

# **QUALITY EVALUATION OF SELECTED NIGERIAN STREET-HAWKED BEVERAGES (ZOBO DRINK, KUNUNZAKI, KUNUN AYA AND TAMARIND JUICE) SOLD IN SABON GARI MARKET KANO STATE. NIGERIA.**

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## **ABSTRACT**

**T***his study was carried out to evaluate the physicochemical properties, microbial load, anti-oxidant properties and anti-nutritional content of locally produced beverages (Zobo drink, KununZaki, KununAya and Tamarind)sold within sabon Gari Market of Kano state Nigeria. The drinks were analysed for microbial (Total viable count, fungal and coliform counts), Physico-chemical (pH, totatitrable acidity, Brix and turbidity) anti-nutritional (Phtate, oxalate and tannin) and anti-oxidant(flavonoid and phenol.) Based on the pH results tamarind is high acid drink while Kununzaki, Kununaya and zobo are both low acid drinks. The titrable acidity of*

## **Introduction:**

Nigerian indigenous drinks are becoming popular in both urban and rural communities because they are cheaper than imported drinks. These beverages are well accepted among Nigerians (Oboh and Okhai, 2012). Beverages in general are food items that are quite different and distinct from other food items; mainly in liquid state but have lower food values relative to other food products (Adelekan et al., 2014).Beverages are

*kununzaki and tamarin drink is high compared to that of Zobo and kununaya. The total plate count, fungal count and coliform count are both high which indicates possible recontamination or poor hygienic practices and or use of reused plastic bottles. The phytate content of zobo drinks was higher than that of Kununzaki and kununAya and local Tamarind drinks having the lowest value. The oxalate content of all the beverages is low which ranged from 0.49 – 0.95mg/ml. The tannin content of all the samples ranged from 0.22 – 1.07mg/ml. with Zobo having the highest value. The flavonoid and phenolic content was highest in zobo drink with a value of  $0.44\pm 0.00$  mg/ml and  $18.95\pm 2.41$  respectively. There was a significant difference ( $p \geq 0.05$ ) between the samples except the total phenol content of Kunun Zaki and Kunun Aya which shows no significant difference.*

**Keywords:** *Microbial quality, Physiochemical properties, anti-nutrients, local beverages anti-oxidant properties*

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Important sources of nutrients and phytonutrients, phenolic acids and flavonoids (Ferruzzi et al., 2020). They are widely consumed, especially by children, pregnant women, the sick, and the elderly. They are also used during the weaning of infants. It is also reported that, social, religious, nutritional, and therapeutic values are associated with an increase of their consumption (Ezekiel et al., 2018).

A recent research shows that Street foods are food or drinks, sold by street vendors which is becoming highly acceptable by consumers due to their low price and constant availability at a given time (Mohd Nawawee et al., 2019). However these locally processed beverages have poor shelf life, besides the fact that they are drinks processed in condition lacking quality assurance and control measures (Kigigha et al., 2018). Their consumption has been reported to potentially increase the risk of food borne diseases caused by a wide variety of pathogens.

**Zobo drink** is a non-alcoholic local beverage, an acid-succulent calyces produced from the dried petals, of the flower *Hibiscus sabdariffa* (Ekanem, 2018). In Nigeria a wide variety of foods are prepared through indigenous

technology from many plant products (Adelekan et al., 2014). The calyx of *Hibiscus sabdariffa* is a considerable source of nutrients, antioxidants and phytochemicals such as flavonoids. The sour taste of Zobo is associated with the organic acids contents such as ascorbic, malic and tartaric acid and the leaves of zobo plants could also be used to produce syrup, gelatin, jam and jelly (Akujobi et al., 2018). It can also be used as vegetable and the seeds as source of oil (Ezeigbo et al., 2015). The drinks can be used traditionally as medicine; for the treatment of hypertension and urinary tract infection. Several studies have shown that extracts of *Hibiscus sabdariffa* have a lipid lowering activity which could reduce the risk of hyperlipidemia and cardiovascular diseases such as atherosclerosis and coronary heart diseases (Akujobi et al., 2018). It can also be used in folk medicine against many ailments such as high blood pressure, liver diseases and fever (Oboh and Okhai, 2012).

*Kunun-zaki* is a traditionally fermented non-alcoholic cereal based beverage mostly consumed in Northern Nigeria (Sengev et al., 2012). The word *Kunun-zaki* is a Hausa word meaning sweet beverage. It is consumed anytime of the day by both adults and children as a pseudoplastic breakfast food drink (Ndulaka et al., 2014). It can be produced either from millet (*Pennisetum typhoides*), sorghum (*Sorghum bicolor*), or maize (*Zea mays*) (Sengev et al., 2012).

It is nutritionally, made up of 87-92% moisture, 3.19-7.86% crude protein, 0.37- 0.75% crude fat, 0.93-1.20% ash and 2.69-5.84% carbohydrate. It can also lead to the reduction of blood cholesterol, lowering the risks of diabetes, and prevention of blood clot formation (CK, 2019). It can be used as weaning drinks for infants in some communities (Oboh and Okhai, 2012).

Tiger nut (*Cyperus esculentus*) is an underutilized tuber of family Cyperaceae, which produces rhizomes from the base of the tuber that are somewhat spherical (Gambo and Da'u, 2014). It is mainly harvested in Spain, West Africa countries like Nigeria, Senegal, or Ghana, and also in South America, as in Chile (Roselló-Soto et al., 2019). It can be used for the production of drink/milk, which can serve as substitute for traditional cow

milk (Gambo and Da'u, 2014). The beverage is an emulsion of oil droplets in an aqueous phase and contains starch granules and small solid particles, Starch granules are related to product stability, in particular regarding color and texture (Roselló-Soto et al., 2019).

According to (Gambo and Da'u, 2014), the milk is nutritious and healthy when compared to any other soft drink, because it can contribute to the reduction in the in cholesterol by diminishing the low density lipoprotein (LDL), and increasing cholesterol, high density lipoprotein (HDL), It also has an antioxidant effect. Roselló-Soto et al., (2019) confirmed that in Europe and United States, it is of high interest as an alternative to milk and for gluten-free diets. Research also shows that *Cyperus esculentus* was reported to help in preventing heart thrombosis and activates blood circulation, responsible for preventing and treating urinary tract and bacterial infection, assist in reducing the risk of colon cancer and lastly thought to be beneficial to diabetics and those seeking to reduce cholesterol or lose weight (Gambo and Da'u, 2014).

*Tamarind (Tamarindus indica)* is a leguminous tree that belongs to the family Fabaceae with Subfamily Caesalpiniaceae (Van-der-Stege et al., 2011). The plant is believed to be indigenous to the tropical (Chimsah et al., 2020). It is known as inli in Hindu-Urdu, asana jawa in India, tamarindo in French, tamarin, tamariner, tamarier des Indes in Dutch and German, tamarinde in Italian, taman in Philippines and locally called Jabbe, Stamiya in Fulfulde and Hausa in Nigeria (Toungos, 2019). Many types of traditional beverages are available in Nigeria but only a few like kunun-zaki, braga, soborodo are popular among the populace. Tamarind beverage is among those beverages which are yet to be widely accepted in Nigeria. (Adeola and Aworh, 2010). Its utilization is increasingly becoming a commercially important underutilized tree crop worldwide (Chimsah et al., 2020). It has long been a popular drink in the tropics and is now bottled in carbonated form in Guatemala, Mexico and Puerto Rico (Toungos, 2019).

The uses of Tamarind is uncountable ranging from Medicinal (having the ability to reduce inflammation in the body, improve vision, boost respiratory health, heal skin conditions, and improve the digestive system

of the body) it also has the ability to relieve pain, strengthens the immune system, reduces fever, lowers cholesterol and improve cardiovascular health, treats piles, and protects against parasites and worms (Toungos, 2019).

## **Methodology**

### ***Sample Collection***

The samples of locally produced Zobo drinks, KununZaki, KununAya (Tiger nut drinks) and Tamarind beverage were purchased at random from SabonGari market in Kano State, Nigeria.

## **Laboratory analysis of the samples**

### ***Determination of physicochemical properties of the samples***

***pH determination:*** The pH of the samples was determined using the method described by Nkama et al., (2010). using pH meter (TECPEL pH meter, model 705) after standardization with pH 4 and pH 7 buffers (BDH, England).

***Brix measurement:*** The brix of the samples was measured according to the method described by Bankole et al., (2013) using hand refracto-meter.

***Determination of titratable acidity (TTA):*** The total titratable acidity (TTA) of the samples was determined using the method described by Nkama et al., (2010). About 10 ml of each sample was titrated with 0.1 N sodium hydroxide to phenolphthalein end point (pink). The titratable acidity was calculated for each sample.

***Turbidity*** was measured in nephelometric turbidity units (NTU) as described by Nkama et al., (2010).

## **Determination of Microbial profile of the samples**

### ***Determination of Total Bacterial total coliform and total fungal***

***Counts:*** was evaluated according to the method of Edem and Elijah, (2016) As described by CK (2019) and Ekanem, (2018). The samples were

subjected to 10-fold serial dilutions. Aliquots (0.1 ml) of appropriate dilutions for each sample were plated by the pour plate method in triplicates onto nutrient agar, MacConkey agar and and Potato dextrose agar (PDA) plates in triplicates for total heterotrophic bacteria count, total coliform count and total fungal count, respectively. These were incubated at 30 °C for 24 hours. Resulting colonies were counted with the aid of a colony counter and the colonial morphologies noted.

### **Determination of anti-oxidant properties of the samples**

***Determination of total phenol:*** The total phenol content of the samples was determined using the method described by Singleton et. al., (1999). 0.2 ml of the extract was mixed with 2.5ml of 10% Folin ciocalteau's reagent and 2ml of 7.5% Sodium carbonate. The reaction mixture was subsequently incubated at 45°C for 40min, and the absorbance was measured at 700nm in the spectrophotometer, Gallic acid was used as standard for estimation of phenol.

***Determination of Total flavonoid:*** The total flavonoid content of the samples was determined using a colorimeter assay described by Bao et al., (2005). 0.2ml of the extract was added to 0.3ml of 5% NaNO<sub>3</sub> at zero time. After 5min, 0.6ml of 10% AlCl<sub>3</sub> was added and after 6min, 2ml of 1M NaOH was added to the mixture followed by the addition of 2.1ml of distilled water. Absorbance was read at 510nm against the reagent blank and flavonoid content was expressed as mg rutin equivalent.

***Determination of free radical scavenging ability:*** The free radical scavenging ability of the extract against DPPH (1, 1- diphenyl-2-picrylhydrazyl) was carried out using a method described by Gyamfi et. al. (1999). 1ml of the extract was mixed with 1ml of the 0.4mM methanolic solution of the DPPH. The mixture was left in the dark for 30min before measuring the absorbance at 516nm.

**ABTS scavenging ability:** 2, 2'-azino-bis (3-ethylbenthiiazoline-6-sulphonic acid) (ABTS) scavenging ability. The ABTS scavenging ability of the samples was determined according to the method describe by Re et al., (1999). The ABTS was generated by reacting an (7mM). ABTS aqueous solution with  $K_2S_2O_8$  (2.45 mM/l, final conc.) in the dark for 16hours and adjusting the absorbance at 734nm to 0.700 with ethanol 0.2ml of the appropriate dilution of the extract was then added to 2.0ml of ABTS solution and the absorbance was read at 732nm after 15min. The TROLOX equivalent antioxidant capacity was subsequently calculated.

### **Determination of anti-nutritional content of the samples**

**Tannin content determination:** This was determined using the method described by Makkar and Good child (1996). About 0.2g of finely ground sample was weighed into a 50ml sample bottle. 10ml of 70% aqueous acetone was added and properly covered. The bottle were put in an ice bath shaker and shaken for 2hours at 30°C .Each solution was then centrifuge and the supernatant store in ice. 0.2ml of each solution was pipetted into the test tube and 0.8ml of distilled water was added. Standard tannin acid solutions were prepared from a 0.5mg/ml of the stock and the solution made up to 1ml with distilled water. 0.5ml of Folin ciocateau reagent was added to both sample and standard followed by 2.5ml of 20%  $Na_2CO_3$  the solution were then vortexed and allow to incubate for 40minutes at room temperature, its absorbance was read at 725nm against a reagent blank concentration of the same solution from a standard tannic acid curve was prepared (Makkar and Goodchild. 1996).

**Phytate content determination:** Phytate was determined according to the method of Wheeler and Ferrel (1971). 4g Sample was soaked in 100ml of 2% HCl for 3hrs and then filtered through a No 1 Whatman filter paper. 25ml ml was takeout of the filtrate and placed inside a conical flask and 5ml of 0.3% of ammonium thiocyanate solution was added as indicator. After which 53.5 Of distilled water was added to give it the proper acidity and this was titrated against 0.00566g per milliliter of standard iron (iii)

chloride solution that contained about 0.00195g of iron per milliliter until a brownish yellow colouration persisted for 5min.

**Oxalate content determination:** Oxalate was determined by soaking 1g of the sample in 75ml of 1.5N H<sub>2</sub>SO<sub>4</sub> for 1h and then filtered through a No 1 Whatman filter paper. 25ml ml was takeout of the filtrate and placed inside a conical flask and this was titrated hot about (80-90°C) against 0.1m KMnO<sub>4</sub> until a pink colour that persisted for 15 sec. (Day and Underwood 1986);

### Statistical analysis

All determinations were carried out in triplicates, subjected to analysis of variance ANOVA and the means were separated by New Duncan Multiple Range Test (NDMRT). Mean and standard deviation of all the samples were calculated and compared. SPSS for Windows program version 21.0 was used to analyze the results obtained.

## Results and Discussion

**Table 1: Physicochemical properties of samples**

Parameters	Ph	BRIX 27°C	@	TTA (%)	TURBIDITY (NTU)
Zobo	6.10±0.14 <sup>a</sup>	6.50±0.07 <sup>c</sup>		0.48±0.04 <sup>c</sup>	73.20±0.14 <sup>a</sup>
Kunun zaki	5.60±0.14 <sup>b</sup>	8.10±0.14 <sup>b</sup>		1.26±0.14 <sup>b</sup>	66.25±0.35 <sup>b</sup>
Kununaya	6.15±0.07 <sup>a</sup>	10.40±0.28 <sup>a</sup>		0.23±0.00 <sup>d</sup>	61.13±0.35 <sup>c</sup>
Local tamarind	3.90±0.14 <sup>c</sup>	7.73±0.11 <sup>b</sup>		1.43±0.35 <sup>a</sup>	50.50±0.14 <sup>d</sup>

Values are Mean of triplicate determination ± S.D Different superscripts on the same row are significantly different (p≤ 0.05) according to Duncan Multiply range test.

**Table 1.** shows the result of the Physicochemical properties of the samples, the pH of Zobo, Kunun Zaki, Kunun aya Tiger nut drinks ranged from 6.10 – 6.60 indicating the low acidic content of the samples, moreover the pH



value of Local tamarind drinks were 3.90 indicating the high acidic content of the tamarind beverages. Adeola and Aworh, (2010) also confirmed that the acid content of tamarind beverage is desirable from food processing standpoint, since it is important in determining the quality of the juices. From the results it was observed that microbial load of the samples decreased with decreases in the pH, which is in agreement with Adeola and Aworh, (2010) which stated that acidity inhibits the growth of surviving heat resistant microorganisms. It has been reported that fermented foods with low pH have some antimicrobial activities. PATTAR (2012) reported a pH value of 2.08 to 3.09 for Tamarind juice which is slightly lower than the observed value in this study. Elmahmood and Doughari, (2007) studied Kununzaki from vendors in girei Local Government and found the pH values between the range of 3.44 and 4.34; this is in conformity with the values obtained in this study.

From the result Zobo and Kunun Aya had the lowest total titratable acid of 0.45g and 0.23g respectively while kunun zaki and Local tamarind drinks has the highest total titratable acid of 1.26 and 1.43, respectively. Ajayi et al 2016 reported a value of 0.14 to 0.21 titratable acidity value for zobo samples. Acidity contributes to the development of flavour by maintaining a proper sugar - acid ratio thereby modifying the sweetness of sugar and palatability of food products, lends tartness to taste and also provides a thirst-quenching effect by encouraging saliva formation in the mouth (Adeola and Aworh, 2010). (Agarry et al., 2010) reported a marked decrease in pH with concomitant increases in titratable acidity of kununzaki samples. Pattar 2012 reported acidity values between 2.72 and 4.10 for tamarind juice extracted using different methods, this is in line with the findings in this study.

### Turbidity of the samples

**Table 2: Microbial Profile**

Parameters	TVBC (cfu/ml)	TCC (cfu/ml)	TFC (cfu/ml)
Zobo	$3.82 \times 10^4 \pm 43.47^a$	$2.29 \times 10^4 \pm 27.12^b$	$1.63 \times 10^4 \pm 18.59^c$
Kununzaki	$3.23 \times 10^4 \pm 37.05^b$	$3.49 \times 10^4 \pm 40.30^a$	$3.77 \times 10^4 \pm 42.92^a$

<b>Kununaya</b>	1.81×10 <sup>4</sup> ±20.90 <sup>c</sup>	2.22×10 <sup>4</sup> ±25.84 <sup>c</sup>	1.72×10 <sup>4</sup> ±20.05 <sup>b</sup>
<b>Local tamarind</b>	1.40×10 <sup>4</sup> ±16.31 <sup>d</sup>	1.89×10 <sup>4</sup> ±22.13 <sup>d</sup>	1.43×10 <sup>4</sup> ±16.58 <sup>d</sup>

Values are Mean of triplicate determination ± S.D Different superscripts on the same row are significantly different ( $p \leq 0.05$ ) according to Duncan Multiply range test.

#### Key

TVBC = Total Viable Bacterial Count

TCC = Total Coliform Count

TFC = Total Fungal Count

The results of microbiological counts of locally produced beverages: Zobo, Kunun Zaki, Kununaya (tigernut drinks) and tarmarind drinks were shown in Table 2: From the Table, the total viable bacterial count of Zobo and Kunun Zaki was  $3.82 \times 10^4$ cfu/ml and  $3.23 \times 10^4$ cfu/ml respectively which is higher than that of tigernut and tarmarind drinks  $1.81 \times 10^4$  and  $1.40 \times 10^4$ cfu/ml. According to Mohd Nawawee *et al.*, (2019), Total viable counts can be used to measure the level of overall bacterial contamination of food or beverage samples tested. The level of average bacterial contamination in the beverages samples tested in this study ranged from  $1.40$ – $3.82 \times 10^4$  CFU/mL which was considerably low when compared to the values reported by Mohammed *et al.*, 2017. (Kigigha *et al.*, 2018) also reported the bacterial contamination of Zobo drink with values of  $< 3.0 - 1.23 \times 10^4$ cfu/ml in Kano. (Elmahmood and Doughari, 2007) found bacterial count values ranging from  $2.5 - 4.6 \times 10^4$ cfu/ml on kunun zaki samples which are the values obtained in this study were within the values obtained. And the counts recorded in this research was lower than the standard set by International Commission on Microbiological specification for Foods (ICMSF, 1996) for aerobic count of  $10^6$ cfu/g Spices are usually added in small quantities to improve taste and flavour and as these are agricultural commodities, which may contain a high level of microbial impurities (Adeyemi and Umar, 1994)

Total coliform is a suitable indicator to detect fecal contamination in food products. The total coliform count of the beverages ranges from  $1.4 - 3.7 \times 10^4$  cfu/ml. The average coliform count is well above the zero value recommended for safety. Enetimi *et al.*, 2020, reported a coliform value of 2.27 Log cfu/ml from locally processed beverages in reused plastic container. If coliform detected in beverages it indicates contamination, such drinks should be devoid of coliforms and the reported levels of coliform that exceeded threshold were possibly due to the unhealthy anthropogenic scavenging and reusing plastic containers in trash cans and dumpsite.

Meanwhile the total fungal counts of the beverages sold within sabongari market of Kano State ranged from  $1.43 - 3.77 \times 10^4$  cfu/ml, which is higher than the total fungal count of kunu-aya (2.26-2.86 log<sub>10</sub>CFU/mL) consumed by students of Kaduna State University as reported by (Ire *et al.*, 2020). Another research also shows that Fungal count of kununzaki sold in Osun State ranged from  $3.3 \times 10^6$  to  $8.0 \times 10^6$  CFU/ml (Imoukhuede *et al.*), which is higher than the value obtained in this research. (Enetimi *et al.*, 2020), also shows that the fungal contamination of locally Processed Beverages in Reused Plastic Container was 3.39 Log cfu/ml, while coliform count was 2.27 Log cfu/ml. The presence of the bacterial, fungal and coliform counts indicates some degree of contamination, but within the acceptable level (threshold limit 10<sup>5</sup>) of the Food and Agricultural Organization (Enetimi *et al.*, 2020).

**Table 3.** Shows the Anti-nutritional content of the samples. Anti-nutrients are the key factor, which reduce the bioavailability of various components of the cereals and legumes (Samtiya *et al.*, 2020). From the results the phytate content of zobo drinks was higher than that of Kununzaki and kununAya and local Tamarind drinks having the lowest value, this could be due to the reasons that Kununzaki and Kununaya undergoes milling, and fermentation process which lower the value of the phytate, this is in agreement with the result of Samtiya *et al.*, (2020) who stated that: milling,

soaking and fermentation technique removes anti-nutrients (e.g. phytic acid and tannins), which are present in the bran of grains.

From the table the phytate content of local tamarind drinks were 3.78 which is higher than the phytate content of Tamarind Seed nut as reported by (Akajiaku et al., 2014). The oxalate content of all the beverages ranged from 0.49 – 0.95. This shows significant difference between kunun zaki and the other samples. The tannin content of all the samples ranged from 0.22 – 1.07 with Zobo having the highest value. Significant difference exist ( $p \geq 0.05$ ) between zobo and Kunun zaki but no significant difference ( $p \geq 0.05$ ) between kunun Aya and local tamarind. Pre-processing treatment of the seeds show reduction in oxalate content. Previous studies have also shown that processing techniques such as cooking, dehulling, soaking, fermentation and germination, improves the nutritional quality of food products by reducing or eliminating the anti- nutrient composition of the food product. (Samtiya *et al.*, 2020) also confirmed that, anti-nutritional factors, which reduce the nutritional value of foods can be reduced by the use of traditional food preparation methods such as fermentation, cooking, soaking and puffing.

**Table 4:** Shows the Antioxidants properties and capacity of the beverages. Antioxidants are substances or compounds that have free radical scavenging capacity while inhibiting oxidative progression (Rahaman et al.) 2020). According to the finding described by (Flieger et al., 2021) which stated that; Antioxidants act by delaying or preventing the oxidation of other chemicals. The flavonoid and phenolic content was highest in zobo drink with a value of  $0.44 \pm 0.00$  mg/ml and  $18.95 \pm 2.41$  respectively. Kunun Zaki and Kunun Aya has the Flavonoid and total phenol content of  $0.16 \pm 0.00$ ,  $9.59 \pm 0.06$  and of  $0.13 \pm 0.01$ ,  $8.30 \pm 0.29$  respectively from the table it was observed that local tamarind drink has the lowest flavonoid and total phenol content of  $0.07 \pm 0.00$ ,  $5.28 \pm 0.89$  respectively. There was a significant difference ( $p \geq 0.05$ ) between the samples except the total phenol content of Kunun Zaki and Kunun Aya which shows no significant difference ( $p \geq 0.05$ ).

There were a lot of literatures that provides ample data to support the antioxidant capacity of beverages. The health benefit of locally produced beverages are mainly attributed to the presence of bioactive compounds such as polyphenols (Nowak and Gośliński, 2020). A research by (Oboh and Okhai, 2012), confirmed the high phenolic and flavonoid content of zobo Drinks, with  $16.81 \pm 0.26 \text{ mg/ml}$  and  $3.91 \pm 0.22 \text{ mg/ml}$  respectively. another research by (Wong et al., 2002) also shows high flavonoid content of Zobo drinks and confirmed the correlation of its content with highest antioxidant scavenging capability. The high content of flavonoids in zobo drink is responsible for the high antioxidant content of the drinks (Wong et al., 2002).

From the table, the antioxidant capacity of the Drinks; the ABTS and DPPH shows that 'zobo' drinks had the highest antioxidant scavenging capability which followed by Kunun zaki as measured by DPPH and ABTS. The result also showed that there was a significant difference among the samples of locally produced beverages in all the assays. ABTS and DPPH free radical scavenging abilities follow the same trend. Kunun zaki drink ranked closely after zobo for DPPH and ABTS. Local tamarind drinks was significantly lower in DPPH and ABTS scavenging ability than Kunun aya. This indicates that local tamarind drink had the lowest ability to scavenge DPPH and ABTS radical.

**Table 3: ANTI NUTRITIONAL CONTENT**

Parameters	Phytate(mg/g)	Oxalate (mg/g)	Tannin (mg/g)
Zobo	$10.30 \pm 0.58^a$	$0.49 \pm 0.64^c$	$1.07 \pm 0.01^a$
Kununzaki	$5.36 \pm 0.58^b$	$0.95 \pm 0.64^a$	$0.22 \pm 0.01^c$
Kununaya	$4.944 \pm 0.00^{bc}$	$0.63 \pm 0.00^{bc}$	$0.35 \pm 0.01^b$
Local tamarind	$3.708 \pm 0.58^c$	$0.77 \pm 0.64^b$	$0.37 \pm 0.01^b$

Values are Mean of triplicate determination  $\pm$  S.D Different superscripts on the same row are significantly different ( $p \leq 0.05$ ) according to Duncan Multiply range test.

**Table 4: ANTI OXIDANT PROPERTIES OF THE SAMPLES**

Parameters	Flavonoid (mg/g)	Total phenol (mg/g)	ABTS (mMol/g)	DPPH (%)
Zobo	0.44±0.00 <sup>a</sup>	18.95±2.41 <sup>a</sup>	0.26±0.00 <sup>a</sup>	34.22±0.08 <sup>a</sup>
Kununzaki	0.16±0.008 <sup>b</sup>	9.59±0.06 <sup>b</sup>	0.10±0.00 <sup>b</sup>	21.06±0.82 <sup>b</sup>
kununaya	0.13±0.01 <sup>c</sup>	8.30±0.29 <sup>bc</sup>	0.01±0.0002 <sup>c</sup>	15.96±1.99 <sup>c</sup>
Local tamarind	0.07±0.00 <sup>d</sup>	5.28±0.89 <sup>c</sup>	0.007±0.00 <sup>d</sup>	3.52±0.00 <sup>d</sup>

Values are Mean of triplicate determination ± S.D Different superscripts on the same row are significantly different ( $p \leq 0.05$ ) according to Duncan Multiply range test.

### **Conclusion.**

The results of this study showed that the microbial load of locally produced beverages (Zobo drinks, KununZaki, KununAya and Tamarind) sold within sabon Gari Market of Kano state Nigeria is high due to possible use of contaminated water during their production and or improper handling methods. Moreover the antioxidant capability of the samples was observed. to be high. The high acidic content of local tamarind dinks could be responsible for its high antimicrobial activities. The findings from this work revealed the high bioavailability of the various nutrients in the drinks due to their low anti nutritional content. This study exposes the beneficial potential of locally produced beverages; hence, there is a need to improve on the hygienic methods of processing of these drinks.

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