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Article

Assessment of nutritional composition and heavy metal content in some edible mushroom varieties collected from different areas of Bangladesh

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Abstract: Four edible mushroom species (*Pleurotus ostreatus, Agaricus bisporus, Volvariella volvacea, Ganoderma lucidum*) from different locations of Bangladesh, were analysed for their protein and metal content profile (K, Na, Fe, Cu, Zn, Mn, Cr, Pb, As and Cd). Trace metals were determined by atomic absorption spectrophotometer, Na and K by flame emission spectrophotometer and protein by micro Kjeldhal method. All element concentrations were determined on a dry weight basis. The protein content of mushrooms varied from 13.8%–34.3% and the metal content of samples ranged from 0.54–2.25% for K and 12.6–81.6, 69.5–626.2, 39.2–163.4, 30.1–75.5, 52.9–104.5, 0.20–0.30, 0.13–0.59 μg g^{-1} for Na, Fe, Cu, Zn, Mn, Cd, Pb, respectively. Arsenic and cadmium concentrations were below the detection limit of the method used. The detection limits of the method for As and Cd are 0.01 μg g^{-1} for each element. In general, K and Fe content were higher than other metals in all mushroom species. The levels of Cu and Zn in some mushroom samples were found to be higher than legal limits.

Keywords: edible mushrooms; heavy metal; nutritional composition

1. Introduction

Mushrooms are large reproductive structures of edible fungi and have been considered as a special kind of food since earliest time and its cultivation is gaining popularity in Bangladesh in recent times. These are very nutritious food and enriched with protein, vitamins and minerals and poor in calorie and cholesterol (Pathak *et al.*, 1998; Chandha and Sharma, 1995; Chang and Miles, 1988 and Bano and Rajarathnam, 1986). Mushrooms have also been reported as therapeutic foods, useful in preventing diseases such as hypertension, hypercholesterolemia (Turkekul *et al.*, 2004) and cancer (Sesli *et al.*, 2008). These functional characteristics are mainly due to their chemical composition (Manzi *et al.*, 2001). Heavy metals are an important source of food contamination and health hazard. The main threats to human health are associated with exposure to As, Cd, Pb, Hg and Cu. Living organisms require trace amounts of some heavy metals, including Fe, Co, Cu, Mn, Cr and Zn. Excessive levels of these metals, however, can be detrimental to living organisms. Other heavy metals such as Cd and Pb have no known beneficial effect on organisms (Falusi and Olanipekun, 2007; Ouzouni *et al.*, 2009; Tuzen *et al.*, 2007). Mushroom species have been known to accumulate great concentrations of heavy metals such as Pb, Cd, Fe, Cu, Mn, Zn, Cr, Ni, Al, and Hg (Kalac *et al.*, 1991; 2001; Svoboda *et al.*, 2000; Kalac and Svoboda, 2001; Falandysz *et al.*, 2003; Dursun *et al.*, 2006; Cocchia *et al.*, 2006; Chen *et al.*, 2009). Recently, extensive research has been carried out all over the world on the factors responsible for the occurrence of heavy metals in mushrooms (Radulescu *et al.*, 2010, Çayır *et al.*, 2010; Gençcelep *et al.*, 2009). The accumulation of heavy metals in macrofungi has been found to be affected by environmental and fungal factors. Environmental factors, such as organic matter amount, pH, and metal concentrations in soil, and fungal factors, such as species of mushroom, morphological part of fruiting body,

development stages, age of mycelium, and biochemical composition, affect metal accumulation in macrofungi (Garcia *et al.,* 1998; Kalac and Svoboda, 2001). Heavy metal contaminated food stuff is a great concern in Bangladesh. Higher content of metals have been observed in mushrooms growing in heavily polluted areas, such as close proximity to high ways with heavy traffic, landfills of sewage sludge and emission areas including cities. High content of metals in mushrooms are also reported from areas contaminated by ores mining and processing (Kalac *et al.,* 2004). Thus, a critical assessment of the health risk from mushroom consumption is necessary through screening of metal accumulating varieties. However, there has been no report, to our knowledge, on the heavy metal levels in edible mushroom samples in Bangladesh. The aim of this study was to document basic chemical and metal concentrations in some edible mushrooms, collected in different districts of Bangladesh.

2. Materials and Methods

The mushroom samples were collected from from National Mashroom Development and Extension Centre, Dhaka and Mashroom Sub-center of Comilla, Chittagong, Mymensingh, Sylhet and Khulna city of Bangladesh during early 2014. The collected samples were washed with deionized water and dried at 105°C for 24 hrs. Dried samples were homogenized using an agate homogenizer and stored in pre-cleaned polyethylene bottles until the analysis started. All reagents were of analytical reagent grade, 69–72% HNO_3, 30% H_2O_2, and 70% $HClO_4$ were used for digestion of samples. Double deionized water was used for all dilutions. During the experiments, all glasswares and equipment were carefully cleaned starting with 2% HNO_3 and ending with repeated rinsing distilled deionized water to prevent contamination. Samples (0.6 g) were digested with 10 ml of HNO_3, 2 ml of H_2O_2, and 4 ml of $HClO_4$ in block digester system maintained temperature 180-200°C until white fumes are evolved and finally diluted to 50 ml with 2% nitric acid. All sample solutions were clear. A blank digest was carried out in the same way. Heavy metals (Fe, Cu, Zn, Mn, Cr, Pb, As and Cd) concentration in the extract were determined by atomic absorption spectrophotometer (SHIMADZU AA-7000), using a deuterium background correction. The crude protein content of the samples was estimated by the micro Kjeldhal method, in which the sample was digested with a known quantity of concentrated sulphuric acid in the block digester. The digested material was distilled after the addition of alkali. The released ammonia was collected in 4% boric acid in the distillation unit. The resultant boric acid, now contained the ammonia released from the digested material, was then titrated against 0.1 N HCl, manually. The nitrogen content thus determined was multiplied by a factor of 6.25 to arrive at the amount of crude protein. Sodium and potassium were determined by flame emission spectrophotometer.

3. Results and Discussion

The habitat, families and common name of mushroom species are listed in Table 1. All of the analysed mushrooms were identified as edible fungi, belonging to the class Agaricomycetes. Basic chemical composition and trace metal levels in the analysed samples are shown in Table 2, expressed in a dry weight basis. The mean levels of protein and analyte ions in analyzed mushroom species are presented in Figure 1. The relative standard deviations were less than 7% for all elements.

Protein concentrations of the mushroom species were generally high and in the range between 13.8 to 34.3%. Protein concentrations of mushroom samples in the literature have been reported to be in the range between 21.57 to 34.77% (Ouzouni *et al.,* 2009), 24.03 to 34.35% (Shelly *et al.,* 2008). Mushrooms proved to be good sources of protein compared with green vegetables.

Mushrooms are also rich in mineral contents. The mushroom species provides a reasonable amount of minerals in comparison with vegetables (Guillamón *et al*., 2010). The evaluated strains differed in mineral content. The levels of K in the samples ranged from 0.54 to 2.25%, and the highest K levels were obtained in PHK strain of Oyster mushroom. Potassium concentration has been reported to be 3.10 to 3.7% in the literature (Shelly *et al*., 2008). Minimum and maximum concentrations of Na were measured as 12.6 and 81.6 µg g-1 in PHK strain and PO2 strain of Oyster mushroom, respectively. Sodium concentrations of mushroom samples, in the literature, have been reported in the ranges of 0.03–4.85 mg g-1 (Genccelep *et al*., 2009). The concentration of Na is relatively low and this is of very great nutritional benefit to the consumer, a finding that has been corroborated by Vetter (2003).

Table 1. Families, Habitat, edibility and common name of mushroom species.

No.	Species	Family	Habitat	Common name
1	*Pleurotus ostreatus* (Jacq. ex Fr.) P. Kumm	Pleurotaceae	In mixed woods	Oyster
2	*Agaricus bisporus* (J.E. Lange) Imbach	Agaricaceae	In forests	Button
3	*Volvariella volvacea* (Bul. ex Fr.) Singer	Pluteaceae	In forests	Straw
4	*Ganoderma lucidum* (Curtis) P. Kars	Ganodermataceae	On trees	Reishi

The levels of trace metals Fe, Cu, Zn, Mn, Cr, Pb in mushroom species were found to be 69.5–626.2, 39.2–163.4, 30.1–75.5, 52.9–104.5, 0.20–0.30, 0.13–0.59 µg g-1, respectively. Arsenic and cadmium contents were below detectable limit determined by flame AAS method. The order of the mean levels of heavy metals in the mushroom samples was found to be as Fe > Cu > Mn > Zn > Cr > Pb. The FAO/WHO has set a limit for heavy metals intakes based on body weight. For an average adult (60 kg body weight), the provisional tolerable daily intake for Fe, Cu, Zn, and Pb are 48 mg, 3 mg, 60 mg, and 214 µg g-1, respectively (FAO/WHO 1999). The trace metal contents in the mushrooms are mainly affected by acidic and organic matter content of their ecosystem and soil (Gast *et al*., 1988). The uptake of metal ions in mushrooms is in many aspects different from plants. For this reason, the concentration variations of metals depend on mushroom species and their ecosystems (Chojnacka and Falandysz 2007; Kowalewska *et al*., 2007; Shin *et al*., 2007).

Iron is vital for almost all living organisms, participating in a wide variety of metabolic processes, including oxygen transport, DNA synthesis, and electron transport (Lynch and Baynes, 1996). The range of Fe levels were between 69.5–626.2 µg g-1, most samples having concentrations between 130 and 400 µg g-1. The average concentration of Fe was 188.2 µg g-1. The maximum Fe level permitted for food is 15 µg g-1 according to Turkish Food Codex Anonymous Regulation (2002). Iron levels in all analyzed mushroom samples were found to be higher than legal limits. The reported Fe values for mushroom samples were 31.3–1,190 µg g-1 (Sesli and Tüzen 1999), 30–150 µg g-1 (Kalaˇc and Svoboda 2001), 180–407 µg g-1 (Isıloglu *et al*., 2001), 146–835 µg g-1 (Tüzen 2003), 56.1–7,162 µg g-1 (Mendil *et al*., 2004), 568–3,904 µg g-1 (Türkekul *et al*., 2004), 102–1,580 µg g-1 (Soylak *et al*., 2005), 211–628 µg g-1 (Mendil *et al*., 2005), 110–11,460 µg g-1 (Yamaç *et al*., 2007), and 150–1,741 µg g-1 (Sesli *et al*., 2008), 67.5–843 µg g-1 (Zhu *et al*., 2011), respectively. Our Fe values are similar to those of previous studies.

Copper is the third-most abundant trace element in human body and small amount of Cu is found in the human body (50–120 mg), but it plays a critical role like vitamin in a variety of biochemical processes (Yaman and Akdeniz 2004). Copper forms part of at least 13 different enzymes, and its presence is needed for each if they are to function properly. It is known that Cu may be toxic to both humans and animals when its concentration exceeds the safe limits (Gast *et al*., 1988). P. ostreatus had the lowest copper concentration (39.2 µg g-1) whereas A. bisporus had the highest (163.4 µg g-1). The average Cu level of the samples was 85.88 µg g-1. Copper concentrations, accumulated in mushroom species, are usually 100–300 µg g-1, which is not considered a health risk (Soylak *et al*., 2005, Kalacˇ and Svoboda, 2001). These levels are above the WHO permissible limits in foods, which is 40 µg g-1 (Bahemuka and Mubofu 1999). Copper contents of mushroom samples in the literature have been reported to be in the ranges: 4.71–51.0 µg g-1 (Tüzen *et al*., 1998), 10.3–145 µg g-1 (Sesli and Tüzen 1999), 12–181 µg g-1 (Tüzen *et al*., 2003), 12–181 µg g-1 (Tüzen 2003), 13.4–50.6 µg g- 1 (Soylak *et al*., 2005), 24.1–86.2 µg g-1 (Mendil *et al*., 2005), 10.6–144.2 µg g-1 (Yamaç *et al*., 2007), and 15– 73 µg g-1 (Sesli *et al*., 2008), respectively. Our Cu levels were found to be higher than those reported in the literature. The Cu results of our study were in similar with those found in the literature (Demirbas, 2001a; Isıldak *et al*., 2004; Kalacˇ *et al*., 1996; Svoboda *et al*., 2000). Our Cu contents were found to be lower than 6.83–31.9 µg g-1 (Zhu *et al*., 2011).

Zinc is an integral component of a wide variety of different enzymes in which it plays catalytic, structural, and regulatory roles. Minimum and maximum concentrations of Zn in our samples were 30.1 and 75.5 µg g-1. The mean Zn content of the samples was 43.24 µg g-1. The WHO permissible limit of Zn in foods is 60 µg g-1 (WHO 1982). The values for Zn in some investigated mushroom samples were above the WHO's values. Zinc concentrations of mushroom samples in the literature have been reported to be in the ranges: 29.3–158 µg g-1 (Isıloglu *et al*., 2001), 33.5–89.5 µg g-1 (Tüzen 2003), 40.3–64.4 µg g-1 (Mendil *et al*., 2004), 45.2–173.8 µg g-1 (Soylak *et al*., 2005), and 43.5–205 µg g-1 (Sesli *et al*., 2008), 42.9–94.3 µg g-1 (Zhu *et al*., 2011), respectively. Our Zn values are in agreement with literature values.

Table 2. Concentrations of protein (%), K (%), Na (µg g^{-1}) and trace metals (µg g^{-1}) of the mushroom samples analyzed.

Mushroom species	Area	Location	Strain	Protein	K	Na	Fe	Cu	Zn	Mn	Cr	Pb	As & Cd
P. ostreatus	Dhaka	NMDEC **	PO2	18.5±0.14	1.75±0.31	32.3±2.1	180.8±2.4	77.6±0.89	35.4±0.32	54.3±0.88	0.21±0.02	0.14±0.02	BDL*
		NMDEC	Florida	16.7±0.20	1.92±0.11	39.7±1.9	163.5±3.1	96.3±1.30	32.6±0.44	64.8±1.20	0.22±0.01	0.15±0.01	BDL
		NMDEC	HK51	18.5±0.12	1.73±0.10	69.3±2.8	345.2±4.8	102.1±2.6	35.5±0.28	68.4±1.56	0.23±0.01	0.14±0.02	BDL
		Agora (SQ)	PO2	25.7±0.15	1.79±0.60	32.3±1.3	114.9±4.2	88.7±1.12	44.2±0.35	104.5±1.8	0.23±0.01	0.18±0.02	BDL
		Agora (DM)	PO2	19.7±0.08	0.77±0.03	32.3±0.9	164.2±4.9	88.5±1.40	36.2±0.23	70.1±0.90	0.23±0.01	0.59±0.03	BDL
		Agora (MB)	PO2	20.9±0.18	1.16±0.4	22.4±1.1	196.5±3.5	160.5±1.9	45.0±0.49	83.0±0.85	0.24±0.00	0.30±0.01	BDL
		Meenabazar		21.0±0.22	1.59±0.02	27.4±1.9	170.0±4.2	39.2±0.88	37.8±0.23	88.0±0.97	0.23±0.01	0.24±0.01	BDL
		Newmarket		21.6±0.31	1.50±0.08	32.3±2.1	137.6±4.2	57.6±0.65	38.8±0.17	76.0±1.02	0.25±0.02	0.21±0.02	BDL
		Kawranbazar		21.8±0.16	1.56±0.20	37.2±2.2	166.8±3.4	89.2±0.44	48.6±0.24	75.1±1.14	0.26±0.02	0.36±0.01	BDL
		Nutunbazar		14.8±0.13	1.75±0.08	47.1±2.0	360.0±5.9	87.5±1.20	30.4±0.18	70.9±0.96	0.27±0.01	0.20±0.01	BDL
		Rowja Brand		24.3±0.11	2.03±0.62	71.8±3.5	162.5±3.4	56.1±0.97	30.6±0.21	70.1±0.89	0.26±0.01	0.16±0.01	BDL
	Chittagong	NMDESC ***	PO2	19.0±0.14	1.35±0.21	29.8±2.3	161.8±3.2	79.5±0.85	50.2±0.43	67.1±0.85	0.21±0.01	0.14±0.02	BDL
		NMDESC	PSC	22.7±0.15	1.32±0.02	32.3±2.4	563.8±6.5	84.5±1.20	56.7±0.42	70.6±0.93	0.20±0.00	0.14±0.02	BDL
		NMDESC	HK51	20.3±0.09	1.54±0.08	47.1±3.2	69.5±1.6	87.1±1.16	52.9±0.34	52.9±1.04	0.22±0.01	0.14±0.03	BDL
		NMDESC	PHK	25.8±0.16	2.25±0.52	12.6±0.8	369.0±3.2	73.5±1.08	51.9±0.24	73.0±1.09	0.21±0.00	0.14±0.01	BDL
	Mymensingh	NMDESC		22.8±0.14	1.52±0.03	47.1±1.2	626.2±5.8	74.3±1.15	75.5±0.54	85.5±1.35	0.27±0.02	0.14±0.02	BDL
		NMDESC		26±0.18	1.53±0.05	74.2±2.6	193.4±2.3	79.5±0.67	32.8±0.26	79.3±1.24	0.24±0.01	0.14±0.02	BDL
		Ganginarpar		15.8±0.17	1.14±0.02	76.7±3.5	182.0±2.5	96.0±0.86	30.1±0.19	75.8±1.03	0.27±0.01	0.16±0.03	BDL
		Seshmor		18.5±0.09	0.75±0.02	27.4±2.1	300.0±4.6	86.0±1.35	44.5±0.42	80.8±1.08	0.27±0.01	0.16±0.01	BDL
		Rohmotpur		14.6±0.10	0.94±0.02	47.1±3.1	270.8±3.9	55.0±1.02	35.5±0.23	75.0±0.95	0.29±0.01	0.16±0.01	BDL
		Sankipara		13.8±0.12	0.91±0.01	37.2±1.6	392.4±4.2	84.0±2.10	31.4±0.14	89.3±0.90	0.30±0.01	0.16±0.01	BDL
	Comilla	NMDESC	PO2	16.7±0.08	1.60±0.08	81.6±3.6	129.5±2.4	81.0±1.23	34.3±0.20	83.8±1.06	0.25±0.01	0.14±0.01	BDL
		NMDESC	Florida	34.3±0.19	1.56±0.05	32.3±2.1	348.5±3.5	134.6±2.8	61.3±0.47	74.9±1.12	0.26±0.02	0.15±0.02	BDL
	Rajshahi	NMDESC	PO2	22.5±0.27	1.33±0.04	37.2±1.6	151.2±3.1	74.5±0.46	54.9±0.35	83.5±1.29	0.26±0.01	0.14±0.01	BDL
A. bisporus	Dhaka	Agora (SQ)		24.7±0.34	1.37±0.05	57.0±2.9	143.6±4.6	163.4±3.9	47.6±0.46	91.1±1.38	0.29±0.01	0.16±0.02	BDL
		Chainese can-1		17.7±0.13	0.54±0.02	52.0±2.7	396.0±5.3	79.7±1.20	39.6±0.38	80.7±1.24	0.30±0.01	0.22±0.02	BDL
		Chainese can-2		18.6±0.12	1.04±0.08	37.2±2.1	370.0±4.8	54.6±0.86	36.3±0.23	83.7±1.23	0.23±0.01	0.15±0.01	BDL
		Chainese can-3		19.6±0.09	1.58±0.04	61.9±3.4	146.0±3.2	71.7±0.23	58.0±0.41	56.2±1.34	0.25±0.00	0.17±0.03	BDL
V. volvacea				18.9±0.14	1.35±0.03	44.6±2.8	322.5±5.2	101.8±2.3	36.5±0.43	78.5±0.97	0.24±0.01	0.25±0.02	BDL
G. lucidum				22.8±0.20	0.91±0.01	37.2±1.3	303.0±3.6	72.5±1.22	52.2±0.47	64.0±0.92	0.21±0.01	0.13±0.01	BDL
Average				20.62	1.40	43.89	253.37	85.88	43.24	75.70	0.25	0.19	BDL

*BDL= Below detectable limit using flame AAS (0.01 µg g^{-1})

**NMDEC: National Mashroom Development and Extension Centre

***NMDEC: National Mashroom Development and Extension Sub-centre

Table 3. Correlations between heavy metal concentrations of the edible mushroom samples.

	Na	Fe	Cu	Zn	Mn	Cr	Pb
Na	1						
Fe	0.593	1					
Cu	0.888	0.157	1				
Zn	-0.999*	-0.551	-0.911	1			
Mn	-0.931	-0.259	-0.995	0.949	1		
Cr	-0.031	-0.823	0.431	-0.020	-0.335	1	
Pb	0.064	0.842	-0.401	-0.013	0.304	-0.999*	1

*Significance at 5% level of probability

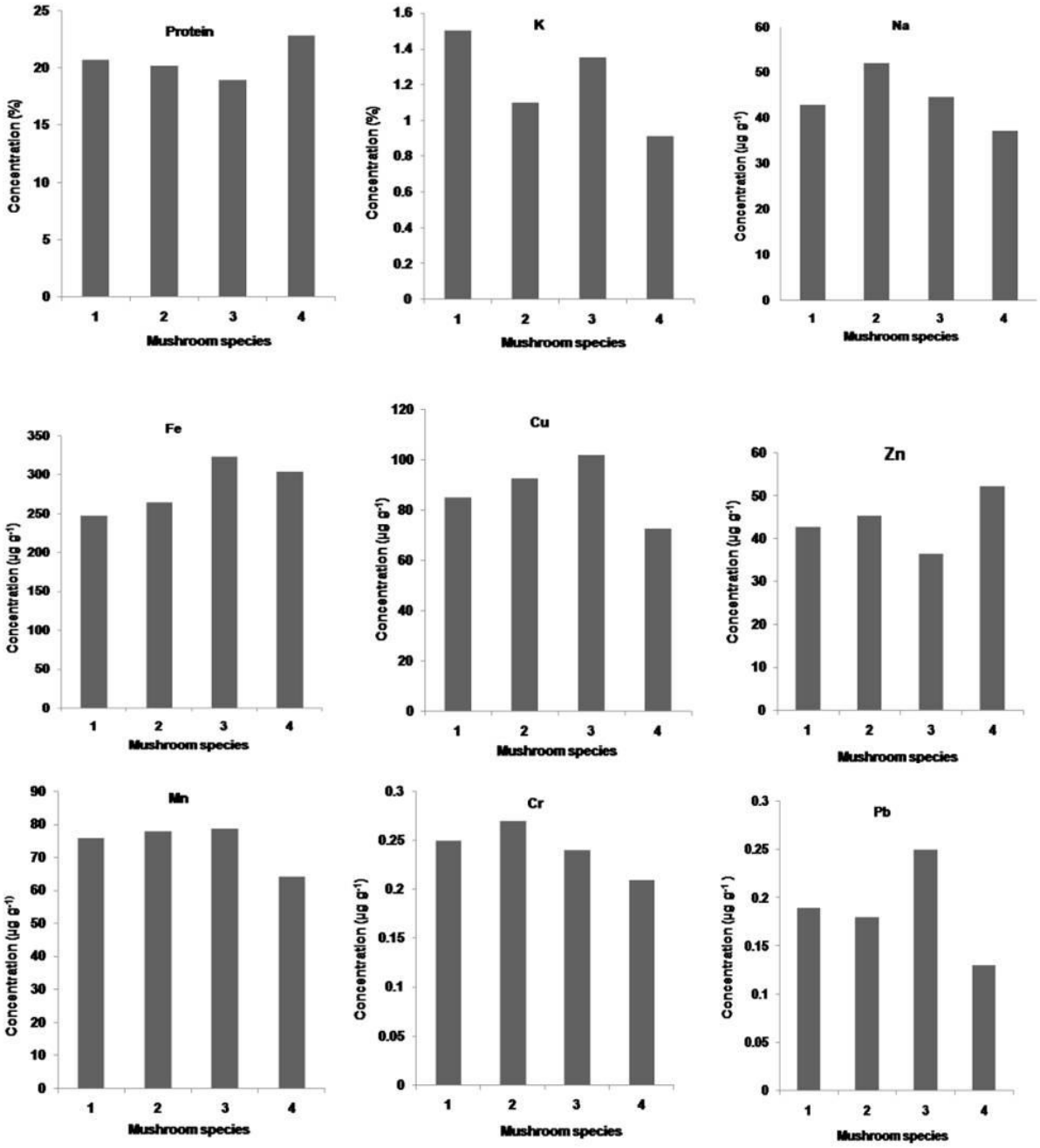

Figure 1. Distribution of mean values of protein and analyte ions in mushroom species: (1) P. ostreatus; (2) A. bisporus; (3) A. bisporus; (4) G. lucidum

Manganese is present in metalloproteins, such as pyruvate carboxylase, and in the cytoplasmic glial enzyme, glutamine synthetase. In this study, the lowest Mn content was 52.9 µg g-1, for the HK51 strain of P. ostreatus species, whereas the highest Mn content was 104.5 µg g-1, for the PO2 strain of P. ostreatus species. The mean Mn content of the samples was 75.70 µg g-1. Toxicity limits of Mn for plants are high (400– 1,000 µg g-1). Our Mn levels are below toxicity limits. Manganese concentrations of mushroom samples, in the literature, have been reported in the ranges of 7.6–56.2 µg g-1 (Demirbas 2001b), 14.5–63.6 µg g-1 (Isıloglu et al., 2001), 5.0–60.0 µg g-1 (Kalaˇc and Svoboda 2001), 12.9–93.3 µg g-1 (Tüzen 2003), 7.1–81.3 µg g-1 (Isildak et al., 2004), 21.7–74.3 µg g-1 (Mendil et al., 2004), 18.1–103 µg g-1 (Mendil et al., 2005), 14.2–69.7 µg g-1 (Soylak et al., 2005), 13.5–113 µg g-1 (Zhu et al., 2011) respectively. Our values for these species are in agreement with those reported earlier.

Chromium plays vital role for the normal metabolism of cholesterol, fat, and glucose. Chromium contents of mushroom samples were found in 0.20–0.30 µg g-1. The average Cr content of the samples was 0.25 µg g-1. These values were well below the FDA recommended daily intake of Cr for foods and feeds, which is 120 µg g-1 (Haider et al., 2004). Chromium values in mushroom samples have been reported to be in the ranges: 7.0–11.0 µg g-1 (Sivrikaya et al., 2002), 0.87–2.66 µg g-1 (Tüzen 2003), 0.16–4.86 µg g-1 (Malinowska et al., 2004), 1.2–4.2 µg g-1 (Mendil et al., 2004), 0.34–1.10 µg g-1 (Soylak et al., 2005), and 1.95–73.8 µg g-1 (Yamaç et al., 2007), 10.7–42.7 µg g-1 (Zhu et al., 2011), respectively. Our Cr contents were found to be lower than those reported earlier.

Lead has no beneficial role in human metabolism, producing progressive toxicity. The Pb level ranged from 0.13 to 0.59 µg g-1 for G. lucidum and strain PO2 of P. ostreatus. The average Pb content of the samples was 0.19 µg g-1. These values were below the WHO permissible limit (2.0 µg g-1) in plant. Lead contents of mushroom samples in the literature have been reported to be in the ranges: 0.40–2.80 µg g-1 (Svoboda et al., 2000), 1.43–4.17 µg g-1 (Tüzen 2003), 0.800–2.700 µg g-1 (Türkekul et al., 2004), 0.82–1.99 µg g-1 (Soylak et al., 2005), and 0.9–2.6 µg g-1 (Sesli et al., 2008), respectively. The Pb results of all mushroom species were in agreement with those found in the literature.

The permissible limit of Cd and As in plants, recommended by WHO, is 0.02 µg g-1 and our values of Cd and As in mushroom samples were below 0.01 µg g-1 (below detectable limit by flame AAS method).

Statistically significant correlation coefficients at 0.05 probability level were established between metal concentrations. The values of correlation coefficients between metal concentrations are given in Table 3. There are good correlations between Mn and Zn (r = 0.949), Na and Cu (r = 0.888), Fe and Pb (r=0.842), Na and Fe (r = 0.593). There are positive correlations of Na and Fe, Na and Cu, Na and Pb, Fe and Cu, Fe and Pb, Cu and Cr, Zn and Mn, Mn and Pb. Negative correlations were found between Na and Zn, Na and Mn, Na and Cr, Fe and Zn, Fe and Mn, Fe and Cr, Cu and Zn, Cu and Mn, Cu and Pb, Zn and Cr, Zn and Pb, Mn and Cr, Cr and Pb.

4. Conclusions

In the present study, the detected levels of Fe, Zn, Mn and Pb were generally in agreement with previously reported. But the Cu contents were higher than those reported earlier and the Cr levels were lower than literature values. In general, the levels of Cu and Zn in some mushroom samples were found to be higher than legal limits. The heavy metal levels of edible mushrooms should be analyzed more often in Bangladesh in order to evaluate the possible danger to human health from them.

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Conflict of interest

None to declare.

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