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Nutritional Composition and Anti-Nutritional Factors of *Mitmiz* - a Local Groundnut (*Arachis hypogaea L.*) Based Snack

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ABSTRACT

The study investigated nutrient contents and anti-nutritional properties of mitmiz, which is a groundnut-based snack produced from milled groundnut and boiled granulated sugar. Seven different samples of *mitmiz* used for this study were purchased from seven different regular producers/sellers in Gashua, Yobe state while the sample prepared in laboratory served as the control sample. There were no significant differences ($p > 0.05$) in ash, crude fibre, calcium and iron content of *mitmiz* with the values of proximate composition ranging from 4.33 - 6.05%, 1.98 - 2.35%, 21.50 - 23.31%, 44.29 - 47.80%, 3.30 - 3.55% and 19.12 – 21.10% for moisture, ash, crude protein, crude fat, crude fibre and carbohydrate respectively while the values of mineral contents ranging from 1365.75 - 1404.68 mg/100g, 26.68 - 31.50 mg/100g, 300.32 - 316.50 mg/100g, 43.10 - 51.28 mg/100g, 870.56 - 884.28 mg/100g, 2.38 - 2.59 mg/100g and 3.36 - 3.46 mg/100g for potassium, calcium, magnesium, sodium, phosphorus, iron and zinc respectively. Also, there were no significant differences ($p > 0.05$) in the values of vitamin contents which ranging from 7.40 - 8.03 mg/100g, 2.00 - 2.31 mg/100g, 2.24 - 2.44 mg/100g, 3.21 - 4.17 mg/100g and 1.80 - 1.97 mg/100g for niacin, riboflavin, thiamine, vitamin E and folate respectively. The study showed that *mitmiz* has high nutritional composition and low anti-nutritional properties. Thus, *mitmiz* could be a cheap source of nutrients and its consumption could lead to reduction in malnutrition and other diet-related diseases which are pandemic in developing countries.

KEYWORDS

Legume
Snack
Street food
Quality
Malnutrition

1. INTRODUCTION

Groundnut (*Arachis hypogaea* L.), a member of the Fabaceae plant family of legumes is said to have originated in South America and then spread to other regions of the world (Balasubramanian et al., 2020). Groundnut is also known as peanut, goober, earthnut, monkey nut, Chinese nut, arachides and other various names by different authors in the literature. Groundnut is known to the Hausas as *gyadda*, to the Ibos as *opapa*, and the Yorubas as *epa* (Shuaibu, 2021). Legumes are inexpensive source of protein and minerals in several African nations because of high cost of animal protein (Muhammad et al., 2021). Currently, there are more than 115 nations where groundnut farming is practiced, with a total global production of 47 million tonnes from 27.9 million hectares of land (Xiao et al., 2022). About 32% of groundnut production in Africa is been produced in Nigeria, Niger, and Burkina Faso (Tarfa et al., 2017). The well-known groundnut pyramid in Kano from the 1950s and 1960s confirm the importance and popularity of groundnut in Nigeria (Abdulrahaman et al., 2014).

This groundnut pyramid greatly contributed to Nigeria economy and created employment opportunity before the discovery of crude oil. There are thousands of different cultivars of the edible seeds of a legume known as the groundnut that can be found worldwide (Arya et al., 2016). Groundnuts are cultivated largely for their edible oil around the world due to their desirable mild flavour and higher smoke point in comparison to other vegetable-based cooking oils (Toomer, 2018). Groundnut is one of the main sources of food and cooking oil in Nigeria (Olatunya et al., 2017). Groundnut is a significant source of oil and is consumed by many people globally due to its higher nutrient content, including fat, protein, unsaturated fatty acids, and amino acids (Liu et al., 2018). Due to their high quantities of protein and oil, which are needed to produce groundnut butter and oil, a significant amount of their production is used for domestic foods (Gong et al., 2018).

Since, groundnuts are high in protein and oil contents as well as containing vitamins, minerals, and other substances that promote good health, groundnuts are prized for their nutritional advantages (Bera et al., 2018). Groundnut comprises trace amounts of Vitamins A and D as well as significant amounts of vitamin E (Eltom et al., 2022). The phenolic compound "resveratrol", which is present in groundnut, functions as a metal chelator, a powerful antioxidant, and a scavenger of reactive oxygen species (Bilal et al., 2021). Groundnuts are consumed as a snack, used to make oil, peanut butter, and as an important component in confectionary items in developed nations (Bonku and Yu, 2020). Less than 40% of the groundnut produced worldwide is eaten as food directly, with over 50% being crushed into oil for human and industrial uses (Bera et al., 2018). Bilal et al. (2021) reported that groundnuts reduce the chance of developing type 2 diabetes.

The famous Groundnut products in Nigeria apart from oil includes *kulikuli*, *donkwa*, *mitmiz*, boiled and roasted groundnuts. *Mitmiz* is a groundnut-based snack which normally produced with milled roasted groundnut and boiled granulated sugar. It is one of the street foods that usually sold in Gashua throughout the year. Gashua is the headquarters of the Bade local government of Yobe state, situated in north-eastern part of Nigeria (Omoniyi and Waziri-Ugwu, 2019). It is usually consumed as snack by all categories of people. However, it should be noted that there is little information about the nutritional composition and anti-nutritional properties of *mitmiz* unlike *kulikuli*, *donkwa*, boiled and roasted groundnuts. Thus, the study aimed to evaluate the nutrient contents and anti-nutritional properties of *mitmiz* sold in Gashua, Yobe state, Nigeria.

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2. MATERIALS AND METHODS

2.1. Materials

Seven (7) different samples of *mitmiz* used for the study were purchased from seven different regular producers/sellers from the seven producing locations (Katuzu, Bultumari, Garin lamido, Sabon gari, Takari, Baba filin tada and Fulatari) in Gashua, Yobe state, Nigeria. Groundnut (SAMNUT 24 variety) was purchase from Central market, Gashua and the control sample was prepared in the Food Preparatory Laboratory, Department of Home Science and Management, Federal University, Gashua.

2.2. Preparation of Control Sample

Figure 1 shows the flowchart for the production of *mitmiz*. Groundnuts were first removed from pods, sorted, roasted, de-skinned and then milled with hammer mill (0.5 mesh). About 175 grammes of granulated sugar was mixed with 450 ml of portable water in the frying pan and the mixture was allowed to boil inside the pot for about 10 minutes when golden brown colour was obtained.

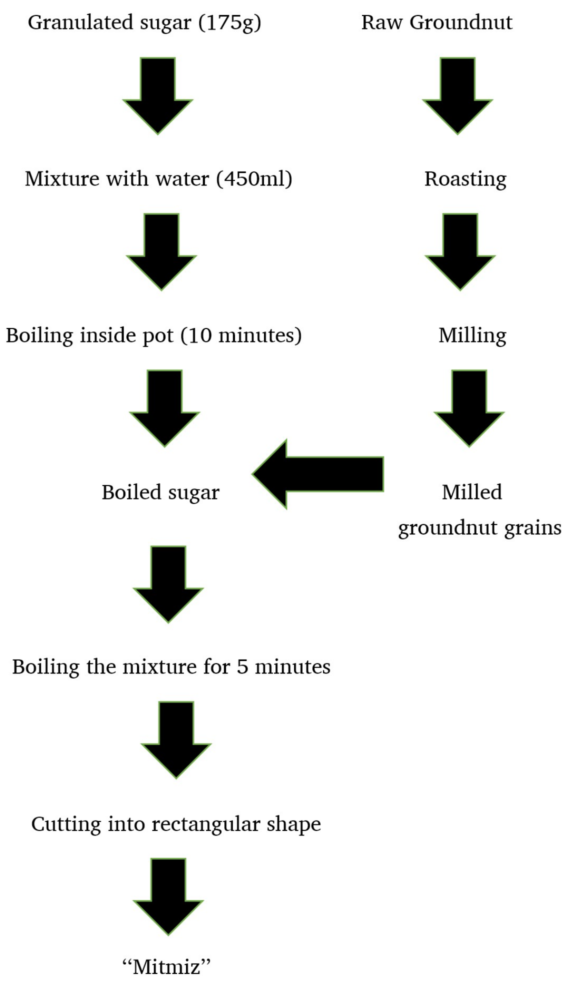

Figure 1. *Flow chart showing the production of mitmiz*

Milled roasted dehulled groundnut (250 g) was added and stirred continually for 5 mins while boiling together to obtain thick mixture. It was then transferred to chopping board, pressed with rolling pin, cut into rectangular shape with knife, packaged in high density polyethylene bag (0.10 mm thickness) and sealed with sealing machine (Impulse sealer, model FS – 200, China).

2.3. Methods

2.3.1. Determination of proximate composition

Moisture, ash, crude protein, crude fat and crude fibre contents of *mitmiz* samples were determined by the methods described by AOAC (2023) while carbohydrate content was determined by difference.

2.3.2. Determination of Mineral and Vitamin contents

The methods described by Tabarsa et al. (2012) were used to determine the mineral contents (Potassium, calcium, magnesium, sodium, phosphorus, iron and zinc) of *mitmiz* samples while the methods of AOAC (2023) were used for the determinations of vitamin contents (niacin, riboflavin, thiamine, vitamin E and folate).

2.3.3. Determination of Oxalate content

Oxalate content of the samples was determined by titrimetric method described by AOAC (2023).

2.3.4. Determination of tannin content

Tannin content of samples was determined using a method described by Oyeyinka et al. (2017). Sample (0.2 g) was extracted for 20 minutes using 10 mL of 1% (v/v) concentrated hydrochloric acid in methanol within capped rotating test tubes. One milliliter of sample extract was mixed with five milliliters of 0.5% vanillin reagent, and after 20 minutes the absorbance was measured at 500 nm using a UV visible spectrophotometer (Jenway 7305 Bibby Scientific, London, UK).

2.3.5. Determination of Phytate content

Phytate content of samples were determined using a method described by Iwuozor (2019) with minor modification. The sample (2 g) was mixed with 100 ml of 2% concentrated HCl in conical flask (250 ml), left for 3 hours and then filtered. Ammonium thiocyanate (5 mL of 0.30%) was added to aliquots of filtrate (2500 mL) in a conical flask. The mixture was then titrated with standard iron (III) chloride solution until it developed a persistent brownish yellow coloration that lasted for four minutes. Phytate content was determined using the formula:

$$\text{Phytate content} = \text{Titre value} \times 100 \times 0.00195 \times 1.90/2$$

2.3.6. Determination of saponin content

Saponin content of samples were determined by spectrophotometric method described by Adeleke et al. (2017) with 1 g of the sample. Standard saponin solutions of 0–10 ppm was used as a reference standard. The absorbance of standard solutions and samples were read at 380 nm using a UV visible spectrophotometer (Jenway 7305 Bibby Scientific, London, UK).

2.3.7. Determination of trypsin inhibitor content

Trypsin inhibitor content of samples was determined using a method described by Adeleke et al. (2017). Sample (1 g) was extracted by soaking it in 50 mL of 0.01 M NaOH overnight at 4°C. The pH was then adjusted to 8.4–10. The sample extract (2 mL) was diluted in the suspension to inhibit 40–60% of the standard trypsin that was employed in the analysis. Trypsin inhibition was achieved using synthetic benzoyl-dl-arginine-pnitroamide as a substrate. Aliquot of sample extracts was read at 410 nm to determine the residual enzyme activity. Trypsin inhibitor activity was calculated as:

$$\frac{2.632 \times A \times D}{S}$$

where, A = change in absorbance, D = dilution factor and S = weight of sample

2.4. Statistical Analysis

All the laboratory analyses were done in triplicates and data obtained from the analyses were subjected to an analysis of variance (ANOVA) and Duncan's multiple range test was used to separate the means from the data when there was a significant difference ($p<0.05$). The statistical analysis was done using SPSS version 25.0 software.

3. RESULTS AND DISCUSSION

3.1. Proximate Composition of *Mitmiz*

Table 1 shows the proximate composition of *mitmiz*. The values of proximate composition ranging from 4.33 - 6.05%, 1.98 - 2.35%, 21.50 - 23.31%, 44.29 - 47.80%, 3.30 - 3.55% and 19.12 – 21.10% for moisture, ash, crude protein, crude fat, crude fibre and carbohydrate respectively. The moisture content (4.33%) of control sample was significantly different ($p<0.05$) from the *mitmiz* purchased from different regular producers/sellers from different locations (commercial *mitmiz* samples). However, moisture content of control sample was lowest in all the *mitmiz* samples and this implied that it could have longer shelf life than the commercial samples. The moisture contents of 12.65%, 6.31%, 7.75% and 6.56% reported for *kulikuli* by Oko et al. (2015), Emelike and Akusu (2018), Achimugu and Okolo (2020) and Obojiofor et al. (2022) respectively were higher than the moisture contents obtained for *mitmiz*. The amount of moisture in food is a good indicator of its shelf life (Agbemafle, 2019). It is anticipated that low moisture content will extent the shelf life of flour blends (Omoniyi et al., 2016). Since the values of moisture content of *mitmiz* were low, it is expected to have longer shelf life. There was no significantly different ($p > 0.05$) in the value of ash content of all the *mitmiz* samples. However, the highest value was observed in ash content (2.35%) of control sample.

The highest ash content could be attributed to the proper sorting of raw groundnut used for the production of control sample. Also, the ash contents of 3.45%, 4.63%, 4.80% and 5.20% reported for *kulikuli* by Oko et al. (2015), Emelike and Akusu (2018), Achimugu and Okolo (2020), and Obojiofor et al. (2022) respectively were higher than the ash contents obtained for *mitmiz*. The ash content can be used to determine the mineral content of food sample (Agbemafle, 2019). The appreciable amount of ash content signifies that *mitmiz* could comprise better mineral contents. The crude protein content (23.31%) of control sample was the highest and significantly different ($p<0.05$) from the commercial *mitmiz* samples.

The highest crude protein content could be attributed to the varietal differences and proper sorting of damaged/spoiled groundnut from raw groundnut used for the production of control sample. The crude protein contents of 12.60% and 13.40% reported for *kulikuli* by Oko et al. (2015) and Emelike and Akusu (2018) respectively were lower than the crude protein contents obtained for *mitmiz* while the crude protein content of 35.98% and 44.70% reported for *kulikuli* by Obojiofor et al. (2022) and Achimugu and Okolo (2020) respectively was higher than the protein contents obtained for *mitmiz*.

Growth and repair of damaged tissues are the primary purposes of proteins in the human body (Sha'a et al., 2019). *Mitmiz* comprises high protein content and this showed that the product is of good quality and good nutrient to the body. 21.00 – 23.00 g of protein of *mitmiz* is recommended nutrient intake for adults when compared it with recommended daily nutrient intake. The crude fat content (47.38%) of control sample was significantly different ($p<0.05$) from the commercial *mitmiz* samples. However, the value of control sample is within the crude fat content (44.29 – 47.80%) obtained for commercial *mitmiz* samples. The crude fat contents of 15.40%, 23.21%, 8.93% and 10.62% reported for *kulikuli* by Oko et al. (2015), Emelike and Akusu (2018), Achimugu and Okolo (2020) and Obojiofor et al. (2022) respectively were lower than the crude fat contents obtained for *mitmiz*.

The fats in groundnuts are crucial for preventing caloric deficiency and supplying the required amount of healthful calories (Manobanda-Narvaez et al., 2022). The high content of fat in *mitmiz* could supply the beneficial vitamins especially the fat-soluble vitamins. The crude fibre content (3.51%) of control sample was not significantly different ($p>0.05$) from the commercial *mitmiz* samples. However, the value of control sample is within the crude fibre content (3.30 – 3.55%) obtained for commercial *mitmiz* samples. The crude fibre contents of 0.25%, 0.26% and 2.26% reported for *kulikuli* by Oko et al. (2015), Emelike and Akusu (2018), and Obojiofor et al. (2022) respectively were lower than the crude fibre contents obtained for *mitmiz* while the crude fibre of 4.41% reported by Achimugu and Okolo (2020) was higher than the crude fibre of *mitmiz*.

Table 1: Proximate composition (%) of mitmiz

Sample	Moisture	Ash	Crude protein	Crude fat	Crude fibre	Carbohydrate
Control	4.33 ± 0.13^{e}	2.35 ± 0.29^{a}	23.31 ± 1.08^{a}	47.38 ± 0.51^{a}	3.51 ± 0.22^{a}	19.12 ± 0.48^{d}
A	5.41 ± 0.01^{c}	2.20 ± 0.20^{a}	22.05 ± 1.00^{ab}	47.04 ± 0.04^{ab}	3.40 ± 0.20^{a}	19.90 ± 0.10^{bc}
B	5.10 ± 0.10^{d}	2.15 ± 0.15^{a}	22.80 ± 1.00^{ab}	46.93 ± 0.03^{ab}	3.32 ± 1.00^{a}	19.70 ± 0.20^{bcd}
C	5.39 ± 0.01^{c}	2.33 ± 0.10^{a}	23.10 ± 1.00^{a}	46.18 ± 0.01^{b}	3.55 ± 0.10^{a}	19.45 ± 0.02^{bcd}
D	5.20 ± 0.05^{d}	2.00 ± 0.10^{a}	21.50 ± 0.10^{b}	47.80 ± 1.00^{a}	3.49 ± 1.00^{a}	20.01 ± 0.01^{b}
E	6.05 ± 0.02^{a}	1.98 ± 0.02^{a}	22.35 ± 0.05^{ab}	47.12 ± 0.02^{ab}	3.30 ± 0.10^{a}	19.20 ± 1.00^{cd}
F	5.81 ± 0.01^{b}	2.25 ± 0.05^{a}	23.00 ± 1.00^{ab}	44.29 ± 0.05^{d}	3.55 ± 0.05^{a}	21.10 ± 0.10^{a}
G	5.70 ± 0.10^{b}	2.30 ± 1.00^{a}	22.50 ± 0.05^{ab}	45.25 ± 0.02^{c}	3.45 ± 0.02^{a}	20.80 ± 0.02^{a}

Values are mean ± standard deviation
Mean values with different superscript within the same column are significantly different ($p < 0.05$)
A: *mitmiz* bought in Katuzu, B: *mitmiz* bought in Bultumari, C: *mitmiz* bought in Garin lamido, D: *mitmiz* bought in Sabon gari, E: *mitmiz* bought in Takari, F: *mitmiz* bought in Baba filin tada, G: *mitmiz* bought in Fulatari

Crude fibre is a component of food consisting of cellulose and lignin and is vital for the human body (Mousavi et al., 2019; Peprah et al., 2020).

The appreciable amount of fibre present in *mitmiz* could assist during the digestion process in body system. The carbohydrate content (19.12%) of control sample was the lowest and significantly different ($p < 0.05$) from the commercial *mitmiz* samples. However, the lowest value could be related to the highest protein content of control sample. The carbohydrate contents of 55.15%, 52.19%, 27.49% and 39.39% reported for *kulikuli* by Oko et al. (2015), Emelike and Akusu (2018), Achimugu and Okolo (2020), and Obojiofor et al. (2022) respectively were higher than the carbohydrate contents obtained for *mitmiz*. The good quantity of carbohydrate, and high protein and fat contents of *mitmiz* could aid in combating undernutrition and other nutritional deficiency diseases. The substantial fat, protein, and carbohydrate contents of the groundnut makes them excellent suppliers of the bulk nutrients required to prevent both certain macronutrient and micronutrient deficiencies as well as gross malnutrition (Olatunya et al., 2017). Carbohydrates are essential for good health, as they are the main fuel for the brain and muscles. Studies showed that those who eat the most carbohydrates, especially those found in whole natural foods like beans, whole grains, fruits, and vegetables have a lower risk for heart disease, type 2 diabetes, and obesity. Groundnuts are an ideal crop to prevent malnutrition in many poor nations where the majority of the population lives below the poverty line because of their high protein content, carbohydrate, and high cost as the price of animal-based foods (Bonku and Yu, 2020).

3.2. Mineral Contents of *Mitmiz*

Table 2 shows the mineral contents of *mitmiz*. The values of mineral contents ranging from 1365.75 - 1404.68 mg/100g, 26.68 - 31.50 mg/100g, 300.32 - 316.50 mg/100g, 43.10 - 51.28 mg/100g, 870.56 - 884.28 mg/100g, 2.38 - 2.59 mg/100g and 3.36 - 3.46 mg/100g for potassium, calcium, magnesium, sodium, phosphorus, iron and zinc respectively.

There were significant differences ($p<0.05$) in potassium, magnesium, sodium and phosphorus content of control sample from the commercial *mitmiz* samples. The control sample had the highest potassium, magnesium, sodium, phosphorus, iron and zinc content and this could be attributed to varietal differences and proper sorting of damaged/spoiled groundnut from raw groundnut used for the production of control sample. The value of calcium content (40.90 mg/100g) and zinc content (3.67 mg/100g) reported for groundnut biscuit by Rohimah et al. (2021) were higher than the values obtained for calcium and zinc content of *mitmiz* while the value of magnesium content (127.08 mg/100g) and iron content (0.69 mg/100g) reported for groundnut biscuit by Rohimah et al. (2021) were lower than the values obtained for magnesium and iron content of *mitmiz*. The value of potassium content (85.53 mg/100g), magnesium content (290. 62 mg/100g) and zinc content (2.40 mg/100g) reported for *kulikuli* by Henry and Ubaji (2022) were lower than the values obtained for potassium content, magnesium content and zinc content of *mitmiz* while the value of calcium content (102.53 mg/100g), sodium content (529.27 mg/100g) and iron content (2.80 mg/100g) reported for *kulikuli* by Henry and Ubaji (2022) were higher than the values obtained for calcium content, sodium content and iron content of *mitmiz*. Phosphorus is being utilized in the production of nucleic acid (Elumba et al., 2022). Since, *mitmiz* contained high phosphorus content, consumption of it could be beneficial in inherited characteristics in the body systems. Potassium helps keep cells healthy and facilitates nerve impulse transmission (Elumba et al., 2022).

Bone production is facilitated by calcium with the aid of magnesium, phosphorus and manganese (Amos et al., 2019). The calcium content of the groundnut species was notably high, and calcium is essential for the structure of biological systems (Olatunya et al., 2017). High potassium and calcium contents in *mitmiz* showed that consumption of it could be beneficial in body systems especially in formation of good teeth and bone. Magnesium helps to maintain healthy bones, support normal blood pressure, and control blood sugar levels (Settaluri et al., 2012). Thus, consumption of *mitmiz* could aid in strong bone, appropriate blood pressure, and maintain normal blood sugar levels.

Iron is an essential component of red blood cells which carry oxygen from the lungs to various organs in the body (Suri et al., 2020). Thus, consumption of *mitmiz* could be assist in lowering the iron deficiency problem especially anaemia. Zinc is a mineral that is necessary for optimal growth and development during pregnancy, childhood, and adolescence periods (Settaluri et al., 2012). Since *mitmiz* comprises appreciable quantity of zinc, its consumption could contribute to healthy growth and development. However, the recommended nutrient intake of *mitmiz* for potassium, calcium, magnesium, phosphorus and zinc for adults are 1365.00 – 1390.00 mg, 26.00 – 31.00 mg, 300.00 – 312.00 mg, 870.00 – 880.00 mg and 3.00 mg respectively

3.3. Vitamin Contents of *Mitmiz*

Table 3 shows the vitamin contents of *mitmiz*. The values of vitamin contents ranging from 7.40 - 8.03 mg/100g, 2.00 - 2.31 mg/100g, 2.24 - 2.44 mg/100g, 3.21 - 4.17 mg/100g and 1.80 - 1.97 mg/100g for niacin, riboflavin, thiamine, vitamin E and folate respectively. There were no significant differences ($p>0.05$) in niacin, riboflavin, thiamine, vitamin E and folate content of control sample from the commercial *mitmiz* samples with control sample having the highest niacin, thiamine, vitamin E and folate contents. The value of vitamin E content (6.70 mg/100g) of groundnut biscuit reported by Rohimah et al. (2021) was higher than the values vitamin E contents of *mitmiz* while the folate content (0.027 mg/100g) reported for groundnut biscuit was lower than the folate contents of *mitmiz*.

Table 2: Mineral contents (mg/100g) of mitmiz

Sample	Potassium	Calcium	Magnesium	Sodium	Phosphorus	Iron	Zinc
Control	1404.68 ± 4.00^{a}	30.28 ± 8.50^{a}	316.50 ± 2.00^{a}	51.28 ± 1.00^{a}	884.28 ± 0.03^{a}	2.59 ± 0.01^{a}	3.46 ± 0.02^{a}
A	1382.81 ± 0.10^{d}	30.05 ± 0.05^{a}	308.20 ± 0.20^{d}	47.92 ± 2.00^{cd}	876.10 ± 6.00^{bc}	2.51 ± 0.01^{a}	3.40 ± 0.02^{a}
B	1380.05 ± 0.04^{de}	28.66 ± 3.00^{a}	305.40 ± 1.00^{e}	47.30 ± 0.05^{cd}	874.50 ± 2.00^{bc}	2.50 ± 1.00^{a}	3.40 ± 1.00^{a}
C	1378.30 ± 2.00^{e}	28.10 ± 0.05^{a}	301.92 ± 0.01^{f}	45.81 ± 0.01^{d}	873.99 ± 0.11^{bc}	2.44 ± 1.00^{a}	3.41 ± 0.01^{a}
D	1368.70 ± 0.20^{f}	27.82 ± 0.02^{a}	300.55 ± 0.11^{fg}	43.30 ± 3.00^{e}	872.66 ± 0.01^{bc}	2.40 ± 0.10^{a}	3.40 ± 0.02^{a}
E	1365.75 ± 1.00^{g}	26.68 ± 1.00^{a}	300.32 ± 0.01^{g}	43.10 ± 0.10^{e}	870.56 ± 10.00^{bc}	2.38 ± 0.03^{a}	3.36 ± 0.01^{a}
F	1385.90 ± 0.05^{c}	30.82 ± 0.01^{a}	311.24 ± 1.00^{c}	48.78 ± 0.02^{bc}	877.45 ± 0.02^{abc}	2.55 ± 0.05^{a}	3.43 ± 0.03^{a}
G	1390.20 ± 0.02^{b}	31.50 ± 0.10^{a}	312.80 ± 0.02^{b}	50.80 ± 0.10^{ab}	880.08 ± 0.03^{ab}	2.57 ± 0.02^{a}	3.45 ± 2.00^{a}

Values are mean ± standard deviation

Mean values with different superscript within the same column are significantly different ($p < 0.05$)

A: *mitmiz* bought in Katuzu, B: *mitmiz* bought in Bultumari, C: *mitmiz* bought in Garin lamido, D: *mitmiz* bought in Sabon gari, E: *mitmiz* bought in Takari, F: *mitmiz* bought in Baba filin tada, G: *mitmiz* bought in Fulatari

Table 3: Vitamin contents (mg/100g) of mitmiz

Sample	Niacin	Riboflavin	Thiamine	Vitamin E	Folate
Control	8.03 ± 0.07[a]	2.12 ± 0.02[a]	2.44 ± 0.02[a]	4.17 ± 2.00[a]	1.97 ± 0.02[a]
A	7.71 ± 2.00[a]	2.00 ± 1.00[a]	2.31 ± 0.01[a]	4.01 ± 0.01[a]	1.90 ± 0.01[a]
B	7.60 ± 2.00[a]	2.15 ± 0.15[a]	2.30 ± 0.20[a]	4.00 ± 3.00[a]	1.80 ± 0.01[a]
C	7.48 ± 0.02[a]	2.28 ± 0.04[a]	2.28 ± 0.03[a]	3.92 ± 0.02[a]	1.80 ± 0.05[a]
D	7.45 ± 0.02[a]	2.31 ± 0.01[a]	2.24 ± 0.04[a]	3.90 ± 0.30[a]	1.82 ± 0.02[a]
E	7.40 ± 0.20[a]	2.11 ± 0.01[a]	2.30 ± 0.20[a]	3.21 ± 0.01[a]	1.80 ± 1.00[a]
F	7.76 ± 0.01[a]	2.08 ± 0.02[a]	2.36 ± 0.10[a]	4.05 ± 0.05[a]	1.92 ± 0.01[a]
G	7.90 ± 0.10[a]	2.10 ± 0.10[a]	2.40 ± 0.20[a]	4.11 ± 0.11[a]	1.91 ± 0.03[a]

Values are mean ± standard deviation
Mean values with different superscript within the same column are significantly different ($p < 0.05$)
A: *mitmiz* bought in Katuzu, B: *mitmiz* bought in Bultumari, C: *mitmiz* bought in Garin lamido, D: *mitmiz* bought in Sabon gari, E: *mitmiz* bought in Takari, F: *mitmiz* bought in Baba filin tada, G: *mitmiz* bought in Fulatari

Table 4: Anti-nutritional properties (mg/100g) of mitmiz

Sample	Saponin	Oxalate	Tannin	Phytate	Trypsin inhibitor
Control	2.02 ± 0.02[b]	ND	2.04 ± 0.03[a]	0.04 ± 0.02[a]	0.50 ± 0.10[a]
A	2.10 ± 0.10[ab]	ND	2.06 ± 0.02[a]	0.05 ± 0.02[a]	0.51 ± 0.10[a]
B	2.15 ± 0.15[ab]	ND	2.04 ± 0.03[a]	0.05 ± 0.03[a]	0.50 ± 0.10[a]
C	2.08 ± 0.01[ab]	ND	2.10 ± 0.10[a]	0.06 ± 0.01[a]	0.53 ± 0.01[a]
D	2.13 ± 0.03[ab]	ND	2.15 ± 0.15[a]	0.05 ± 0.02[a]	0.52 ± 0.02[a]
E	2.20 ± 0.10[a]	ND	2.08 ± 0.04[a]	0.05 ± 0.01[a]	0.53 ± 0.02[a]
F	2.15 ± 0.02[ab]	ND	2.05 ± 0.01[a]	0.05 ± 0.03[a]	0.52 ± 0.02[a]
G	2.13 ± 0.02[ab]	ND	2.10 ± 0.10[a]	0.06 ± 0.02[a]	0.53 ± 0.01[a]

Values are mean ± standard deviation
Mean values with different superscript within the same column are significantly different ($p < 0.05$)
A: *mitmiz* bought in Katuzu, B: *mitmiz* bought in Bultumari, C: *mitmiz* bought in Garin lamido, D: *mitmiz* bought in Sabon gari, E: *mitmiz* bought in Takari, F: *mitmiz* bought in Baba filin tada, G: *mitmiz* bought in Fulatari
ND: Not Detected

However, the values of niacin (1.09 mg/100g), riboflavin (1.10 mg/100g) and thiamine (1.32 mg/100g) reported for *kulikuli* by Henry and Ubaji (2022) were lower than the values obtained for niacin, riboflavin and thiamine contents of *mitmiz*. Vitamins are crucial micronutrients that the body needs to carry out a variety of tasks, including enhancing the immune system, producing energy, and aiding in food digestion (Bonku and Yu, 2020).

Niacin deficiency leads to pellagra which is a reversible nutritional disease and wasting illness (Awuchi et al., 2020). Riboflavin is crucial for the metabolism of lipids, proteins and carbohydrate as well as for maintaining healthy skin and proper vision (Bonku and Yu, 2020). Consumption of *mitmiz* could resolved pellagra, skin and vision problems, since it contains appreciable amounts of niacin and riboflavin contents. Deficiency of thiamine, vitamin E and folate causes beriberi, inadequate electrical impulse transmission along the nerves and abnormalities in the neural tube (Awuchi et al., 2020). Also, consumption of *mitmiz* could resolved beriberi and neural tube problems, since it contains appreciable amounts of thiamine and vitamin E contents. The recommended nutrient intake of *mitmiz* for niacin, thiamine, vitamin E and riboflavin for adult are 7.00 mg, 2.00 mg, 3.00 – 4.00 mg and 2.00 mg respectively.

3.4. Anti-Nutritional Properties of *Mitmiz*

Table 4 shows the anti-nutritional properties of *mitmiz*. The values of anti-nutritional properties ranging from 2.02 - 2.20 mg/100g, 2.04 - 2.15 mg/100g, 0.04 - 0.06 mg/100g and 0.50 - 0.53 mg/100g for saponin, tannin, phytate and trypsin inhibitor respectively. There were no significant differences ($p > 0.05$) in tannin, phytate and trypsin inhibitor content of control sample from the commercial *mitmiz* samples. Oxalate was not detected in all the samples of *mitmiz*. Antinutrients in food have been shown to prevent the proper absorption and utilisation of vital nutrients and further reducing its bioavailability (Abubakar and Gana, 2017). The values of saponin (0.41 mg/100g) and tannin (0.12 mg/100g) reported for *kulikuli* by Henry and Ubaji (2022) were lower than the values obtained for saponin and tannin contents of *mitmiz* while the value of phytate (0.48 mg/100g) reported for *kulikuli* were higher than the value obtained for phytate content of *mitmiz*. Recent research suggests that saponins have qualities that are anticarcinogenic, immunostimulatory, and hypocholesterolemic (Sha'a et al., 2019). Since, *mitmiz* contained low saponin content, consumption of *mitmiz* could assist in stimulate immune system, lower cholesterol level and prevent cancer in body system. Tannins may react with metal ions to form compounds and macromolecules like proteins and polysaccharides (Srivastava et al., 2022).

The low quantity of tannin content in *mitmiz* could have some nutritional benefit to the body system. Phytate may act as an antioxidant by securing iron and preventing the production of free radicals (Manano et al., 2018). Trypsin inhibitors decrease the action of digestive enzymes (Unigwe et al., 2018). *Mitmiz* could be cheap source of phytochemical and improve the rate of digestive enzymes since it consists of low tannin and trypsin inhibitor contents.

4. CONCLUSION

The study revealed that commercial *mitmiz* samples contain high protein, mineral and vitamin contents which showed that it could serves as cheap source of nutrient in human diet. The low anti-nutritional factors of commercial *mitmiz* implies that it is safe for human consumption and could be a cheap source of phytochemicals which could improve nutrition and health. The commercial *mitmiz* samples are in compared favourably with control samples in term of ash, crude fibre, calcium, iron, zinc and vitamin content. Thus, *mitmiz* is a cheap source of nutrient especially in developing countries like Nigeria and consumption of it could lead to reduction in malnutrition and other diet-related diseases which are pandemic in developing countries.

CONFLICT OF INTEREST

The authors declare no conflicts of interest.

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