentration drinks.

Our study found that there was no difference in the cost per volume or standard drink equivalence in all the drinks. However, the study in Western Kenya found a higher cost per ethanol concentration and standard drink equivalence.<sup>28</sup> This may imply that the local alcohol drink sellers have pegged a price that is able to cover their cost of production irrespective of the type of drink and since most brewing houses make more than one drink, they are still able to make some profit. It also may suggest that all drinks are almost equally acceptable and there is no significant difference in intake base on the ethanol concentration. There may also be other socio-cultural reasons beyond the scope of our study.

A limitation of the study is that it did not cover all the locally brewed alcoholic drinks in the area as it focused on commercial brewing houses. In addition, the drinks are prepared slightly differently in the different brewing houses and we could not completely rule out the effect of contaminants. The method of alcohol determination used is a standard widely used and the protocol was followed meticulously.

## **V. Conclusion**

The study found that the ethanol concentration of locally brewed alcoholic drinks in Vwang District, Jos, Plateau State, Nigeria ranged between 2.78 – 6.34%. When converted to Standard Drink Equivalents, a litre of the drinks would be approximately 2.19 – 5.02 standard drinks. There was no difference in the cost per volume based on the standard drink equivalent of the drink. This calls for the creation of community awareness on the dangers of the cumulative effects these drinks to their health. It would also be important for the methods of preparation of these drinks to be standardized and labelled.

## **AUTHORS DISCLOSURES**

No funding was received for this research.

## **CONTRIBUTORS**

M.G. designed the study, contributed to the acquisition of data, analysed the data and co-wrote the manuscript. M.S. designed the study, contributed to the acquisition of data and co-wrote the manuscript. K.A., J.D and P.D contributed to the methodology and the acquisition of data and co-wrote the manuscript. C.C., B.G., F.D., and N.J. contributed to the acquisition of data and co-wrote the manuscript. B.C. verified the analytical methods and co-wrote the manuscript. M.D. and A.M supervised the research and co-wrote the manuscript. All authors provided critical feedback and approved the final version of the manuscript.

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