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Nutritional and Metal Composition of *Lepiota procera, Boletus edulis and Boletus badius* (Mushroom) Species in Owhelogbo, Isoko North Local Government Area of Delta State, Nigeria

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Abstract: ***The proximate and metal composition of Lepiota procera, Boletus edulis and Boletus badius (mushroom) Species in Owhelogbo, Isoko North Local Government Area of Delta State, Nigeria were studied. The mushroom species were harvested in triplicate in the farmyard, uncultivated land and forest from the host community. Moisture content was determined by drying to a constant weight at 60 – 80^{o}C in a circulating oven, Oil content was determined by soxhlet extraction with hexane as solvent, protein by the kjeldahl method, and crude fiber by the acid and alkaline digestive methods. The total carbohydrate content was estimated by difference obtained after subtracting protein, fat, water, crude fiber and ash percentage from one hundred. Elemental analysis was done by Atomic Absorption Spectrophotometer (AAS). The results from this study reveal that the mushroom species has high moisture and appreciable carbohydrate content. This could be the reason while mushroom species are susceptible to fungi and bacterial infection; the high protein content, appreciable fibre and ash content could be why mushroom is celebrated as source of powerful nutrients since it provide many of those attribute most commonly found in meat, beans and grains. Data's from this study further reveal that the mushroom species show rich source of Ca, K and Mg with appreciable source of other minerals such as Fe, Na and Mn. Also, the concentration level of metals in the various mushroom species was generally very low. This is an indication that the vegetation under investigation is excellently free from industrial pollutant. As Nigeria is racing toward industrialization, it is thus recommended that the heavy metal levels of edible mushrooms should be analyzed more often in this region in order to evaluate the possible danger to human health from them, bearing in mind that the uptake of metal ions in mushrooms is in many respects different from plants. Hence, the resident government, multinationals, cooperate bodies and individuals should note that no matter their activities, be it synthesizing or analyzing, they should have it at the back of their mind that their immediate environment come first. Their activities is responsible for the level of the various form of contamination witnessed in our various environment.***

Keyword: CHO – Carbohydrate, proximate, analysis, minerals, heavy metals, mushroom, Owhelogbo

1. Introduction

Mushrooms are saprophyte. They are group of organism devoid of chlorophyll with gills; generally included for convenience in the division "micota." They are microfungi with distinctive fruity body which can be hypogeous or epigeous, large enough to be seen with the naked eye and to be picked by hand [1, 2]. They fall between the best vegetable and animal protein source [3]. While mushroom is commonly placed in the vegetable category for dietary recommendations, it is however not a vegetable based on their cellular organization and composition such as chitin and ergosterol [4]. Mushrooms are umbrellas like fungus that consist of a stalk topped by a flat or cup-shaped cap. Their spores are produced on special cells called "*basidia,"* located on the underside of the cap. Mushrooms grow almost everywhere on every natural material imaginable. Some fungi grow only in association with certain trees. Others grow on large logs. Mushrooms are also found in soil, on decomposing leaves, and in dung, mulch and compost. Mushrooms are stored in the refrigerator in either plastic or paper bags. When the use of plastic bags is preferred, then it might be a good idea to poke a few holes in it to allow some air to circulate to due to it perishable nature. Mushroom has assumed greater importance in the diets of both the rural and urban dwellers, unlike previously when consumption was confined to rural Nigerians. They are relatively much cheaper than beef and chicken that contain similar nutrient [3]. Mushroom can be prepared by first rinsing particularly dirty mushrooms or with a good wipe with a damp paper towel. It can be bake, broil, fry, grill, puree, raw, sauté, steam. Mushroom have long be cultivated and use as food source in Nigeria due to it nutritional value. [5] reported the Protein content of mushroom to be 3-7% when fresh and 25- 40% when dry, Contain all essential amino acids, amides and lysine. Low in sodium; ideal for people with heart and kidney ointments, have Fe, Ca, K, P and folic acid. It has vitamin C, cynocobalimin content found only in animal products. They further stated that the Consumption of mushrooms slows down the spread and effect of cancer, heart disease and thus, boost immune system. Their protein value was reported by [6] to be twice as that of asparagus and potatoes, four times as that of tomatoes and carrots, and six times as that of oranges. Also, the energy level varies according to species, which is about equal to that of an apple. Notwithstanding, metal concentration in vegetations had in the recent past witnessed increased concentration due to man's anthropogenic activities resulted to great environmental concern. They can enter the food chain when absorbed by plant and the grazed by animal. Heavy metal concentrations in mushroom are considerably higher than those in agricultural crop plants, vegetables and fruit [7]. This suggests that mushroom posses

a very effective mechanism that enables them readily take up some heavy metals from the ecosystem. [7] Observed that some wild edible mushroom species have been known to accumulate great concentration of heavy metal such as lead, cadmium, copper, chromium zinc and nickel. The accumulation of heavy metals in microfungi has been found to be affected by environmental and fungi factors. Environmental factors such as organic matters, pH and metal concentrations in the soil, and fungi factors such as species of mushroom, morphological part of fruiting body, developmental stages; age of mycelium and biochemical composition affect metal accumulation in microfungi. Mushroom is easy to cultivate and this is seen in the use of idle structures for growth, the use of agricultural waste as substrate - mostly waste materials from farms, plantations or factories, it involve the use of small initial capital, possible production all the year round, and most of all, it can create employment and thus, generate income for farmers. Owhelogbo is a modern town in Isoko North Local Government Area of Delta State, in the Niger Delta region of Nigeria. With increase agricultural activities coupled with machineries put in place by both the State and federal government to promote farming such as "Delta without oil by Delta state; the export processing zone set up by the federal government and located in Warri and by the recent commitment of the federal government to environmental issues, all geared to promote commercial agriculture, also since metals may enter the food chain as a result of the uptake of edible mushrooms, the objective of this study is to determine the nutritive value and the level of heavy metal concentration in these edible mushrooms and thus, report possible contamination that would represent health hazard of three species grown in the Owhelogbo community in other to encourage people to embark on their husbandry.

2. Materials and Methods

Three mushroom species were harvested in triplicate in the farmyard, uncultivated land and forest from the Owhelogbo community in Isoko North Local Government area of Delta State, Nigeria. The mushroom samples were kept in a sterile paper bag to avoid any form of contamination and was immediate taken to the Botany Department of the Delta State University, Abraka Delta State. The mushroom species were gently soaked and washed with deionized distilled water and wiped with kitchen towel. The fleshy mushroom fruit were chopped into pieces with steel knife. Large portion was taken for moisture and ascorbic acid content determination. The rest of the chopped mushroom samples were dried under room temperature for one week before milling to a coarse powder and stored in an air tight bottle prior to analysis.

Proximate Analysis

Moisture content was determined by drying 2g of the fresh mushroom sample to constant weight at 60 - 80^{o}C in a circulating oven, for ash, 2g of the prepared sample were placed in a ceramic crucible that had been previously heated and cold until a constant weight was obtained. The samples were then subjected to ashing in a muffle furnace maintained at about 550^{o}C until a constant final weight for ash was achieved. Oil content was determined by soxhlet extraction with hexane as solvent, protein by the kjeldahl method, and crude fiber by the acid and alkaline digestive methods [8]. The total carbohydrate content was estimated by difference obtained after subtracting protein, fat, water, crude fiber and ash percentage from one hundred.

Mineral Analysis

The dried and ground edible mushroom samples were sieved with a 2mm rubber sieve. 2g of each mushroom sample was weighed and subjected to dry ashing in a clean porcelain crucible at 550^{o}C in a muffle furnace. The resultant ash was dissolved in 5ml of HNO_3/ HCl/H_2O (1:2:3) and heated gently on a hot plate until brown fumes disappeared. To the remaining material in each crucible, 5ml de-ionized water was added and heated until a colourless solution was obtained. The mineral solution in each crucible was transferred into a 100ml volumetric flask by filtration through a Whatman No. 42 filter paper and the volume made up with de-ionized water. This solution was used for elemental analysis by Atomic Absorption Spectrophotometer (AAS). A 10cm-long cell was used and concentration of each element in the sample was calculated according to the percentage of dry matter.

3. Results and Discussions

Table 1: Proximate composition of edible mushroom species (%)

Parameters	*L. procera*	*B. edulis*	*B. badius*
CHO	50.01±0.12	47.72±0.14	46.80±0.22
Protein	21.24±0.20	22.32±0.17	27.34±0.11
Fibre	2.84±0.20	0.37± 0.22	3.14±0.19
Fat	1.96±0.27	1.28±0.11	1.39±0.14
Ash	3.12±0.29	2.77±0.11	2.49±0.29
Moisture	78.51±0.34	84.47±0.14	79.72±0.20

Values are mean of triplicate, CHO - Carbohydrate

Table 2: Metal composition of three mushroom species in (ppm)

Parameters	*L. procera*	*B. Edulis*	*B. badius*
Pb	0.120±0.02	0.200±0.03	0.140±0.02
Cd	0.080±0.03	0.320±0.04	0.200±0.03
Zn	0.278±0.05	0.139±0.02	0.139±0.03
Cu	0.800±0.06	0.536±0.02	0.800±0.07
Ni	0.006±0.03	0.006±0.04	0.006±0.06
Cr	0.128±0.02	0.090±0.04	0.160±0.03

Values are mean of triplicate

Table 3: Mineral Composition mushroom species in mg/100g

Parameters	*L. procera*	*B. Edulis* .	*B. badius*
Mg	1.84	2.02	1.97
Fe	0.69	0.58	0.58
Mn	0.03	0.05	0.05
K	2.24	3.03	3.24
Na	0.61	0.52	0.57
Ca	3.42	3.08	3.21

Table 1 shows the proximate composition of *Lepiota procera, Boletus edulis and Boletus badius* species in g/100g. Results from analysis reveal that the mushroom species tested for had high moisture content that range from 78.51±0.34 to 84.47±0.14. This explains why mushroom is preserved by placing them in a folded brown paper bag and the bag kept in the main compartment of the refrigerator. It was reported by [4, 9], that the bag absorbs the excess moisture from the mushrooms and thus preventing them to get soggy or moldy. The high moisture content also explains why mushrooms are not kept near foods with strong odors or flavors – they will absorb them like a sponge. The results from table 1 further revealed that the three mushroom species contains high quality carbohydrate and an appreciable amount of protein, fibre and ash. The high carbohydrate and moisture content suggest that great care must be taken in mushroom handling and preservation because these high contents would increase mushroom susceptibility to fungal and bacterial infections. This finding showed that mushroom could be celebrated as a source of powerful nutrient since it provide many of the nutritional attributes of farm produce, as well as attributes more commonly found in meat, beans and grains. The low fat content of the mushroom species listed in this study could suggest that mushroom diet could be an effective method for reducing daily energy and fat intake. The appreciable amount of the fiber content in the various mushroom species helps lower cholesterol and is important for the digestive system. Results from table 2 reveal that all the metals under investigation in this study were detected in all mushroom species investigated. The highest metal concentration for Pb, and Cr was observed in *Boletus Edulis* with 0.140 and 0.160ppm respectively. *Leprota procera* had the highest metal concentration for Zn to be 0.278ppm while *Boletus badius* had the highest metal concentration for Cd to be 0.320ppm. *Leprota procera* and *Boletus Edulis* had maximum metal concentration for Cu to be 0.800ppm. The three mushroom species under investigation had metal concentration for Ni to be 0.006ppm. Finding from previous studies reveals that the accumulation of heavy metal in mushroom depends on the type of substrate, the study area, metals interaction and the species of mushroom [10, 11]. [10] reported the accumulation of metal concentration on mushroom growing on heavily polluted area. They further reported that the uptake of metals from substrate by mushroom mycelia and sporocarps, largely depend on the nature of the metallic compound because the availability of the cation depends to a greater extent, on the respective anions. Data's from table 2 further reveals that the metals under investigation were below the permissible limit of the WHO and the International / National Standard for Heavy Metals in Food except for Cd which is above their permissible limit of 0.300ppm and 0.1ppm respectively. Cadmium is a highly toxic metal with a natural occurrence in soil, but it is also spread in the environment due to human activities. Cadmium is known as a principal toxic metal, since excessive cadmium exposure may give rise to renal, pulmonary, hepatic, skeletal, reproductive effects, and cancer. It was reported that cadmium is accumulated mainly in kidneys, spleen, and liver, and its blood serum level increases considerably following mushroom consumption [12]. Results from table 3 reveal that mushroom is a rich source of minerals. The results of mineral composition of this study showed that these mushroom species can be used for diet formulation. The importance of mineral in our diet cannot be over emphasized given their roles in metabolic reaction, bone rigidity and osmoregulation among others. The low Na and fairly high K content in the mushroom samples shows that mushroom could be used for diet formulation [13]. Potassium is an important mineral that aid the maintenance of normal fluid and mineral balance. it was reported by [13] that the presence of these low Na and K content of the mushroom species is an added advantage because while Na is essential for normal heart and muscle function, K helps in muscles contract, maintain fluid balance, and maintain a normal blood_pressure Normal potassium levels in the body help to keep the heart beating regularly. They further reported that Potassium may help reduce your risk of kidney stones and also bone loss as you age but too much sodium has adverse effects on your heart and a direct relationship with hypertension in human. The result from the study also witnesses the presence of minerals such as Mg, Ca, Fe and Mn. The presence of an appreciable amount of these minerals in mushroom species gave them their unique quality as food. Ca helps to keep the bones and teeth strong, thereby supporting skeletal structure and function. It also play key roles in cell signaling, blood clotting, muscle contraction and nerve function [14]. The body cells use calcium to activate certain enzymes, transport ions across the cellular membrane, and send and receive neurotransmitters during communication with other cells [4, 14]. As an electrolyte, or a particle that helps conduct electricity in the body, calcium is also one of the key players in maintaining a regular heartbeat. As reported by [14]. Although excess Ca consumption can lead to constipation and kidney stones, Ca may decrease the risk for colorectal cancer and can lower systolic blood pressure in individuals with high blood pressure. The presence of Mg in the various mushroom species could leads to the normal metabolism of calcium and phosphorus and also, activates some enzymes responsible for the break - down of glycogen. Fe is required for the production of red blood cells (a process known as haematopoiesis), it is also part of haemoglobin (that is the pigment of the red blood cells) binding to the oxygen and thus facilitating its transport from the lungs through the arteries to all cells throughout the body. The mineral is also involved in the conversion of blood sugar to energy and also boast the immune system. Mn serves as an enzyme activator.

4. Conclusion

This study has been able to demonstrate that mushrooms contain very useful nutrients that the body cannot do without. Although, they are low in calories**,** excellent source of potassium**,** rich in iron which is responsible for production of hemoglobin and oxygenation of red blood cells, Copper that is essential in making red blood cells; provides a great source of dietary fibre that helps in digestion; good source of protein and other important minerals. The concentration level of the heavy metal in the various mushroom species was generally very low. This is an indication that the vegetation within the community under investigation is excellently free from industrial pollutant. As Nigeria is racing toward industrialization, it is thus recommended that the heavy metal levels of edible

mushrooms should be analyzed more often in this region in order to evaluate the possible danger to human health from them bearing in mind that the uptake of metal ions in mushrooms is in many respects different from plants. For this reason, government at all sphere should implement environmental policies to limit the introduction of these toxic metals through man's anthropogenic activities and also put programmes in place to educate, encourage and sponsor school graduates at all level into mushroom farming in order to reduce the rate of unemployment the country is experiencing and so make protein and other food supplement available to the ever increasing population. Most especially, the resident government, multinationals, cooperate bodies and individuals should note that no matter their activities, be it synthesizing or analyzing, they should have it at the back of their mind that their immediate environment come first. Their activities is responsible for the level of the various form of contamination witnessed in our various environment.

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