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Ash and Mineral Content of Mycelia of *Collybia diminuta*, *Tricholoma lobayense* and *Oudemansiella canarii* Grown in Liquid Culture

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The ash and mineral content of mycelia of *Collybia diminuta*, *Tricholoma lobayense* and *Oudemansiella canarii* grown in liquid media were determind. The ash content was found to be 4.40 and 5.10, 6.80 and 7.21, and 5.03 and 5.90 g/100g dry wt. in mycelia of *C. diminuta*, *T. lobayense* and *O. canarii* in basal and optimal media respectively. Calcium content was found to be 1339 and 1512, 1780 and 1815 and 2045 and 2405 mg/100g dry wt., magnesium conrent was 695 and 715, 450 and 592, and 215 and 272 mg/100g dry wt. and iron content was found to be 7.68 and 7.92, 9.95 and 10.08, and 8.50 and 9.72 mg/100g dry wt. in mycelia of *C. diminuta*, *T. lobayense* and *O. canarii* grown in basal and optimal media respectively.

Key words : Ash, Minerals, Mycelia, *C. diminuta*, *T. lobayense*, *O. canarii*

INTRODUCTION

Mushrooms are good source of minerals. Phosphorus, potassium, sodium, calcium and magnesium are considered to be the major mineral constituents while copper, zinc, iron and other trace elements such as manganese and cobalt make up the minor constituents. The ash and mineral contents of mushrooms have been reviewed by several workers; (Altamura *et al.*, 1967 ; Zakia *et al*, 1971 Zhuk *et al.*, 1974 ; Lee and Changs 1975). The analyses of dried mushroom indicate that they contain a higher mineral content than fresh mushrooms even when the concentrations are calculated on an equivalent dry weight basis (Crisan and Sands, 1978). Mutsch *et al.* (1979) have found that fungi contain less Fe in comparison with higher plants. Garcia *et al.* (1980) have reported that mushrooms mycelia contain 7.45-18.73% ash (dry wt. basis) by the chemical analyses of 20 different edible mushrooms. Thitasnt *et al.* (1980) have reported

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the high content of calcium in some edible mushrooms. The total ash and 25 minerals and trace element contents have been estimated in several species of mushroom which are found to be high in Hg and Se (Varao *et al.* 1980). Kosaric and Nabuo (1981) have reported that the submerged biomass of morel mushrooms grown in cheese whey contain 8.5% ash. *Macrolepiota zeyheri* and *Agaricus brunnescens* are found to contain 5.52 and 26.27 mg of Ca, 87.45 and 144.00 mg of Mg per 100g of dry weight respectively (Wehmeyer *et al.*, 1981) Gupta *et al.* (1982) have analysed various minerals and trace elements (Fe, Al, K, Mg, Ca) quantitatively of *Macrolepiota rachodes* to asses its nutritive value. Ohtonen (1982) has analysed the mineral content (Mg, Mn, Fe, Cu and Zn) in *Lactarius rufus* and *Suillus variegatus*. The Mg content in both the species are found to be low compared to many other fungal species. The ash and minerals content (Ca, K, Na, Cu, P and Mn)of *Agaricus campestris*, *A. rodmani* and *Collybia* sp. have been determined by Zakhary *et al.* (1983). Twenty one species of mushrooms have been analysed for metal by Kikuchi *et al.* (1984) and they have found that mineral contents (Fe, K, Na, Mg, Zn, Cu and Mn) in mushrooms is almost similar in majority of cases to those found in vegetables. The mushrooms contain 5.78 mg/g fresh wt. of Ca^{++} which is lower than that of vegetables. It is also interesting to note that Al, Mg and Cd are significantly higher in mushrooms grown in soil than in those grown in trees. Lasota *et al.* (1984) have reported that the contents of Mg and Ca in 15 mushrooms (12 wild and 3 cultivated spp.) vary from 57.4-106.2 and 11.8-162.6 mg/g dry matter respectively and the authors have also noted that the level of mineral contents in mushrooms depend on species, place of growing and season.

In this present investigation an attempt has been made to determine ash and mineral content of the mycelia of *C. diminuta*, *T. lobayense* and *O. canarii* grown in liquid culture.

MATERIALS AND METHODS

The tissues cultures of *Collybia diminuta* (Berk. & Br.) Sacc., *Tricholoma lobayense* Heim. and *Oudemansiella canarii* (Jungh.) Hohn were used in this investigation.

For this investigation both the basal and optimal liquid synthetic media were used to produce mycelium for comparative analysis. These were (i) *Basal synthetic liquid medium* containing glucose, 30 g ; yeast extract, 2 g ; peptone, 2.5 g ; $MgSO_4.7H\ O$, 0.5 g ; $Ca(NO_3)$, 0.5 g ; $(NH_4)_2.HPO_4$, 0.25 g ; KH_2PO_4, 0.25 g ; $FeCl_3$, 10 mg ; $CaCl_2$ (0.1M), 5 ml ; $ZnSO_4$, 0.1 mg ; inositol, 50 mg ; thiamine, 100 μg ; biotin, 50 μg ; folic acid, 100 μg and distilled water, 1 litre ; pH was adjusted to 5.5 ; and (ii) *Optimal synthetic liquid media* for maximum

growth of the three test fungi ; starch (40 g/1) and yeast extract (4 g/1), maltose (40 g/1) and yeast extract (4 g/1), glucose (40 g/1) and yeast extract (4g/1) media were prepared by adding all other necessary nutrients including vitamins and macro/micro nutrients as same as in basal medium which was found to be best combination for the growth. The pH of the medium of each of the three test fungi viz., *C. diminuta*, *T. lobayense* and *O. canarii* were adjusted to their respective optimal values of 6.5, 6.5 and 6.0 with 0.2M phosphate buffer before sterilization. An aliquot of 50 ml of each medium was dispensed in each 250 ml Erlenmeyer flask, plugged and sterilized at 10 p.s.i for 20 minutes. The flasks were inoculated separately with 1.0 ml of cell suspension of each test fungus and incubated (stationary) in complete darkness at 30°, 20° and 20°C (+0.5°C) for 15, 20 and 20 days respectively.

The mycelia were harvested by filtration through a tarred sintered funnel (Jena IG-3). The filtered mycelia were washed repeatedly with distilled water to make them free from any adhering media and dried to a constant weight in a vacuum oven at 60°C for 24 h cooled in a desiccator and weighed.

Chemical methods used were those of the Association of Official Agricultural Chemists (A.O.A.C.) or other accepted procedures. The methods finally used were those which gave the most consistent results. In the preparation of material for analyses, all samples were ground to a fine powder and kept in a desiccator. Before analyses, samples for chemical determinations were dried to constant weight in a vacuum oven at 60°C. Analytical data were reported on a moisture free basis. In all cases, mean data of triplicate mycelial samples were presented.

Estimation of calcium, magnesium and iron were done following the methods of Vogel (1961). A sample of 250 mg of white ash residue of each test fungus was digested with 5 ml of concentrated HCl in a steam bath till the acid was boiled off. The digested resdue was dissolved in a definite volume of dilute HCl, filtered and the volume made to 50 ml with distilled water. The resulting ash solutions were used for determination of Ca^{++} and Mg^{++} titrimetrically (Vogal 1961).

For the determination of iron, from dry ash residue, 100 mg samples were weighed and dissolved in 2 ml concentrated HCl, and evaporated nearly to dryness to remove excess acid. Then diluated slightly with 5 ml distilled water followed by a few drops of dilute $KMnO_4$ (0.2%) solution until a persistent slight pink colouration developed (after stirring well). After treating with K-thiocyanate solution (2M), the transmission was recorded in a ERMA photoelectric colorimeter, using 410 nm filter. The data were tabulated by comparing the same with the data of a standard curve prepared using ferrous ammonium sulphate.

RESULTS AND DISCUSSION

It is evident from the data given in Table 1, that mycelia of all the test fungi yield more ash (%) when grown in submerged condition in their respective synthetic optimal media, than that of basal media. The ash content (g/100g dry wt.) of the mycelia of *C. diminuta*, *T. lobayense* and *O. canarii* were estimated to be 5.10%, 7.21% and 5.90% respectively under optimal conditions while it was 4.40%, 6.80% and 5.03% respectively under basal conditions. In case of all the three test fungi, the comparatively high ash values in the optimal conditions indidate the increase of assimilation of mineral constituents from the optimal medium. Other workers have obtained comparable results to those mentioned above. Jennison *et al.* (1957) have reported 3.66 in malt extract medium and a higher ash content of 5.35% in optimal synthetic medium for *Lentinus tigrinus* in submerged culture.

Table 1. *Ash and mineral content (dry weight basis) of the mycelia of* Collybia diminuta. Tricholoma lobayense *and* Oudemansiella canarii *grown submerged in basal and optimum synthetic media**

Test organisms	Ash content (g/100g dry wt.)		Mineral content (mg/100g dry wt.)					
			Ca		Mg		Fe	
	Basal medium	Optimum medium	Basal medium	Optimum medium	Basal medium	Optimum medium	Basal medium	Optimum medium
Collybia diminuta	4.40 ±0.10	5.10 ±0.11	1339 ±0.04	1512 ±0.10	695 ±0.05	715 ±0.01	7.68 ±0.10	7.92 ±0.09
Tricholoma lobayense	6.80 ±0.10	7.21 ±0.11	1780 ±0.14	1815 ±0.08	450 ±0.02	592 ±0.04	9.95 ±0.11	10.08 ±0.10
Oudemen-siella canarii	5.03 ±0.13	5.90 ±0.12	2045 ±0.12	2405 ±0.09	215 ±0.01	272 ±0.07	8.50 ± 0.08	9 72 ±0 12

*Results are the mean of three replications

Among the three minerals analysed from the above three test fungi, calcium content was found to be higher in all cases followed by magnesium and very low in iron content. The three test fungi showed comparatively higher content of Ca, Mg and Fe in the optimal media than that of basal media. In *Oudemansiella canarii*, calcium content was found to be highest among the three test fungi. The maximum amount of magnesium content was found to be in *Collybia diminuta* but the highest increase of magnesium content in the optimal medium

been found in case of *Tricholoma lobayense*. In the three test fungi iron content was very low but among them *Tricholoma lobayense* showed a little high amount of iron content. In case of *Oudemansiella canarii*, iron content showed a remarkable increase (1.22 mg/100g dry wt.) in the optimal conditions compared to the basal synthetic media.

The findings of the present investigation regarding the iron content in the test fungi closely resemble the view of Mutsch *et al.* (1979). The high content of calcium in the test fungi are similar to the findings of Thitasnt *et al.*, (1980).

REFERENCES

Altamura, M. R., Robbins, F. M., Andreotti, R. E., Long, L. Jr. and Hasselstrom, T. (1967). Mushroom ninhydrin positive compounds, amino acids, related compounds and other nitrogenous substances found in cultivated mushroom, *Agericus campestris*. *J. Agr. Food Chem*., **15** : 1040-1043.

Association of Official Agricultural Chemists (1960). *Official and Tentative Methods of Analysis*, 9th ed., A.O.A.C., Washington D. C.

Crisan, E. V. and Sands, A. (1978). Nutritional value. In *The Biology and Cultivation of Edible Mushrooms* Ed. by Chang, S.T. and Hyes, W.A. Academic Press, Inc. (London) Ltd. : 137-168.

Garcia, O., Rosario, M., Taisir, A. and Toniya Jsasa, M.E. (1980). Macro-and Micro-nutrients in edible mushrooms I. Macronutrients. *An. Bromatol.*, **32**(2) : 145-168.

Gupta, S., Misra P.S., Pathak, N.L., Goyal, S. and Goyal, R. (1982). Chemical composition of *Macrolepiota rachodes*. *Fitoterapia*, **53** (1/2) : 13-16.

Kikuchi, Masayuki, Tamakawa, Katsumi, Hirosima, Kiika, Aihara, Yoshiyuki, Mishima and others (1984). Contents of metals in edible mushrooms. *Shokuhin Eiseigaku Zasshi* **20** (6) : 534-542.

Kosaric, N. and Nabueo, M. (1981). Growth of morel mushroom mycelium in cheese whey. *J. Dairy Res.*, **48**(1) : 149-162.

Lasota, W. and Florozak, J. (1984). Magnesium, calcium, sodium and potassium level in some species of multifructificated mushrooms. *Bromatol. Chem. Toksykol*., **17**(3) : 189-193.

Lee, T. F. and Chang, S. T. (1975). Nutritional analysis of *Volvariella volvacea*. *J. Chin, Soc. Hortic. Sci.*, **21** : 13-20.

Mutsch, F., Horak, O. and Kinzel, H. (1979). Trace elements in higher fungi. *Z. Pflanzen-physiol*., **94**(1) : 1-10.

Ohtonin, R. (1982). Mineral concentration in some edibie fungi and their relation to fruit body size and mineral status of substrates. *Annals. Botanici Fennici*. **19**(4) : 203-209.

Thitasnt, M., Kanterarak, S. Sultajet, M. (1980). Oxalate and calcium in bamboo shoots and mushrooms. *Chisng. Mai. Med. Bull*., **19**(4) : 153-160.

Varao, P., Lahelma, O., Nuwetamo, M., Saari, E. and Koivistoinea, P. (1980). Mineral element composition of Finnish foods. VII. Potato, vegetables, fruits, berries, nuts and mush-rooms. *Acta. Agric. Sc. and Supply*. **22** : 89-113.

Vogel, A.I. (1961). *A Text Book of Quantitative Inorganic Analysis.* 3rd Edn. The English Language Book Society and Longman. **434** : 436-437, 785-786.

Wehmeyer, A. S., Coetzee, J. C. and Elcker. A. (1981). Nutrient content of *Macrolepiota zeyhari* and *Agaricus brunnescins. S. Afr. J. Sci.*, 77(9) : 426-427.

Zakhary, J. W., Taiseen, M., Abo-Bkr. A., Rafik el-Mahdy and Shehata, A.M., El-Tabay (1983). Chemical composition of wild mushrooms collected from Alexandria, Egypt. *Food Chem.*, **11**(1) : 31-42.

Zakia, B., Srinivasan, K. S. and Sing, N.S. (1971). Essential amino acid composition patterns of a mushroom *Volvariella diplasia. J. Fd. Sci. Technol.*, **8** : 180-182.

Zhuk, Yu, T.I.E., Tsapalova, A.A. and Dyagileva, N.A. (1974). Chemical composition of some edible mushroom species. *Izv. Sib. Otd. Akad. Nauk. SSSR Ser. Biol. Nauk.*, **3** : 47-52.

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