The Levels of Minerals and Vitamins in Some Wild and Cultured Mushroom Species from Turkey

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Abstract: In today's world, *Pleurotus ostreatus* (Jacq.) P. Kumm. and *Agaricus bisporus* (J. E. Lance) Imbach species which are grown both wild and cultured are very popular for humans diet because these species have been used in traditional medicine, economically and pharmacology. Two species of edible mushrooms *Pleurotus ostreatus* and *Agaricus bisporus* were selected from natural and cultured ones to determine vitamins and mineral contents levels. In this study, total protein levels, vitamin A-E and C levels and some mineral levels such as Fe, Cu, Zn, K, Na and Ni were investigated in both natural and cultured species.

Key words: *Pleurotus ostreatus*, *Agaricus bisporus*, minerals, vitamin, HPLC, AAS.

1. Introduction

Mushrooms contain high amounts of protein, vitamins, fiber, carbohydrates, fatty acids and minerals and also play an important role in the destruction of organic matter in the environment. Especially wild edible mushrooms have been used in many areas since ancient times, and popularity is increasing day by day. In today's world, *Pleurotus ostreatus* (Jacq.) P. Kumm. and *Agaricus bisporus* (J. E. Lange) Imbach species which are grown both wild and cultured are very popular for humans diet because these species have been used in traditional medicine, economically and pharmacology [1].

According to these popularities, in this study, total protein levels, vitamin A, E and C levels and some mineral levels such as Fe, Cu, Zn, K, Na, and Ni were investigated in both natural and cultured species to raise awareness and increase consumption. In this wise, these species can be used as human food

supplement. In addition, while literature data which are done in Turkey only, give information about the wild species contents, but in this study, there is a comparison to wild and cultured samples to seeing differences of the measure of contents.

Iron (Fe) is a trace element that is essential to humans and other living organisms. It functions as an integral part of hemoglobin, myoglobin, cytochrome, and other respiratory enzymes to bind with oxygen and facilitate its transport. Copper (Cu) along with iron, is involved in the synthesis of hemoglobin. Copper functions in the formation of collagen and the maintenance of the myelin sheath surrounding nerve fibers. Zinc (Zn) the formation of collagen is dependent on the trace element zinc. Zinc is also component of insulin, is involved in its storage and releases and apparently serves to increase the duration of insulin action after it is injected. Zinc is also involved in many processes such as DNA, RNA, protein synthesis and cell division, reproduction, night vision, immune system and healing of wounds. Nickel (Ni), studies have shown nickel to be important for growth, reproduction, hematopoiesis, and iron and zinc

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metabolism. Ni is absorbed in the small intestine and excreted in urine. Sodium (Na) is the predominant cation of the extracellular fluid. Its major function is that of maintaining the normal water distribution and osmotic pressure of plasma. Potassium (K) is the major intracellular cation of the body. It has an important role in cell metabolism by participating in regulation of many cellular process. K is also important in neuromuscular excitation. Vitamin A (retinol) designates a group of compounds essential for vision, cellular differentiation, growth, reproduction, and immun system function. Naturally occurring compounds with vitamin A activity are retinol, retinal, and retinoic acid. Vitamin E (α -tocopherol) functions in the body as a powerful antioxidant; it is primary free radical scavenger in membranes. Vit E can prevent peroxidation of polyunsaturated fatty acids (PUFAs) in cell membranes. Vitamin C (ascorbic acid) functions as a potent agent and can donate one or two of its electrons to an acceptor molecule. A number of enzymes require Vit C for maximum activity. Vit C also functions as a reducing agent of antioxidant in nonenzymatic reactions [2].

2. Materials and Methods

These species were collected from Tokat's different localities and cultured. Total protein levels were

studied with fume methods, vitamins were detected by reverse phase HPLC methods and the minerals were examined with microwave age burning after AAS. Study's natural samples were collected from Tokat's different localities. Mushroom samples cultivated in culture were obtained from Gaziosmanpaşa University Biology Department. Two species of edible mushrooms *Pleurotus ostreatus* and *Agaricus bisporus* were selected from natural and cultured ones to determine protein, vitamins and mineral contents levels. All analyses were carried out in the central research laboratory of Bingöl University.

3. Results and Discussion

According to the results, total protein levels were detected very close level at both species in cultured and natural ones (Figs. 1, 3-5).

While Vitamin A levels were found higher in cultured specimens and especially very high at *Agaricus* species samples, Vitamin C levels were found high at *Pleurotus* species samples (Tables 1 and 2). Besides these, Vitamin E was detected very high measured in *Agaricus bisporus* cultured samples (1,590.16 $\mu\text{g/g}$) also natural *Pleurotus ostreatus* samples had high level against the cultured samples (998.24 $\mu\text{g/g}$) (Figs. 2 and 3).

In addition, mineral contents of each sample to both

Fig. 1 Total protein levels of all mushroom samples (%).

Table 1 The levels of *Pleurotus ostreatus* species contents.

<i>Pleurotus ostreatus</i>	Total protein (%)	A Vitamin (µg/g)	E Vitamin (µg/g)	C Vitamin (µg/g)
Natural samples	36.25	9.62	998.24	1,481.25
Cultured samples	23.18	66.86	654.16	334.36

Table 2 The levels of *Agaricus bisporus* species contents.

<i>Agaricus bisporus</i>	Total protein (%)	A Vitamin (µg/g)	E Vitamin (µg/g)	C Vitamin (µg/g)
Natural samples	34.80	106.14	1,020.81	384.56
Cultured samples	23.74	159.20	1,590.16	269.30

Fig. 2 The vitamin A-C and E levels of all mushroom samples (µg/g).

Fig. 3 The vitamin A chromatography at HPLC of mushroom species (µg/g).

species had different measure ranges. Fe mineral levels were found high in natural samples of both specimens but Cu, Zn, K and Ni levels were very high in natural *Agaricus bisporus* and *Pleurotus ostreatus* cultured samples. Fe, Zn and Ni minerals were

detected very close amounts among the cultured and natural samples for each species (Tables 3 and 4). In addition, for each mineral, it was found to be high in cultured samples of *Pleurotus* species, high in natural samples of *Agaricus* species. *Pleurotus* species has the

higher quantity of Cu minerals than *Agaricus* species. In addition, cultured samples had the higher measure of Cu minerals than natural ones in *Pleurotus* species. K and Na minerals were measured at very high levels while Na minerals were seen very high in *Pleurotus* species, *Agaricus* species have not been measured.

Compared to some literature data which were done

in Turkey's different region, our study results showed seen very high measures (Table 5).

According to the consequences, these mushroom species have high mineral contents and are very healthy for human natural life. So we can say, these mushroom samples can be used as human food supplement.

Fig. 4 The vitamin C chromatography at HPLC of mushroom species ($\mu\text{g/g}$).

Fig. 5 The vitamin E chromatography at HPLC of mushroom species ($\mu\text{g/g}$).

Table 3 The levels of mineral contents of *Pleurotus ostreatus* species.

<i>Pleurotus ostreatus</i>	Fe (mg/kg)	Cu (mg/kg)	Zn (mg/kg)	Ni (mg/kg)	K (g/kg)	Na (g/kg)
Natural samples	593.20	872.00	339.60	0.094	69.32	47.96
Cultured samples	286.80	4,632.00	345.20	0.100	76.88	195.80

Table 4 The levels of mineral contents of *Agaricus bisporus* species.

<i>Agaricus bisporus</i>	Fe (mg/kg)	Cu (mg/kg)	Zn (mg/kg)	Ni (mg/kg)	K (g/kg)	Na (g/kg)
Natural samples	797.20	205.20	524.80	0.132	125.92	-
Cultured samples	743.60	138.80	405.60	0.118	11.56	-

Table 5 The literature data for about the species mineral contents (*P. ostreatus* a, b means that: they were collected from different areas of district).

Some literature	Mushroom species	Fe (mg/kg)	Cu (mg/kg)	Zn (mg/kg)	Ni (mg/kg)	K (g/kg)	Na (g/kg)
Demirbaş 2001 [3]	<i>Pleurotus ostreatus</i>	86.1	13.6	29.8	-	-	-
	<i>Agaricus bisporus</i>	126	5.22	17.8	-	-	-
	<i>Pleurotus ostreatus</i> a	125	54	250	2.51	8,270	-
Uzun et al. 2011 [4]	<i>Pleurotus ostreatus</i> b	65	62	265	2.64	17,775	-
	<i>Agaricus bisporus</i>	50	78	110	1.10	27,490	-
Dursun et al. 2006 [5]	<i>Pleurotus ostreatus</i>	507.3	14.3	58.3	3.7	21,603.3	-
Gençelep et al. 2009 [6]	<i>Pleurotus ostreatus</i>	682	47.1	142	-	21.9	1.53
Işıldak et al. 2007 [7]	<i>Agaricus bisporus</i>	0.23406	0.04182	0.03858	0.00424	-	-

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