Analysis of Nutritive and Medicinal Values of Selected Edible Mushrooms at the University of Eastern Africa Baraton Farm, Nandi County

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Abstract

The analysis of nutritive and medicinal values of selected edible mushrooms that is oyster, button and ordinary native mushroom consumed in the University of Eastern Africa Baraton were evaluated. The objectives of the study were; to determine the nutritive value of the selected mushrooms in the University of Eastern Africa Baraton, farm, to analyze the presents of minerals in the selected mushrooms and to determine the medicinal nature of the analyzed minerals and nutrients found in the mushrooms. The mushroom varieties were harvested and dried, then proximate, mineral and vitamin analyzed to determine their presence and their nutritive and medicinal values of the minerals determined. Standard scientific methods were used to analyze for approximate nutrient and mineral composition. The approximate content of the mushroom was found to be in the range of 7.80 – 23.40% for protein, 6.40 – 8.01% for fat, 2.40 – 11.74% for fibre, 2.48 – 4.08% for ash matter and 58.60 – 63.20% for carbohydrate. Five key essential mineral elements were analyzed: magnesium, selenium, iron, zinc and iodine having values of 0.80 to 2.76%, 2.90 to 6.02%, 2.72 to 4.50%, 3.38 to 4.44% and 0.30 to 0.62% respectively. The order of performance from the analysis showed that ordinary native, button and oyster mushroom respectively have the highest level of nutrients and minerals. In addition, the results showed that mushrooms have high nutrient potentials hence it will serve as a good means of reducing the incidence and high prevalence of malnutrition in UEAB and Kenya at large given that it is affordable when it comes to the indigenous mushrooms and even the propagated ones.

Keywords: Edible Mushrooms, minerals, Wild Mushrooms, Cultivated, Nutrients, Medicinal, ordinary native, Oyster, Button

INTRODUCTION

Mushrooms are a widely distributed food resource on earth and have been consumed because of their nutritional value and medicinal properties for over 2000 years. For their enjoyable flavor and taste, human health was improved by mushrooms due to their nutrients, including digestible proteins, carbohydrates, fiber, vitamins, minerals, and antioxidants (Acharya et al., 2017, Zhang et al., 2016).

Although mushrooms are often grouped with vegetables and fruits, they are actually fungi. They are macro-fungi which belong either to Basidiomycetes or Ascomycetes and they are very distinct from plants, animals and bacteria (Mushigeni and Chang, 2001). It is a reality now that the growing interest in the cultivation of mushrooms can help in solving many problems of global importance such as protein shortage as well as improving the health and well-being of people, considering that mushrooms are

valuable health foods which are low in calories and provide essential minerals (Rahi et al., 2016; Toledo et al., 2016; Nagy et al., 2017).

In most rural African village communities, indigenous edible mushrooms are highly treasured (Weinheim, 2006) since they start growing soon after the first rains and become very handy vegetables long before the agricultural crops planted are ready for harvesting (Chipompha, 1985). Nutritionally, edible mushrooms provide essential nutrients and contribute significantly to man's diet. Many studies on nutrient determination have revealed that mushrooms contain substantial amount of essential nutrients like proteins as reported by Olila et al. (2008) who found out that protein content on dry weight basis can be as high as 25.8% as determined in *Termitomyces microcarpus*. Additionally, other results have also shown that nutrient contents with respect to specific nutrients can significantly differ in mushrooms of same genus as evidenced by a study conducted by Kansci et al. (2003) who found out that the protein content in six *Termitomyces* species ranged from 15 - 19% on dry weight.

Despite the many studies on nutrients and minerals determination in different mushroom species globally, little or no work has been carried out in Kenya to compare the nutritive value between cultivated and indigenous mushrooms and this work aims at determining and comparing selected nutrients in some cultivated and indigenous edible mushrooms in the University of Eastern Africa, Baraton, Nandi County.

MATERIALS AND METHODS

Sample Collection and Identification

The three samples of dry ordinary native (Agaricus campestris), button (Agaricus bisporus) and oyster (Pleurotus ostreatus) mushroom were obtained in the agriculture research farm and the ordinary native mushroom sourced from a farmer who grows mushroom at Baraton Center. The samples were then transferred to the laboratory for analysis. Most of the analysis was done in the biology lab of our university due to their specialized apparatus and tools. The native mushroom grew on ordinary soil and was obtained along fences with rich fertile soils whereas the button and the oyster mushroom were raised from wheat straw substrate.

Sample preparation

Before the nutrient analysis was done, the moisture content of the three samples of the mushroom was determined using a oven with a fan set at 100°C until all of them have constant weights to avoid biases. After that, the samples were all dried to constant weights and then grounded to powder for analysis.

Determination of Minerals

All the three samples having been extracted and dried, the mineral content of the test samples was determined by the dry ash extraction method which was invented by Maurice R. Marshall. The resulting ash was dissolved in a 100mls of diluted hydrochloric acid and then diluted into 100mls in a volumetric flask using distilled water. The resulting mixture was used for various analyses in determining the presence of nutrients and minerals in the various mushroom species. The minerals analyzed included: Zinc, Selenium, Magnesium, Magnesium and Iron.

Determination of Zinc

In the determination of zinc ions presence, 1gram of the sample was first digested with 20ml of acid mixture (600ml) Conc HNO3. About 5ml from the different samples of the three mushroom species was used. Also, standard solution of zinc was prepared in

concentration of 0.0, 0.2, 1.0 which was used to vary the test of the availability of the zinc ions in the three mushroom species.

Determination of Selenium

In determining copper and selenium minerals, 2grams of each sample was collected and was added into HCL. The mixture of the diluted clear digest was used for spectrophotometric reading. Also, standard solutions derived from the mixture of the elements were prepared in concentrations of 0.0, 0.5, 1.0 and 1.5ppm.

Magnesium determination

The 5mls of the mixture from each sample of the three mushrooms species were placed in a titration flask using a pipette and diluted to 100 ml with distilled water and subsequently 15 ml of buffer solution, five to ten drops of Eriochrome black T indicator and 2ml of triethanolamine were added. The mixture was titrated with Ethylene Acetate solution from red to clear blue. A scale developed which will determine the approximate amount of ions of magnesium was used depending on the colour arising from the test.

Iron determination

The prepared mixture solution was passed through the absorption spectrophotometer to read the iron concentration. The Standards were made with 10 mg/L using ferrous ammonium sulphate where 3 - 60 ml of iron standard solution (10mg/L) were placed in stepwise volumes in 100 ml volumetric flasks. Then, 2 ml of hydrochloric acid were added and then brought to the volume with distilled water. The mixture was measured using the atomic absorption spectrophotometer in mg/L. The whole procedure was repeated three times.

Crude fibre determination

Mushroom has a lot of fibre. The mushroom crude fibre was determined using the Hennenberg-Stohmann method. A 5g sample from each of the three mushrooms was boiled in a solution of octanol for approximately 20 minutes. After boiling, pyrex classes were used to filter the boiled solutions and the residue was washed using the boiled water at least 2 times to remove traces of hydrochloric acid which was used before during the preparation of the solutions from each mushroom species. The pyrex class which contained the residues was dried at 100°C for four hrs, cooled to room temperature and then weighed to find out the mass. The crucibles were then placed in a hot furnace at around 500°C for 4hours, and then cooled to room temperature and then weighted again and the mass recorded. The fibre content was then calculated using the formular below:

$$\% \text{ Ash} = \frac{W_2 - W_3 \times 100}{\text{wt of sample}}$$

Where W_2 = wt of crucible + sample after washing and drying in oven

W_3 = weight of empty crucible

Protein determination

Crude protein was determined using the biuret solution to identify its presence. A biuret solution is a blue solution that, when it reacts with protein, it changes its colour to pink purple. Solution of 10 mls from each species of the mushrooms was placed in a test tube and several drops of biuret solution was introduced and the colour was observed and recorded. The colour meter was used to analyse the approximated percentage of proteins in the three mushroom samples.

Fat determination

The fat presence in the three mushroom species was determined using ethanol reagent. Ethanol was added to the solutions from the three samples of the mushrooms. The initial colour of the solution should have been colorless and when the colour changed to a white emulsion, it showed the presence of crude fat. The heavier the intensity of the emulsion. The higher the amount of fat content in the mushroom species. This process was repeated for all the species of the selected mushrooms.

Statistical analysis

All data obtained from the study were analyzed using STATA package so as to determine the means and standard deviations and were subjected to one way analysis of variance (ANOVA). Differences in the nutritive and medicinal values for the three mushroom species used in the study were evaluated using least significance difference test at 5% level of significance.

RESULTS AND DISCUSSION

The following table displays the nutritive composition of native, oyster and button mushroom as analyzed.

Table 1: The Proximate Composition of Button, Oyster and ordinary native Mushroom Varieties

	Mushroom species	Carbohydrate %	Protein%	Fat%	Fibre%	Ash %
1	Oyster	58.60±0.10	7.80±0.10	6.40±0.10	2.40±0.10	2.48±0.10
2	Button	61.0±0.10	12.10±0.10	6.70 ±0.10	11.74±0.10	3.00±0.10
3	Ordinary native	63.20 ±0.10	23.40±0.10	8.01±0.10	7.40±0.10	4.03±0.10

Source: Laboratory Analysis, Agriculture Research Farm (2021)

From the lab analysis, the mushroom with the highest ash content was the ordinary native mushroom with a percentage of 4.03±0.10 followed by button mushroom with a percentage of 3.00 ± 0.10 and oyster mushroom with lowest content of ash at 2.48 ±0.10%.

The Fat content was the highest in ordinary native mushroom at 8.01 ± 0.10% and lowest in the oyster mushroom which had 6.40 ± 0.10% and the button mushroom had 6.70 0. ± 10%. As seen in the results in table one above, the ordinary native mushroom had the highest protein content of 23.40± 0.10%, button comes second at 12.10 ±0.10% and oyster had the least content of proteins at 7.80 ±0.10%.

Fibre is very crucial in our food since it helps in our digestion. The content of fibre in the three analysed mushroom species were as follows: oyster; 2.40±0.10 %, button, 11.74±0.10 % and ordinary native 7.40±0.10% respectively. Therefore, the highest in fibre is button mushroom and the least is oyster mushroom variety.

From the results above, the mushroom variety which had the highest carbohydrate content was the ordinary native mushroom at 63.20 ±0.10%, followed by button at 61.0±0.10 % and the oyster species had the least content of carbohydrates at 58.60±0.10 %.

Determination of Selected Minerals

Table 2: Selected mineral contents of oyster, button and the ordinary native mushrooms in percent

	Mushroom Species	Iron	Magnesium	Selenium	Zinc	Iodine
1	Oyster	4.50±0.10	1.62±0.10	4.98±0.10	3.90±0.10	0.32±0.01
2	Button	2.80±0.10	0.80± 0.10	2.90±0.10	3.38±01.0	0. 62±0.01
3	Ordinary native	2.72±0.10	2.76±0.10	6.02±0.10	4.44±0.10	0.30±0.01

Source: Lab Analysis Agriculture Research Farm (2021)

The three selected species of mushrooms underwent tests for selenium minerals as shown in the table 2 above. The selenium content was highest in sample ordinary native variety at 6.02±0.10, button mushroom at 2.90±0.10 and oyster mushroom at 4.98±0.10.

The content of iron tested in the three varieties of the mushroom was as follows: oyster had 4.50±0.10, button had 2.80±0.10 and ordinary native had an iron content of 2.72±0.10 percent. The highest content is from oyster mushroom while button as the least iron content.

The highest zinc content was seen in the ordinary native variety of mushroom at 4.44±0.10, followed by oyster which had a content of 3.38±01.0 percent and lastly button mushroom variety which had 3.38±01.0 percent.

Mushrooms have lowest levels of iodine as is evident from the lab analysis. The iodine content of the mushroom's variety were as follows: button having the highest content at 0. 62±0.01, oyster at 0.32±0.01 and the least was the ordinary native mushroom at a percentage of 0.30±0.01.

Mushrooms also exhibited moderate contents of magnesium which is a macro nutrient. From the lab analysis of the three varieties, the magnesium content was as follows: the ordinary native mushroom having the highest amount of magnesium at 2.76±0.10 percent, oyster follows with a content percentage of 1.62±0.10 and last was button with a content of 0.80± 0.10 percent.

DISCUSSION

Proximate Composition

From the laboratory analysis of the selected mushroom varieties, the amount of fats in the mushrooms ranged from 6.40% - 8.01% with ordinary native mushroom having the highest content and oyster mushroom having lowest content. The fat content of the mushrooms is low when compared to the content of carbohydrates and proteins. This agrees with earlier reports such as the one done in Turkey by Caglarlmak et al., (2002). The protein contents of the mushrooms analysed, ranged from 7.80% to 23.40%. These amount of protein in the mushrooms speaks much on its nutritional perspective. The mushroom protein contains all the nine essential amino acids required by humans.

Due to the presence of biologically active compounds of proteins, they are used as anticancer, antiviral, hepatoprotective, immune potentiating and hypocholesterolemic agents. This review aimed to discuss the high nutritional and therapeutic potential of mushrooms and their applications as functional foods or as a source of nutraceuticals for maintenance and promotion of health and life quality.

From the lab analysis, the carbohydrate contents in the mushrooms varied from 58.60% to 63.20%. This showed that mushrooms are a rich source of carbohydrates. The carbohydrate content of the mushrooms appeared similar to those reports by Ogbe and Obeka (2013) that the carbohydrate contents range from 61.24 and 69.93%) naturally. Therefore, this analysis showed a similarity with what other researchers have done.

The fibre amounts of the mushrooms were notably high, suggesting that the mushrooms would be valuable in improving human health by quickening the excretion of wastes and toxins from the body. The fibre contents ranged from 2.40% -11.74% as obtained from the laboratory analysis.

Mineral Composition and Its Nutritive and Medicinal Role

The five selected essential minerals (magnesium, zinc, iodine, iron and selenium) were determined in the three mushroom varieties. The content amounts are presented in Table 2 above; all the mineral elements were found in appreciable amounts and ranged widely among the species.

Magnesium is very important in the maintenance of osmotic balance between cells mostly in animals and least use by plants in cell osmosis. In these selected mushrooms, magnesium is present in 0.80 – 2.70%. This combined with calcium minerals is very important and crucial for lowering blood pressure, reducing the incidences and probabilities of osteoporosis and maintenance of bones.

Iron, which is essential for the biosynthesis of the oxygen-carrying pigment of red blood cells and the cytochromes that function in cellular respiration , is also present in good amounts in the mushrooms. The content amount of iron found in the mushrooms varied from 2.72 to 4. 50%. These therefore clarify the importance of mushroom to human nutrition and health.

Zinc which is indispensable in numerous biochemical pathways as an important co-factor for certain enzymes was equally present in the three mushroom species analyzed. The zinc content from the lab results showed that the three mushroom varieties have a zinc content ranging from 3.38 to 4.44%. zinc is is found in the cells throughout the body and it's needed for defensive (immune) system to work properly. Zinc plays an important role in cell division, cell growth, wound healing, and the breakdown of carbohydrates. Zinc is also needed for the sense of smell and taste.

Selenium is one of the body's antioxidant nutrients, working primarily as part of the enzyme glutathione peroxidase which was found has a part of mushroom content during the lab analysis. Selenium was found to be in the range of 2.90 to 6.02% which is quite considerable.

From the results, Selenium was the leading mineral in content in the mushrooms compared to the other mineral elements analyzed. According to research, Selenium plays a critical role in metabolism and thyroid function and helps protect the body from damage caused by oxidative stress. Selenium may also help boost the immune system, slow age-related mental decline and even reduce the risk of heart disease.

Iodine is completely indispensable to life. The iodine from foods becomes iodide. Iodide occurs in the body in small amounts, but its key role in the body forms an integral part of the thyroid hormones that regulate body temperature, nerve and muscle function, reproduction, growth, metabolic rate and more are well established. The iodine content of the mushrooms was found in minute amounts of 0.30 to 0.62%.

According to research, the body also needs thyroid hormones for proper bone and brain development during pregnancy and infancy.

CONCLUSION AND RECOMMEDATION

The findings from this study revealed that mushrooms are highly nutritious foods. They are rich in macro nutrients and minerals even selenium which has an anti-oxidant nutrient. Their protein content is high, offering up to 7.8% - 23.40%, higher than the protein content of most vegetables. Mushrooms are foods that can be eaten extensively by anybody, both the old and young, females and males. It is also good food for hypertensive patients as its high magnesium content and other minerals that were not analyzed can help to control blood pressure. Therefore, mushroom consumption should be encouraged in the communities especially here in University of Eastern Africa, Baraton and its environs were its consumption and awareness of its importance is very low at 23% and also its cultivation should be encouraged so that there will be a year-round production and availability of mushrooms in all seasons. Mushrooms is a sure bet for human health. Try it today

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