Studies on Chemical Composition and Nutritive Evaluation of Wild Edible Mushrooms

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ABSTRACT: *Agaricus bisporus and Agaricus bitorquis are among most favorite mushrooms of the world. Mineral contents, proximate composition and fatty acid profile of these mushrooms were determined for evaluation of their dietary value. Na, K and Li contents were high, while Cr, Cu, Pb, Co, Zn, Mn and Ni concentrations were low in both Agaricus bisporus and Agaricus bitorquis. Proximate analysis showed that both mushrooms have sufficient quantity of protein, lipids, carbohydrates and cellulose. Gas chromatographic analysis of fatty acid methyl esters revealed that linoleic acid (44.19 %) and oleic acid (40.13 %) were the dominant fatty acids in Agaricus bisporus and Agaricus bitorquis respectively.*

KEY WORDS: *Agaricus bisporus, Agaricus bitorquis, Fatty acids, Mineral contents, Linoleic acid.*

INTRODUCTION

Many Asian countries use traditionally wild edible mushrooms as delicious and nutritional foods and medicine. Wild edible mushrooms are appreciated not only for texture and flavor but also for their chemical and nutritional characteristics [1, 2]. Cultivated mushrooms have higher protein contents and minerals, low in fat and rich in B vitamins, vitamin D, vitamin K and sometimes vitamins A and C [2-6]. Wild edible mushrooms have a worldwide distribution. Mushrooms are not only sources of nutrients but also have been reported as therapeutic foods, useful in preventing diseases such as hypertension, hypercholesterolemia and cancer [7, 8]. These functional characteristics are mainly due to the presence of dietary fiber and in particular chitin and beta glucans [4]. Studies have also shown antitumor, antiviral, antithrombotic and immunomodulating effects of mushrooms [9].

Numerous species (more than 2000) of mushrooms exist in nature; however, only a few are used as a food. *Agaricus bisporus* and *Agaricus bitorquis* are two of the most abundant wild edible mushrooms found in the

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central Punjab, Pakistan. Both are easy to recognize and they are collected in large quantities in autumn. The taste and size of their fruiting bodies are important factors for considering these mushrooms as potential important foodstuffs. Although the edible wild mushrooms command higher prices than the cultivated mushrooms, people refer to consume wild one due to their flavor and texture.

There are many reports on cultivated and wild edible mushrooms and their nutritional value from different regions of the world, very little information is available about these two species from Pakistan. In this regard, present study was under taken to investigate the mineral content, proximate composition and fatty acid profile of *Agaricus bisporus* and *Agaricus bitorquis*.

EXPERIMENTAL

The mushrooms used in present study were collected, fresh from the plains of Punjab, Pakistan in spring. Specimen identifications were done by mushroom laboratory, Institute of Horticultural Sciences, University of Agriculture, Faisalabad, Pakistan. The mushroom samples were packed in opaque plastic bags, which were stored in a refrigerator during transportation to analytical laboratory. The collected mushrooms were oven dried at 70 °C for 72 h to constant weight.

The dried materials grounded into powdered form using food processor (Moulinex, France). The obtained powdered materials were stored in airtight jars for further studies.

Pure cellulose, moisture content, ash content, crude protein, crude lipids, total carbohydrates and tannin were determined using standard methods [10]. The energy values of mushrooms were evaluated using formula described by *Crisan* and *Sands* [11].

$$\text{Energy value (kcal/100g)} = (2.62 \times \%\ \text{protein}) + (8.37 \times \%\ \text{fat}) + (4.2 \times \%\ \text{carbohydrate})$$

The mushroom samples were wet digested according to the reported method [12]. The Na, K and Li were analyzed using flame photometer (Sheerwood 450 flame photometer). The trace metals (Cr, Cu, Pb, Co, Zn, Mn, Ni, Ca, and Mg) were determined by Perkin Elemer Analyst 300 spectrometer [13].

Fatty acids profile in *Agaricus bisporus* and *Agaricus bitorquis* was determined using a reported method [14]. All experiments were performed in triplicate. Statistical analysis was performed using statistical functions of Microsoft Excel, 2004.

Table 1: Proximate analysis of Agaricus bisporus and Agaricus bitorquis.

Parameters	*Agaricus bisporus*	*Agaricus bitorquis*
Moisture (%)	5.9 ± 0.12	12.1 ± 0.13
Ash (%)	11.01 ± 0.26	10.11 ± 0.10
Protein (%)	16.4 ± 0.01	19.53 ± 0.01
Carbohydrate (%)	56.47 ± 0.21	39.94 ± 0.17
Lipid (%)	26.21 ± 0.17	36.09 ± 0.36
Cellulose (%)	62.25 ± 1.24	61.92 ± 1.17
Tannin (mg/g)	3.797 ± 0.12	3.797 ± 0.31
Oxalate (mg/g)	0.667 ± 0.01	0.539 ± 0.02
Energy value (kcal/100g)	499.52 ± 9.32	520.99 ± 9.91

RESULTS AND DISCUSSION

The proximate composition of *Agaricus* spp. is tabulated in table 1. *Agaricus bisporus* was low in moisture content (%) in comparison to *Agaricus bitorquis*, while ash contents (%) of both species were comparable. The crude protein content (%) was 16.40 ± 0.01 in *Agaricus bisporus* and 19.53 ± 0.01 in *Agaricus bitorquis*. The protein contents of both species were comparable to average proteins present in mushrooms (i.e. 17.5 %) [12]. Crude lipids were 26.21 ± 0.17 and 36.09 ± 0.36 % in *Agaricus bisporus* and *Agaricus bitorquis* respectively. The reported average crude lipid (%) in edible mushrooms is 29 % [12]. The cellulose contents of both mushrooms were comparable while there was a significant difference in carbohydrates present in *Agaricus bisporus* (56.47 ± 0.21 %) and *Agaricus bitorquis* (39.94 ± 0.17 %). The amount of carbohydrates determined in *Agaricus bitorquis* is comparable to previously reported average value for edible mushrooms [12], while in case of *Agaricus bisporus*, it was much higher than reported value. This difference might be due to growth conditions, genetic factors, geographical variations and analytical procedures [15, 16].

Both mushrooms were low in oxalate content and high in tannin (table.1). Cellulose (%) of both *Agaricus* species was comparable to each other. *Agaricus bisporus* and *Agaricus bitorquis* were high in energy value. The energy values of *Agaricus bisporus* and *Agaricus bitorquis* were 499.52 ± 9.32 and 520.99 ± 9.91 kcal/100g respectively. Sufficient quantities of Na, K and Li were detected in both mushrooms. Na, K and Li contents were

27.28 ± 0.963, 8.35 ± 0.351 and 39.7 ± 0.975 mg/g in *Agaricus bisporus* and 20.46 ± 0.821, 8.55 ± 0.382 and 36.93 ± 0.982 mg/g in *Agaricus bitorquis* respectively. Na is an important mineral that regulates volume flow and pressure of blood. K is an essential nutrient and has important role in synthesis of amino acids and proteins [17].

Li is an important trace element with important pharmacological activities [18]. *Agaricus bisporus* and *Agaricus bitorquis* were found to contain trace amounts of Cr, Cu, Pb, Co, Zn, Mn, Ca, Ni and Mg. The Cr, Cu, Pb, Co, Zn, Mn, Ca, Ni and Mg content were 0.134 ± 0.020, 0.108 ± 0.015, 0.062 ± 0.019, 0.019 ± 0.010, 0.083 ± 0.016, 0.056 ± 0.02, 0.204 ± 0.034, 0.073 ± 0.008 and 0.0136 ± 0.008 mg/g in *Agaricus bisporus* while 0.120 ± 0.019, 0.093 ± 0.016, 0.024 ± 0.011, 0.057 ± 0.020, 0.283± 0.014, 0.029 ± 0.013, 0.205 ± 0.029, 0.087 ± 0.009 and 0.125 ± 0.015 mg/g in *Agaricus bitorquis*. Cd and Pb are best known for their toxicological properties[18]. Low levels of Cd and Pb in both mushrooms suggested their non toxic nature. Cu plays an important role in proteins synthesis [19].

Zn is an essential micronutrient associated with number of enzyme, especially those for synthesis of ribonucleic acids and DNA polymerases [20]. Ni is also an essential element, and its daily uptake of 100 mg is recommended for good health [21]. Ca is the major component of bone and assists teeth development [22]. Mg is an important element because many enzymes require it as co-factor [23]. Cadmium may contribute to biological processes, but have not been established as essential. Cu and Mn play important role in enzymatic catalysis and are crucial to virtually all biochemical and physiological process. Cr has important role in reduction of cardiovascular disease and adult diabetes [24]. Cobalt is essential in trace amounts for human life. It is important vitamin B-12, and plays a key role in the body's synthesis of this essential vitamin. Cobalt has also been used as a treatment for anemia, because red blood cells to be produced.

Total amount of fatty acids detected in *Agaricus bisporus* and *Agaricus bitorquis* were 97.33 and 99.99 %, respectively. Linoleic acid was dominant fatty acid in *Agaricus bisporus* that accounts for 44.19 % of total fatty acid identified [25]. The main component of *Agaricus bitorquis* was oleic acid (40.13 %). The other fatty acids detected in *Agaricus bisporus* were: caprylic 1.76, palmitic 4.34, stearic 1.79, oleic 21.47, eicosanoic 6.30 and erucic acid 12.849 % respectively. *Agaricus bitorquis* was found to contain caprylic 0.59, palmitic 4.28, stearic 2.03, linoleic 31.03, linolenic 11.27, eicosanoic 4.10 and erucic acid 6.56 % respectively. The lipids extracted from *Agaricus bisporus* and *Agaricus bitorquis* contained more amounts of unsaturated fatty acids than the saturated one. Our findings are in close agreements with the reported results [25]. It was observed that unsaturated fatty acids were more dominant in wild edible mushrooms. The concentration of unsaturated fatty acids in these mushrooms is very important from nutritional standpoint. Oils rich with unsaturated fatty acids are considered as health oil for human nutrition. Oils with high levels of linoleic and oleic acids are very important human health, as they reduce atherosclerosis by interesting with HDL in blood. The most important essential fatty acid in human nutrition is linolenic acid. The amount of linolenic acid detected in *Agaricus bisporus* and *Agaricus bitorquis* was 4.63 and 11.27 % respectively. *Agaricus bitorquis* was found to contain highest amount of essential linolenic acid in comparison with the values reported in the literature of mushrooms.

CONCLUSIONS

The results of present study indicated that *Agaricus bisporus* and *Agaricus bitorquis* were low in moisture, ash and oxalate contents while high in protein, lipids, carbohydrate, cellulose and tannin contents. Na, K and Li were present in sufficient quantities in both species, while Cr, Cu, Pb, Co, Zn, Mn, Ca, Ni and Mg were present in trace concentrations. The concentration of unsaturated fatty acid in these mushrooms was high in comparison to saturated fatty acids. *Agaricus bitorquis* contained considerable quantity of linolenic acid, which is regarded as very essential for human health.

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