# TRACE ELEMENTS COMPOSITION OF BOLETUS MUSHROOMS FROM THE PROVINCE OF YUNNAN, CHINA

**Martyna Saba[1], A. Hanć[2], T. Li[3], D. Barałkiewicz[2], Y. Wang[4], J. Falandysz[1]**

*[1]University of Gdańsk, Laboratory of Environmental Chemistry & Ecotoxicology, Gdańsk, Poland*
*[2]Adam Mickiewicz University, Department of Trace Element Analysis by Spectroscopy Method, Poznań, Poland*
*[3]Yuxi Normal University, College of Resources and Environment, Yuxi, Yunnan, China*
*[4]Institute of Medicinal Plants, Kunming, Yunnan, China*
martyna.saba@phdstud.ug.edu.pl

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## Introduction

Yunnan province of China has a large biodiversity of mushrooms, plants and animals life. Topography a mild climate with fine weather is also unique - with as much as much as 3000 m deep canyons and different types of forests. Consumption of mushrooms from wild is up to 24 kg per capita annually by certain locals in Yunnan, while specific is a way of their cooking (using a wok) (Wang et al., 2014).

The province of Yunnan is also diverse in geochemical composition of soil bedrock and is somewhere under an impact by the Circum-Pacific Mercuriferous Belt. Hence, mushrooms from some regions of the Yunnan are be elevated in geogenic mercury (Kojta et al., 2014; Falandysz et al., 2015). Although in a recent decade were available some data on mineral constituents composition of the Yunnan's mushrooms, are gaps in knowledge because of a biodiversity of the species and diversity of the regions there (Fan, 1991).

This study presents data on 20 metallic and semi-metallic elements in three species of the genus *Boletus* (*B. luridus*, *B. magnificus* and *B. tomentipes*) determined by inductive coupled plasma - dynamic reactive cell – mass spectrometry (ICP-DRC-MS) and cold vapour – atomic absorption spectroscopy (CV-AAS).

## Methods

In total, 24 specimens of *B. luridus*, 38 of *B. magnificus*, 38 of *B. tomentipes* were collected in Yunnan (one sample of *B. tomentipes* was also from the province of Sichuan). They were separated into caps and stipes, than prepared and pooled respectively and examined. Fresh mushrooms directly after pickup were cleaned up from any visible plant vegetation and soil debris with a plastic knife and the bottom part of stem was cut-off, and further rinsed with deionized water. Thereafter, the mushroom samples were placed into plastic basket of an electrically heated commercial dryer (dehydrator for vegetables etc.) and dried at 65 °C to constant mass. Dried fungal materials were pulverized in a porcelain mortar and kept in sealed polyethylene bags under dry conditions. Before digestion with nitric acid, the samples were dried at 65 °C for 12 h using an electrically heated laboratory oven. The elements such as Li, V, Cr, Mn, Co, Ni, Cu, Zn, As, Rb, Sr, Ag, Cd, Sb, Cs, Ba, Pb, Tl, U were determined using the ELAN DRC II ICP-MS Inductively Coupled Plasma Mass Spectrometer (PerkinElmer, SCIEX, Canada) equipped with a Meinhard concentric nebulizer, cyclonic spray chamber, dynamic reaction cell, Pt cones and quadruple mass analyzer.

## Results

Lithium concentrations in caps were from 0.15±0.09 to 0.61±0.43 mg $kg^{-1}$ dry biomass (db), while median values showed on similar content of this element in the caps of all three species ($p > 0.05$; Mann – Whitney U test). Rubidium in caps of *Boletus* mushrooms was at 90±35-460±350 mg $kg^{-1}$ db, and in stipes 56±7-

160±120 mg $kg^{-1}$ db. There is no other data on Rb in mushrooms from Yunnan or elsewhere in China from available literature. Caesium apart from a high result in *B. luridus* from the site of Midu in the Dali Autonomous Prefecture (160 mg $kg^{-1}$ db in caps and 55 mg $kg^{-1}$ db in stipes) occurred at much smaller but similar concentrations (< 1.0 mg $kg^{-1}$ db) in mushrooms from other sites.

Strontium and barium at specifically elevated concentration were found in *B. tomentipes* from the Panzhihua site in the Sichuan Province, which showed Sr in caps at 5.3 mg $kg^{-1}$ db and in stipes at 26 mg $kg^{-1}$ db, and Ba in caps at 10 mg $kg^{-1}$ db and in stipes at 100 mg $kg^{-1}$ db. The second sample that was relatively rich in both elements was *B. luridu*s from the Jiangchuan site in the Yuxi Prefecture - Sr in caps at 2.8 mg $kg^{-1}$ db and in stipes at 2.2 mg $kg^{-1}$ db, and Ba in caps at 32 mg $kg^{-1}$ db and in stipes at 12 mg $kg^{-1}$ db.

Vanadium was mg $kg^{-1}$ db) at 0.18-4.4 in caps and at 0.24–9.0 in stipes of *B. tomentipes*, and respectively at 0.97–3.9 and 0.68–10 in *B. luridus* and at 0.77–2.1 and 0.69–1.1 in *B. magnificus*. Chromium occurred, on the average, in caps of *B. tomentipes* at 5.0±2.9 mg $kg^{-1}$ db, in *B. luridus* at 6.9±7.1 and in *B. magnificus* at 7.6±2.2 mg $kg^{-1}$ db, but a large fluctuation can be noted in content of Cr in mushrooms from a particular sites. The mean values of manganese concentrations in *B. tomentipes*, *B. luridus* and *B. magnificus* were respectively in caps at 17±8, 28±21 and 13±2 mg $kg^{-1}$ db, and distribution of element between caps and stipes of mushrooms was almost equal. Cobalt and nickel were in *Boletus* spp. at around 1.0 mg $kg^{-1}$ db in caps and at around 1.0–2.0 mg $kg^{-1}$ db in stipes, but in a few samples were much higher.

*Boletus tomentipes*, *B. luridus* and *B. magnificus* in this study were relatively rich in essential copper and zinc, while their caps showed both elements in greater concentrations than stipes. Uranium occurred in similar concentrations in caps of *B. tomentipes* and *B. luridus* i.e. at 0.65±0.053 and 0.053±0.049 mg $kg^{-1}$ db and also in stipes, i.e. at 0.10±0.09 and 0.098±0.099 mg $kg^{-1}$ db, while at smaller concentrations in *B. magnificus*, where was distributed equally between caps.

The chalcophile elements such as Ag, Cd, Hg, Tl, Pb, As and Sb which are considered as hazardous when at elevated content in foods were all found in the *Boletus* spp. but usually in small concentration, and exception was As in some sites.

## Conclusion

The interspecies differences in content of several trace elements observed in *B. luridus*, *B. magnificus* and *tomentipes* could be roughly attributed to known different geochemistry of soils in Yunnan, while a within species difference was observed for copper.

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