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Comparative Study on the Phytochemical and Micronutrients Levels in Selected Edible Mushroom Samples

Moses Adondua Abah[1], Arowora Kayode Adebisi[2], Iyekekpolor Osamudiame Moses[3], Arowora Mercy Dooshima[4], Isaac John Umaru[5], Ukoh Daniel Uchechukwu[6], Mgbede Timothy[7]

[1,2,3,5,7]Federal University Wukari, Taraba State, Nigeria

[4]National Teachers Institute, Wukari Centre, Wukari, Taraba State, Nigeria

[6]Abia State University, Uturu, Abia State, Nigeria

m.abah@fuwukari.edu.ng

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Abstract

Edible mushrooms have been known to possess various phytochemical and micro nutrient levels. Edible mushrooms can be eaten and they supply nutritional benefits to the human body system. It is not widely consumed mainly due to paucity of information about it. Therefore, this research was conducted to compare the phytochemicals and micronutrients levels in two selected edible mushrooms (*Pleurotus ostreatus and Agrocybe aegerita*). Fully matured mushroom species of Oyster and Tea tree mushroom were collected, air dried and then stored in transparent polythene bags. Quantitative determination of phytochemicals and micronutrients (minerals and vitamins) present was carried out. Tea tree mushroom used in this research can be said to have the higher concentration of phytochemicals (phenols and poly-phenols), as there was no significant difference ($p>0.05$) in Oyster mushroom in comparison to Tea tree mushroom for phenols and poly-phenols. The results obtained from this research indicated that there was no significant decrease($p>0.05$) in Oyster mushroom in comparison to Tea tree mushroom for Sodium, Iron, Magnesium, Selenium, Manganese. While there was a non-

significant increase ($p>0.05$) in Oyster mushroom in comparison to Tea tree mushroom for Potassium, Calcium, Phosphorus, Copper. Tea tree mushroom had higher composition of vitamins A and C than oyster mushroom which were not significantly different ($p>0.05$). The findings in this study revealed that Tea tree mushroom (*Agrocybe aegerita*) is slightly better than Oyster mushroom (*Pleurotus ostreatus*) based on their phytochemicals and micronutrients (minerals and vitamins).

Keywords: Phytochemicals, Mushrooms, Micronutrients, *Pleurotus ostreatus, Agrocybe aegerita*

INTRODUCTION

Mushrooms have been consumed since earliest history. Ancient Greeks believed that mushrooms provided strength for warriors in battle, and the Romans perceived them as the "Food of the gods." For centuries, the Chinese culture has also treasured mushrooms as a health food, an "elixir of life." They have been part of the human culture for thousands of years and have considerable interest in the most important civilizations in history because of their sensory characteristics. They have also been recognized for their attractive culinary attributes (Mar'ıa *et al.*, 2015). Mushroom is used throughout the world to express the different species of fungus that belong to the order of *Basidomyecets* or *Ascomycetes*. *Basidomyecets* or *Ascomycetes* can be found everywhere in soils rich in organic matter and humus, moist wood, animals waste after heavy rain or a sudden change of temperature and soon after a few hours or day's they disappear, leaving no sign but, mycelium (Zeid *et al.,* 2011). Based on their chemical composition and benefits, mushroom can be classified as poisonous and edible, where edible mushroom can also be categorized into wild and cultivated edible mushrooms (Girma and Tasisa, 2020). As estimated by different researchers, there are over 70,000 fungi species in the world. About 2000 species (31 genera) are primarily edible mushrooms. However, about 10% of some 30 species are poisonous mushrooms and relatively small, numbers are considered as lethal (Teferi *et al.,* 2013).

Nowadays, mushrooms are popular valuable foods because they are low in calories, carbohydrates, fat, and sodium: also, they are cholesterol-free. Besides, mushrooms provide important nutrients, including selenium, potassium, vitamins, proteins, and fibre. All together with a long history as food source, mushrooms are important for their healing

capacities and properties in traditional medicine. It has been reported for beneficial effects on health and treatment of some diseases (Mar'ıa *et al.*, 2015). Many nutraceutical properties are found in mushrooms, such as prevention or treatment of Parkinson, Alzheimer, hypertension, and high risk of stroke. They are also utilized to reduce the likelihood of cancer invasion and metastasis due to anti-tumoural attributes. Mushrooms act as antibacterial, immune system enhancer and cholesterol lowering agents; additionally, they are important sources of bioactive compounds. As a result of these properties, some mushroom extracts are used to promote human health and are found as dietary supplements (Mar'ıa *et al.*, 2015).

Pleurotus ostreatus, the pearl Oyster mushroom or tree Oyster mushroom, is a common edible mushroom. It was first cultivated in Germany as a subsistence measure during World War I and is now grown commercially around the world for food (Eger *et al.,* 1976). The oyster mushroom is one of the more commonly sought wild mushrooms, though it can also be cultivated on straw and other media. It has the bittersweet aroma of benzaldehyde (which is also characteristic of bitter almonds) (Beltran-Garcia *et al.,* 1997). The mushroom has a broad, fan or oyster-shaped cap spanning 5–25 cm; natural specimens range from white to gray or tan to dark-brown; the margin is in rolled when young, and is smooth and often somewhat lobed or wavy (Beltran-Garcia *et al.,* 1997). The oyster mushroom is frequently used in Japanese, Korean and Chinese cookery as a delicacy. It is frequently served on its own, in soups, stuffed, or in stir-fry recipe *P.ostreatus* can provide significant support to human against malnutrition and diseases (Krishnamoorthy, 2014).

Agrocybe aegerita is an important mushroom cultivated in Korea, Japan, Europe, and Africa. *A. aegerita* is a kind of saprophyte fungi and a basidiomycetes which belongs to the family *Bolitiaece*. It is very fibrous, has a good feel and peculiar fragrance compared to others, and can be cultivated all year round in bottle cultivation facilities. However, it requires long duration culturing in culture bottles and is more susceptible to contamination than others. It has a high antioxidant effect and free-radical scavenging ability, which is correlated with total phenolic content (Lo and Cheung, 2005).

There is paucity of information on the phytochemicals and micronutrients composition of edible mushroom; this has led to poor consumption of mushroom. Processing (drying)

extends the shelf life of mushroom and also its availability across various seasons of the year. In view of aforementioned there is need for a research to be conducted in order to fill the gap of information. Therefore, this research aimed at evaluating the phytochemical and micronutrients levels in selected edible mushrooms which are the *Pleurotus ostreatus* (Oyster Mushroom) and *Agrocybe aegerita* (Tea-tree mushroom).

MATERIALS AND METHODS

Sample Collection and Identification

Fully matured mushroom species of *Plueurotus ostreatus* (Oyster Mushroom) and *Agrocybe aegerita* (Tea tree mushroom) were collected from Takum Local Government of Southern Taraba, Nigeria on the 26th of October, 2020. Collection was made by uprooting its substratum with the aid of a scalpel. The samples were then identified according to their morphological features.

Sample Preparation

The samples were air dried for approximately 7 days and stored in transparent polythene bags that were loosely tightened to allow for proper aeration and some of the samples were stored in ice box to retain their freshness before transported for analysis in the nutrition laboratory.

Dry Ashing for Elemtal Analysis

The method described by Ikon et al. (2019) with some little modifications was used for this purpose. Five (5) grams of the sample was weighed into "high form" porcelain crucible then crucible was placed with the sample into furnace and temperature was increased gradually until it reached 550°C.The sample was then ash until a white or grey ash was observed in the crucible. The ash was dissolved by adding 2 mL of conc. HNO_3 to the crucible. The dissolved ash was then transferred into 100 mL volumetric flask. It was then diluted to volume with diluted H_20 and shaken. Standards and unknown samples were ran using AAS Buck 210 (for Ca, Fe, Mg, Se, Zn, Mn and Cu) and Jenway ME 882 Flame photometer (for Na and K) using air acetylene flame integrated mode and concentration of unknown were quantified from the calibration curve of standards.

Phosphorus Determination

For the determination of phosphorus, Vanadomolybdate (yellow) method was employed. Twenty (20)g of ammonium molybdate 4-hydrate (NH_4) 6 Mo7 O_{24} .4H_2O was dissolved in 400 ml warm water (50º C) and left to cool. 1.0g ammonium vanadate (NH_4 VO_3) was dissolved in 300 ml boiling distilled water, left to cool and 40 ml conc. nitric acid was added gradually with stirring. Then the molybdate solution was added gradually to the acid vanadate solution stirred and diluted to a litre with water. A stock solution was then prepared containing 3.834 g potassium dihydrogen phosphate (KH_2PO_4) per litre. Twenty (25) ml was diluted to 250 ml (1 ml = 0.2 mg P_2O_5). The concentration of phosphorus in the sample solution was determined by a spectrophotometer as the yellow phosphor-vanado-molybdate complex.

Determination of Phytochemicals

Determination of Total Phenolic Compounds

Total phenolic compounds were determined according to method described by Ikon et al. (2019) with some little modifications. One hundred (100) mg of the sample extract was dissolved in 100ml of triple distilled water. One (1) ml of the solution was transferred to a test tube and 0.5 ml 2N of Folin-Coicalteu reagent was then added.1.5 ml 20% of Na_2CO_3 solution was added and the volume was made up to 8ml with triple distilled water and vigorously shaken. It was allowed to stand for 2hours.The absorbance was taken at 765nm (spectroscopic determination). The total phenolic content was estimated using a standard calibration curve obtained from various diluted concentrations of gallic acid.

Determination of Total Alkaloids

Total alkaloids were determined according to method described by Ikon et al. (2019) with some little modifications. Five (5) gram of the sample was put into a 250ml beaker.200ml of 10% acetic acid in ethanol was added and the beaker was covered with aluminum foil. It was then allowed to stand for 4 hours. The extract was filtered and concentrated on a water bath to one-quarter of the original volume. Concentrated ammonium hydroxide was added drop wise to the extract until the precipitation was complete. The whole solution was then allowed to settle. The precipitate was collected and washed with dilute ammonium hydroxide and then filtered. The residue is the alkaloid which was then dried and weighed.

$$\%\text{Alkaloid} = \frac{weight of alkaloid}{weight of sample} * 100$$

Determination of Total Flavonoids

Total flavonoids were determined according to method described by Ikon et al. (2019) with some little modifications. One hundred (100) ul of the extract was mixed in methanol (10mg/ml) with 100 ul of 20% aluminium trichloride in methanol. A drop of acetic acid was added and then diluted with methanol to 5ml.The absorbance was read at 415nm after 40 minutes. Blank samples were prepared from 100ml of the extract and a drop of acetic acid was added and diluted to 5ml with methanol. The absorbance of standard rutin solution (0.5 mg/ml) in methanol was measured under the same conditions. All determinations were carried out in triplicates

Determination of Total Tannins

Total tannins were determined according to method described by Ikon et al. (2019) with some little modifications. Five hundred (500) mg of the sample was transferred to a 50 ml plastic bottle.50ml of distilled water was added and shaken for one hour in a mechanical shaker. The mixture was then filtered into a 50ml volumetric flask to make up the mark.5ml of the filtrate was pipetted into a test tube and mixed with 2ml of 0.1M $FeCl_3$ in 0.1N HCl and 0.008 M potassium ferrocyanide. The absorbance was measured at 120 nm after 5 minutes.

Determination of Total Saponins

Total saponins were determined according to method described by Ikon et al. (2019) with some little modifications. Twenty (20) g of the sample was placed inside a conical flask.100$cm^3$of 20% aqueous ethanol was added. The sample was heated over a hot water bath for 4 hours with continuous stirring at 55 degree Celsius. The mixture was filtered. The residue was re-extracted with another 200ml 20% ethanol. The combined extracts were reduced to 40 ml over water bath at 90 degree Celsius. The concentrate was transferred into a 250ml separator funnel and 20 ml of diethyl ether was added and shaken vigorously. The aqueous layer was recovered while the other layer was discarded. The purification process was repeated.60 ml of n-butanol was added and washed twice with 10ml of 5% aqueous sodium chloride. The remaining solution was heated in a water bath. After evaporation the samples were dried in an oven to a constant weight. The saponin content was calculated using standard formulae.

Determination of Glycosides

Glycosides were determined according to method described by Ikon et al. (2019) with some little modifications. One (1) g of the fine powder of the sample was soaked in 10ml of 70% ethanol for 2 hours and then filtered. The extract obtained was then purified using lead acetate and Na_2HPO_4 solution before the addition of freshly prepared Buljet's reagent (containing 95ml aqueous picric acid + 5ml 10% aqueous NaOH). The difference between the intensity of colors of the experimental and blank (distilled water and Buljet's reagent) samples gave the absorbance and is proportional to the concentration of glycosides.

Determination of Terpenoids

Terpenoids were determined according to method described by Ikon et al. (2019) with some little modifications. The dried extract of the sample was soaked in 9ml of ethanol for 24 hours. The extract after filtration was extracted with 10mL of petroleum ether using separation funnel. The ether extract was separated in pre weighed glass vials and left to completely dry. Ether was evaporated and the yield (%) of total terpenoids contents was measured by the formula (wi-wf/wi*100).

Determination of Vitamins

Determination of Vitamin A

Vitamin A was determined according to method described by Ikon et al. (2019) with some little modifications. One gram of the sample was weighed and macerated with 20ml of n-hexane in a test tube for 10 minutes.3ml of the upper hexane extract was transferred into a dry test tube in duplicates and evaporated to dryness.0.2ml of acetic anhydride chloroform reagent was added and 2ml of 50% trichloroacetic acid (TCA) in chloroform reagent was added, 2ml of 50% trichloroacetic acid was also added. The absorbance was taken at 15 seconds and 30 seconds intervals at 620nm.

Determination of Vitamin C

Vitamin C was determined according to method described by Ikon et al. (2019) with some little modifications. A total of 0.5g of the sample was weighed, macerated with 10ml of 0.4% oxalic acid in a test tube for 10 minutes. It was then centrifuged for 5 minutes and the solution filtered. One (1) ml of the filtrate was transferred into a dry test tube in duplicates. Nine (9) ml of 2,6 dichlorophenol indophenol was added. Absorbance was taken at 15 seconds and 30 seconds interval at 520nm.

Determination of vitamin E

Vitamin E was determined according to method described by Ikon et al. (2019) with some little modifications. One (1) g of the sample was weighed, macerated with 20ml of n-hexane in a test tube for 10 minutes and centrifuged for 10 minutes. The solution was filtered.3ml of the filtrate was transferred into a dry test tube in duplicates and evaporated to dryness in a boiling water bath.2ml of 0.5N alcoholic potassium hydroxide was added and boiled for 30 minutes in a water bath.3ml of n-hexane was added and was shaken vigorously.N-hexane was transferred into another set of test tubes and evaporated to dryness.2ml of ethanol was added to the residue, 1ml of 0.2% ferric chloride in ethanol was added.1ml of 0.5% α^1 α^1-dipyidyl in ethanol was added followed by the addition of 1ml of ethanol to make it up to 5ml.The solution was mixed and absorbance taken at 520nm against the blank.

Determination of vitamin K

Vitamin K was determined according to method described by Ikon et al. (2019) with some little modifications. One (1) g of the sample was transferred into a 50ml polypropylene tube, 15ml of 2-hexane was added followed by 4ml of water. The mixture was sonicated for 30 seconds and vortexed for 10 minutes. After centrifugation, the upper phase was collected and evaporated to dryness under a stream of nitrogen. Residues are dissolved in 2ml of hexane. The lipid extract was then applied to a 3ml silica column. After which the column was preconditioned with 8ml of hexane, the extract was filtered through the column followed by a wash with 8ml of hexane. The residue of the silica column was slowly dissolved in 0.2ml of 2-propanol while been heated slightly. The extract was then applied to a C18 SPE column preconditioned by washing with 10ml of methanol followed by 6ml of water. After filtration, the column was washed with 6l of water followed by 6ml of acetonitrile. The vitamin k rich fraction was eluted with 10ml of methanol. The eluants

were evaporated to dryness and dissolved in the mobile phase of the reversed phase chromatography.

Statistical Analysis

The results were expressed as mean ± standard deviation for the two mushroom species. Differences between groups were assessed by Paired-samples T-Test with the use of Statistical Package for Social Science (SPSS) Version 26. Differences at <0.05 was considered significant.

RESULTS

Phytochemical Composition of *Plueurotus ostreatus* (Oyster Mushroom) and *Agrocybe aegerita* (Tea-tree mushroom)

In this study, phytochemical analysis of *Pleurotus ostreatus* and *Agrocybe aegerita* revealed that their extracts contain tannins, alkaloids, flavanoids, phenolics, glycosides, polyphenols, glycosides, quinines, saponins, terpenes and steroids, with phenolics having the highest concentration in both species of mushroom; *Pleurotus ostreatus* (105.37 ± 0.02^{a}) and *Agrocybe aegerita* (126.43 ± 0.01^{a}) respectively. Tannin increased non-significantly ($p>0.05$) in oyster mushroom (1.42 ± 0.00^{a}) in comparison to tea tree mushroom (1.35 ± 0.00^{a}). Alkaloids increased non-significantly ($p>0.05$) in oyster mushroom (2.35 ± 0.00^{a}) when compared to Tea tree mushroom (1.52 ± 0.00^{a}). Flavonoids decreased non-significantly ($p>0.05$) in Oyster mushroom (7.45 ± 0.00^{a}) in comparison to Tea tree mushroom (8.55 ± 0.00^{a}). Polyphenols decreased non-significantly ($p>0.05$) in Oyster mushroom (25.36 ± 0.01^{a}) in comparison to Tea tree mushroom (31.17 ± 0.01^{a}). Quinines decreased non-significantly ($p>0.05$) in Oyster mushroom (0.16 ± 0.01^{a}) in comparison to Tea tree mushroom (0.22 ± 0.01^{a}). Saponins decreased non-significantly ($p>0.05$) in Oyster mushroom (2.15 ± 0.00^{a}) in comparison to Tea tree mushroom (3.00 ± 0.00^{a}). Terpenes decreased non-significantly ($p>0.05$) in Oyster mushroom (0.12 ± 0.00^{a}) in comparison to Tea tree mushroom (0.15 ± 0.00^{a}). Steroids increased non-significantly ($p>0.05$) in Oyster mushroom (0.15 ± 0.00^{a}) in comparison to Tea tree mushroom (0.12 ± 0.00^{a}). Phenols decreased non-significantly ($p>0.05$) in Oyster mushroom (25.36 ± 0.01^{a}) in comparison to Tea tree mushroom (126.43 ± 0.01^{a}). Glycosides decreased non-significantly ($p>0.05$) in Oyster mushroom (3.74 ± 0.01^{a}) in comparison to Tea tree mushroom (5.33 ± 0.01^{a}) (Table 1).

Table 1. Phytochemical Composition of *Plueurotus ostreatus* (Oyster Mushroom) and *Agrocybe aegerita* (Tea-tree mushroom)

Phytochemicals mg/100g	Oyster Mushroom	Tea tree Mushroom
Tannins	1.42±0.00[a]	1.35±0.00[a]
Alkaloids	2.35±0.00[a]	1.52±0.00[a]
Flavonoids	7.45±0.00[a]	8.55±0.00[a]
Phenolics	105.37±0.02[a]	126.43±0.01[a]
Glycosides	3.74±0.01[a]	5.33±0.01[a]
Polyphenols	25.36±0.01[a]	31.17±0.01[a]
Quinines	0.16±0.01[a]	0.22±0.01[a]
Saponins	2.15±0.00[a]	3.00±0.00[a]
Terpenes	0.12±0.00[a]	0.15±0.00[a]
Steroids	0.15±0.00[a]	0.12±0.00[a]

*Each value represents the mean of 2 determinations ± standard deviation values (n=2). Mean in same row having different letters of alphabets are statistically significant ($p<0.05$).

Mineral Composition of *Plueurotus ostreatus* (Oyster Mushroom) and *Agrocybe aegerita* (Tea-tree mushroom)

Mineral analysis of mushroom species reveals the most abundant element being potassium, followed by calcium, phosphorus, and then sodium. Calcium increased non-significantly ($p>0.05$) in Oyster mushroom (633.64±0.02[a]) in comparison to Tea tree mushroom (515.37±0.02[a]). Copper increased non-significantly ($p>0.05$) in Oyster mushroom (0.44±0.02[a]) in comparison to Tea tree mushroom (0.32±0.02[a]). Iron decreased non-significantly ($p>0.05$) in Oyster mushroom (16.75±0.00[a]) in comparison to Tea tree mushroom (18.23±0.01[a]). Magnesium decreased non-significantly ($p>0.05$) in Oyster mushroom (132.92±0.00[a]) in comparison to Tea tree mushroom (145.63±0.01[a]). Potassium increased non-significantly ($p>0.05$) in Oyster mushroom (852.41±0.00[a]) in comparison to Tea tree mushroom (755.73±0.01[a]). Sodium decreased non-significantly ($p>0.05$) in Oyster mushroom (211.43±0.01[a]) in comparison to Tea tree mushroom (322.52±0.00[a]). Phosphorus increased non-significantly ($p>0.05$) in Oyster mushroom (226.75±0.00[a]) in comparison to Tea tree mushroom (117.08±0.07[a]). Selenium increased non-significantly ($p>0.05$) in Oyster mushroom (0.17±0.01[a]) in comparison to Tea tree mushroom

(0.23±0.0[a]). Manganese decreased non-significantly (p>0.05) in Oyster mushroom (12.86±0.02[a]) in comparison to Tea tree mushroom (14.05±0.00[a]). Copper increased non-significantly (p>0.05) in Oyster mushroom (0.44±0.02[a]) in comparison to Tea tree mushroom (0.32±0.02[a]).

Table 2. Mineral Composition of *Plueurotus ostreatus* (Oyster Mushroom) and *Agrocybe aegerita* (Tea-tree mushroom)

Minerals mg/100g	Oyster Mushroom	Tea tree Mushroom
Calcium(Ca)	633.64±0.02[a]	515.37±0.02[a]
Iron (Fe)	16.75±0.00[a]	18.23±0.01[a]
Magnesium(Mg)	132.92±0.00[a]	145.63±0.01[a]
Potassium(K)	852.41±0.00[a]	755.73±0.01[a]
Sodium(Na)	211.43±0.01[a]	322.52±0.00[a]
Phosphorus(P)	226.75±0.00[a]	117.08±0.07[a]
Selenium(Se)	0.17±0.01[a]	0.23±0.0[a]
Zinc(Zn)	1.32±0.01[a]	1.32±0.01[a]
Manganese(Mn)	12.86±0.02[a]	14.05±0.00[a]
Copper(Cu)	0.44±0.02[a]	0.32±0.02[a]

*Each value represents the mean of 2 determinations ± standard deviation values (n=2). Mean in same row having different letters of alphabets are statistically significant (p<0.05).

Vitamin Composition of *Plueurotus ostreatus* (Oyster Mushroom) and *Agrocybe aegerita* (Tea-tree mushroom)

Vitamin analysis of *Pleurotus ostreatus* and *Agrocybe aegerita* revealed that vitamin A has the highest composition in *Plueurotus ostreatus* (Oyster Mushroom) (392.80±0.03[a]) and *Agrocybe aegerita* (Tea-tree mushroom) (416.86±0.01[a]). Vitamin E decreased non-significantly (p>0.05) in Oyster mushroom (0.26±0.01[a]) in comparison to Tea tree mushroom (0.36±0.01[a]). There was non-significant (p>0.05) decrease of vitamin C in Oyster mushroom (14.16±0.01[a]) in comparison to Tea tree mushroom (16.36±0.01[a]).Vitamin A decreased non-significantly (p>0.05) in Oyster mushroom (392.80±0.03[a]) in comparison to Tea tree mushroom (416.86±0.01[a]).Vitamin D decreased non-significantly (p>0.05) in Oyster mushroom (0.34±0.01[a]) in comparison to Tea tree mushroom (0.56±0.01[a]). Vitamin K decreased non-significantly (p>0.05) in Oyster mushroom (0.02±0.00[a]) in comparison to

Tea tree mushroom (0.04 ± 0.01^a). Vitamin B_1 increased non-significantly ($p>0.05$) in Oyster mushroom (0.26 ± 0.00^a) in comparison to Tea tree mushroom (0.19 ± 0.01^a) (Table 3).

Table 3. Vitamin Composition of *Plueurotus ostreatus* (Oyster Mushroom) and *Agrocybe aegerita* (Tea tree mushroom)

Vitamins mg/100g	Oyster Mushroom	Tea tree mushroom
Vitamin A	392.80 ± 0.03^a	416.86 ± 0.01^a
Vitamin B_1	0.26 ± 0.00^a	0.19 ± 0.01^a
Vitamin E	0.26 ± 0.01^a	0.36 ± 0.01^a
Vitamin C	14.16 ± 0.01^a	16.36 ± 0.01^a
Vitamin D	0.34 ± 0.01^a	0.56 ± 0.01^a
Vitamin K	0.02 ± 0.00^a	0.04 ± 0.01^a

*Each value represents the mean of 2 determinations ± standard deviation values (n=2). Mean in same row having different letters of alphabets are statistically significant ($p<0.05$).

DISCUSSION

Mushrooms are characterized with their levels of mineral elements that are essential for human health. Major mineral constituents in mushrooms are K, P, Na, Ca, Mg and elements like Cu, Zn, Fe, Mo, Cd form minor. Mushrooms have ability to accumulate heavy metals like Cd, Pb, Ar, Cu, Ni, Ag, Cr and Hg (Mdasaduzzaman and Mousumi, 2012). *Pleurotus ostreatus* and *Agrocybe aegerita* contain mainly the following constituents: alkaloids, glycosides, saponins, tannins, flavonoids, reducing compounds, polyphenol, quinones, phenols, steroids, phytosteriods terpenoids, carbohydrates, proteins, vitamins (Anjana *et al.,* 2016). Mushrooms are also known to be one of the best sources of vitamins especially; wild mushrooms which contain high amounts of vitamin D_2. Mushrooms also contain vitamin B-complex and vitamin C in small amounts, but they are poor in vitamins A, D, and E (Heleno *et al.,* 2012).

In this study, phytochemical analysis of *Pleurotus ostreatus* and *Agrocybe aegerita* revealed that its extract contains tannins, alkaloids, flavonoids, phenolics, glycosides, polyphenols, glycosides, quinines, saponins, terpenes and steroids, with phenolics having the highest concentration. The results are in accordance with reports from previous literature (Ikon *et al*., 2019).

Tannin increased non-significantly ($p>0.05$) in oyster mushroom (1.42 ± 0.00^a) in comparison to tea tree mushroom (1.35 ± 0.00^a). Alkaloids increased non-significantly ($p>0.05$) in oyster mushroom (2.35 ± 0.00^a) when compared to Tea tree mushroom (1.52 ± 0.00^a). Flavonoids decreased non-significantly ($p>0.05$) in Oyster mushroom (7.45 ± 0.00^a) in comparison to Tea tree mushroom (8.55 ± 0.00^a). Polyphenols decreased non-significantly ($p>0.05$) in Oyster mushroom (25.36 ± 0.01^a) in comparison to Tea tree mushroom (31.17 ± 0.01^a). Quinines decreased non-significantly ($p>0.05$) in Oyster mushroom (0.16 ± 0.01^a) in comparison to Tea tree mushroom (0.22 ± 0.01^a). Saponins decreased non-significantly ($p>0.05$) in Oyster mushroom (2.15 ± 0.00^a) in comparison to Tea tree mushroom (3.00 ± 0.00^a). Terpenes decreased non-significantly ($p>0.05$) in Oyster mushroom (0.12 ± 0.00^a) in comparison to Tea tree mushroom (0.15 ± 0.00^a). Steroids increased non-significantly ($p>0.05$) in Oyster mushroom (0.15 ± 0.00^a) in comparison to Tea tree mushroom (0.12 ± 0.00^a). Phenols decreased non-significantly ($p>0.05$) in Oyster mushroom (25.36 ± 0.01^a) in comparison to Tea tree mushroom (126.43 ± 0.01^a). Glycosides decreased non-significantly ($p>0.05$) in Oyster mushroom (3.74 ± 0.01^a) in comparison to Tea tree mushroom (5.33 ± 0.01^a). Two phytochemical parameters out of the ten have the highest concentration namely; Phenols and poly phenols in both varieties of mushrooms but there was a non-significant decrease ($p>0.05$) observed in Oyster mushroom in comparison to Tea tree mushroom for the two parameters. Tea tree mushroom from this research can be said to have the higher concentration of phytochemicals (Phenols and Poly-phenols). Tea tree mushroom contained high level of phenol that are known to be anti-oxidants. This is suggestive of the fact that consuming them may facilitate the prevention of free radicals reacting with other molecules in the body, preventing damage to DNA as well as long term health effects (Anjana *et al.,* 2016; Tatah *et al.,* 2023). Higher level of polyphenol found in Tea-tree mushroom may help prevent blood clots and reduce blood sugar levels and lower heart disease risks. They may also promote brain function, improve digestion and offer some protection against cancer.

Mineral analysis of mushroom species reveals the most abundant element being potassium, followed by calcium, phosphorus, and then sodium. Calcium increased non-significantly ($p>0.05$) in Oyster mushroom (633.64 ± 0.02^a) in comparison to Tea tree mushroom (515.37 ± 0.02^a). Copper increased non-significantly ($p>0.05$) in Oyster mushroom (0.44 ± 0.02^a) in comparison to Tea tree mushroom (0.32 ± 0.02^a). Iron decreased non-significantly ($p>0.05$) in Oyster mushroom (16.75 ± 0.00^a) in comparison to Tea tree

mushroom (18.23 ± 0.01^{a}). Magnesium decreased non-significantly ($p>0.05$) in Oyster mushroom (132.92 ± 0.00^{a}) in comparison to Tea tree mushroom (145.63 ± 0.01^{a}). Potassium increased non-significantly ($p>0.05$) in Oyster mushroom (852.41 ± 0.00^{a}) in comparison to Tea tree mushroom (755.73 ± 0.01^{a}). Sodium decreased non-significantly ($p>0.05$) in Oyster mushroom (211.43 ± 0.01^{a}) in comparison to Tea tree mushroom (322.52 ± 0.00^{a}). Phosphorus increased non-significantly ($p>0.05$) in Oyster mushroom (226.75 ± 0.00^{a}) in comparison to Tea tree mushroom (117.08 ± 0.07^{a}). Selenium increased non-significantly ($p>0.05$) in Oyster mushroom (0.17 ± 0.01^{a}) in comparison to Tea tree mushroom (0.23 ± 0.0^{a}). Manganese decreased non-significantly ($p>0.05$) in Oyster mushroom (12.86 ± 0.02^{a}) in comparison to Tea tree mushroom (14.05 ± 0.00^{a}). Copper increased non-significantly ($p>0.05$) in Oyster mushroom (0.44 ± 0.02^{a}) in comparison to Tea tree mushroom (0.32 ± 0.02^{a}).

According to this research, Oyster mushroom is a better source of potassium, phosphorus, copper, calcium than Tea tree mushroom. Oyster mushroom is a rich source of calcium which acts as a major component of bone and assists teeth development (Brody, 1994). Potassium and calcium are important constituents of the analysed mushroom species, as they have reported to play roles in stimulating action potential across nerve endings, and also to enhance heart contractile rate (Jeremy *et al.,* 2007). Calcium and phosphorus which were found to be present in the analysed mushroom species are directly involved in the development and maintenance of the skeletal system and participate in several physiological processes and plays an important role in muscle contraction, blood clot formation and nerve impulse transmission, the maintenance of cell integrity and acid base equilibrium and activation of several important enzymes. Phosphorus is an important constituent of nucleic acids and cell membranes and is directly involved in all energy- producing cellular reactions (Knochel *et al.,*2006; Tatah *et al.,* 2024). Sodium, another vital constituent of the analysed mushroom species is implicated in the maintenance of osmotic pressure of extra cellular fluid and balance. It also plays a role in neuro muscular excitability and maintains the degree of hydration of plasma proteins (Mdasaduzzaman and Mousumi, 2012). Magnesium serves as an essential cofactor in many enzymatic reactions in intermediary metabolism (Akpananbiater, 1998). Tea tree mushroom from this research can be said to have the higher concentration of minerals (Sodium, Manganese, Magnesium, Iron, Selenium), even though Oyster mushroom also possesses a reasonable amount of minerals (Potassium, Phosphorus, Copper, Calcium). Research has shown the involvement of these elements in

the regulation of certain activities in human cells, tissues and organs. For instance, increase in Ca_2^+concentration in cells strengthens the contraction of heart muscles while Fe_3^+ is involved in blood circulation. In general, minerals in diets are solely required for metabolic reactions, transmission of nerve impulses, rigid bone formation and regulation of salt and water balance in the body (Brown, 2012; Anih *et al.,* 2023).

Vitamin analysis of *Pleurotus ostreatus* and *Agrocybe aegerita* revealed that vitamin A has the highest composition in *Plueurotus ostreatus* (Oyster Mushroom) (392.80 ± 0.03^a) and *Agrocybe aegerita* (Tea-tree mushroom) (416.86 ± 0.01^a). Vitamin E decreased non-significantly ($p>0.05$) in Oyster mushroom (0.26 ± 0.01^a) in comparison to Tea tree mushroom (0.36 ± 0.01^a). There was non-significant ($p>0.05$) decrease of vitamin C in Oyster mushroom (14.16 ± 0.01^a) in comparison to Tea tree mushroom (16.36 ± 0.01^a).Vitamin A decreased non-significantly ($p>0.05$) in Oyster mushroom (392.80 ± 0.03^a) in comparison to Tea tree mushroom (416.86 ± 0.01^a).Vitamin D decreased non-significantly ($p>0.05$) in Oyster mushroom (0.34 ± 0.01^a) in comparison to Tea tree mushroom (0.56 ± 0.01^a). Vitamin K decreased non-significantly ($p>0.05$) in Oyster mushroom (0.02 ± 0.00^a) in comparison to Tea tree mushroom (0.04 ± 0.01^a). Vitamin B_1 increased non-significantly ($p>0.05$) in Oyster mushroom (0.26 ± 0.00^a) in comparison to Tea tree mushroom (0.19 ± 0.01^a) (Table 3).

From this research, Tea tree mushroom has a higher composition of vitamin A and vitamin C.

Tea tree mushroom as a source of vitamin A helps form and maintains healthy teeth, skeletal and soft tissue, mucus membranes and skins. It is also known as retinols because it produces the pigments in the retina of the eye. Vitamin A Promotes good eye sight especially in low light. it also plays a role in healthy pregnancy and breast feeding (Heleno *et al.,* 2012). Tea tree mushroom also as a source of vitamin C also known as ascorbic acid is necessary for the growth and development and repair of all body tissues. It's involved in many body functions, including formation of collagen, absorption of iron, the proper functioning of the immune system, wound healing and the maintenance of cartilage, bones and teeth. It's also one of the many antioxidants that can protect against damage caused by harmful molecules called free radicals as well as toxic chemicals and pollutants like cigarette smoke. Free radicals can build up and contribute to the development of health conditions such as cancer, heart disease and arthritis (Heleno *et al.,* 2012).

CONCLUSION

Pleurotus ostreatus and *Agrocybe aegerita*species of mushroom are not widely used in Nigeria. They are valuable as a result of their nutritional composition, some of which have been experimentally established and an attempt has been made to isolate and quantitatively identify some phytochemicals, micro nutrients (minerals and vitamins) in them. This study has determined some phytochemicals and micronutrients constituents present in the mushroom samples, which can be useful information for decision on their consumption. From this research, Tea tree mushroom has been determined to have the higher concentration of minerals (Sodium, Manganese, Magnesium, Iron, Iron, Selenium), even though Oyster mushroom also possesses a reasonable amount of minerals (Potassium, Phosphorus, Copper, Calcium) and also higher concentration of phytochemicals (phenols and s poly-phenols) and a higher composition of vitamins A and C.

It can be concluded however that *Pleurotus ostreatus* and *Agrocybe aegerita*species of edible mushroom have excellent phytochemical and micronutrient properties and thus can serve as a good source of food supplement supplying the body with essential minerals and vitamins and also phytochemicals which can serve as protective cover against infections.

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