Asian Journal of Chemistry Vol. 20, No. 3 (2008), 1871-1874

Determination of Lead, Cadmium, Arsenic, Iron, Zinc, Copper, Nickel and Magnesium in Some Cultivated *Agaricus bisporus* and *Pleurotus ostreatus* Mushrooms of Iran

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Several samples of *Agaricus bisporus* and *Pleurotus ostreatus* mushrooms from different cultivation farms were collected from the market and after sample preparation were tested by flame atomic absorption spectroscopy for measuring copper, zinc, iron and magnesium. Graphite furnace atomic absorption spectroscopy was applied for measuring cadmium, lead, nickel and arsenic. The results of this study showed that content of all measured elements were in close accordance with the similar studies performed previously in other countries.

Key Words: Cultivated mushrooms, Trace elements, Heavy metals, Determination.

INTRODUCTION

Mushrooms are among valuable nutritional sources, low in calories and high in vegetable proteins, vitamins and minerals. Previous studies demonstrated the capability of some mushroom species in accumulating certain trace elements and toxic metals[1].

Mushroom's consumption has been increased by a factor of 60 % per annum in Iran in the last 4 years resulting in a huge increase in its cultivation for domestic use and exportation. The present study relates to the determination of certain beneficial trace elements as well as some heavy metals in cultivated mushrooms of Iran.

EXPERIMENTAL

All the reagents were of analytical grade. Double deionized water (Milli-Q Millipore 18.2 MΩ cm^{-1} receptivity) was used in this study. HNO_3, H_2SO_4 and H_2O_2 were of suprapur quality (Merck). All the glassware was soaked in dilute HNO_3 and rinsed with distilled water prior to use. Standard solutions

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for calibration were prepared by diluting a stock solution of 1000 mg/L of metals (Panreac).

Samples of *Agaricus bisporus* (41 samples) and *Pleurotus ostreatus* (8 samples) cultivated in different cultivation farms in Tehran and Mazandaran provinces were purchased in triplicate at sales points.

After cleaning from soil and washing with demineralized water, the mushrooms were sliced and dried at 50 °C overnight and crushed in mortar.

The dried mushrooms (2 g) were placed in a porcelain crucible and ashed at 450 °C for 20 h, then the ash was dissolved in 4 mL concentrated HNO_3, evaporated to dryness, heated again at 450 °C for 3 h and dissolved in 1 mL of concentrated HNO_3 and 1 mL of concentrated H_2SO_4 and brought to volume of 25 mL with demineralized water. For analysis of arsenic 2 g of dried sample was digested by 10 mL of an oxi-acidic mixture HNO_3: H_2SO_4:H_2O_2 (4:1:1) at 60 °C for 2 h. Potassium permanganate 6 % w/v was used for oxidation of the sample and its excess was reduced with a solution of hydroxylamine sulphate.

Varian AA 220 flame atomic absorption spectrophotometer (AAS) with deuterium background correction was used for determination of Fe, Cu, Zn and Mg. The wavelength and slit values (nm) were 248.3 and 0.2 for Fe, 324.7 and 0.5 for Cu, 213.9 and 1.0 for Zn and 285.2 and 0.5 for Mg.

For detection of Ni, Cd, Pb and As Varian GTA 110 graphite furnace AAS was used. The wavelength and slit values (nm) for Ni, Cd, Pb and As were 232 and 0.2, 228.8 and 0.5, 283.3 and 0.5 and 193.7 and 0.5, respectively.

Detection limit is defined as the concentration corresponding to three times the standard deviation of ten blanks. Detection limit values of elements as microgram per liter were found to be 0.15 for Mg, 0.15 for Fe, 0.14 for Cu, 0.06 for Cd, 0.25 for Pb, 0.04 for Zn, 0.12 for Ni and 2 for As.

The standard addition procedure was used in all determinations. A calibration curve was established on the basis of standard solutions.

Correlations between concentrations of the metals were tested by regression analysis. All samples were run in triplicate and element concentrations were determined on a dry weight basis.

RESULTS AND DISCUSSION

Heavy metal levels in the analyzed samples are given in Table-1.

It has been previously shown that magnesium is the third major mineral element in fungal fruiting bodies[2]. We found very close levels of Mg in the analyzed samples in comparison to the levels reported by Mattila *et al.*[2]. Mushrooms are quite good sources of Zn and Cu, whereas Fe contents of them are low[2]. In accordance with previous studies we found higher levels of Zn and Cu in *P. ostreatus* and *A. bisporus*, respectively[2-4]. It has been shown that mushroom play the part of a toxic element filter of Ni and only

by adding huge amounts of this element to their substrates an increase in Ni content could be observed[5], hence the Ni content in the analyzed samples closed to literature value[4,5].

TABLE-1
METAL CONTENT IN CULTIVATED MUSHROOMS
(DRY MATTER BASIS)

Element	*Agaricus bisporus*		*Pleurotus ostreatus*	
	Mean	Confidence interval for mean (95%)	Mean	Confidence interval for mean (95%)
Mg [mg/kg]	1223.80	1182.5, 1265.5	1419.20	1353.1, 1485.5
Zn [mg/kg]	63.62	61.07, 66.17	85.62	82.58, 88.72
Cu [mg/kg]	37.20	36.07, 38.33	17.16	16.02, 18.31
Fe [mg/kg]	37.83	34.37, 41.30	70.44	65.95, 74.87
Ni [mg/kg]	1.84	1.68, 2.00	2.23	2.09, 2.37
As [mg/kg]	< DL	–	< DL	–
Pd [µg/kg]	532.90	517.62, 548.17	381.00	371.99, 391.56
Cd [µg/kg]	235.40	230.08, 240.72	416.94	405.78, 428.10

DL = Detection limit

There are limited reports regarding arsenic concentration in mushrooms especially cultivated ones[1]. In the only report we were able to find dealing the cultivated mushrooms the concentration of this element was reported as zero[4]. This could be related to the detection limit of the study. Similarly in the present study, the detection limit of the test dissuaded us from reporting arsenic concentration in the samples.

The results obtained of average lead content in the tested mushrooms fall within the range determined in Turkey[6], higher than what reported in Finland[2], lower than the analyzed amount in Poland[7] and well beyond the regulated limit of the European commission[8].

Cadmium is known as one of the most principal toxic elements accumulated in mushrooms produced in contaminated substrates[9,10] or within a town[11]. Cadmium content in all the analyzed samples was below the statutory limit regulated by the European commission[8].

ACKNOWLEDGEMENT

This work was supported by grant no. 132/6521 from the Research Council of Tehran University of Medical Sciences.

REFERENCES

1. P. Kalac and L. Svoboda, *Food Chem.*, **69**, 273 (2000).
2. P. Mattila, K. Konko, M. Eurola, J.M. Pihlava, J. Astola, L. Vahteristo, V. Hietaniemi, J. Kumpulainen, M. Valtonen and V. Piironen, *J. Agric. Food Chem.*, **49**, 2343 (2001).
3. J. Vetter, *Acta Aliment.*, **19**, 27 (1990).
4. J. Vetter, *Food Chem.*, **50**, 277 (1994).
5. L. Racz, L. Papp, B. Prokai and Z. Kovacs, *Microchem. J.*, **54**, 444 (1996).
6. M. Tuzen, M. Ozdemir and A. Demirbas, *Z. Lebensm. Untes. Forsch.*, **206**, 417 (1998).
7. M. Krelowska-Kulas, W. Kudelka and S. Popek, *Nahrung.*, **44**, 63 (2000).
8. Commision Regulation (EC) 466/2001, *Off. J. Eur Comm.*, **L77**, 1 (2001).
9. P. Kalac, J. Burda and I. Staskova, *Sci. Total Environ.*, **105**, 109 (1991).
10. L. Svoboda, K. Zimmermannova and P. Kalac, *Sci. Total Environ.*, **246**, 61 (2000).
11. L. Svoboda and P. Kalac, *Bull. Environ. Contam. Toxicol.*, **71**, 123 (2003).

(*Received*: 19 February 2007; *Accepted*: 2 November 2007) AJC-6055