Asian Journal of Chemistry Vol. 20, No. 4 (2008), 3109-3114

Some Chemical Components of *Lactarius pyragalus* from Diverse Locations

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The aim of this study was to determine pH, moisture, ash, nitrogen, protein and mineral contents in mushroom samples of *Lactarius pyragalus* collected from different locations in some districts and villages of Samsun and Ordu provinces at Middle Black Sea Region of Turkey. Some chemical components of fresh *L. pyragalus* samples are as follows: pH 5.95, moisture 68.74 %; ash 1.13 %, N 0.71 % and protein 4.42 %. Mean mineral contents (mg kg^{-1}) of *L. pyragalus* samples were found to be: P 100.96, K 3510.37, Ca 87.27, Fe 52.38, Mg 301.48, Na 154.43, Zn 40.64, Cu 9.01 and Mn 4.68. Significant differences were found among locations for other chemical properties of *L. pyragalus* with the exception of Ca, Na and Mn contents.

Key Words: *Lactarius pyragalus*, Chemical component, Protein, Minerals.

INTRODUCTION

Mushrooms are important for both their nutritive and medicinal values[1-3]. Mushrooms are considered as source of good value protein, vitamins (belonging to the B group), a low energy value (low fat concentration), carbohydrates, amino acids, minerals and various aromatic substances[4]. Mushrooms have been a food supplement in various cultures and they are cultivated and eaten for their edibility and delicacy. Wild growing mushrooms have been a popular delicacy in many countries, especially in some central and east European countries and yearly consumption may exceed 10 kg for some individuals[5]. The consumption of wild and cultivated mushrooms continues to increase in many countries[2,5-7].

Turkey has a large edible mushroom potential and is becoming an important exporter of wild mushrooms[6]. Picking and consumption of wild edible mushroom has been a popular delicacy, particulary in the middle

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Black Sea Region of Turkey. *L. pyrogalus* is an ectomycorrhizal fungus associated with *Corylus*. It is one of the most consumed and liked species in Ordu and Samsun provinces of Turkey because of their delicacy and abundance. Therefore, it is important to determine the levels of essential elements such as protein and mineral contents in this mushroom species.

The chemical composition and nutritional quality of different wild and cultivated mushroom species have been studied[1,3,8-19]. No detailed studies on the chemical composition of *Lactarius pyragalus* have been previously reported. The aim of this study was to determine the some chemical components such as pH, moisture, ash, nitrogen, protein and minerals in mushroom samples of *L. pyragalus* from different locations.

EXPERIMENTAL

Lactarius pyragalus (Bull.: Fr.) Fr. samples were collected from different areas in 9 hazelnut orchards of some villages and districts of Samsun and Ordu provinces at Middle Black Sea Region of Turkey between September and October 2006. For the identification, the habitat and morphological characteristics of the collected mushrooms were recorded and photographed. The macro fungi were carried to the laboratory and then their spore prints were extracted and spore measurements were determined. Fungi were identified according to Heilmann-Clausen *et al.*[20].

The contents of minerals, protein, nitrogen, ash, moisture and pH in 90 samples of *L. pyragalus*, collected from (1) Salipazari district, Samsun province, (2) Ordu province, (3) Sutozu village, Terme district, Samsun province, (4) Unye district, Ordu province, (5) Terme district, Samsun province, (6) Kasyayla village, Samsun province, (7) Gundogdu village, Terme district, Samsun province, (8) Baskoy village, Tekkekoy district, Samsun province, (9) Cimenli village, Tekkekoy district, Samsun province, were analyzed. Samples were cleaned and washed with demineralized water. Moisture content was determined by the direct oven drying method: the loss in weight after oven-drying 1 g each of the sample at 105 °C to constant weight was expressed as % moisture content[21]. Ash was determined as the residue of incineration of 1 g powdered sample in a crucible of known weight at 550 °C in a muffle furnace[22]. Nitrogen (N) was determined by the micro-Kjeldhal method. Crude protein was calculated as N × 6.25[11]. The solution of ash dissolved in a drop of trioxonitrate (V) acid made up to 50 mL with deionized water was analyzed for K, Ca, Mg, Fe, Cu, Mn, Na and Zn using the atomic absorption spectrophotometer and P using UV-Visible spectrophotometer after making ammonium vanadate molybdate complex at 436 nm using established procedures of Perkin-Elmer[23].

Descriptive statistics such as mean values, standard deviations of the means, minimum-maximum values and coefficient of variation (%) were

computed separately for each chemical component by SPSS. The statistical significance of obtained results was assessed with one-way Anova analysis, followed by the Duncan multiple range test.

RESULTS AND DISCUSSION

Descriptive statistics for some chemical components of *L. pyragalus* as the mean of 90 mushroom samples collected from 9 locations are presented in Table-1. Means for chemical components of fresh *L. pyragalus* samples were as follows: pH 5.95, moisture 68.74 %, ash 1.13 %, N 0.71 % and protein 4.42 %. Mean mineral contents (mg kg^{-1}) of *L. pyragalus* samples were found to be: P 100.96, K 3510.37, Ca 87.27, Fe 52.38, Mg 301.48, Na 154.43, Zn 40.64, Cu 9.01 and Mn 4.68. Results of the present study for some chemical components of *L. pyragalus* showed differences when compared with the literatures[8,10,18,24]. These differences may be mainly depends on mushroom species and analytical procedures used in the laboratory analyses. Concentrations of the elements in fruiting bodies are generally species dependent[5].

TABLE-1
SOME CHEMICAL COMPONENTS OF *L. pyragalus* SAMPLES

	Mean and standard error of mean	Minimum-maximum values	Coefficient of variation (%)
pH	5.95 ± 0.06	5.50 - 6.30	4.20
Moisture (%)	68.74 ± 1.37	57.49 - 78.29	8.45
Ash (%)	1.13 ± 0.05	0.78 - 1.47	17.24
N (%)	0.71 ± 0.03	0.51 - 0.92	14.79
Protein† (%)	4.42 ± 0.15	3.19 - 5.72	14.80
Protein‡ (%)	24.84 ± 0.54	21.62 - 29.78	9.16
P (mg kg^{-1})	100.96 ± 7.26	55.88 - 156.25	30.49
K (mg kg^{-1})	3510.37 ± 234.23	2126.70 - 5117.89	28.31
Ca (mg kg^{-1})	87.27 ± 22.15	15.79 - 332.49	107.69
Fe (mg kg^{-1})	52.38 ± 9.69	21.16 - 149.39	78.48
Mg (mg kg^{-1})	301.48 ± 34.81	91.19 - 633.68	48.99
Na (mg kg^{-1})	154.43 ± 32.04	12.60 - 539.71	88.01
Zn (mg kg^{-1})	40.64 ± 3.10	26.70 - 77.18	32.31
Cu (mg kg^{-1})	9.01 ± 0.85	2.19 - 16.35	40.14
Mn (mg kg^{-1})	4.68 ± 0.50	1.18 - 10.58	45.41

†Fresh mushroom samples; ‡Dried mushroom samples.

Except for Ca, Na and Mn contents, significant differences were also found among other chemical properties of *L. pyragalus* collected from different locations (Tables 2 and 3). The moisture content of mushroom samples ranged from 59.44 to 76.47 % (Table-2). These values were found

TABLE-2
pH, MOISTURE, ASH, NITROGEN AND PROTEIN CONTENTS OF *L. pyragalus* COLLECTED FROM DIFFERENT AREAS IN 9 LOCATIONS

Locations (L)	pH	Moisture (%)	Ash (%)	N (%)	Protein† (%)	Protein‡ (%)
1	5.50f*	66.18abc*	1.17bc*	0.68bc*	4.23bc*	21.82b*
2	5.85d	74.48a	1.22b	0.59c	3.69c	27.61a
3	5.70e	76.47a	1.12bcd	0.91a	5.68a	22.24ab
4	6.31a	59.44c	0.95de	0.75abc	4.70abc	28.37a
5	5.90d	61.76bc	1.20bc	0.67bc	4.21bc	24.28ab
6	5.90d	69.53abc	0.99cde	0.59c	3.68c	24.25ab
7	6.20ab	69.89abc	1.26b	0.71bc	4.45bc	25.05ab
8	6.08c	70.05abc	0.80e	0.68bc	4.22bc	24.69ab
9	6.15bc	70.87ab	1.46a	0.79ab	4.95ab	25.23ab

*Significant at 0.01 level; †Fresh mushroom samples; ‡Dried mushroom samples.

TABLE-3
MINERAL CONTENTS OF *L. pyragalus* COLLECTED FROM DIFFERENT AREAS IN 9 LOCATIONS

Locations L	P (mg kg^{-1})	K (mg kg^{-1})	Ca (mg kg^{-1})	Fe (mg kg^{-1})	Mg (mg kg^{-1})
1	106.87ab**	4455.61ab**	31.73	29.77d**	347.83bc**
2	126.96a	2656.01cd	48.46	25.78d	302.99bc
3	102.53ab	3620.19bc	42.26	34.00d	321.35bc
4	144.16a	4193.76ab	69.46	24.55d	374.48b
5	96.46ab	3994.54ab	88.44	30.76d	394.50b
6	96.07ab	3239.69bcd	225.88	56.02c	201.55cd
7	120.27a	4972.95a	212.79	94.17b	565.46a
8	57.30b	2258.79d	49.76	28.55d	110.37d
9	58.05b	2201.83d	16.63	147.87a	94.79d

Locations L	Na (mg kg^{-1})	Zn (mg kg^{-1})	Cu (mg kg^{-1})	Mn (mg kg^{-1})
1	108.79	31.77b**	7.96bc*	3.59
2	113.80	34.59b	4.67c	3.24
3	51.12	31.38b	7.42bc	4.82
4	170.38	36.46b	8.20bc	5.30
5	267.09	35.80b	5.97bc	2.37
6	126.32	48.48b	12.15ab	5.14
7	377.09	71.83a	14.68a	7.64
8	20.55	38.22b	11.75ab	4.61
9	154.76	37.21b	8.27bc	5.45

*Significant at 0.05 level; **significant at 0.01 level.

to be lower than data reported by Crisan and Sands[25] stated that most fresh mushrooms contained about 90 % moisture. The moisture content of mushrooms depends on their harvesting time, maturation period and environmental conditions[25].

The protein contents of *L. pyragalus* from 9 locations ranged from 3.68 to 5.68 % and 21.82 to 28.37 % for fresh and dried samples, respectively (Table-2). It has been reported that protein content of the fresh *A. campestris* samples was 3.03 %[26]. Zrodlowski[27] reported that the protein content of *A. bisporus* varies between 0.8 and 3.5 g 100 g^{-1} fresh matter. The protein content of edible fungi on a dry weight basis usually ranges from 19 to 35 %[25], from 15.4 to 26.7 %[28], from 14.6 to 22.3 %[29] and from 27.30 to 44.20 %[19]. According to Yildiz *et al.*[30], the protein contents of macrofungi specimens collected from location around Diyarbakir and Batman ranged from 7.2 to 51.2 % of dry weight. The protein contents of *L. pyragalus* found in the present study were in agreement with those researcher's results. It can be understood from the data that the *L. pyragalus* is good protein source when compared with both other cultivated or edible wild mushroom species and some commercially important fish species from the Black Sea[31].

Mineral compositions of *L. pyragalus* were found between 57.30 and 144.16 mg kg^{-1} of P, 2201.83 and 4972.95 mg kg^{-1} of K, 16.63 and 225.88 mg kg^{-1} of Ca, 24.55 and 147.87 mg kg^{-1} of Fe, 94.79 and 565.46 mg kg^{-1} of Mg, 20.55 and 377.09 mg kg^{-1} of Na, 31.38 and 71.83 mg kg^{-1} of Zn, 4.67 and 14.68 mg kg^{-1} of Cu, 2.37 and 7.64 mg kg^{-1} of Mn. Among locations, Gundogdu village of Samsun province had the highest mineral concentrations for K, Mg, Na, Zn, Cu and Mn. Mineral contents of mushroom were generally affected by locations (Table-3). These differences might be sourced from the growth conditions, genetic factors, geographical variations and also analytical procedures in laboratory analyses[32]. Yildiz *et al.*[30] reported that protein contents and organic elements can vary from region to region and among mushroom species. This result can arise from physical and chemical differences of growth regions and genetic structures of species. The same species samples, collected from different regions, contain different amounts of protein. It has been rather difficult to determine the effects of environmental factors on the concentrations of elements[33].

This study attempts to contribute to knowledge of the some chemical properties of *L. pyragalus*. In addition, further studies will be performed on the effects of soil micro and macro nutritional elements.

ACKNOWLEDGEMENT

The authors wish to thank Dr. A. Verbeken (Lab. Botany, University of Gent, Belgium) for her kind help in the identification of the mushroom species.

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(*Received*: 1 July 2007; *Accepted*: 19 January 2008) AJC-6222