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Research Article

CULTIVATION OF EDIBLE MUSHROOMS (*AGARICUS BISPORUS*) IN THE LABORATORY AND DETERMINATION OF PROXIMATE AND MINERAL COMPOSITIONS OF CULTIVATED MUSHROOMS WITH OTHER PROTEIN SOURCES

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ABSTRACT

Cultivation of edible mushrooms (*Agaricusbisporus*) in the laboratory and determination of proximate and mineral compositions of cultivated mushrooms with other protein sources were carried out. Mushrooms seeds (spores) were purchased from a rented store at WedotatoryKuru, Jos South. Samples of wild mushrooms were collected from Gindiri and Maijuju forest in Jos, Plateau state. Samples were packaged in sterile polythene bags and were transported to the Laboratory, Veterinary Research Institute, VOM. Wheat straw, paddy straw and cotton waste were used as substrates at different combinations. Substrates were soaked in water and 3% lime was mixed in cotton waste to maintain its pH, the substrates were piled up and covered with polythene sheet. Substrates were allowed to ferment for 7 days and were spread on a clean floor for evaporation of excess moisture. Spores were inoculated under standard procedure. Method of identification of edible mushrooms was the cluster analysis using Unweight Pair of Group Method. Proximate composition and mineral elements analyses were carried out using standard methods. Results showed that as temperature increased, mycelia growthin diameteralso increased. The highest mycelia growth(9.00mm) was recorded at day eight (8) after inoculation and at the temperatures of 28^0C and 36^0C respectively. At 38^0C mycelia growth of cultivated mushroom attained its highest growth and started shrinking. Proximate compositions like crude protein and crude fiber was highest 21.64% and 17.30% respectively in cultivated than wild mushrooms and other sources analyzed. Macro minerals was highest in both mushrooms than beans, beef and eggs with potassium having the highest value. In micro minerals analyzed, there was no significant difference $p>0.05$ between both mushrooms and other sources analyzed. Edible mushrooms cultivated in the laboratory is also rich in protein, crude fiber and minerals, it can therefore be recommended as food supplements in places where there is shortage of protein and food minerals

INTRODUCTION

The rapidly increasing world population generates the challenges of providing necessary food sources. In particular, protein supply poses a problem since essential amino acids cannot be replaced. One possible solution to this problem is single cell protein (SCP) production. Bacteria and yeast are candidates for the synthesis of SCP, bacteria grow more rapidly and efficiently than yeast on cheap substrates and they produce and provide a higher content of protein (Iyaka, 2014). People need to eat protein so that the body can repair itself and maintain healthy cells in the skin, muscle and organs (Cherian, 2009).The amount of protein in mushrooms is much less than meat. Dietary protein is not one substance, but actually a combination of amino acid molecules. However, these foods do not have entire protein molecules, just the amino acids. Meat are always complete proteins, mushrooms can still form a complete protein when combined with foods that make up missing amino acids. For example, mix mushrooms with broccoli and corn to make a complete protein (Iyaka, 2014).Mushrooms are an amazing food, they are meaty, juicy and chewy, and their flavor lends itself to an endless array of dishes and cuisines. A common misconception though is that due to their meaty, earthy flavor, mushrooms can be a good replacement for meat. This is further exacerbated by offering vegetarian a Portobello mushroom steak at cookouts. Mushrooms are a great source of nutrients, but protein is not one of them. A 3-ounce serving has just 3 grams of protein,

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compare to 20-25 grams of protein for a comparable serving of chicken or beef. They are a source of many minerals: selenium, copper, potassium, phosphorus, zinc and manganese (Adamu*et al.,* 2016).

MATERIALS AND METHODS

Collection of samples

Mushrooms seeds (spores) were purchased from a rented store at WedotatoryKuru, Jos South. Samples of wild mushrooms were collected from Gindiri and Maijuju forest in Jos, Plateau state. Samples were packaged in sterile polythene bags and were transported to the Laboratory, Veterinary Research Institute, VOM for analyses.

Cultivation of edible mushrooms (Agaricusbisporus)in the Laboratory

Wheat straw, paddy straw and cotton waste were used as substrate. Substrates were soaked in water and 3% lime was mixed in cotton waste to maintain its pH. After soaking, the substrates were piled up and covered with polythene sheet. Substrates were allowed to ferment for 7 days. Substrates were spread on floor for evaporation of excess moisture (Owaid*et al.,* 2017)

Combination of substrates utilized for cultivation

T_1 = Cotton waste
T_2 = Paddy straw
T_3 = Saw dust 1:1
T_4 = Saw: Paddy straw 1:1
T_5= Cotton waste: paddy straw 1:1
T_6 = Cotton waste: saw dust 1:1
T_7 = Paddy Straw: Cotton waste: saw dust 1:1:1

Each substrates (300g) was filled in polypropylene bags (6×8)cm and pasteurized by local methods. Inoculum of the fungus was given under aseptic conditions and during spawn running the temperature was 22-26^{0}C. The experiment was laid out according to completely randomized design under two-way factional. Time required for accomplishment of spawn running emergence of primordial, harvesting stage after primordial initiation, number of fruit bodies, stalk length (mm), stalk diameter (mm), average individual weight of fruiting bodies were measured and recorded(Owaid*et al.,* 2017)

Identification of cultivated and wild mushrooms

Method of identification was the cluster analysis using the UPGM= Unweight Pair of Group Method (Sneats and Sokol, 1973)

Determination of proximate analysis

Proximate compositions such as moisture, carbohydrates, crude protein, fiber, fat and oil, ash contents were determined using methods of AOAC (2012).

Mineral analysis

Methods of AOAC (2012) were adopted for determination of the following minerals:Iron, Zinc, Calcium, Magnesium, Manganese and Copper using Atomic Absorption Spectrophotometer (ASS).

Statistical analysis

The results from all experiments were analyzed using analysis of variance (ANOVA) for multiple compositions using stratigraphic statistics graphics 2.1 system software (Statistical Graphics Corp Rockville, MD, USA) with a IBM personal system 2 model 20 computer. Differences were considered significant when $P < 0.05$

RESULTS AND DISCUSSION

Table 1 Effects of temperature on mycelia growth of laboratory cultivated *A. bisporus*

Mycelia colony in diameter (cm)

Temperature (^{0}C)	2DAI	4DAI	6DAI	8DAI
16	1.12	1.70	2.64	4.0
20	1.24	2.56	4.08	6.76
24	1.40	4.10	6.60	8.00
28	2.12	4.24	7.04	9.00
32	1.66	4.24	7.04	9.00
36	1.60	2.00	2.96	1.26

NB: DAI = Day After inoculation

Table 2 Proximate analysis for protein in wild, cultivated mushrooms and other protein sources (Eggs, Beans, and Beef)

Sample	Crude protein	Fat	Ash	Crude fibre	Moisture	NFE
Wild mushroom	17.32	3.61	8.19	7.87	15.36	63.01
Cultivate mushroom	21.64	1.05	9.05	17.30	7.65	50.96
Egg	49.14	40.11	3.09	0.01	73.92	7.65
Beans	20.90	4.61	3.48	9.52	6.12	61.49
Beef	75.11	7.79	4.01	0.04	65.80	13.05

Legend
NFE- Nitrogen Free Extract

Table 3 Determination of macro minerals content in laboratory cultivated, wild mushrooms and other protein sources

Parameters	Wild mushroom	Cult. Mushroom	Beans	Egg	Beef
Calcium (Ca)	0.9488	0.8673	0.8653	0.9089	1.8016
Phosphorus (P)	2.0000	1.9000	0.8000	0.3000	0.6000
Potassium (K)	3.9509	3.8992	3.8892	0.0323	3.6916
Nitrogen (N)	0.2000	0.6000	0.4000	0.1000	0.6000
Iron (Fe)	0.7921	0.8409	-	0.0129	-

Table 4 Determination of micro minerals content in laboratory cultivated, wild mushrooms and other protein sources

Parameters	Wild mushroom	Cult. Mushroom	Beans	Egg	Beef
Manganese (Mn)	0.2509	0.2398	0.5519	0.2554	0.2554
Copper (Cu)	0.0056	0.0042	0.0052	0.0058	0.0052
Lead (Pb)	0.2131	0.0681	0.0771	0.2559	0.0124
Chromium (Cr)	0.1389	0.4957	0.0691	0.0672	0.1713
Zinc (Zn)	0.4673	0.4653	0.4816	0.4730	0.4816
Cadmium (Cd)	0.0126	0.0110	0.0127	0.0113	0.0124
Nikel (Ni)	0.0169	0.0216	0.0186	0.0005	0.0186

DISCUSSION

Species of *Agaricusbisporus* took minimum number of days, it was observed that after spawn running primordial formations took 7-8 days. An average number of 5 days was taken to effect the harvesting of the fruiting bodies. It was observed that the protein contents of eggs and beef were more than that of mushrooms and beans. This is expected as eggs have been reported to contain high amount of proteins(Cherian, 2009). Similarly Nutrient composition of beef meat contains high biological value protein and important micronutrients that are needed for good health throughout life. It also contains a range of fats. Recent analyses have shown that there has been a

significant trend to leaner cuts of meat over the past two decades creating a wide disparity of nutrient composition (Williams and Droulez, 2010). While the nutritional composition will vary somewhat according to breed, feeding regimen, season and meat cut, in general beef meat has a low fat content, is moderate in cholesterol and rich in protein and many essential vitamins and minerals. The value of crude protein, which is 75.11g/100g was observed to be high this is expected for analysis on dry matter basis especially when initial sample contains a high amount of moisture as in this case (moisture content 65.80). The crude fiber, ash content and crude fat for beef are 0.04,4.01 and 7.79 respectively which agrees with other nutritional research findings on beef(Rodrigues and de Andrade, 2004).Similarly proximate composition of white cowpea beans has crude protein value of 20.90% which agrees with several work done on nutritional analysis of beans. Inobeme*et al.*(2014)reported to have crude protein values of white cowpea beans which ranges from 21-23%. Similarly Adamu *et al*. (2016) reported a value of 26.18 for white cowpea obtained in Nigeria.The nutritional analysis of cultivated and wild mushrooms as seen in this study showed protein levels of 17.32 and 21.64g/100g. This value although lower than that for eggs, beef and beans has nutritional significance since its value is higher than millet, cereals and most grains. The nutritional benefit of mushrooms goes beyond its protein content only. It could also be seen that the crude fiber content is 7.35±0.1 and 17.30 which is far higher than 0.01 and 0.04 for eggs and meat respectively. Generally dietary crude fiber plays an important role in decreasing the risks of many disorders such as constipation, diabetes, cardiovascular diseases (CVD), diverticulosis and obesity (Pereira *et al*., 2012). A great variability can also be observed among mushrooms in the dietary fiber supply. In general, a remarkably high or appreciable level of total fiber ranging from 7.87 and 17.30 for wild and laboratory cultivated mushrooms was observed as compared to 0.04 and 0.01g/100g of meat and eggs respectively. The minerals composition in mushrooms are considerably higher than those in agricultural crops. Mushrooms possess a very effective mechanism that enables them readily take up some minerals from the ecosystem compared to green plants growing in similar conditions(Svoboda *et al*., 2000) Thus, they might be used directly in diet and promote health, taking advantage of the additive and synergistic effects of all the bioactive compounds present(Pereira *et al*., 2012). Values of copper, potassium and iron were in agreement with some of the previous studies on mushrooms(Kalyoncu *et al.,*2010; Iyaka, 2014) whereas values of zinc, calcium, manganese and phosphorus were low as compared with previous studies of Mohiuddin *et al*. (2016).

CONCLUSION

It was concluded from findings of this study that edible mushrooms can be cultivated under controlled conditions in the laboratory for commercial purposes. It was established from findings of this study that mushrooms still have appreciable levels of proteins which could serve as alternatives to the more expensive protein sources. Its high fiber and a wide range of both micro and macro mineral contents cannot be overemphasized as compared to other expensive sources. Therefore mushrooms can be supplemented in places where there are acute shortage of protein and minerals

References

Adamu, A S, Ajayi, M.G. and Oyetunde, J.G.(2016). "Inorganic And Proximate Nutritional Composition of Common Beans In Nigeria." *European Journal of Pure and Applied Chemistry* 3 (2).

Association of Official Analytical Chemist (AOAC) (2012). Official Methods of Analysis of AOAC International. 18th Edition, Maryland, USA

Cherian, G.(2009). "Eggs and Health. Nutrient Sources and Supplement Carriers." In *Complementary and Alternative Therapies and the Aging Population*, 333–46.doi:10.1016/B978-0-12-374228-5.00016-0.

Inobeme, A B Nlemadim, P A; Obigwa, I. and Ajai. I.(2014). "Determination of Proximate and Mineral Compositions of White Cowpea Beans (Vigna Unguiculata) Collected From Markets in Minna, Nigeria." *International Journal of Scientific & Engineering Research* 5 (8).

Iyaka, Y. A. (2014). "Nutrient Content of Selected Edible Leafy Vegetables." *American Journal of Applied Chemistry* 2 (3): 42. doi:10.11648/j.ajac.20140203.12.

Kalyoncu, F. Bülent, E. Hasan, Y. Erbil, K. and Halil, M. S. (2010). "Chemical Composition of Four Wild Edible Mushroom Species Collected from Southwest Anatolia." *Gazi University Journal of Science* 23 (4): 375–79. doi:10.1093/o.

Mohiuddin, KM, Mehediul, A. Taufique, A, and Istiaq, A. (2016). "Assessment of Nutritional Composition and Heavy Metal Content in Some Edible Mushroom Varieties Collected from Different Areas of Bangladesh." *Asian Journal of Medical and Biological Research* 1 (3): 495. doi:10.3329/ajmbr.v1i3.26468.

Pereira, E. L. B, Anabela, M, and Isabel C.F.R. (2012). "Towards Chemical and Nutritional Inventory of Portuguese Wild Edible Mushrooms in Different Habitats." *Food Chemistry* 130 (2): 394–403. doi:10.1016/j.foodchem.2011.07.057.

Rodrigues, V C, and de Andrade. N.F.(2004). "Chemical Physical Meat Characteristics of Buffaloes and Cattle Entire and Castrated." *Revista Brasileira De Zootecnia-Brazilian Journal of Animal Science* 33 (6): 1839–49.

Svoboda, L., K. Zimmermannová, P.and Kalač, P(2000). "Concentrations of Mercury, Cadmium, Lead and Copper in Fruiting Bodies of Edible Mushrooms in an Emission Area of a Copper Smelter and a Mercury Smelter." *Science of the Total Environment* 246 (1): 61–67. doi:10.1016/S0048-9697(99)00411-8.

Williams, P. and Veronique, D. (2010). "Australian Red Meat Consumption - Implications of Changes over 20 Years on Nutrient Composition." *Food Australia* 62 (3): 87–94.

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