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ALCOHOLIC AND HEAVY METAL LEVELS OF A LOCAL ALCOHOLIC BEVERAGE (JIKO) WIDELY PRODUCED AND CONSUMED IN ZONKWA, KADUNA STATE, NIGERIA

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ABSTRACT

This work assessed the physico-chemical properties, alcohol and heavy metal concentration of Jiko produced and consumed in Zonkwa, Kaduna State. The alcohol content was determined by the pycnometer method, the heavy metal concentration was determined by Atomic Absorption Spectrophotometry. The pH of the samples ranged from 2.42 to 2.58 while the percentage moisture content was in the range 87.66 to 95.54 %. Dry matter content ranged from 4.46 to 12.34 %. The Titratable acidity ranged from 1.40 to 2.41 g/dm^3. Sugar and alcohol contents were in the range 11.68-18.28 mg/dm^3 and 1.69-5.23 % v/v respectively. The concentration of Zn, Fe, and Mn were in the range 0.155 to 1.143 mg/dm^3, 0.275 to 2.953 mg/dm^3, 0.073 to 0.196 mg/dm^3 while the corresponding values for Pb, and Cd were in the range 0.000 to 0.700 mg/dm^3, 0.000 to 0.002 mg/dm^3 respectively. Cr and Ni were not detected in all the samples analysed. The result shows that Jiko is an acidic alcoholic drink which contains Zn, Fe, Mn, Pb, and Cd. The concentration of Zn was less than the 5.0 mg/dm^3 maximum contaminant limit(MCL) by the WHO, while Fe, Mn, and Pb exceeded the MCL.

KEYWORDS: Ethanol determination, pycnometer method, Titratable Acidity, AAS, Jiko.

1.0 INTRODUCTION

1.1 Background To The Study

An alcoholic beverage is any drink that contains ethanol which is the product of a yeast-mediated anaerobic fermentation that converts sugars like glucose, fructose and sucrose to ethanol (alcohol) and carbon dioxide (World Health Organization, 2018). The most common base ingredients of alcoholic drinks are fruits, cereals, molasses and vegetables (Julyan, 2008). Traditional alcoholic beverages are indigenous to a particular area and are prepared by the local people using old age techniques and locally available raw materials (Abawari, 2013).

Ethanol, commonly called ethyl alcohol is the principal alcoholic component in wine produced in the fermentation of sugars by yeast. Wine-making is a rigidly controlled process and the final commercial product is subjected to stringent regulations regarding the alcohol content, acidity, sulphur dioxide quantity, sugar content, quality of the grapes, and amount of preservatives. Alcohol or ethanol is considered the most widely used recreational drug worldwide, and its production, consumption, and sale are strictly regulated by laws (Menden, 2016). Some of the indigenous African fermented alcoholic beverages include Egyptian bouza, Tanzanian Wanzuki, gongo, tembo-mnazi and gara, Nigerian palm-wine, Kenyan muratina and uragua, and South African kaffir beer (Haftu, 2018).

1.2 Alcohol Content Of Different Beverages

Percentage by volume (% vol) is used to indicate the ethanol content of beverages; this is also called the French or Gay-Lussac system (National Institute of Health, 2020). The American proof system is double the percentage by volume; a vodka which is 40% by volume is thus 80 proof in the USA (IARC, 1988). The ethanol content in beer usually varies from 2.3% to over 10% vol, and is mostly 5–5.5% vol. In some countries, low-alcohol beer, i.e. below 2.3% vol, has obtained a considerable share of the market. In general, beer refers to barley beer, although sorghum beer is consumed in large quantities in Africa. The ethanol content of wine usually varies from 8 to 15% vol, but light wines and even non-alcoholic wines also exist. The ethanol content of spirits is approximately 40% vol, but may be considerably higher in some national specialty spirits. (IARC, 2018).

1.3 JIKO DRINK

Jiko is a local beverage which is produced and widely consumed in Zonkwa and environs. It is produced from the roots of over 10 different plants combined together to give the properties desired by the producers and consumers. Jiko is made up of the roots of plants, water, locally made brown sugar (mazankwala in Hausa), ginger and local spices (kayan yaji).

The roots for the drink are washed and placed in water for the extraction of the soluble components in the roots to take place. This is followed by the addition of the locally made brown sugar, ginger and the local spices. These ingredients are added to the taste and quality desired by the producer. This mixture stays in the water for one week to ferment unto maturity at ambient temperature as no heating is required. After one week in the water and the producer is satisfied, the mixture is filtered to remove all insoluble components of the preparation leaving behind a brownish filtrate which is ready for consumption.

1.4 Statement of the Problem

Local alcoholic beverages have established an enviable position in the beverage market as evidenced by their high rate of consumption. There are a number of reports on the effects of excessive consumption of these beverages. Many of the producers of these beverages do not know nor provide the complete chemical composition of their products. The alcohol content and other components present are unknown to the consumer.

1.5 Justification

Assessment of the alcohol content and other components of local and international alcoholic beverages have been conducted in some areas, but no data is available on alcoholic beverages produced and consumed in Zonkwa. Hence there is need to quantify the major contents of these drinks and compare with those of safety and regulatory standards.

2.0 LITERATURE REVIEW

2.1 Alcohol Content In Beverages

Samuel & Yohanna (2017) in their study of local alcoholic beverages consumed in Barkin Ladi local government area of plateau state reported results which showed the mean alcohol content of Burukutu and Pito at 4.88% (v/v) and 3.35% respectively. Ezeonu et al (2017) found out that the percentage nutritional contents of the respective cereal alcoholic drinks (sorghum, millet and corn) in Wukari found a higher bioethanol content of sorghum-beer (10.29±0.01), compared to those of millet (9.87±0.02) and corn (8.69±0.02). It means it portends higher intoxicating potential, which may pose harmful effects if over-indulged. Based on the findings of this study, sorghum made Burukutu is a richer source of essential nutrients and minerals – many of which act as co-factors in energy and drug metabolism.

Elema in 2018 worked on the booka beverage in Ethiopia and reported a pH content ranging between 2.903 to 3.123. The moisture, ash, Fat, protein and total carbohydrate were recorded as 82.18, 0.82, 1.43, 7.01 and 8.56% respectively. Except the moisture content all the proximate analyses were significantly higher than the previously documented alcoholic beverage of Ethiopia. Adeleke and Abiodun (2010) evaluated the physico- chemical properties of beverages from osun state found out that the pH range from 4.2-6.3, titratable acidity ranged from 0.8-11.7. Ogogoro had highest percentage of alcohol content of 37.6%, burukutu had 4.6%, palmwine had 3.1%, while nunu and kunnun zaki had lower values.

2.2 Elements in Beverages

The concentration of metals in many alcoholic beverages can be a significant parameter affecting their consumption and conservation. This derives from the negative and positive effects caused directly or indirectly by the presence of metals.(Ayalew et al, (2017). Ezeonu et al (2017) reported in a comparative analysis of sorghum, millet and corn beer that sorghum-beer contained the highest levels of Fe (2.460±0.010 mg/100g); Mg (68.350±0.10 mg/100g); Ca (31.57±0.010 mg/100g); and Zn (2.485±0.015 mg/100g), with the least levels recorded for corn-beer.

3.0 MATERIALS AND METHODS

3.1 The Study Area

Zonkwa is the headquarters of Zangon Kataf local area as well as the Bajju Chiefdom headquarters in Kaduna state. It's geographical coordinates are latitude 9^0 47' 0" North, and longitude 8^0 17' 0" East. Zonkwa has an elevation of 798m above sea level, and an average annual temperature of 24.8°C. The indigenous people of Zonkwa are predominantly farmers. A good number of the citizens of Zonkwa are traders and civil servants.

3.2 Materials and Sampling

Jiko was purchased in plastic one litre containers at different production and drinking parlours in Zonkwa town. 3 one litre ready to serve samples of Jiko were purchased at different but popular drinking locations and labelled J1, J2, J3. Sample containers were properly sealed and stored in the refrigerator until required for analysis.

3.3 Determination Of PH, Moisture And Dry Matter Content

PH, Moisture content and dry matter content were determined according to the methods in AOAC (2006).

3.3 Determination of Total Acidity

Total acidity was determined by titration of sample against 0.05M NaOH according to the method in AOAC(2019).

3.4 Determination of Sugar Content

Sugar content was determined with a UV spectrophotometer at an absorbance of 485nm according to AOAC (2019). Measurements were in triplicate and the average was determined.

3.5 Determination of Alcohol Content by Pycnometer Method

Alcohol content was determined by the pycnometer method which is a density based method as described in AOAC (2019).

3.6 Determination of Heavy Metal

The concentration of heavy metals (Zn, Fe, Mn, Pb, Cd, Ni, and Cr) in the beverage samples was determined using Atomic Absorption Spectrophotometry (AAS).

4.0 RESULTS

4.1 Parameters of The Beverage Samples

The physico chemical parameters of the beverage samples are presented in Table 4.1

Table 4.1: The physico chemical parameters of the Jiko Samples.

Sample	**J1**	**J2**	**J3**
pH	2.49±0.70	2.42±0.28	2.58±0.05
Moisture content (%)	94.92±0.24	87.66±0.04	95.54±0.10
Dry matter content (%)	5.08±0.24	12.34±0.04	4.46±0.10
Titratable acidity(g/dm^3)	1.40±0.13	1.69±0.01	2.41±0.01
Sugar (mg/dm^3)	11.68±0.91	17.28±1.07	18.28±0.35
Alcohol (% v/v)	5.23±0.03	2.24±0.17	1.69±0.18

Table 4.2: Concentration of heavy metals in beverage samples (mg/dm^3).

Sample	**Zn**	**Fe**	**Mn**	**Pb**	**Cd**	**Cr**	**Ni**
B1	1.142	2.953	0.177	0.700	0.002	ND	ND
B2	1.142	0.822	0.196	0.059	ND	ND	ND
B3	0.155	0.275	0.073	ND	ND	ND	ND

4.2 DISCUSSION

4.2.1 pH

From Table 4.1, it is observed that the pH of the Jiko samples ranged from 2.42 to 2.58, showing that all the samples are acidic. The average pH for Jiko samples was observed to be

2.50. The results shown agree with the range of values 2.85 to 4.02 and 2.903 to 3.123 obtained by by Haftu (2018) and Elema (2018) respectively, but less than the value 4.2 to 6.3 obtained by Abiodun (2010).

4.2.2 Moisture and Dry Matter Content

It was observed that the percentage moisture content for Jiko samples ranged from 87.66 to 95.54% with a mean value of 92.71%. The percentage dry matter content for Jiko samples ranged from 4.46 to 12.34 % with a mean of 7.29. The moisture content observed in this research is higher than the average values of 87.0±0.98% and 85.1±0.56% reported for Burukutu and kunu respectively by Emurotu et al., (2017).

4.2.2 Titratable Acidity

The titratable Acidity of beverage samples (g/dm^3) as presented in Table 4.1 shows that the titratable acidity of Jiko samples ranged from 1.40 to 2.41 g/dm^3. The mean titratable acidity for Jiko samples was observed to be 1.832 g/dm^3. The mean results reported in this study are observed to be close to the mean value of 1.78 g/dm^3 reported for street toddy beverage. (Singaravadivel et al., 2012).

4.2.3 Sugar and Alcohol Content

The sugar and alcohol content of the beverage samples as presented in Table 4.1 shows that the sugar content of Jiko samples ranged from 11.69 to18.28 mg/dm^3 with a mean of 15.59mg/dm^3. It was also observed that the alcohol content of Jiko samples ranged from 1.69-5.23% v/v with a mean of 3.05 % v/v. This result is similar to that reported by Samuel and Yohanna (2017).

4.2.4 Concentration of Heavy Metals in the Beverage Samples (mg/dm^3)

From the concentration of heavy metals in the beverage samples as presented in Table 4.2, it was observed that the concentration of zinc in Jiko samples ranged from 0.155 to 1.143 mg/dm^3. The mean concentration of zinc in Jiko samples is 0.406 mg/dm^3. This result falls within the range 0f 0.11 to 7.38mg/dm^3 reported by Salako et al (2016) and the range of 0.045 to 13.89mg/dm^3 reported by Abbas (2014). The results obtained was also observed to be less than the average value of 2.49 mg/dm^3 reported by Ezeonu et al (2017). The concentration of zinc in the samples analysed was observed to be less than the maximum contaminant limit of 5.0mg/dm^3 (WHO, 1993).

The concentration of iron in Jiko samples ranged from 0.275 to 2.953 mg/dm^3. The mean concentration of iron in Jiko samples is 1.344 mg/dm^3. The results shown are similar to the range of 0.97 to 2.45mg/dm^3 and 0.020 to 2.46mg/dm^3 reported by Salako et al (2016) and Maduabuchi et al (2008) respectively. The concentration of iron in all the samples analysed was observed to be higher than the recommended limit of 0.03 mg/dm^3 (WHO, 1993).

It was observed that the concentration of manganese in Jiko samples ranged from 0.073 to 0.196 mg/dm3. The results obtained are within the range of 0.001 to 0.730 mg/dm^3 reported by Maduabuchi et al (2008) but greater than the range of 0.0001 to 0.024 mg/dm^3 reported by Abbas (2014). The concentration of manganese in all samples analysed was found to be above the limit of 0.05mg/dm^3 (WHO,1993). Over exposure to Mn causes manganism, a motor syndrome similar to Parkinson disease by interfering with several neurotransmitter systems (Kim et al., 2015).

It was observed that Jiko samples had a range of ND-0.700mg/dm^3 for lead. The result obtained in this research is greater than the 0.028mg/dm^3 reported by Bengol et al (2010) but within the range reported by Salako et al (2016). The concentration of lead in all samples (except J3) is above the 0.01 mg/dm^3 MCL set by WHO (1993). This shows that consumers of Jiko are susceptible to lead poisoning.

It was observed that the concentration of cadmium ranged from ND to 0.002 mg/dm^3, This result agrees with the range of 0 to 0.26mg/dm^3 reported by Salako et al (2016. The presence of cadmium in samples J1 may be due to the fertilizers and herbicides used on farms. It was observed that the Cd in Jiko samples analysed was less than the maximum permissible limit of 0.003 set by the WHO (2011).

Chromium and Nickel were not detected in all samples analysed.

CONCLUSION AND RECOMMENDATION

5.2 CONCLUSION

The results from this work shows that Jiko is an acidic beverage. Acidic drinks are capable of affecting the teeth by eroding the enamel which is the part which protects the teeth. People who consume these drinks can have the enamel of their teeth worn out and weakened, causing long term tooth erosion and exposing the teeth to bacteria infection.

The essential elements Zn, Fe and Mn were found to be present in all the beverage samples. This means that consumers of the drink can get the nutritional benefits of these elements by consuming these drinks. Caution however should be observed in consumption of these drinks because the concentration of Fe and Mn in all the samples was found to be above the maximum contaminant limit recommended by the WHO (1993).

The concentration of Pb in Jiko samples exceeded the maximum contaminant levels set by the WHO (1993).

5.3 RECOMMENDATION

Alcoholic beverages such as Jiko although beneficial to the consumer (such as provision of essential elements like Zn, Fe and Mn) have been associated with some adverse health effects. It is recommended that consumers of these beverages eat fruits such as banana and vegetables such as spinach to help neutralize the effects of the acids consumed through these beverages in the body.

The adverse health effects of drinking these beverages may not manifest in the early stage, but in the future due to the ability of these heavy metals to bio-accumulate in the body.

It is also recommended that an awareness campaign be carried out on the effects associated with the consumption of Jiko. Alternative drinks which may offer same benefits as Jiko without posing any serious health effects is recommended.

Mobile surveillance units should be set up by relevant government regulatory agencies to use inexpensive rapid test kits to verify the safety of locally prepared beverages which are sold in our communities.

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