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Comparative Analysis of Mineral Composition in Locally Prepared and Commercial Ginger Drinks Sold in Gombe Metropolis

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Abstract

Ginger (*Zingiber officinale*) is a widely consumed spice and medicinal plant valued for its nutritional and therapeutic properties. In Nigeria, ginger drinks are popular because of their refreshing taste and perceived health benefits; however, evidence comparing the mineral composition of locally prepared and commercial products remains limited. This study evaluated the mineral composition of selected locally prepared and commercially produced ginger drinks obtained from different locations in Gombe metropolis. Five samples, comprising four locally prepared ginger drinks and one commercial brand, were analyzed for calcium (Ca), magnesium (Mg), sodium (Na), potassium (K), zinc (Zn), and iron (Fe) using atomic absorption spectrophotometry (AAS). Mineral concentrations varied among the samples, with potassium and sodium being the most abundant and iron occurring at relatively low concentrations. The Riyal sample contained the highest potassium concentration (7.45 mg/L), the Tudun Wada sample recorded the highest sodium concentration (11.49 mg/L), and the commercial ginger drink had the highest calcium concentration (2.46 mg/L).

Statistical analysis revealed no significant difference ($p > 0.05$) between the mineral contents of locally prepared and commercial ginger drinks. These findings indicate that ginger drinks sold in Gombe metropolis contain beneficial mineral elements within acceptable limits and may supplement dietary intake of nutrients involved in fluid balance, bone development, immune responses, and enzymatic activities. The study provides comparative evidence on the mineral profiles of locally prepared and commercial ginger drinks and establishes a basis for more comprehensive nutritional assessments using larger samples and additional nutritional parameters.

Keywords: Atomic Absorption Spectrophotometry; Ginger Drink; Gombe Metropolis; Mineral Composition; Nutritional Analysis

INTRODUCTION

Ginger (Zingiber officinale Roscoe), a member of the family Zingiberaceae, is one of the most widely used spices and medicinal plants in the world. It is believed to have originated from Southeast Asia and has been used for thousands of years in traditional medicine and food preparation. Ginger is valued for its characteristic pungent flavor, aroma, and medicinal properties, which have made it an important ingredient in many cultures across the globe.

In Nigeria, ginger is cultivated extensively in several states, with Southern Kaduna recognized as one of the major producing areas. The crop contributes significantly to local trade and household income, especially among smallholder farmers. Ginger is commonly used in the preparation of beverages, spices, herbal remedies, and confectioneries. In recent years, ginger drinks have gained popularity because of their refreshing taste and perceived health benefits.

Scientific studies have shown that ginger contains several biologically active compounds such as gingerols, shogaols, zingiberene, and paradols. These compounds possess antioxidant, antimicrobial, anti-inflammatory, and pharmacological properties that may help in the management of nausea, digestive disorders, cardiovascular diseases, and other health conditions. In addition to its phytochemical composition, ginger also contains important nutrients and minerals that support normal body functions.

Minerals such as calcium, magnesium, potassium, sodium, zinc, and iron play vital roles in maintaining physiological balance, bone development, enzyme activities, immune function, and proper nerve transmission. Since ginger drinks are widely consumed within

Gombe metropolis, it is important to evaluate their mineral composition in order to determine their nutritional relevance and possible contribution to human health.

Despite the increasing consumption of both locally prepared and commercially produced ginger drinks, there is limited information regarding their mineral content and nutritional quality in Gombe metropolis. This study was therefore designed to compare the mineral composition of selected locally prepared and commercial ginger drinks sold within the metropolis using Atomic Absorption Spectrophotometry (AAS).

Ginger standards have been well documented in USP (United State Pharmacopoeia) and National formulary. The chemistry of ginger is well documented with the respect to the oleoresin and volatile oil. There are stringent criteria for the usage of medical grade (should contain 1.5% or more volatile oil). The studies have identified more than 400 different compounds in ginger and major constituents are as follows:

a. Carbohydrates- about 70%

b. Lipid- about 8% which includes free fatty acids.

c. Volatile oils- about 3% consist mainly of the sesquiterpenes, beta-bisabolene

d. In addition, raw fibres, vitamins and minerals are also present in ginger.

Ginger also contains amadaldehyde, paradole, gingerdiols, gingerdiacetates, gingerenones, 6- gingersulfonic acid, diterpense, gingerglycolipids A, B and C (Qian and Liu 1992; Huang et al., 1991; Pecoraro et al., 1998; Anonymous 1997; Frisch et al., 1995).

Ginger the root of the plant *Zingiber officinale* roscoe that belongs to the family *Zingiberaceae*, is globally one of the most commonly used spice and medicinal agent. The plant is known as Sringavera in Sanskrit and it is speculated that this term may have given way to Zingiber in Greek and then to the Latin term Zingiber (Vasala, 2004). Ginger is loaded with antioxidants, compounds that prevent stress and damage to your body's DNA. They may help your body fight off chronic diseases like high blood pressure, heart disease, and diseases of the lungs, plus promote healthy aging. Powdered ginger is the buff-coloured ground spice made from dried root (Marx and McKavanagh, 2015). Preserved or 'stem' ginger is made from fresh young roots, peeled and sliced, then cooked in a heavy sugar syrup. The ginger pieces and syrup are canned together. They are soft and pulpy, but extremely hot and spicy. Ginger, ginger rhizome, and its major active components: 6-gingerol, 6-shogaol, and 6-paradol (Bardsley, 2013). The aromatic constituents include zingiberene and bisabolene, while the pungent constituents are known as gingerols and shogaols (Levita et al., 2018).

Fig. 1- Ginger (Zingiber officinale)

MATERIALS AND METHODS

Materials

The materials used in this study include: Ginger drink samples, Distilled water, Nitric acid (HNO_3), Hydrochloric acid (HCl), Sodium hydroxide (NaOH), Standard solutions of mineral elements (Na, K, Ca, Mg, Fe, Zn.

Instruments

The following instruments were used in this study: Atomic absorption spectrophotometer (AAS), pH meter, Analytical balance, Microwave digestion system, Centrifuge, Volumetric flasks, Beakers and pipettes

Sampling Procedure

Four samples of ginger drink were collected from different local manufacturers in the study area and one sample from a standard company. The samples were labeled and transported to the laboratory for analysis. The samples were stored in clean, dry, and labeled containers.

Analytical Methods

Preparation of Samples

The ginger drink samples were prepared for analysis as follows:

a. The samples were mixed thoroughly and a representative portion was taken.

b. The representative portion was weighed using an analytical balance and transferred into a microwave digestion system.

c. 5 mL of nitric acid was added to the sample and digested using the microwave digestion system

d. The digested sample was cooled and diluted.

Analysis of Mineral Elements

The analysis of mineral elements was carried out using the Atomic Absorption Spectrophotometer (AAS). The instrument was calibrated using standard solutions of the mineral elements (Na, K, Mg, Fe, Ca, Zn) before analysis.

The procedure for the analysis of mineral elements is as follows:

a. The pH of the sample was adjusted to a range of 4-6 using a pH meter.

b. The sample was aspirated into the AAS flame and the absorbance of the mineral elements was measured at their respective wavelengths.

c. The concentration of the mineral elements in the sample was determined using the calibration curve.

Statystical Analysis

The data obtained from the analysis of the mineral elements in the ginger drink samples were analyzed using statistical software such as Microsoft Excel and SPSS. Descriptive statistics such as means, standard deviations, and ranges were calculated. Inferential statistics such as t-tests and ANOVA were used to determine the significance of the differences observed between the mineral content of the samples.

RESULTS

The analysis of mineral elements: Calcium, Magnesium, Sodium, Zinc, Potassium, and Iron in ginger drinks samples from Gombe metropolis is presented in Table 1.

Table 1: Mean Concentrations of Mineral Elements in Ginger Drink Samples from Gombe metropolis

Samples	Mean Concentrations (mg/L)					
	Ca	Mg	Na	K	Zn	Fe
Pantami	1.26±0.18	0.13±0.25	1.22±0.12	2.51±0.15	0.10±0.01	0.00
Riyal	0.94±0.01	0.27±0.00	4.19±0.04	7.45±0.02	0.34±0.01	0.16±0.00
Jekadari	1.26±0.05	5.23±0.13	1.32±0.02	4.63±0.00	2.47±0.01	0.00±0.13
Tudun wada	0.54±0.00	2.80±0.03	11.49±0.02	3.84±0.06	0.55±0.01	0.00
Commercial Ginger	2.46±0.00	1.25±0.01	0.72±0.00	1.57±0.01	0.21±0.00	0.09±0.00
Recommended daily intake						

All values are presented as mean ± standard error of mean,

Ginger drink Pantami: Mean concentration of the elements Ca, Mg, Na, K, Zn, and Fe are found to be 1.26, 0.13, 1.22, 2.51, 0.10, and 0.00 respectively.

i. Ginger drink Riyal: Mean concentration of the elements Ca, Mg, Na, K, Zn, and Fe are found to be 0.94, 0.27, 4.19, 7.45, 0.34, and 0.16 respectively.
ii. Ginger drink Jekadafari: Mean concentration of the elements Ca, Mg, Na, K, Zn, and Fe are found to be 1.26, 5.23, 1.32, 4.63, 2.47, and 0.00 respectively.
iii. Ginger drink T/Wada: Mean concentration of the elements Ca, Mg, Na, K, Zn, and Fe are found to be 0.54, 2.80, 11.49, 3.84, 0.55, and 0.00 respectively.
iv. Commercial Ginger: Mean concentration of the elements Ca, Mg, Na, K, Zn, and Fe are found to be 2.46, 1.25, 0.72, 1.57, 0.21, and 0.09 respectively.

DISCUSSION

The results showed that ginger drink contains mineral elements such as Na, K, Ca, Mg, Fe, and Zn. The mean concentration of K was found to be the highest among the mineral elements analyzed, followed by Na, Mg, and Ca.

The high concentration of K in ginger drink is important as it plays a significant role in maintaining fluid balance in the body and regulating blood pressure. Na is also important in maintaining fluid balance, while Mg and Ca are essential for the development and maintenance of bones and teeth.

The concentration of Fe, and Zn in ginger drink was relatively low, but they still contribute to the overall mineral content of the drink. These minerals are important for various physiological processes such as oxygen transport, immune function, and enzymatic activity.

The results of this study also showed that there was no significant difference in the mineral content of ginger drink samples obtained from local manufacturers, and that of the standard company as well ($p<0.05$). This suggests that the mineral composition of ginger drink is consistent across different brands, which is important for consumers who are looking to obtain a certain level of mineral intake from their diet. Overall, the findings of this study provide useful information on the mineral composition of ginger drink, which can be used to guide dietary recommendations and product formulation in the food and beverage industry.

The findings of the study revealed that ginger drink is a rich source of minerals, including calcium, iron, magnesium, potassium, and zinc. The mineral compositions of the ginger drink samples analyzed were found to be within the recommended daily intake of mineral compositions of ginger drink samples varied depending on the manufacturer and vendor.

The study found that potassium and sodium were the most abundant minerals in ginger drink samples. Potassium is an essential mineral for maintaining fluid level in the body, healthy blood pressure, and heart function. Sodium is also important in maintaining fluid balance.

Calcium, another mineral found in ginger drink, is an essential mineral for strong bones and teeth. Magnesium is also present which is important for maintaining healthy muscle and nerve function. Iron was found in trace amount but it also functions in the formation of red blood cells. Zinc, which was also found in ginger drink samples, is essential for the immune system and wound healing.

CONCLUSION

The study has shown that ginger drink is a rich source of minerals that are essential for human health. The mineral compositions of ginger drink samples analyzed in this study were found to be within the recommended daily intake of minerals for human consumption. The findings of this study highlight the potential health benefits of consuming drink.

Recommendation

This study has some limitations, including the small sample size and the limited geographical scope of the study. Future research should include a larger sample size and a more diverse geographical area to provide a more comprehensive analysis of ginger drink mineral compositions. Additionally, future research could investigate the effect of processing and storage on the mineral compositions of ginger drink. Overall, this study has provided valuable insights into the mineral compositions of ginger drink and their potential health benefits. Further research is needed to fully understand the implications of consuming ginger drink and its effect on human health.

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