

Economically Important Wild Mushroom Saffron Milk Cap [Lactarius deliciosus (L.) Gray] of Aegean Region, Turkey

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ABSTRACT: The edible wild mushrooms have an economic value throughout the world. The world market for wild mushrooms was valued at US\$ 3-5 billion. In Turkey, about 40 wild mushroom species are used for home consumption and 25 of them are used for sale. Saffron milk cap (*Lactarius deliciosus* (L.) Gray) is among one of the well-known wild mushroom species due to its intensive consumption and trade especially Aegean Region of Turkey. The aim of this study was to evaluate ethnobotany, socio-economic and nutritional value of *Lactarius deliciosus* (L.) Gray. According to our results, *L. deliciosus* is valuable for folk of Aegean Region as a low priced and easily accessible food source and as a source of income. Food composition results showed that *L. deliciosus* is rich in Vitamin B, minerals and dietary fibre. The antioxidant activity values of saffron milk caps were determined as 9.9 1/IC50 according to the DPPH (1,1-diphenyl-2-picrylhydrazyl radical scavenging effect) method and 46.4 µM trolox equivalent /g sample according to the TEAC (Trolox Equivalent Antioxidant Capacity/ABTS) method.

Keywords: *Lactarius deliciosus*, saffron milk cap, ethnobotany, socioeconomy, nutritional value, antioxidants.

Türkiye - Ege Bölgesi'nde Ekonomik Öneme Sahip Yabani Çıntar Mantarı [Lactarius deliciosus (L.) Gray]

ÖZ: Yenilebilir doğa mantarları dünya genelinde ekonomik değere sahiptir. Dünya pazarında doğa mantarlarının değeri 3-5 milyar ABD dolarıdır. Türkiye'de 40 kadar doğa mantarı ev tüketiminde ve bunların 25'i satış için kullanılmaktadır. Çıntar mantarı (*Lactarius deliciosus* (L.) Gray) yoğun tüketimi ve ticarete konu olması nedenleriyle Türkiye'de özellikle Ege Bölgesinde en bilinen doğa mantarları arasında yer almaktadır. Bu çalışmanın amacı *Lactarius deliciosus* (L.) Gray'in etnobotanik, sosyo-ekonomik, besin ve antioksidan değerlerinin değerlendirilmesidir. Çalışmamızın sonuçlarına göre; Ege Bölgesindeki yerel halk için çıntar mantarı düşük ve kolay ulaşılabilir bir gıda kaynağı ile gelir kaynağı olmasıyla önemlidir. Gıda kompozisyon analiz sonuçlarına göre *L. deliciosus* Vitamin B, mineral ve lif içeriği açısından zengindir. Çıntar mantarının antioksidan değerleri DPPH (1,1-difenil-2-pikrilhidrazil radikal süpürme etkisi) yöntemine göre 9.9 1/IC50 ve TEAC (Trolox Eşdeğeri Antioksidan Kapasitesi/ABTS) yöntemine göre 46.4 µM trolox eşdeğeri /g örnek olarak belirlenmiştir.

Anahtar Sözcükler: *Lactarius deliciosus*, çıntar, etnobotani, sosyo-ekonomi, besin değeri, antioksidan.

INTRODUCTION

There are about 14,000-22,000 mushroom species known worldwide. Of these, about 7000 species are considered to possess varying degrees of edibility, and more than 3000 species are regarded as prime edible mushrooms (Chang and Miles, 2004). At present, worldwide usage and consumption of wild edible mushrooms are considerable high. 200-300 mushroom species are gathered from wild or cultivated for their aroma and nutritional and healing properties in the Far East countries such as China, Japan and Korea. The world market for wild mushrooms was valued at US\$ 3-5 billion (Jong, 2005; Anonymous, 2009).

2400 mushroom species were recorded (Solak *et al.*, 2015) and nearly 300 wild mushroom species are known to be edible in Turkey. Wild edible mushrooms have been part of the human diet in Turkey (Pekşen and Akdeniz, 2012). 40 mushroom species are collected from wild for consumption and nearly 25 of them sold at local or foreign markets. In the past decade, export revenues of wild mushrooms were estimated at US\$ 187, 554 million (Adanacioglu *et al.*, 2016; Anonymous, 2016). Saffron milk cap mushrooms (*Lactarius* spp.) are very popular with their aroma, taste and nice appearance among commercialized wild mushroom species in Turkey. *Lactarius deliciosus* (L.) Gray is one of the well-known mushroom within *Lactarius* species, due to its intensive collection, consumption and trade from autumn to winter, in the Aegean region of Turkey.

Lactarius deliciosus (L.) Gray is locally known as çıntar, kanlıca, elicek, ebişek, melki, merki, sütlü mantar, çam melkisi, çam mantarı, espir, espit, tirit and glifoz in Turkey. *Lactarius deliciosus* is member of genus *Lactarius* in the order *Russulales* containing several edible species. *L. deliciosus* is an ectomycorrhizal fungal specie grows in coniferous woodland, particularly under pines. It is easily recognized by the saffron-colored sap it bleeds when damaged, the concentric rings of carrot-coloured blotches on the surface of the cap,

and its tendency to turn green with age or after being handled (Anonymous, 2012).

The purpose of this study was to assess ethnobotany, socio-economic, nutritional and antioxidant values of saffron milk cap [*Lactarius deliciosus* (L.) Gray].

MATERIALS AND METHODS

The study was conducted in Izmir, Aydin and Balıkesir provinces of Aegean Region. Aegean Region is situated in the western part of Turkey and Mediterranean Climate is seen.

Questionnaire surveys were carried out for collecting ethnobotanic and socio-economic data by using face-to-face interviews with saffron milk cap mushroom collectors and consumers. Monographic research technique was used in the study. In this technique, data were collected through questionnaire survey, using face-to-face interviews with saffron milk cap mushroom collectors and consumers.

Mushroom samples were taken from local markets for food composition analysis. Identification of the specimen was performed according to literature (Lincoff, 2009). Proximate composition (protein, dietary fibre and carbohydrate) of samples were analyzed according to reference AOAC procedures (Latimer, 2012). Minerals were determined by ICP MS after microwave digestion using NMKL 186 method. The procedure described by Gökmen *et al.* (2000) was used for vitamin C analysis. Thiamin and riboflavin were analyzed by HPLC (Agilent 1260, Agilent Technologies, Santa Clara, CA) with fluorescence detection and Lahely *et al.* (1999) procedure was modified for the determination of niacin.

The antioxidant capacity studies were performed by DPPH (1, 1-diphenyl-2-picryl hydrazyl) radical scavenging method and TEAC (Trolox Equivalent Antioxidant Capacity/ABTS Method) were expressed as Trolox equivalents with spectroscopic measurements. These methods were made by the Thermo Scientific™ Multiskan™ GO microplate

reader supplied from the BFN Project. IC50 values were calculated from the concentration-effect linear regression curve (Cemeroğlu, 2010; Öztürk *et al.*, 2011).

RESULTS AND DISCUSSION

In this presented study, 41 collector and 77 consumer questionnaires were finalized. According to our results *L. deliciosus* is important for two main reasons for the local people of region: as a low priced and easily accessible food source and as a source of income.

As given in Table 1, in the region, while most of the collected *L. deliciosus* is marketed (80 %), the rest is used for household consumption (10.4 %) and distributed to neighbor-relatives (9.3 %). Only very few amount of collected mushrooms are used for animal feed (1 %).

According to De Frutos *et al.* (2008), the most popular distribution channels for wild edible mushrooms are, direct sales, intermediaries, or sales to mushroom industries. Our results indicated that direct marketing channels are mainly preferred by saffron milk cap collectors. 59 % of collectors preferred to sell their gathered saffron milk caps directly to consumers at local markets and 41% of

them sell their saffron milk caps to trader at local market (Table 2). The local market price for saffron milk cap was determined as 5-10 TL/kg and their retail price was recorded as 1.25-1.50 TL/kg in 2014.

Saffron milk cap consumption frequency is high in the Aegean Region. According to saffron milk cap vegetation periods, 39 % of consumers are consumed saffron milk cap mushroom 1-2 times per week and, 37 % of them are consumed 3-4 times per week (Fig.1). It is determined that saffron milk cap consumption amount per households is 17.8 kg and consumption amount per capita is 5.7 kg/year.

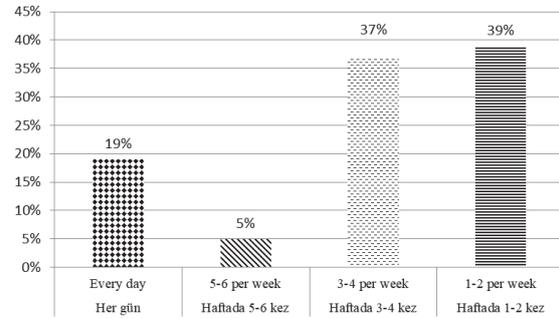


Figure 1. Consumption frequency of saffron milk cap of Aegean Region (%).

Şekil 1. Ege Bölgesi'nde çintar mantarının tüketim sıklığı (%).

Table 1. Using pattern of saffron milk cap collected from Aegean Region.

Çizelge 1. Ege Bölgesi'nden toplanan çintar mantarının tasarruf şekillerine göre dağılımı.

Mushroom name Mantar adı	Household consumption (%) Ev tüketimi (%)	Distributed to neighbors/relatives (%) Komşu-akrabaya dağıtılan (%)	Used for animal feed (%) Hayvan beslemeye kullanılan (%)	Marketed (%) Pazarlanan (%)	Amount collected (kg) Toplanan miktar (kg)
Saffron milk cap Çintar	10.4	9.3	0.1	80.2	7024

Table 2. The saffron milk cap marketing status of collectors in Aegean Region.

Çizelge 2. Ege Bölgesi'nde toplayıcıların çintar mantarını pazarlama şekilleri.

Mushroom name Mantar adı	Average distance to market (km) Pazara ortalama uzaklık (km)	Proportion of selling to Consumers at local market (%) Yerel pazarda tüketiciye satış yapanların oranı (%)	Proportion of selling to Trader at local market (%) Yerel pazarda tüccara satış yapanların oranı (%)	Proportion of selling to trader at village (%) Köyde tüccara satış yapanların oranı (%)
Saffron milk cap Çintar	27	59.0	41.0	0

Saffron milk cap is frequently used in various dishes in the studied areas mainly in the autumn and winter, freshly after collection. Pickling, canning, and drying techniques used by local people make this mushroom consumed the whole year. Saffron milk cap is eaten as fried, roasted, meatballs, scrambled eggs and pies. It is used in rice pilaf and soups.

L. deliciosus is often used as food in the Aegean Region therefore proximate composition and mineral contents of saffron milk cap were determined and given in Table 3 and Table 4, respectively.

It is reported that chemical composition of mushrooms depends on composition of substratum, size of pileus, harvest time, and species of mushroom (Bernas *et al.*, 2006; Pushpa and Purusphothama, 2010; Onbasili *et al.*, 2015). Protein content of mushrooms varies between 0.8 g/100 g-1 fresh matter, ie. 7.6 g/ 100 g-1 dry matter (Bernas *et al.*, 2006). It is known that the fat content of mushrooms is low and consumed for low calorie diet (Onbasili *et al.*, 2015). In the previous reports, it is possible to see various fat content from 0.8 % to 27.5 % in dry mushrooms (Colak *et al.*, 2009).

In general, herein the gross composition of *L. deliciosus* was found as water (91.9 %), protein (0.17 %), fat (0.32 %), carbohydrates (2.86 %), fiber (4.05 %) and ash (0.66 %). Similar results reported for the Portuguese *L. deliciosus* in which moisture content 90.05 ± 0.53 , total fat 0.22 ± 0.00 , crude protein 2.96 ± 0.04 , ash 0.51 ± 0.02 and carbohydrates 6.26 ± 0.15 (g/100 g of fresh weight) were determined (Barros *et al.*, 2007). *L. deliciosus* from Kastamonu province of Turkey also studied and moisture, fat, protein, ash and dry matter levels of the mushroom were found as 8.75 ± 0.72 , 2.64 ± 0.16 , 75.25 ± 0.15 , 4.61 ± 0.03 , $89.96 \pm 0.24\%$ mg/100g (% dry weight) respectively (Onbasili *et al.*, 2015).

L. deliciosus was found as a good source of dietary fiber which has important physiological effects on

glucose, lipid metabolism and good for intestinal health.

Reis *et al.* (2012) reported that the main constituents in the ash are potassium and, depending on the mushroom, phosphorus (Mattila *et al.*, 2001) or magnesium (Manzi *et al.*, 1999), in addition to calcium, copper, iron and zinc (Guillamón *et al.*, 2010). High potassium content is characteristic of mushrooms (Kalac, 2013). According to our results, K was the most abundant element (215 ± 4 mg/100g fresh weight) in the samples of *L. deliciosus*, it was followed by P (36.6 ± 1.2 mg/100g fresh weight). *L. deliciosus* was also found rich in Mg, Ca and Fe, 10.6 ± 0.1 ; 3.4 ± 0.3 ; 2.5 ± 0.6 ; mg/100g fresh weight, respectively.

Mushrooms are important source of vitamins; especially Vitamin group B is abundant (Breene, 1990; Wani *et al.*, 2010). Similar results were obtained from this study. Our findings showed that saffron milk cap is also rich in Vitamin group B (Table 5).

Ozturk *et al.* (2014) determined that the DPPH activity of *L. deliciosus* was 6.43 mg/ml and Onbaşili *et al.* (2015) showed that DPPH scavenging activity of *L. deliciosus* methanolic extract was found to be IC50: >17 . Herein the antioxidant activity values of *L. deliciosus* was determined as 9.9 1/IC50 according to the DPPH (1,1-diphenyl-2-picrylhydrazyl radical scavenging effect) method and 46.4 μ M trolox equivalent /g sample according to the TEAC (Trolox Equivalent Antioxidant Capacity/ABTS) method. The results of *L. deliciosus* were compared to the results of the Butylated hydroxyl toluene (BHT) which is a reference synthetic antioxidant compound and available commercially (Table 6).

If the results of the two methods are compared, the antioxidant activity results have parallels. These results show that saffron milk cap has quite low antioxidant activity with regards to methods which used in this study.

Table 3. Proximate chemical composition of saffron milk cap (*L. deliciosus*).

Çizelge 3. Çıntar mantarının (*L. deliciosus*) yaklaşık besin bileşimi.

Species name Tür adı	Moisture Nem (g/100g)	Fat Yağ (g/100g)	Protein Protein (g/100g)	Carbohydrate Karbonhidrat (g/100g)	Ash Kül (g/100g)	Dietary fiber Diyet lifi (g/100g)	Energy Enerji (kcal/100g)
<i>L. deliciosus</i>	91.9±0.4	0.32±0.04	0.17±0.01	2.86±0.47	0.66±0.01	4.05±0.09	23.1±2.0

Table 4. Mineral contents of saffron milk cap (*L. deliciosus*) (mg/100g fresh weight).

Çizelge 4. Çıntar mantarı (*L. deliciosus*)'un mineral içeriği (mg/100g taze ağırlık).

Species name Tür adı	Ca	Fe	Mg	P	Zn	K	Na	Cu
<i>L. deliciosus</i>	3.4±0,3	2.5±0.6	10.6±0.1	36.6±1.2	0.57±0.03	215±4	3.9±0.1	0.06±0.01

Table 5. Vitamin content of saffron milk cap (*L. deliciosus*).

Çizelge 5. Çıntar mantarı (*L. deliciosus*)'un vitamin içeriği.

Species name Tür Adı	Vit C (mg/100g)	Thiamin (mg/100g)	Riboflavin (mg/100g)	Niacin (mg/100g)	Alpha-tocopherol (mg/100g)
<i>L. deliciosus</i>	nd	0.22±0.01	0.33±0.04	1.23±0.11	5.38±0.29

nd: Not detected.

Table 6. The antioxidant activity values of saffron milk cap (*L. deliciosus*).

Çizelge 6. Çıntar mantarı (*L. deliciosus*)'un antioksidan aktivite değerleri.

Species name Tür adı	1/IC50* (DPPH)	STD	µM trolox equivalent / g sample (TEAC) µM trolox eşdeğeri / g örnek (TEAC)	STD
<i>L. deliciosus</i>	9.9	0.4	46.4	0.4
BHT**	2101.2	277.1	16651.9	59.0

*the reverse of the dry plant value in terms of mg which inhibits 50% of the 1g DPPH radical.

**Butylated hydroxyl toluene.

CONCLUSION

The majority of collected saffron milk cap is sold at local markets by family members who gathered it in the region. Thus, the income from saffron milk cap is an important source to Aegean Region people.

Based on our findings, saffron milk cap has quite low antioxidant activity but it is rich in vitamin B, minerals and dietary fiber. When we consider the consumption frequency of saffron milk cap is high,

this mushroom can serve as a valuable food source for folk of Aegean Region.

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