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Mineral, vitamin and phytochemical determination of some wild Macrofungi collected from Gwandu emirate, Kebbi State, northwest Nigeria

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Abstract
The study was done to determine the Mineral, Vitamin and Phytochemical content of some wild macrofungi collected from Gwandu emirate, Kebbi state, Nigeria. Mushrooms are macrofungi with unique fruiting body. Due to their abundance in practically all regions of Nigeria, they have continued to spark research interest in recent years; despite this, many individuals are still unaware of their nutritional benefits. Fresh and Matured Macrofungi collected from the wild and were weighed to get both the fresh and dry weight before the identification was done. They were identified as *Coprinus* sp., *Lycoperdon* sp., *Bovista* sp., *Chlorophyllum rachodes, Agaricus compestris, Podaxis* sp., *Chlorophyllum brunneum Termitomyces* sp., *Volvariella* sp. and *Auricularia* sp. The identified macrofungi were sun dried while the large size mushrooms were initially dried to a constant weight in an oven at 40-50°C, to reduce the water content before sun drying and they were grinded into powder form. The results showed that the mushroom contained significant amounts of calcium, magnesium, potassium, and sodium and trace amounts of manganese and zinc. Vitamin A, C, E, B1, B2, and B3 are important coenzyme precursors for enzymes engaged in intermediate metabolism and are found in significant quantities in macrofungi. Phytochemical such as Alkaloid, Flavonoids, Saponins, Tannin and Phenolic found in Mushroom were of considerable amount while Steroid, Glycoside and terpenoid are either in small amount or absent. Mineral, vitamin and photochemical present in these mushrooms indicate that they contain nutrients required for human growth and development, and so their uses may be encouraged.

Keywords: Coenzymes, Fruiting body, Identification, Mushroom, Nutritional and Trace

Introduction

Fruiting bodies of bigger Fungus, or Macromycetes, were once collected during excursion gathering. These Macromycetes' fruiting bodies were once referred to as mushrooms or toadstools. Researchers also used the term "truffle" to designate various fruiting bodies of edible fungi, despite the fact that they were defined as growing below ground, and many have since been discovered in forays gathering truffles (Rahi and Malik, 2016) [25]. The term mushroom can also refer to edible toadstool or basidiomycetes, polypore (without gills or lamellae), large fungus, toadstool that are toxic, poisonous, or simply inedible, mycelium extension of a fungus; a mass of interwoven hyphae, agaric (fleshy mushroom), sporocarp of a fungus rather than the mycelium (Osemwegie *et al.*, 2014) [21]. Das (2010) [6], regarded mushroom as visible fungi with distinctive carpophores (Stem of a fruiting body) often represent a short reproductive stage in the life cycles of Basidiomycetes and some Ascomycetes.

Mushrooms are members of the kingdom of fungi, which is different from plants, animals, and microorganisms (Berch *et al.*, 2007) [3]. Mushrooms do not have to be limited to Ascomycetes or basidiomycetes, nutritive or poisonous, edible or inedible, fleshy or nonfleshy, epigeous or hypogeous, which can be found in a variety of natural settings. Mushrooms include edible, endomycorrhizae, and ectomycorrhizae that live in symbiosis with the roots of some plants, as well as saprophytic species that have been observed growing on plant tissue and plant wastes. Adedayo (2011) [1], reported that Mushrooms are regarded as a nutritious food due to its high and high-quality protein content, low fat and cholesterol level, minerals, and vitamins.

Mushrooms are one of the few naturally occurring sources of vitamin; such as vitamin D, which are required for strong bones and teeth riboflavin (B2), niacin (B3), and pantothenic acid (B5). They all aid in the breakdown of proteins, lipids, and carbohydrate for use as energy (Adedayo, 2011) [1]. Mushrooms have four functions in general: nutritional value, delicious attributes, physiological impacts, and cultural characteristics. Because of their high protein, trace mineral content and vitamins, wild growing mushrooms are considered a delicacy in many nations (Rugolo *et al.*, 2022) [26].

Nonetheless, mushroom has been proposed in numerous publications as a very good source of nutritional dietary product, tonic, food, and in certain cases for medical purposes (Stamets, 2000) [29]. The Nutritive importance of mushrooms is as a result of their high content of vitamins, minerals, essential amino acids and low lipid content, People that consume Mushroom are often found to have higher intake levels of vitamins, minerals; and in some cases found to consume less alcohol, fat and sodium. Mushroom eaters have been said to meet the required daily allowance (RDA) and "daily recommended intake (DRI) for calcium, copper, iron, magnesium, phosphorus, zinc, folate, niacin, riboflavin, thiamin, vitamin A, B6, B12, C, E, energy, carbohydrate, fiber and protein compare to those who do not consume mushroom'' hence they have a better nutrient profile compare to those who do not consume mushroom (Stamets, 2011; Zahid *et al.*, 2010) [28, 31]. Many wild and cultivated mushrooms contain chemical components that are beneficial to human health. Their nutritious potential is owing to their low calorie content, high content of several vitamins, micro- and macro elements and protein. Mushrooms benefit plants, humans, and the environment but are underappreciated. However, many industrialized countries around the world, including as Asia, Europe, and America, prized them for their nutritional and therapeutic applications, as evidenced by reports of their nutrient content and medicinal qualities(Osemwegie, 2014) [22]. This study will therefore examine the Mineral, vitamin and mineral composition of some mushroom species found in Gwandu Emirate in Kebbu State, North western Nigeria.

Materials and methods

For powder sample preparation for analysis, the method of Obiloma *et al.* (2019) [16], was adopted in the powder sample preparation. Macro fungi were cleaned from mud and other forms of dirt. They were sun dried while the large size mushrooms were initially dried to a constant weight in an oven at 40-50°C, to reduce the water content. They were ground into powder with a blender, sieved through a 120m aperture, and packaged in an airtight polyethylene bag for further analysis. All chemicals and reagents used were of analytical grade.

Determination of mineral element

The minerals were extracted using the dry ashing method as adopted by Oibiokpa *et al.* (2017) [17]. One gram (1g) of each sample was weighed into crucibles and the sample was ashed for 2hrs at 550^0 C and allowed to cool. The ash was transferred into a 250ml beaker, to which 15ml of concentrated hydrochloric acid and 5ml of concentrated nitric acid was added. The beaker was placed on a hotplate set at 100^0C till the acid evaporated to dryness. An aliquot (10ml) of distilled water was added to the beaker and the sample was filtered into a 100ml volumetric flask and made up to the mark. The mineral content of the digested sample was analysed using atomic absorption.

Determination of Vitamin Determination of vitamin A (β-Carotene)

Vitamin A was determined by the colorimetric method adopted by Uzoekwe *et al.* (2021) [30]. Where (1g) of the sample and standard were mixed with 30ml absolute alcohol and 3ml 50% KOH solution was added to it and boiled gently for 30 minutes under reflux. After washing with distilled water, vitamin A was extracted with 3 times 50ml of diethyl ether. The extract was then evaporated to dryness at low temperature and then dissolved in 10ml of isopropyl alcohol. One (1) ml of prepared standard vitamin A solution and that of the dissolved extract were then transferred to separate cuvettes and their respective absorbance values were read in a spectrophotometer at 325nm with a reagent blank set at zero (Opene *et al.*, 2018) [20].

$$\text{Vitamin A} = \frac{Absorbance\ of\ sample \times concentration\ standard}{Absorbance\ of\ standard}$$

Determination of vitamin E (Tocopherol)

This was determined by the Futter – Mayer colorimetric method of the Association of Analytic chemists. One 1 gram of the sample was mixed with 10ml methanolic sulphuric acid and allowed to boil gently under reflux for 30mins with continuous agitation. This was transferred into a separating funnel and treated with 3 times 30ml diethyl ether, recovering ether layer each time. The ether extract was transferred to a desiccator, dried for 30mins and later evaporated to dryness at room temperature. The dried extract was dissolved in 10ml of pure ethanol. One (1) ml of the dissolved extract and an equal volume of standard vitamin E were transferred into separate tubes. After continuous addition of 5ml of absolute alcohol and 1ml of the concentrated nitric acid solution, the mixture was allowed to stand for 5mins and the respective absorbance was measured in a spectrophotometer at 410nm with blank reagent set at zero (Okwu and Emenike, 2006a; Opene *et al.*, 2018; Uzoekwe *et al.*, 2021) [19, 20, 30].

$$\text{Vitamin E} = \frac{Absorbance\ of\ sample\ \text{x Conc.standard}}{Absorbance\ standard}$$

Determination of Vitamin C

This was determined by the titrimetric method adopted by Uzoekwe *et al.* (2021) [30]. Five (5) gram of the sample was homogenised in 6% EDTA/TCA (2:1) extracting solution. The homogenate was filtered and used for analysis. Twenty (20) ml of 30% KI solution was added to it and titrated against 0.1M $CuSO_4$ solution. The endpoint was marked by a black

coloration. A reagent blank was also titrated. Vitamin C content was calculated based on the relationship below. One ml of 0.1 moles $CuSO_4$ =.88mg vitamin C (Ileola *et al.*, 2019; Okwu and Emenike, 2006b; Uzoekwe *et al.*, 2021) [13, 19, 30].

$$\text{Vitamin C} = \frac{1\times.88\times \text{titre}-\text{blank}}{W}$$

Determination of vitamin B1 (Thiamine)

The AOAC method was used to analyze vitamin B1 levels in samples. A 200 ml volumetric flask was filled with 1.5 g of the test sample, 100 ml of 0.1 N HCL solutions, and the mixture was heated in a water bath at 100°C for 30 minutes. After cooling, the flask's contents were filled to the mark with 0.1M HCL solution and thoroughly mixed. Whatman No. 1 filter paper was used to filter the solution. The first 20 ml of the filtrate was discarded. The remaining filtrate (100 ml) was transferred into a centrifuge tube containing 0.5 g frankonite powder (a flocculant that causes particles to precipitate faster during centrifugation), stirred for 10 minutes with a stirrer, and centrifuged at 5,000 rpm for 5 minutes to separate layers. The supernatant liquid was then discarded while 5 ml of absolute alcohol and 5 ml of the potassium ferric-cyanide solution in sodium hydroxide solution were added after it was previously frozen at 0°C. After 10 minutes of mixing, the mixture turned pinkish, so 10 ml of toluene solution was added, stirred for 10 minutes, and centrifuged for 10 minutes at 5,000 rpm. On the toluene layer, bright pink color was transferred. Thiamine standard (0.5 mg) was prepared, and 10 ml of the standard solution was treated in the same way as the sample above (Okafor *et al.*, 2018) [18]. The standard and sample solutions were read at 530 nm.

$$Thiamin = \frac{Absorbance\ of\ sample}{Absorbance\ of\ standard} \times \frac{weight\ of\ standard\ (mg\ )}{weight\ of\ sample\ (g)} \times 100$$

Determination of vitamin B2 (Riboflavin)

Vitamin B2 was analyzed and determined by the method of AOAC. A known weight of 1.5 g of sample was placed into 200 ml volumetric flask; 100 ml of acetic acid: water mixture (50:50) was added and heated in a boiling water bath at 100C for 30 min. The mixture in the flask was cooled to 20°C, then made up to the mark with acetic acid-water solution. The mixture was stirred for 10 min using the stirrer and then filtered in the dark. The first 20 ml of the filtrate was discarded, 0.5 mg of riboflavin standard solution was prepared, and 10 ml of the standard solution was transferred into a 200 ml volumetric flask and treated in the same manner as the sample above. The fluorescence of the standard and sample solutions was measured with a spectrophotometer at 460 nm (Okafor *et al.*, 2018) [18].

$$\text{Riboflavin} = \frac{absorbance\ of\ sample}{absorbance\ of\ standard} \times \frac{weight of\ standard\ (mg)}{weight\ of\ sample\ (g)} \times 100$$

Determination of vitamin B3 (Niacin)

The AOAC method was used to analyze vitamin B3 levels in samples. The sample (1.5 g) was precisely weighed into a volumetric flask of 200 ml. About 5ml of a 5 N HCl solution was added, followed by 5.0 ml of dichloromethane and 90 ml of deionized water. The mixture was stirred and heated in a boiling water bath at 100°C for 30 minutes. It was then cooled and the flask filled with distilled water was then filtered through Whatman No. 1 filter paper, discarding the first 20 ml of the filtrate. A 0.5 mg niacin standard solution was prepared, and 10 ml of the stock solution was taken and treated the same as the sample above. The absorbance of the standard and sample solutions was measured at 410 nm using a spectrophotometer.

$$\text{Niacin} = \frac{absorbance\ of\ sample}{absorbance\ of\ starndard} \times \frac{standard\ weight\ (mg)}{sample\ weight\ (g)} \times 100$$

Ethanol Extraction

To acquire the extracts for phytochemical compound determination, 10 g of each powdered mushroom sample was placed in a conical flask, and 100 ml of 75% ethanol was added and plugged with cotton. The powder samples were extracted with ethanol at room temperature for 24 hours with constant stirring. After 24 hours, the supernatant was filtered and the solvent was evaporated to produce the crude extract. The leftovers or slurry were maintained at 4°C in McCartney bottles for future use. (Ikon *et al.*, 2019) [12].

Preliminary Test for Phytochemicals

Test for Alkaloids

In a test tube warmed in a steam bath, five (5) ml of 2% HCl was added to two (2) ml of each mushroom extract. This was filtered and separated into two sections for the tests listed below:

• In a test tube, a few drops of Wagner's Reagent (Potassium-iodine solution) were added to one part of the filtrate. This was seen with a reddish-brown precipitate.

• A few drops of Meyer's Reagent (Potassium mercuric iodine solution) were added to the remaining filtrate in a test tube. This was seen with a cream-colored precipitate (Doris, 2018) [9].

About one (1) ml of the extract was treated with 1 ml of dilute NaOH. The presence of a cloudy precipitate confirmed the presence of flavonoids (Doris, 2018) [9].

Test for Flavanoids

About one (1) ml of the extract was treated with 1 ml of dilute NaOH. The presence of a cloudy precipitate confirmed the presence of flavonoids (Doris, 2018) [9].

Test for Saponins

About one (1) ml of the extract was added to 4 ml of distilled water and shaken. A stable frothing or foaming indicated the presence of saponins (Doris, 2018) [9].

Test for Steroids

Two (2) ml of acetic anhydride was added to 0.5 g of the extract and filtered. One (1) ml of concentrated H_2SO_4 was added to the filtrate in roughly the same volume. The color transitioned from violet to blue or green, indicating the presence of steroids (Doris, 2018) [9].

Test for Glycosides

Five (5 ml) was treated with two (2) ml of glacial acetic acid containing one drop of ferric chloride solution. 1 ml of concentrated H_2SO_4 was added to dilute this. A brown ring at the interface indicates the presence of a cardenolide deoxy-sugar. In the acetic acid layer, a violet ring appeared below the brown ring, while a greenish ring formed just above the brown ring and gradually spread throughout this layer (Doris, 2018) [9].

Test for Phenols
Two (2) ml of the mushroom extract was treated with 5 ml of distilled water and heated for 30 mins in a water bath containing 1 ml of 1% Potassium ferrocyanide solution. The formation of green-blue colouration indicated the presence of phenol (Ikon *et al.*, 2019) [12].

Test for Terpenoids
Five (5) ml of extract was mixed in 2 ml of chloroform and concentrated H_2SO_4 (3ml) was carefully added to form a layer. A reddish-brown colouration of the interface was formed to show positive results for the presence of terpenoids (Doris, 2018) [9].

Test for Tannins
Five (5) ml of the extract was treated with 2 ml of HCl and boiled for 5 min. The presence of red precipitate confirmed the presence of tannins (Doris, 2018) [9].

Determination of Alkaloids
About 5 grams of the sample was weighed into a 250 ml beaker, and 200 ml of 10% acetic acid in ethanol was added, covered, and set aside for 4 hours. This was filtered, and the extract was concentrated to one-quarter of its original volume in a water bath. Drop by drop, concentrated ammonium hydroxide was added to the extract until the precipitation was complete. The entire solution was allowed to settle before being collected, washed with dilute ammonium hydroxide, and filtered. The residue is the alkaloid, which was dried and weighed (De Britto *et al.*, 2013; Ileola *et al.*, 2019) [7, 13].

$$\% \text{ Alkaloids} = \frac{W2-W1}{Wo} \times 100$$

Where, W1 = weight of the filter paper, W2= weight of the filter paper plus alkaloids residue, Wo= weight of the sample.

Determination of Flavanoids
At room temperature, 10 g of each Mushroom sample was extracted repeatedly with 100 ml of 80% aqueous methanol. The entire solution was then filtered through No. 41 Whatman filter paper. The filtrate was allowed to dry over a water bath before being weighed to a constant weight (Ileola *et al.*, 2019; Soni and Sosa, 2013) [13, 27].

$$\% \text{ Flavanoids} = \frac{W2-W1}{Wo} \times 100$$

Where; W1 = weight of the filter paper, W2= weight of the filter paper plus flavanoids residue and Wo= weight of the sample.

Determination of Saponins
Five (5) grams of the sample were dispersed in 50 ml of distilled water-prepared of 20% ethanol, and the mixture was heated over a hot water bath at 55°C for 4 hours with constant stirring. After filtration, the residue was re-extracted with another 50 ml of 20% ethanol and reduced to 20 ml in a hot water bath at boiling temperature. In a separating funnel, the concentrated solution was forcefully shaken with 10 ml of diethyl ether; the aqueous layer was then collected for the purification procedure, which was then repeated. After adding 20ml of but-1-ol to the filtrate, it was washed with 10ml of 5% aqueous sodium chloride. The entire combination (sample) was heated in a hot water bath to evaporate and then oven dried at 40°C to a consistent weight (De Britto *et al.*, 2013; Ileola *et al.*, 2019) [7, 13].

$$\% \text{ Saponins} = \frac{W2-W1}{Wo} \times 100$$

Where; W1 = weight of the filter paper, W2= weight of the filter paper plus saponin residue and Wo= weight of the sample

Determination of Total Phenolic
100 milligrams of the sample extract was weighed and diluted in 100 ml of distilled water. One (1) ml of this solution was transferred to a test tube, followed by 0.5 ml 2N of the Folin-Ciocalteu reagent and 1.5 ml 20% Na2CO3 solution, and finally, the volume was made up to 8 ml with distilled water, followed by vigorous shaking, and finally allowed to stand for 2 hours and filtered with filter paper before the absorbance at 765 nm was measured. The standard was garlic acid. (De Britto *et al.*, 2013) [7].

Data analysis
Data collected were subjected to a one-way analysis of variance

Results
Mushroom collected
The findings of the various tests carried out during the study are reported below. The mushrooms collected were identified as: *Coprinus* sp., *Lycoperdon* sp., *Bovista* sp., *Chlorophyllum rachodes, Agaricus compestris, Podaxis* sp., *Chlorophyllum brunneum Termitomyces* sp., *Volvariella* sp. and *Auricularia* sp.

Mineral determination
Mineral determination of wild Macrofungi is presented in Table 1. The mineral includes Zinc, Manganese, Calcium, Sodium Magnesium, Potassium and Copper. From the result, the concentration of Zinc ranges from 0.66 in *Agaricus compestris* to 11.78 in *Volvariella* sp. Manganese ranges from 0.34 in *Agaricus compestris* to 1.69 in *Bovista* sp. Calcium ranges from 5.90 in *Bovista* sp. to 25.60 in *Chlorophyllum rachodes.* Sodium ranges from 25.86 in *Bovista* sp. to 167.94 in *Chlorophyllum brunneum.* Magnesium ranges from 20.75 to *Lycoperdon* sp. to 70.63 in *Chlorophyllum rachodes.* Potassium ranges from 11.43 in *Bovista* sp. to 361.70 in *Podaxis* sp. and copper was not detected in any of the samples

Vitamin determination
The results of vitamins are presented in Table 3. The result for Vitamin A ranges from 29.91±0.89 in *Chlorophyllum rochades* to 65.56±3.89 in *Termitomyces* sp. Vitamin C ranges from 28.02±0.17 in *Volvariella* sp. to 98.37±0.92 in *Chlorophyllum brunneum*. Vitamin E ranges from 25.81±0.47 in *Termitomyces* sp. to 94.68±3.19 in *Chlorophyllum rachodes*. Vitamin B1 ranges from 4.79±0.50 in *Chlorophyllum brunneum* to with 78.18±0.63 in *Bovista* sp. Vitamin B2 ranges from 20.71±0.85 in *Volvaruella* sp. to 86.73±0.68 in *Chlorophyllum brunneum* and lastly Vitamin B3 ranges from 9.79±0.26 in *Termitomyces* sp. to 84.15±1.29 in *Chlorophyllum rachodes*.

Table 1: Mineral composition of some wild Macrofungi collected from Gwandu Emirate, Kebbi State (Mg/100g)

Macro fungi	Zn	Mn	Ca	Na	Mg	K	Cu
Coprinus sp.	1.42	0.94	12.60	107.74	27.39	178.00	ND
Lycoperdon sp.	1.98	1.10	9.03	73.86	20.75	140.67	ND
Bovista sp.	2.09	1.69	5.90	25.86	47.82	11.43	ND
Chlorophyllum rochades	ND	ND	25.60	91.18	70.63	272.73	ND
Agaricus compestris	0.66	0.34	10.80	59.62	31.86	198.63	ND
Podaxis sp.	2.45	1.11	9.26	57.84	67.52	361.70	ND
Chlorophyllum brunneum	2.12	0.41	8.08	167.94	53.10	275.36	ND
Termitomyces sp.	2.29	1.42	12.60	60.66	55.11	30.71	ND
Volvaruella sp.	11.78	0.73	8.40	131.02	28.43	22.50	ND
Auricularia sp.	2.01	0.98	13.64	70.69	43.26	96.15	ND

N D = not detected

Table 2: Vitamin composition of some wild Macrofungi collected from Gwandu Emirate, Kebbi State (Mg/100g)

Sample	Vitamin A	Vitamin C	Vitamin E	Vitamin B1	Vitamin B2	Vitamin B3
Coprinus sp.	60.44±0.50	81.69±15.46	52.07±0.28	61.61±2.27	51.99±0.75	55.93±0.68
Lycoperdon sp.	30.66±0.54	82.62±5.25	61.73±0.85	34.42±2.64	44.49±0.11	72.63±0.98
Bovista sp.	45.13±0.65	75.41±2.05	40.13±2.92	78.18±0.63	78.39±0.97	66.80±1.63
Chlorophyllum rochades	29.91±0.89	85.19±0.99	94.68±3.19	50.99±0.19	55.46±3.89	84.15±1.29
Agaricus compestris	35.66±1.19	72.66±1.14	41.33±2.41	25.14±0.93	67.09±1.63	15.17±2.16
Podaxis sp.	44.83±0.77	52.74±1.09	52.77±1.12	19.25±1.27	47.19±2.72	54.19±3.32
Chlorophyllum brunneum	39.20±0.27	98.37±0.92	45.09±0.7^{d}	4.79±0.50	86.73±0.68	25.43±1.03
Termitomyces sp.	65.56±3.89	43.47±1.55	25.81±0.47	48.07±1.69	32.25±0.65	9.79±0.26
Volvaruella sp.	55.72±1.52	28.02±0.17	64.19±0.38	8.84±0.68	20.71±0.85	48.20±0.99
Auricularia sp.	30.07±0.62	61.58±1.45	39.83±1.45	50.21±0.81	64.95±1.46	38.93±0.64

Values are expressed as means ± SEM (Standard error of means)

Phytochemical Screening: Phytochemical screening Table 3 indicates the presence of Alkaloids, flavonoids, saponins Phenols and tannins while steroids, glycosides and terpenoid were either not present or little amount was seen.

Phytochemical determination: Result of Phytochemical is represented in Table 4. Alkaloids content ranges from 15.33±2.31 in *Podaxis* sp. to 24.00±1.00 in *Termitomyces* sp. Flavanoids ranges from 14.00±2.00 in *Lycoperdon* sp. to 59.33±1.15 in *Chlorophyllum rachodes*. Phenol ranges from 10.51±0.29 in *Termitomyces* sp. to 37.33±4.53 in *Auricularia* sp. Saponin ranges from 1.67±0.53 in *Podaxis* sp. to 4.00±1.00 in *Agaricus compestris* and Tannins ranges from 9.550±0.50 in *Bovista* sp. to 24.583±0.89 in *Lycoperdon* sp.

Table 3: Preliminary Phytochemical screening of some wild Macrofungi collected from Gwandu Emirate, Kebbi State

Macro fungi	Alkaloids	Flavanoids	Saponin	Steroid	Glycoside	Phenol	Terpinoid	Tanins
Coprinus sp.	+	+	-	-	+	+	-	+
Lycoperdom sp.	+	++	+	-	-	+	+	+
Bovista sp.	+	+	+	-	-	+	-	+
Chlorophyllum rachodes	-	+++	-	-	-	+	-	+
Agaricus compestris	+	+	+++	-	-	+	-	+
Podaxis sp.	+	+	+	+	-	+	+	+
Chlorophyllum brunneum	+	-	+	-	+	+	-	+
Termitomyces sp.	+	-	-	-	-	+	+	+
Volvaruella sp.	-	++	++	-	-	-	-	+
Auricularia sp.	+	+	-	+	-	++	+	+
+ = Present, - = absent								

Table 4: Phytochemical analysis of some wild Macrofungi collected from Gwandu Emirate, Kebbi State (Mg/100g)

Macrofungi	Alkaloid	Flavonoid	Phenols	Saponin Tannis
Coprinus sp.	20.00±2.00	42.00±2.00	20.40±0.23	ND 23.500±1.17
Lycoperdon sp.	19.33±2.31	14.00±2.00	17.75±0.66	1.33±0.15 24.583±0.89
Bovista sp.	16.33±4.73	16.67±1.15	11.38±0.22	2.33±1.08 9.550±0.50
Chlorophyllum rochades	ND	59.33±1.15	19.70±0.35	ND 13.287±0.25
Agaricus compestris	23.67±2.08	19.33±4.16	12.04±0.23	4.00±1.00 15.377±0.49
Podaxis sp.	15.33±2.31	22.67±1.52	13.46±0.48	1.67±0.53 22.023±0.43
Chlorophyllum brunneum	18.33±2.52	ND	13.19±0.23	0.33±1.53 13.010±1.69
Termitomyces sp.	24.00±1.00	ND	10.51±0.29	ND 15.407±5.17
Volvaruella sp.	ND	48.00±1.00	ND	2.67±1.53 17.169±6.77
Auricularia sp.	19.00±3.61	30.67±1.53	37.33±4.53	ND 16.053±0.99

Values are expressed as means ± SEM (Standard error of means) ND: not detected

Discussion

The findings in study revealed that the mushroom had high concentrations of Calcium, Magnesium, Potassium, and Sodium, but low levels of Mangenese and Zinc. This result is in line with that of (Crisan and Sands, 1978) [5] and (Chang and Miles, 2004) [4], who discovered that the most abundant minerals in mushrooms are Potassium, Phosphorus salt, Calcium, Magnesium, and Sodium. The trace metal level of mushrooms is related to the species of mushroom, the location of the sample, the age of the fruiting bodies and mycelium, and the distance from pollution sources (Kalac, 2009) [14] which are primarily influenced by the acidity and organic matter content of the soil. Because this species contains these vital nutrients and minerals, it can be used for medical purposes in healthcare delivery systems. Potassium and Calcium are essential for activating action potential across nerve ends as well as increasing heart contractile rate (Peter and Tolulope, 2015) [15].

Zinc is essential for protein synthesis, appropriate body development, and sickness healing. It is also required for protein digestion (Muhammad *et al.*, 2011) [15]; it is also a component of DNA, which is required for cell division and synthesis, thus its importance in wound healing Calcium is the most abundant mineral in bone and aids in tooth growth. Magnesium is required for several enzyme processes in intermediate metabolism (Akpanabiatu *et al.*, 1998) [2] Calcium and phosphorus are directly engaged in the development and maintenance of the skeletal system and play a vital role in muscle contraction, blood clot formation, nerve impulse transmission, cell integrity and acid-base homeostasis, and the activation of several critical enzymes. Phosphorus is an essential component of nucleic acids and cell membranes, and it plays a direct role in all energy-producing biological reactions. Manganese controls blood sugar levels, energy production, and cell reproduction. Manganese deficiency may result in birth abnormalities if a pregnant mother does not acquire enough of this essential element. (Igile *et al.*, 2013) [11].

Vitamins are organic chemicals that are required in trace or significant amounts by humans and other living organisms. It is primarily derived from vegetables, fruits, and nuts. It is referred to as a vitamin because the body cannot produce it. The macro fungi contain a considerable amount of vitamins when compared with other reports on the vitamin content of mushrooms. Vitamin A is essential for vision as the precursor for the visual pupil rhodopsin and immune responses (Han *et al.*, 2013) [10], Vitamin C is a potent antioxidant and has been associated with lower risks of cardiovascular disease, stroke, cancer and also promotes wound healing, collagen development, red blood cell creation, and immune system stimulation (Padayatty *et al.*, 2003) [23]. Vitamin E is a key antioxidant that protects lipoproteins and cellular membranes from oxidative damage, therefore the high levels are significant (Oibiokpa *et al.*, 2017) [17]. Vitamins B1, B2 and B3 are key coenzyme precursors for enzymes involved in intermediate metabolism. They also play role in muscle contraction (Oibiokpa *et al.*, 2017) [17].

All these compounds found in these macrofungi, have been shown to have beneficial medicinal activities. For example, larger levels of flavonoids have been proven to protect against oxidative stress, whilst alkaloids have been shown to have a stimulating effect as well as significant antipyretic effects. It can also be used as a strong anaesthetic and pain reliever this agrees with the report of Ikon *et al.* (2019) [12]. Saponins can also limit cancer cell growth, increase the immune system and energy, lower cholesterol, function as a natural anti-inflammatory, antibacterial, and anti-oxidant, and reduce the intake of certain nutrients such as glucose and cholesterol this is in line with Peter and Tolulope (2015) [15]. Tannin concentrations found in mushrooms were found to have astringent properties, which aid in the healing of wounds and inflamed mucous membranes this also agrees with the report of Okwu and Emenike (2006a) [19]. Phenolic compound found in Mushroom makes them an ideal nutraceutical which may assist in the reduction of oxidative damage (Dilfy *et al.*, 2020) [8].

Conclusion

The survey on the identified mushrooms collected in Kebbi State's Gwandu Emirate, revealed that they had Minerals, vitamins and Phytochemicals. The Mineral include Calcium, Magnesium, Potassium, and Sodium, but low levels of Mangenese and Zinc. Vitamins include vitamin A, C, E, and B, and phytochemicals includes alkaloids, flavanoids, phenols, tannins and saponins. They were found to be of considerable amount which are beneficial to human as they provide a diverse variety of nutrients required for human growth and development, and so their uses may be advocated.

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