Molecular Studies, Nutritional Composition and Functional Properties of *Volvopluteus* Species in Keana Local Government Area, Nasarawa State, Nigeria

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ABSTRACT

Keana forests are well known for high diversity of mushroom, an un-culturable and economic mushroom in Nasarawa state, Nigeria, but their systematics is limited and unorganized. This study focused on Molecular Studies, Nutritional Composition and Functional Properties of *Volvopluteus* species in Keana Local Government Area, Nasarawa state, Nigeria. Identification was based on morphological characteristics and ITS region rRNA sequences. The proximate composition, phytochemical and functional properties were investigated using standard analytical techniques. The *Volvopluteus* species samples collected from Keana were identified as *Volvopluteus earlei.* The highest nutrient detected from soil the *Volvopluteus earlei* was harvested from was nitrogen (9.0948±0.07 mg/g) while Magnesium (0.6104±0.01 mg/g) was the lowest. Flavonoids (12.35mg/g) were the highest chemical compounds detected and saponin (0.98mg/g) has the lowest. Carbohydrates (57.83 ± 2.03%) was the most abundant nutritional component, while fat (2.83 ± 0.31%) was the least. Oil absorption (462.0 ± 3.12%) was the highest, and gelation concentration (2.2 ± 0.1%) was the lowest. From the findings of this study *Volvopluteus earlei* from Keana should be used as a functional ingredient in food products such as bread, pastries, soups, and flour-based foods.

Keywords: Forests, Nutritional Composition, Functional Properties, *Volvopluteus* species, flour-based foods.

INTRODUCTION

The organisms of the fungal lineage include mushrooms, rusts, smuts, puffballs, truffles, morels, and yeasts, as well as many less well-known organisms [1]. More than 700, 00 species of fungi have been described however, some estimates of total numbers suggests that 1.5 million species may exist [2]. Edible mushroom has for a long time been recognized not only as a delicacy, but also for their use as food in man's diets. Mushrooms have been found to be rich sources of protein, lipids, amino acids, glycogen, vitamins and mineral elements [3]. According to [4], the mineral salt content of mushrooms is superior to that of meat and fish and nearly twice that of the most common vegetables.

Mushrooms could be defined as the fruiting bodies of macro fungi. These may include both edible/medicinal and poisonous species. However, originally, the word "mushroom" was used for the edible members of macro fungi. Mushrooms with other fungi are something special in the living world, being neither plants nor animals [5]. They have been placed in a kingdom of Out of about 70,000 described fungi species over 10,000 species produce fruit bodies of sufficient size to be considered as mushrooms (macrofungi) of these, only 100 mushrooms are experimentally grown, 50 are economically cultivated and 30 are commercially cultivated, with only about 6 having reached an industrial scale of production in many countries these are: *Agaricus bisporus, Lentinus edodes, Volvariella volvacea, Pleurotus* species (Oyster mushrooms), *Flammulina velutipes, Auricularia auricular* (Cat ears) [6].

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Mushrooms are devoid of leaves, and of chlorophyll containing tissues. This renders them incapable of photosynthetic food production. Yet, they grow, and they produce new biomass. How? For their survival, for their growth, and for their metabolism, they rely on organic matter synthesized by the green plants around us, including organic products contained in agricultural crop residues [7]. The organic materials, on which mushrooms derive their nutrition, are referred to as substrates. Mushrooms are a unique biota which assembles their food by secreting degrading enzymes and decompose the complex food materials present in the biomass where they grow, to generate simpler compounds, which they then absorb, and transform into their own peculiar tissues. These substrate materials are usually by-products from industry, households and agriculture and are usually considered as wastes. And these wastes, if carelessly disposed of in the surrounding environment by dumping or burning, will lead to environmental pollution and consequently cause health hazards. However, they are actually resources in the wrong place at a particular time and mushroom cultivation can harness this waste/resource for its own beneficial advantage [8,9].

MATERIALS AND METHODS

Methods

Study Area

This was carried out in Keana**,** Keana Local Government Area is situated in the town of Keana, is well known for its Salt Village which is located 100 kilometers away from Lafia**.** Keana has an area of 1,048.1 km^2 and a population of about 80,000. it is home to Federal Government Girls College, Keana. [10].

Collection of *Volvopluteus earlei*

Volvopluteus earlei was collected from Keana Local Government Area. The various species of *Volvopluteus earlei* collected from Keana Local Government Area, Nasarawa State was transported to the Department of Microbiology, Nasarawa State University Keffi for physical identification and Microscopically identification was made from *Volvopluteus earlei* mounted in 5% KOH and stained with 1% aqueous Melzer`s reagent and Congo red. Sections of pileus, lamellae and context was prepared with a razor blade and then observed under light microscope. At least fifteen basidiospores were measured from each *Volvopluteus earlei*

Processing of the Sample

Washing and chopping, the mushroom parts was rinsed to remove soil and extraneous matter such as other parts of the same mushroom or grasses herbs or any other unwanted matter. Collected samples were then chopped into small fragments 3-5 cm pieces, air dried at room temperature the samples were turned up and down at least twice a day to hasten drying and grind into powder by use of machine to obtain fine sample powder.

Phytochemical Analysis

The drying and grind into powder was subjected to qualitative phytochemical analysis to identify bioactive compounds in the sample using standard procedure described by Banerjee *et al*. [11] and Sahira and Cathrine [12].

Test for carbohydrates

i. General test (Molisch's) few drops of Molisch reagent (α-naphthol) was added to the 1 ml of the drying and grind into powder, followed by addition of 1 ml of conc. sulphuric acid down the side of the test tube. The mixture was allowed to stand for 2 minutes and diluted with 5 ml of distilled water. The appearance of red color at the interphase of two layers, confirm the presence of carbohydrate.

ii. Barfoed's test (test for sugar) The drying and grind into powder (0.5 g) was dissolved in distilled water in a test tube and 1 ml of distilled water containing in a test tube, 1 ml of Barfoed's reagent was added. The mixture

was heated on a water bath for 2 minutes. A red precipitate of Cu2O was observed which indicate the presence of sugars.

iii. Test for reducing sugar (Fehling test) the drying and grind into powder (0.5 g) was in dissolved water in a test tube, equal volume (5 ml) of Fehling solution A and B was added and heat on a water bath. Red precipitate of Cu2O observed indicate the presence of reducing sugar.

iv. Benedict's test the extract was treated with 2ml of benedicts reagent and was gently heated. the formation of an orange-red precipitate indicated the presence of reducing sugar[12].

Test for phenol

Ferric chloride tests the drying and grind into powder (0.5 g) was dissolved in ethanol in a test tube and few drops of 10 % ferric chloride (FeCl3) solution was added and boiled on a water bath. Violet coloured was observed which indicated the presence of a phenolic hydroxyl group.

Lead acetate tests the drying and grind into powder was mixed with a few drops of 10% lead acetate reagent. The presence of white precipitate was observed which indicated the presence of phenolic compounds [12].

Test for flavonoids

A method by Sahira and Cathrine [12] was adopted for ferric chloride test and alkaline reagent test Ferric chloride test 3ml of the drying and grind into powder was mixed with a few drops of 55vferric chloride. The presence of a dark green color indicated the presence of flavonoids.

Alkaline reagent tests a few drops of sodium hydroxide were added to the mixture afterwards a dark yellow color was formed the a few drops of dilute acetic acid was added after which it became colorless which indicated the presence of flavonoids.

Test for Tannins

Approximately (2 g) of drying and grind into powder was boiled in 10 ml of distilled water in a test tube on a water bath and cooled, the mixture was filtered and the filtrate was use for the following test. (A). To 1 ml of filtrate in first test tube, few drops of lead acetate was added to it in test tube, a white precipitate was observed which indicate the presence of tannins. (B). To 1 ml of the filtrate in second test tube, three drops of 1 % of ferric chloride (FeCl3) solution was added and the blue–black, green or blue-green precipitate was observed to show the presence of tannins. (c). Approximately (2 ml) of Ethanoic acid and 2 ml of 10 % lead acetate each was added to 5 ml of filtrate in third test tube and a white precipitate was observed which indicates the presence of tannins (d). Approximately 3 drops of 10 % HCl and 1 drop of methanol was added to 2 ml of filtrate in fourth test tube and mixture was boiled on a water bath. A red precipitate was observed which indicate the presence of tannins [12]

Test for Alkaloids

Sample of drying and grind mushroom (1 g) was dissolved 5 ml of 1 % aqueous hydrochloric acid (HCl) in a test tube and the mixture were stirred on the water bath and filtered; 3 ml of the filtrate was taken and divided into 3 portions 1 ml each.

i. Dragendoff" s reagent to the 1 ml of the first portion of filtrate in a test tube Dragendoff" s reagent was added and orange red precipitate was observed which show the presence of alkaloid. b. Mayer's reagent to the 1 ml of the second portion of filtrate, Mayer's reagent was added and a buff coloration was observed which indicate the presence of alkaloid c. Wagner's reagent to the 1 ml of the third portion of filtrate, Wagner's reagent was added and a dark brown precipitate was observed. The colours changed observed in a, b and c, confirmed the presence of alkaloid [12]

Test for Steroids

Libermann Burchard test 0.5 g of drying and grind mushroom was dissolved in 2 ml of chloroform in a test tube and filtered. Acetic acid (2 ml) was added to the filtrate and the mixture was cooled in iced. Concentrated tetraoxosulphate (VI) acid was added to the mixture down the side of the test tube in iced and violet coloured changed to bluish green was observed which indicate the presence of steroidal nucleus (i.e aglycone portion of the cardiac glycoside [11].

Test for Glycosides

General test two grammes (2 g) of drying and grind mushroom was dissolved in 25 ml of 2.5 M tetraoxosulphate (VI) acid in a beaker and boiled on a water bath, the mixture was neutralized with 20 % potassium hydroxide. 5 ml of equal volume of Fehling solution A and B was added to a neutralized mixture in beakers and boiled. Brick red precipitate was observed which indicated the presence of glycosides.

Keller – Killiani test drying and grind mushroom (0.5 g) was dissolved in distilled water in a test tube; 1 ml of glacial acetic acid and few drops of ferric chloride solution was added to the aqueous solution of the drying and grind mushroom. 1 ml of concentrated sulphuric acid was added to the mixture at an angle 45 °C to the wall of the test tube. The mixture was allowed to stand for some minutes, and a purple ring color was observed at the interphase, which indicates the presence of glycoside.

Test for Proteins

Ninhydrin test few drops of ninhydrin reagent was added to the extract. The presence of blue color indicated a positive result.

Millon's test a few drops of Millon's reagent was added to 2ml of the extract. The presence of a white precipitate indicated the presence of protein.

Xanthoproteic test a few drops of concentrated nitric acid was added to the extract. Yellow coloration indicated the presence of protein.

Test for Terpenoids

Salkowski test: Two (2) mL of the extracts were treated with 2 mL of chloroform and 3 mL of concentrated sulphuric acid, to form a layer. A reddish-brown coloration of the interface confirms the presence of terpenoids.

Test for Saponins

Foam test 1ml of the extract is boiled with 6ml distilled water and is Shaken rapidly. The formation of foam indicated the presence of saponins.

Physiochemical Parameters of the Soil Sample

Determination of phosphate

Phosphate was determined using portions of the soil samples which were weighed into a beaker. A 0.5M of $NaHCO_3$ extraction solution was added to the beaker and stirred gently. The soil-extraction solution mixture was allowed for 30 minutes to extract the P which was filtered using a filter paper. The concentration of P in the filtered extract was measured using colorimetry [13].

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Determination of Calcium (Ca) and Magnesium (Mg)

The prepared soil samples were weighed in an appropriate amount in a beaker. 1m ammonium acetate was added into the beaker and stirred gently. The soil-extraction solution mixture was allowed to stand for 30 minutes to extract the Ca and Mg using filter paper. The concentration of Ca and Mg in the filtered extract was measured using atomic absorption spectroscopy [14,15].

Determination of Potassium (K) and Sodium (Na)

The soil samples were weighed in an appropriate amount in a beaker and1M ammonium acetate was added into the beaker and stirred gently. The soil-extraction solution mixture was allowed to stand for 30 minutes to extract the K and Na using filter paper. The concentration of K and Na in the filtered extract was measured using flame photometry [15].

Molecular Identification of *Volvopluteus earlei*

Fungal Genomic DNA Extraction

Extraction was done using a ZR fungal/bacterial DNA mini prep extraction kit supplied by Inqaba South Africa. A heavy growth of the pure culture of the fungal isolates was suspended in 200 microliters of isotonic buffer into a ZR Bashing Bead Lysis tubes, 750 microliters of lysis solution was added to the tube. The tubes were secured in a bead beater fitted with a 2ml tube holder assembly and processed at maximum speed for 5 minutes. The ZR bashingbead lysis tube was centrifuged at 10,000x*g* for 1 minute.

Four hundred (400) microliters of supernatant were transferred to a Zymo-Spin IV spin Filter (orange top) in a collection tube and centrifuged at 7000 x*g* for 1 minute. One thousand two hundred (1200) microliters of fungal/bacterial DNA binding buffer was added to the filtrate in the collection tubes bringing the final volume to 1600 microliters, 800 microliters were then transferred to a Zymo-Spin IIC column in a collection tube and centrifuged at 10,000x*g* for 1 minute, the flow through was discarded from the collection tube. The remaining volume was transferred to the same Zymo-spin and spun. Two hundred (200) microliters of the DNA Pre-Was buffer was added to the Zymo-spin IIC in a new collection tube and spun at 10,000x*g* for 1 minute followed by the addition of 500 microliters of fungal/bacterial DNA Wash Buffer and centrifuged at 10,000x*g* for 1 minute.

The Zymo-spin IIC column was transferred to a clean 1.5 microliter centrifuge tube, 100 microliters of DNA elution buffer were added to the column matrix and centrifuged at 10,000x*g* microliter for 30 seconds to elute the DNA. The ultra-pure DNA was then stored at -20 degree for other downstream reaction.

Amplification

Internal Transcribed Spacer (ITS) Amplification

The ITS region of the rRNA genes of the isolates was amplified using the ITS1F: 5'-CTTGGTCATTTAGAGGAAGTAA-3' and ITS4: 5'- TCCTCCGCTTATTGATATGC-3, primers on a ABI 9700 Applied Biosystems thermal cycler at a final volume of 50 microliters for 35 cycles. The PCR mix included: the X2 Dream taq Master mix supplied by Inqaba, South Africa (taq polymerase, DNTPs, MgCl), the primers at a concentration of 0.4M and the extracted DNA as template. The PCR conditions was as follows: Initial denaturation, 95ºC for 5 minutes; denaturation, 95ºC for 30 seconds; annealing, 53ºC for 30 seconds; extension, 72ºC for 30 seconds for 35 cycles and final extension, 72ºC for 5 minutes.

The product was resolved on a 1% agarose gel at 120V for 15 minutes and visualized on a UV transilluminator.

Sequencing

Sequencing was done using the Big Dye Terminator kit on a 3510 ABI sequencer by Inqaba Biotechnological, Pretoria South Africa. The sequencing was done at a final volume of 10ul, the components included 0.25 ul

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BigDye® terminator v1.1/v3.1, 2.25ul of 5 x Big Dye sequencing buffer, 10µM Primer PCR primer, and 2-10ng PCR template per 100bp. The sequencing condition was as follows 32 cycles of 96°C for 10s, 55°C for 5s and 60°C for 4min.

Phylogenetic Analysis

Obtained sequences was edited using the bioinformatics algorithm Trace edit, similar sequences were downloaded from the National Center for Biotechnology Information (NCBI) data base using BLASTN. These sequences were aligned using ClustalX. The evolutionary history was inferred using the Neighbour-Joining method in MEGA 6.0. The bootstrap consensus tree inferred from 500 replicates is taken to represent the evolutionary history of the taxa analysed. The evolutionary distances were computed using the Jukes-Cantor method.

The obtained ITS sequence from the fungal isolates produced an exact match during the megablast search for highly similar sequences from the NCBI non-redundant nucleotide (nr/nt) database.

RESULTS AND DISCUSSION

Morphological Characters of the Mushroom

Table 1: Morphologic and microscopic characteristics of the experimental sample. The *Volvopluteus earlei* grows convex, later expanding to broadly convex or nearly flat, white to cream, occasionally with pale brown or grayish tints in the center. The microscopic shows that the spores are ellipsoid to oblong, relatively thick walled and no amyloid, the size ranges from 7-8.3µm and the mushroom is *Volvopluteus earlei* as shown in Figure 1.

Molecular Characterization

The Agarose gel electrophoresis showing the amplified ITS fragment is as shown in Plates 1. The amplified ITS fragment bands on Lane 1-2 represent the ITS bands at 500bp while lane L represent the 100bp DNA ladder.

The phylogenic tree of the *Volvopluteus earlei* is as shown in Figure 2 Phylogenetic analysis of partial ITS sequence collections using Distance, Parsimony measurements and Maximum Likelihood presented similar inferred trees that only had minor differences. Based on these phylogenetic analyses of the partial ITS sequences, were identify as *Volvopluteus earlei*

Physicochemical Parameters of the Soil

The soil physicochemical parameters are as shown in Table.2. The highest physicochemical parameters detected from soil the *Volvopluteus earlei* was harvested from was nitrogen (9.0948±0.07 mg/g) followed by phosphorus (8.6245±1.23 mg/g), potassium (3.2255±1.10 mg/g), calcium (1.9205±0.21mg/g) and the lowest was magnesium (0.6104±0.01 mg/g)

Table 1: Morphology of the Study Sample Mushroom

Physical morphology			**Microscopic morphology**		**Organism**
Shape	**Pigment**	**Size**	**Shape**	**Size**	
The mushroom grows convex, later expanding to broadly convex or nearly flat. Surface: Smooth, sometimes slightly sticky when moist	White to cream, occasionally with pale brown or grayish tints in the center	Ranges from 4-10 cm in diameter	Spores are ellipsoid to oblong, relatively thick walled and no amyloid. Chellocystidia are abundant, ventral and variable in shape Pileipllis having parallel hyphae	Ranges from 7-8.3µm	*Volvopluteus earlei*

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Figure 1: A Picture showing the Study Mushroom

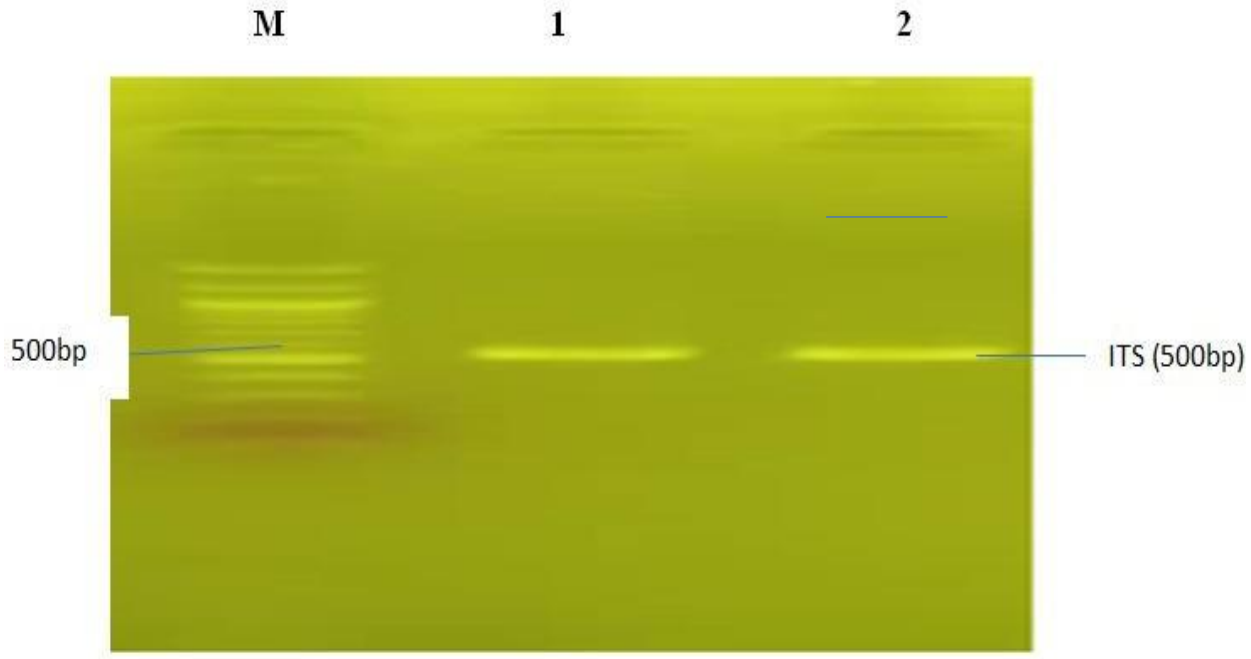

Plate 1: Agarose gel electrophoresis showing the amplified ITS fragment. Lane 1-2 represent the ITS bands at 500bp while lane L represent the 100bp DNA ladder

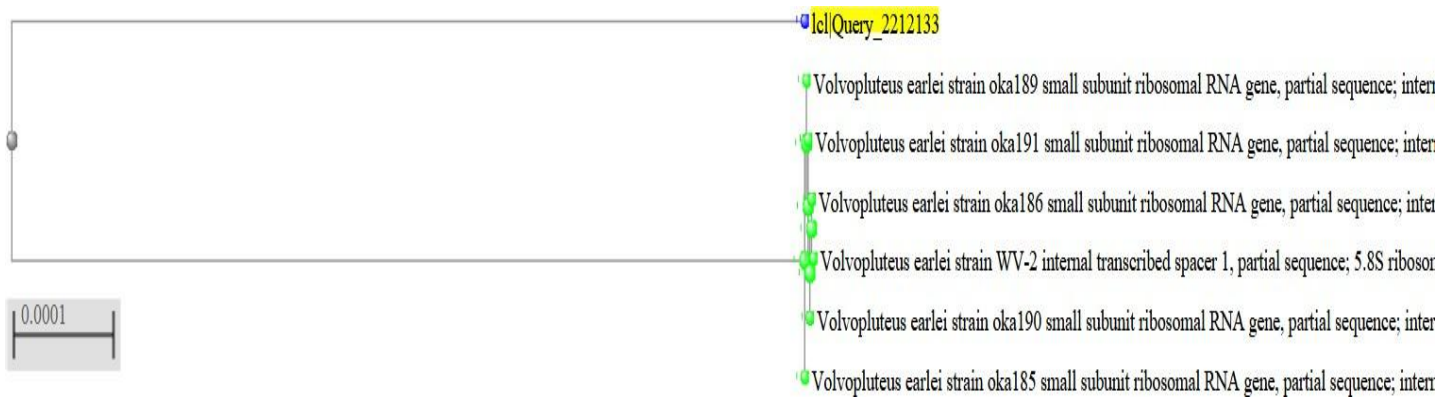

Figure 2: Molecular phylogenetic analysis of ITS sequences of *Volvopluteus earlei*

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Table 2 physicochemical parameters of the soil the *Volvopluteus earlei* from Keana

Parameter	Concentration (mg/ml)
Magnesium	0.6104±0.01
Calcium	1.9205±0.21
Nitrogen	9.0948±0.07
Potassium	3.2255±1.10
Phosphorus	8.6245±1.23

Nutritional Composition of the Mushroom Sample

The nutritional compositions of *Volvopluteus earlei* from Keana are as shown in Table 3. The nutritional compositions detected from the *Volvopluteus earlei* were moisture (7.88 ± 0.54 %), ash (4.09 ± 0.33 %), fat (2.83 ± 0.31%), crude protein (21.64 ± 1.11 %), crude fiber (5.73 ± 0.21 %) and carbohydrate (57.83 ± 2.03 %)

Functional properties of *Volvopluteus earlei*

Table 4 shows some functional properties of *Volvopluteus earlei* from in Keana. Some of the functional properties from *Volvopluteus earlei* were foaming capacity (111.8 ± 4.0 %), foaming stability (71.2 ± 0.6 %), water absorption (391.6 ± 2.0%), oil absorption (462.0 ± 3. 12%), oil emulsion (58.1 ± 2.0 mLg^{-1}), Oil emulsion stability (36.3 ± 4.1mLg^{-1}) gelation concentration (2.2 ± 0.1%) and bulk density (381.1 ± 2.0 gL^{-1}).

Phytochemical of *Volvopluteus earlei*

Table 5 shows the phytochemical composition of *Volvopluteus earlei* from Keana. The phytochemical composition detected from the *Volvopluteus earlei* were flavonoid (12.35 mg/g), saponins (0.98 mg/g), proteins (7.53 mg/g), alkaloids (5.55 mg/g), tannins (6.28 mg/g), steroids(1.32mg/g) , glycosides (2.75 mg/g), terpenoids (2.55 mg/g), phenolic compounds (6.23 mg/g), and carbohydrate (8.52 mg/g).

Table 3 Nutritional Compositions of *Volvopluteus earlei* from Keana

Parameters	Content (%)
Moisture	7.88 ± 0.54
Ash	4.09 ± 0.33
Fat	2.83 ± 0.31
Crude Protein	21.64 ± 1.11
Crude fiber	5.73 ± 0.21
Carbohydrate	57.83 ± 2.03

Table 4 Functional properties of *Volvopluteus earlei* from Keana

Properties	**Contents**
Foaming capacity (%)	111.8 ± 4.0
Foaming stability (%)	71.2 ± 0.6
Water absorption (%)	391.6 ± 2.0
Oil absorption (%)	462.0 ± 3. 12
Oil emulsion (mLg^{-1})	58.1 ± 2.0
Oil emulsion stability (mLg^{-1})	36.3 ± 4.1
Gelation concentration (%)	2.2 ± 0.1
Bulk density (gL^{-1})	381.1 ± 2.0

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Table 5 Phytochemical qualitative contents of the *Volvopluteus earlei* from Keana

	EtOH Extract	**MeOH Extract**
Test for Alkaloid		
a) Mayers test	Negative	Positive
b) Wagners test	Negative	Positive
c)Dragendroffs test	Negative	Positive
Test for terpenoids	Positive	Positive
Test for steroids	Positive	Positive
Test for Glycosides		
a) Libermann Burchards test	Positive	Negative
b) Keller-Killiani test	Positive	Positive
Test for Flavonoids		
a) Alkaline reagent test	Negative	Positive
b) Ferric chloride test	Negative	Positive
Test for Phenolics compounds		
a) ferric chloride test	Negative	Positive
b) lead acetate test	Negative	Positive
Test for carbohydrates		
a) fehlings test	Negative	Positive
b) benedict test	Negative	Positive
c) molischs test	Negative	Positive
d) barfoed test	Negative	Positive
Test for Amino acids		
a) ninhydrin test	Negative	Negative
b) millons test	Negative	Negative
c) xanthoproteic	Negative	Positive
Test for Saponins		
a) froth test	Negative	Positive
Test for tannin		
a) ferric chloride test	Positive	positive

Table 6 Phytochemical quantitative contents of the *Volvopluteus earlei* from Keana

Chemical	**Contents (mg/g)**
Flavonoid	12.35
Saponins	0.98
Proteins	7.53
Alkaloids	5.55
Tannins	6.28
Steroids	1.32
Glycosides	2.75
Terpenoids	2.55
Phenol	6.23
Carbohydrates	8.52

DISCUSSION

Historically, the local community has used *Volvopluteus earlei* as a food additive, medicinal ingredient, and nutraceutical component, particularly in soups. This study seeks to scientifically elucidate its properties and validate its traditional use. Traditionally, mushrooms are used for nutritional, medicinal and mythological benefits in Nigeria [16,17] acknowledged that the uses of mushroom genetic resources are not only of high interest in agronomy, agriculture, human food and animal feed but also for the discovery, production and

development of molecules or components with high added value in industries such as chemical and pharmaceutical industries.

Volvopluteus earlei grows convex, later expanding to broadly convex or nearly flat, white to cream, occasionally with pale brown or grayish tints in the center. The microscopic shows that the spores are ellipsoid to oblong, relatively thick walled and no amyloid, the size ranges from 7-8.3µm and the mushroom is *Volvopluteus earlei.* In a similar study conducted by Hira *et al.,* [18] which reported that *Volvopluteus earlei* is identified by the medium sized basidiomata with whitish or slightly grey pileus, white to pinkish lamellae, broadly ellipsoid to ellipsoid 15.5–19.6 × 10.1–14.4µm basidiospores, infrequent pleurocystidia, lageni form to narrowly utriform cheilocystidia, and pileipellis composed of ixocutis.

It grows gregarious or solitary on forest soil, grassland, roadsides, and gardens. It mostly occurs on clayey-loamy with medium lime soil that is rich in humus [19, 20]. The species is found in boreal and subtropical to tropical regions [19]. These species was previously described from Cuba and then from USA, Africa, Mexico, Spain, Argentina, Italy and Turkey [19].

Phylogenetic analysis of partial ITS sequence collections using Distance, Parsimony measurements and Maximum Likelihood presented similar inferred trees that only had minor differences. Based on these phylogenetic analyses of the partial ITS sequences, were identify as *Volvopluteus earlei. In* blast results, these sequences were 99% similar to the sequences from Hira *et al.,* [18]

The highest phytochemical parameters detected form the sample in this study, was Flavonoids followed by Carbohydrates, Protein, Tanin, Phenol, Alkaloids, Glycosides, Terpenoids, Steroids, and the lowest was Saponins which was in slightly agreement with the work of Akinyinka *et al.* [21] which has low concentrations for alkaloids, glycosides, phenol and saponin, while flavonoids and Carbohydrates were in high concentrations.

The soil nutrient composition in this study showed the soil were enrich with components from decay materials which is similar to study reported by Chandrawati *et al.,* [22], which suggested that the mineral elements in the soil may affect the growth of *Volvopluteus earlei.*

From this study it was observed that *Volvopluteus earlei* nutritional compositions was high such as moisture content, ash, crude protein, crude fiber and carbohydrate. None of these nutritional compositions qualified as oil rich plant food compared with crude fat content of bean or any other cereals, this makes *Volvopluteus earlei* a healthy food which can be used in improving of fortifying food for human which can act as medication in control some underline illness [23].

The highest physicochemical parameters detected from soil sample in this study, was nitrogen (9.0948±0.07 mg/g) followed by phosphorus (8.6245±1.23 mg/g), potassium (3.2255±1.10 mg/g), calcium (1.9205±0.21mg/g) and the lowest was magnesium (0.6104±0.01 mg/g) was not in agreement with the study carried-out by Yusuf *et al*. [24]. The Phosphorous from the soil in the sample was (8.35-10.37mg/kg), Magnesium (1.56-2.11cmol/kg), Potassium (0.13-0.22cmol/kg), Nitrogen (10.35-10.37mg/kg). However, the Nitrogen is in agreement with Dandwate [25] who reported similar values. Based on the categorization [18], the soils from the study area range between medium to low concentration.

The Ash, Crude Protein and Carbohydrate, this means that *Volvopluteus earlei* under study would supply the required protein assuming complete protein absorption. The crude fiber may be compared with the legumes such as pigeon pea and cowpea [22]. There is evidence that dietary fiber has a number of beneficial effects related to its indigestibility in the small intestine. The value of carbohydrate obtained in this study compares favorably with the value of *Volvariella volvacea* mushroom as reported by Anthony and Joyce [26]. The foaming capacity and stability of *Volvopluteus earlei* Flour. This suggests that *Volvopluteus earlei* may be attractive for products like cakes or whipping topping where foaming is important. The water absorption capacity the values are comparatively higher than African yam. The high-water absorptivity reported in the present study suggests that a variety of mushroom flours may be used in the formulation of some foods such as sausage, dough, processed cheese, baked products and soups [27]. The highest oil absorption capacity found in

Volvopluteus earlei. Oil absorption capacity is important since oil acts as a flavor retainer and increases the mouth feel of foods. It has been reported that variations in the presence of non-polar side chains, which might bind the hydrocarbon side chains of oil among the flours, explain differences in the oil binding capacity of the flours [28].

CONCLUSION

The soil *Volvopluteus earlei* was harvested from in Keana contains nitrogen, phosphorus, potassium, calcium, magnesium. The nutritional compositions in the *Volvopluteus earlei* were moisture, ash, fat, crude protein, crude fiber, carbohydrate. Some of the functional properties in the *Volvopluteus earlei* were foaming capacity, foaming stability, water absorption, oil absorption, oil emulsion, Oil emulsion stability, gelation concentration and bulk density were high

Compliance with ethical standards

Acknowledgments

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Disclosure of conflict of interest

No conflict of interest among of the authors

Statement of informed consent

Informed consent was obtained from all individual participants included in this study

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