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Original Contribution

ESTIMATION OF SOME METAL ELEMENTS AND PROXIMATE PROPERTIES OF *BOLETUS EDULIS(fr)*, A WILD MUSHROOM SPECIES IN THE NIGERIAN SAVANNAH

S. D. Gyar*, G. Owaku

Microbiology Unit, Department of Biological Sciences, Nasarawa State University, Keffi, Nigeria.

ABSTRACT

A wild species of *Boletus edulis* was obtained in a harvest from the fallowing green lands of the Nasarawa State University, Keffi, Nigeria and cleaned, air dried, crushed into powder and ashed in a furnace for analysis. Proximate values (in percentage) of ash and moisture contents, crude protein, crude fibre fat and carbohydrates were obtained after analysis of the ash by application of the standard methods prescribed by the Association of Analytical Chemists (AOAC). Analysis for metals was carried out using the Atomic Absorption Spectrophotometer (AAS). For proximate values, percentage moisture was 28.99 ± 0.01, being the highest , followed by carbohydrate;25.95 ± 0.03 with protein at 5.22± 0.01 being the lowest among others. AAS showed calcium having the highest concentration (in mg/l); 14.94, then magnesium; 12.37. Zinc had the lowest value; 0.10mg/l of all the nine metals analyzed for. The results obtained for this mushroom have been discussed and particular attention paid to the nutritional and metabolic importance of this experimental species. Appropriate recommendations have also been made on observed results**.**

Key words: wild mushroom, metal elements and proximate values

INTRODUCTION

A mushroom is a fleshy, spore bearing fruiting body of a fungus, varying from well known cap and stem types, and their functions is to produce sexual spore (1). Typically, mushrooms produce above ground, on soil or its food sources. The word mushroom is most often applied to fungi (Basidiomycota, Ascomycete) that have a stem, a cap (pileus) and gills (lamellae) on the underside or the cap. However, mushroom can also be refer to a variety of gilled fungi, with or without stem and the term is used even more generally to described both the fleshy fruiting body of some ascomycotta and the woody or leathering fruiting body of some Basidiomycotta. And can edible or non edible (2).Edible mushroom are been found to be a very good immune booster and have been found useful in the management of HIV/AIDs patients (3).

***Correspondence to:** *S. D. Gyar, Microbiology Unit, Department of Biological Sciences, Nasarawa State University, Keffi, Nigeria. Email-silasgyar @ yahoo.co.uk*

Mushroom production began long in China before Europe and America (2). These Authors also show that *Auriculara auricula* was first cultivated in China in AD600 while *flaminelins velutipes* was grown around AD800-9000.Cultivation of other mushrooms such as *Tremella fuciformis*, lentinus edodes and volvariella voliacae was first recorded in China AD 1800, 1600 and 1700 respectively.

Boletus edulis can be found most commonly in Europe, North America and Africa. The mushroom can grow singly or in a small cluster of two or three specimens. Its habitat consist area dominated by pine (*pinus spp*). Spruce (*picea spp*). Eastern hemlock (*Tsuga canadesis*), woody (*Abies spp*) trees. Not limited to this location, the king Bolete is also found in hardwood forest containing oaks, in swamp and wet lands. It fruits from summer to autumn, following sustained rainfall. This mushroom can also be found during the fall in Syria and also Lebanon where it grows in large clusters on decaying oak tree stumps. It is also found on farmland in Nigeria during the raining season (4).

Although, there are existing reports on the mineral and proximate values of mushrooms, the current study has both the objectives of establishing the values of these two parameters for this African species of mushroom and also, obtain and document the empirical details of these characteristics .Another objective is to project this species of mushroom as one with ready sources of nutrients depending of course, on the outcome of investigations.

MATERIALS AND METHODS

Sample Collection and Processing

The experimental species of *Boletus edulis* was collected from Tattara Mada in Kokona Local Government area of Nasarawa State, an African Sub Saharan community in Nigeria, in April 2008 during the early rains. The specimen was sun-dried for four (4) weeks after which it was further dried in the hot air oven for 1 hour at 70ºC and thereafter, grounded into powder form by means of a laboratory mortar.

Proximate Analysis

This was done in order to determine the percentage compositions of ash, crude protein, crude fibre, carbohydrate, crude fat and moisture contents. The standard prescribed methods of the Association of Officials of Analytical Chemists AOAC, (1990) (5) were used.

Determination of Mineral Ion Compositions

Analyses of minerals was done through ashing by drying the powdered preparation for two hours at 200^0C and further drying at 550^0C for four hours in a furnace to obtain a constant weight.0.5g of ashed sample was digested in a volumetric flask with concentrated nitric acid and made up to 50ml with deionised water and filtered .Sodium and Potassium were determined as in the reports of Aremu *et a*l, (2006) using a flame photometer (Model 405 Corning, UK). The determination of other metals was by the use of the Atomic Absorption Spectrophotometer (AAS Solar 969) in the analytical laboratories of the Science Equipment and Research Company (SESCO) ,Abuja, Nigeria. The determination of each value was in triplicates using BDH Analar chemicals of analytical grades (England). The detection limits of each metal was earlier determined in accordance with the Techtron (1975) standards with the optimum analytical grade between 0.1 ± 0.5 absorbance units with 0.87-.22% coefficient of variation. Values of mineral ions obtained during the analysis were recorded in mg/100g protein.

RESULTS AND DISCUSSION

The proximate compositions of *Boletus edulis* obtained from this study are as shown in **Table 1**.It shows that this species of mushroom is a very rich source of plant fiber. The fiber content (10.34%) is far above that of some legumes (bambra nut, cowpea) (2.1 and 4.4%) as reported by (6).Mushrooms are largely reported to have high fibre content resulting in high content of roughages (3). Roughages are known to aid in digestion offering good surfaces for enzyme action (2)

Table 1. *Results showing the concentration of proximate value in Boletus edulis*

Parameters	Composition (%)
Moisture content	28.99 ± 0.11
Ash content	22.06 ± 0.13
Crude fat content	07.44 ± 0.02
Crude fiber content	10.34 ± 0.10
Crude protein content	5.22 ± 0.01
Carbohydrate (by difference)	25.95 ± 0.11

Results are mean ± standard deviation of triplicate samples**.**

Table 2. *Results showing the concentration of metals ions (mg/l) in Boletus edulis using the ASS*

Parameters	Concentration (mg/l)
Calcium (Ca)	14.94 ± 0.01
Magnesium (Mg)	12.3 ± 0.03
Manganese (Mn)	0.56 ± 0.02
Sodium (Na)	2.44 ± 0.01
Zinc (Zn)	0.10 ± 0.02
Chromium (Cr)	0.27 ± 0.03
Iron (Fe)	2.55 ± 0.10
Potassium (K)	2.01 ± 0.11
Copper (Cu)	0.55 ± 0.22

Results are mean ± standard deviation of triplicate samples.

The protein content of 5.22% observed here is higher than that of rice (4.5%) and water melon (4.5%) but lower than that of major plant protein such as cowpea (8.89%), African locus bean (11.13%), pigeon pea (18.65%),as in the report of Etang *et al*, (7). This protein value is rather low compared with other reports obtained for such mushroom species as *Pleutus cervinus* (8), *Macrolepiota procerus* and *Plurotus pulmonarius* (9).The biological value of a protein depends upon its amino acid composition. The concept is based on the fact that injected proteins are hydrolyzed to their constituent amino acids that are absorbed by the body. Therefore, it is not the protein which are required but rather the amino acids present in the proteins (10).

The proximate analysis shows that this species of mushroom to have a low fat content of 7.44, Oei; and Manu, Tawah and Martin (11) have I earlier reports, mentioned some mushroom species as having low fat contents. This low value makes this species suitable for those with low dietary fat requirement. The moisture content of 28.99% for this species of mushroom is relatively higher than those in legumes when compared to the value of 2.1 and 6.9% reported by Aremu *et al*, (12). The high moisture content imposes on this species of mushroom a short-shelf life. This is because high moisture content engenders microbial deteriorations arising from high water activity ($^{a}/_{w}$). (13).Ash content was 22.06%; a reflection of the high content of organic matter present in the sample. The value is higher than that of pigeon pea reported by (14).

Table 2 is for the results of the concentration of metal ions in the experimental species of mushroom. The order of ion concentrations are: Ca > Mg > Fe > K > Na > Mn > Cu > P > Cr > Zn. The presence of Cu in the species points to anthropogenic input, indicating the heavy metal accumulative potential of this mushroom. The concentration of the Cu (0.5544 mg/l) was far lower than the recommended limit of 4mg/g in food and the lethal dose of 2-3 mg/g for adults (CEC, 1980) (15). However, excess concentration of Cu in humans may lead to an ailment, referred to as Wilson disease (16). This implies therefore that this mushroom is safe for consumption as far as the required concentration of Cu is concerned since it is far lower than the lethal concentration vis-à-vis the World Health Organization values (17).

The concentration of Mg (12.360 mg/l), Ca (14.941 mg/l), Na (2.4415 mg/l) and K (2.519 gm/l) are below the recommended value by the WHO (17) (Mg (300 mg/l), Ca (100 mg/l), Na (20mg/l) and K (10.00mg/l),) this may be due to environmental attributes, since they are accumulators of metals and these are only absorbable to the extent of their bioavailability (7). Therefore, in this case, supplementation may be required when the mushroom is used as food. Calcium and phosphorus are associated with growth and maintenance of bone, teeth and muscles while copper and calcium help haemoglobin formation and transport of ions (18,19). Zinc is an essential enzyme while iron helps in cellular oxidation and magnesium is an essential intracellular fluid cation (16). On the whole, the presence of all these metals in

this species of mushroom presents it as a potentially useful substance for all human biochemical and physiological requirements. It must be however added that, if this particular mushroom is to serve the nutritional needs of a consumer, it may be necessary to consume higher quantities to enable it meet up with the WHO (18) quantities for dietary needs.

CONCLUSION AND RECOMMENDATIONS

The results in this study show that this species of mushroom is rich in food substances useful in the body. Though concentration of some mineral ions in the species of mushroom is low, their supplement might bring them up to the required nutritional value. The fat content of the species of mushroom was observed to be very low which makes it suitable for those who require low fat dietary food. From these, it is generally conclusive therefore, that *B. edulis* is suitable for human consumption and is a cheap source of nutrients and minerals since it grows in the wild. The experimental species is recommended for consumption.

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