

# The Level of Zinc (Zn) in Yekoso-Areke Ethiopian Distilled Traditional Beverage

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## ABSTRACT

Home-grown fermented and distilled beverages are very popular traditional drinks in Ethiopia. Among these, Arekies, korefe, tej and tella are very common in northern part of Ethiopia. Specifically Yekoso-Arekie which is double distilled and possess unique extra ingredient which is called Yekoso-Kitel the most common beverage in Debre-Birhan town. However, there is no any report on the level of Zinc in this beverage. The purposes of this study were to determine the amounts of Zinc and to compare this parameter of selected Ethiopian traditional alcoholic beverage (Yekoso-Arekie) from Ethiopia in the specific area Debre-Birhan with other similar beverages. A total of nine bulk samples were collected randomly from vending houses from nine different kebeles. For these purposes, two experimental parts has been implemented sequentially, the first part is digestion of the sample with H<sub>2</sub>O<sub>2</sub> and conc. HNO<sub>3</sub>; the second part is absorbent measurement: the standard, blank and samples were placed in to auto sampler test tube then after placed at sampling area of FAAS in the order of analysis: first the standard solutions in increasing concentration, then the blank and the samples follow. The amount of zinc in yekossoarekie was determined. since this local drink has not standard reference in the nation, the researcher took the standard reference from WHO, Zinc, Zn (mg) Content in distilled Alcoholic beverage, all (gin, rum, vodka, whiskey) is between 0.0283 mg/l and 0.9824mg/l. The researcher concludes that Yekosso-Arekie has remarkable levels of Zinc; as a result the consumers of this beverage can get its vital for activating growth and physical and neurological development in infants, children and teenagers since Zinc is an essential micronutrient for human health.

**Keywords:** Traditional beverage, Yekosso-arekie, Zinc, Digestion

## INTRODUCTION

In all over the world, some types of alcoholic beverage native to their region are prepared and consumed [1]. Indigenous fermented alcoholic beverages from different parts of the world are described. Among these, information on the microbiology and biochemical properties of varieties of the indigenous African fermented alcoholic beverages is available. These include Egyptian bouza, Tanzanian wanzuki, gongo, tembo-mnaziandgara, Nigerian palm-wine, Kenyan muratna and uragela, and South African kaffir beer [2]. Similarly in Ethiopia, some of indigenous fermented beverages include borde, korefe, shamita, tej and tella which are very popular traditional drinks. Borde and shamita are mainly prepared in central and southern Ethiopia [3]. Whereas considering popularity, traditional alcoholic beverages namely, 'katikala' (areki), korefe and tella are very common in northern part of Ethiopia. Fermented beverages vary considerably in type. Fermented beverages produced

from cereals usually referred to as beers while those produced from fruits are classified as wines [4]. Among fermented foods, alcoholic beverages have been widely consumed by people around the world. Fermented products can play an important role, contributing to the livelihoods of rural and perturbing dwellers [5]. In developing countries, traditional fermentation serves many purposes. It can improve the taste of food, enhance the digestibility of food, preserve food from degradation by noxious organisms, and increase nutritional values. Further, it is used for medical reasons, recreational purposes, in marriages, in religious and non-religious ceremonies, at festivals and social gatherings, at burial ceremonies and as food substitutes [6]. Arakie is a local distilled beverage, ground gesho leaves and water are kept for 3-4 days and after that a kita made of tef or other cereals and germinated barley or wheat is added. The mixture is allowed to ferment for 5-6 days and then distilled. In the villages distillation is carried out with primitive equipment's made of gourds and wood. The local beer

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tella can also be distilled to produce Arakie. This beverage is more expensive than the other drinks and is popularly viewed as very strong and dangerous to consume. Arakie is brewed in rural and semi-urban areas and is used more commonly by farmers and semi-urban dwellers than by people who live in the cities. And in cities, people who drink arakie are predominantly from lower class or those who have become dependent on alcohol and cannot afford to buy industrially produced alcohol beverages.

The arakie can be redistilled and will then have higher alcohol content (22.0-28.0 % Alcohol). Yekosso-Arekie is one of the sub classes of Arekie, which is familiar around Debre-Birhan /Ethiopia/ is prepared by distillations of kosso leaf with a normal Arekie which is prepared as stated above. As the researcher mentioned above Yekosso-Arekie has many components as a raw material i.e. barley, wheat, water, gesho leaves and kosso leaves which can be a source of different metal which are potentially hazard or essential to us. So it needs to analyze the presence or absence of potential hazard metals or the content of essential metals. The researcher impressed to determine Zinc, since it is an essential micronutrient for human health. Zinc is an essential mineral that is naturally present in some foods, added to others, and available as a dietary supplement. Zinc is also found in many cold lozenges and some over-the-counter drugs sold as cold remedies. Zinc is involved in numerous aspects of cellular metabolism. It is required for the catalytic activity of approximately 100 enzymes and it plays a role in immune function, protein synthesis, wound healing, DNA synthesis, and cell division. Zinc also supports normal growth and development during pregnancy, childhood, and adolescence and is required for proper sense of taste and smell. A daily intake of zinc is required to maintain a steady state because the body has no specialized zinc storage system [7].

The Joint FAO/WHO Expert Committee on Food Additives (JECFA) provisional maximal tolerable daily intake of Zn is 1000 µg/kg bw/day [15]. The Expert Group on Vitamins and Minerals safe upper limit (SUL) for Zn is 4.2 mg/day (equivalent to 700 µg/kg bw/day in a 60 kg adult) for total dietary intake.

## EXPERIMENTAL

### Reagents and chemicals

Sample (Yekosso-Arekie) was used. Reagents used in the analysis were all analytical grades. HNO<sub>3</sub> (69-72%) (Spectrosol, BDH, England) and H<sub>2</sub>O<sub>2</sub> (30%) (BDH Chemicals Limited, Poole, England) were used for the digestion of this alcoholic beverage sample. Stock standard solutions containing 1000 mg L<sup>-1</sup> in 2% HNO<sub>3</sub> of the metal (Zn) (Buck Scientific Puro-Graphictm) were used for preparation of calibration standards and in the spiking experiments [8]. Working standard solutions were obtained by suitable dilution from stock solution. Distilled-deionized water was used throughout the experiment for sample preparation and dilution, and rinsing of apparatus prior to analysis.

### Apparatus and instruments

A refrigerator (Samsung Hitachi, Japan) was used to keep the alcoholic beverage samples till the analysis. 250 mL round bottomed flasks fitted with reflux condensers were used on Kjeldahl apparatus hot plate to digest the samples. Flame atomic absorption spectrophotometers (Analytik Jena ZEE nit 700P, Germany) equipped with deuterium arc background connectors and hollow cathode lamps with air-acetylene flame was used for

the analysis of the analyte metal (Zn) in the sample. A micropipette (100-1000 µL) was used for the volume measurement of reagents and standards.

### Sampling

The sample type was selected based on having of unique ingredients that is called Yekesso leaf. Similarly sample area was selected due to considerations of widely fermentations and consumptions areas of sampled beverages. Though, Debre-Birhan is the icon source of this beverage (Yekosso-Areke). A total of nine bulk samples were collected randomly from vending houses from nine different kebeles. 81mL of the beverages were taken from the different sites of the towns [9]. All the samples were collected using glass amber bottles. The prepared bulk samples of the beverages were kept in a refrigerator at 4°C until the analysis time.

### Digestion of samples

Required equipment was prepared on the laboratory desk, and then the round bottom flasks were sacked in acid and then washed with distilled water. After drying of them, the digestion procedures were optimized by varying: the ratio and amount of HNO<sub>3</sub> and H<sub>2</sub>O<sub>2</sub> added to the sample, the digestion time and the temperature required for the digestion. The procedures which consumed least amount of the reagents and lower time and temperature for the digestion, giving clear solution with no precipitate were considered as the optimum procedure. Smaller amounts of reagents and lower temperature and time than the optimum parameters resulted in incomplete digestion of samples which were indicated by colored and unclear digest with precipitates [10]. The optimized digestion procedure: 10ml Yekosso-Arekie were measured with pipette by sacking with pipette filler and placed in to separate flasks. For the round bottom flasks (for blank, samples), 1ml of H<sub>2</sub>O<sub>2</sub> & 1ml conc. HNO<sub>3</sub> of were added for each by measuring with pipette step by step respectively for replicate analysis and to take the average of absorbance for reducing of systematic error). Then the flasks were feet to kjeldahi setup by closing their aperture with the condensers, after that the kjeldahi has been turn on at 1200c for 5/2 hours at the end clear solutions were obtained. Then the kjeldahi has been turn off and cooled for a while. After cooling, filtration was done by using filter paper, beaker (50ml) and separators funnel. The filtered solutions were placed in sample beakers separately and filled up(diluted) to the mark of 25 ml by using distilled water finally the beakers were labeled and placed in to the fridge until the absorbance measurement.

### Determination of the metal in the sample by FAAS

Stock standard solutions containing 1000 mg L<sup>-1</sup> in 2% HNO<sub>3</sub> of the metal, Zn, was used for the preparation of calibration standards and in the spiking experiments. All the analyses were carried out using flame atomic absorption spectrophotometer at the wavelength of 213.9 nm of the metal. For the preparation of calibration curve, a series of four working standards were prepared for the metal. The working standards were prepared from the intermediate standards, that were earlier prepared from the stock solutions (1000 mg L<sup>-1</sup>). The standard solutions which have concentrations of 0.25ppm, 0.5ppm, 0.75ppm and 1ppm in 50ml from 1000ppm standard solution were prepared by diluting with de-ionized water. (To prepare standard solutions use the so called dilution equation: C<sub>1</sub>V<sub>1</sub> = C<sub>2</sub>V<sub>2</sub>, where C<sub>1</sub> is the concentration of the stock solution, V<sub>1</sub> is the volume of the stock solution needed, C<sub>2</sub> is the concentration of the desired standard solution, V<sub>2</sub> is the volume of the desired standard solution). The standard, blank

and samples were placed in to auto sampler test tube and placed at sampling area of FAAS in the order of analysis: first the standard solutions in increasing concentration, then the blank and the samples follow. The FAAS was turned on, then absorbance versus concentration were measured for the standard and calibration curve has been plotted, finally the absorbance of blank and two samples were measured and the data was recorded (Figure 1).

## RESULT AND DISCUSSIONS

The standard solutions which have 50ml volume for each of four standards from 1000 ppm standard stock solution were prepared with  $C1V1=C2V2$  relation formula.  $V1=50\mu\text{l}$ ;  $V2=37.5\mu\text{l}$ ;  $V3=25\mu\text{l}$ ;  $V4=12.5\mu\text{l}$ . The equation of regression line (calibration curve) was determined from standard sample concentrations (X) and absorbance (Y):  $Y=0.7728X-0.0067$ .

Yintercept(-0.0067), this shows that the regression line starts approximately from 0:0 (from the joint of concentration & absorbance lines). The slope (b)=0.7728, this shows that concentration and absorbance has positive relationships (Table 1).

**Table 1:** standard solutions absorbance.

Number	Concentrations in mg/l	Absorbance at 213.9 nm wave length
1	0.25	0.18384
2	0.5	0.38766
3	0.75	0.56718
4	1	0.76882

The concentration (X) of Zinc in the sample =  $0.7728X - 0.0067$ ;  $X = (Y + 0.0067) / 0.7728$ . But  $Y = (A - A_0) / 2$  where A is absorbance of each sample,  $A_0$  absorbance of the blank solution, Y is the absorbance of Zinc (analyte) in the sample that gave the concentration of Zinc in the sample. The milligram of Zinc to liter of Yekosso-Arekie, Zinc weight in 1000ml sample = 0.27342 mg; in 25ml sample = A;  $A = (25\text{ml sample} \times 0.27342 \text{ mg}) / 1000\text{ml sample} = 0.00684 \text{ mg zinc in } 25\text{ml}$ . Sample or in 10 ml Yekosso-Arekie, so 10ml Yekosso-Arekie = 0.00684 mg zinc, 1000ml Yekosso-Arekie = X,  $X = (1000\text{ml yekossoarekie} \times 0.00684 \text{ mg zinc}) / 10\text{ml Yekosso-Arekie}$  is between 0.6552 and 0.7118 mg of Zinc per liter of Yekosso-Arekie.

The concentrations of Zn varied from 0.12 mg/l in ogogoro to 3.86 mg/l in raphia palm wine, Burukutu and raphia palm wine generally contained higher concentrations of Zn than the oil palm wine, pito, and ogogoro. The permissible limit of Zn in alcohol is set at 5.0 mg/l. The concentrations of Zn in fresh and bottled palm wine in Benin City, Nigeria were found to be in the range of 0.98–8.88 mg/l. The low concentrations of Zn found in ogogoro (local gin) were similar to 0.126–0.137 mg/l range that was reported for Brazilian cachaca (sugar-cane spirit). Zinc concentrations in the range of 0.2–1.3 mg/l have been reported in wines from Brazil, Portugal, and Chile. In Ethiopian wines Zn concentrations is in the range of 1.82–2.70 mg/L. The concentrations of Zn reported in this study were similar to concentrations of Zn reported in the literatures for wines, ogogoro and cachaca. The concentrations of Zn recorded in this study were below the permissible limit for Zn in wines; as a result it hasn't over dose effect for the consumers with respect to Zinc contents.

## CONCLUSIONS

Traditional distilled alcoholic beverage of Ethiopia namely Yekossoarekie was investigated for its essential metal content. The result confirmed that Zinc concentrations in Ethiopian distilled beverages differ among samples of different kebeles because metals in beverages are derived from various raw materials, equipment and brewing processes. In terms of metallic content, the Ethiopian Yekossoarekie was found comparable with wine and African traditional beverages. The metal in this beverage was below the WHO limits. The researcher concludes that Yekosso-Arekie has remarkable levels of Zinc; as a result the consumers of this beverage can get it's vital for activating growth and physical and neurological development in infants, children and teenagers since Zinc is an essential micronutrient for human health.

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