

## Nutrient Content of *Pleurotus pulmonarius* (Fr.) Quel. Grown on Some Local Lignocellulosic Wastes

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### ABSTRACT

The aim of study as to determine the effects of some composts on the nutritional value of *Pleurotus pulmonarius* (Fr.) Quel. The energy, dry matter, moisture, crude protein, fat, ash, organic matter, and nitrogen free extract were 311.3-313.9 (kcal 100 g<sup>-1</sup>), 91.8-92.5, 7.5-8.2, 27.3-38.6, 1.5-1.9, 5.3-6.4, 35.9-46.8 and 86.0-87.1 (g 100 g<sup>-1</sup>) of dry weight, respectively. The contents of polymeric substance were determined 13.6-16.2% of cellulose, 20.4-21.8% of hemicellulose and 0.1-0.3% of lignin. It was observed that the crude fat, energy, lignin and hemicellulose contents of *P. pulmonarius* were not statistically significant depending on the substrates used in the culture ( $p>0.05$ ), but there were variations in other nutrients ( $p<0.05$ ). It is highly valued as a good source of proteins, energy and carbohydrates, but rather low in their fat, lignin and hemicellulose contents. It supports that the substrate products used in the culture of *P. pulmonarius* can affect the nutrient composition of the mushroom such as energy, crude protein and carbohydrate.

### Research Article

#### Article History

Received : 03.03.2021

Accepted : 06.05.2021

#### Keywords

Nutritive value

*Pleurotus pulmonarius*

Lignocellulosic wastes

Cultivation

Edible mushrooms

## Bazı Lokal Lignoselülozik Atıklar Üzerinde Kültürü Yapılan *Pleurotus pulmonarius* (Fr.) Quel.'in Besin İçeriği

### ÖZET

Bu çalışmanın amacı, bazı kompost ortamlarının *Pleurotus pulmonarius* (Fr.) Quel'in besin değeri üzerindeki etkilerini belirlemektir. Enerji, kuru madde, nem, ham protein, yağ, kül, organik madde ve azotsuz öz madde miktarları kuru ağırlığın; 311.3-313.9 (kcal 100 g<sup>-1</sup>), 91.8-92.5, 7.5-8.2, 27.3-38.6, 1.5-1.9, 5.3-6.4, 35.9-46.8 ve 86.0-87.1 (g 100 g<sup>-1</sup>) olarak bulunmuştur. Polimerik madde içeriği ise % 13.6-16.2 selüloz, % 20.4-21.8 hemiselüloz ve % 0.1-0.3 lignin olarak belirlenmiştir. Mantarın; ham yağ, enerji, lignin ve hemiselüloz içeriğinin, kültürde kullanılan substratlara bağlı olarak istatistiksel olarak önemli bir farklılık bulunmadığı ( $p>0.05$ ), fakat diğer besin öğelerinde ise değişkenlikler olduğu gözlenmiştir ( $p<0.05$ ). *P. pulmonarius*, iyi bir karbonhidrat, enerji, protein kaynağı olarak oldukça değerlidir, ancak yağ, lignin ve hemiselüloz içerikleri bakımından oldukça düşüktür. *P. pulmonarius*'un kültüründe kullanılan substrat ürünlerin mantarın enerji, ham protein ve karbonhidrat gibi besin bileşimini etkileyebileceğini desteklemektedir.

### Araştırma Makalesi

#### Makale Tarihi

Geliş Tarihi : 03.03.2021

Kabul Tarihi : 06.05.2021

#### Anahtar Kelimeler

Besin değeri

*Pleurotus pulmonarius*

Lignoselülozik atıklar

Kültür

Yenilebilir mantarlar

**To Cite:** Akyüz M, İnci Ş, Kırbağ S 2022. Nutrient Content of *Pleurotus pulmonarius* (Fr.) Quel. Grown on Some Local Lignocellulosic Wastes. KSU J. Agric Nat 25 (1): 25-30. <https://doi.org/10.18016/ksutarimdog.vi.890663>.

### INTRODUCTION

Mushrooms are natural edible gift for humankind with unique taste, flavor and medicinal properties (Maity et al., 2021). Edible mushrooms have drawn remarkable interest of the food industry. They were called the “Food of the Gods” (Valverde et al., 2015)

and serve as good source of many nutraceutical compounds such as protein, unsaturated fatty, carbohydrate, mineral substances, vitamins, amino acids, dietary fiber, volatile organic compounds etc (Corrêa et al., 2016; Bach et al., 2017; Sardar et al., 2017; Ma et al., 2018). It has been recently shown that mushrooms have bioactive compounds exhibiting

antioxidant, antiviral, antifungal, antimicrobial, hepatoprotective, antimutagenic, anticarcinogenic, antituberculous, cytotoxic, antitumor, immunological, antidiabetic, hypolipidemic, antiinflammatory etc. making them as alternatives to synthetic drugs (Wasser and Weis, 1999; Wasser, 2011, 2014; Carrasco-González et al., 2017; Finimundy et al., 2018; Barbosa et al., 2020).

It is estimated that over 2300 mushroom species have some medical and nutritional value, but only around 25 are widely accepted as food and few are commercially cultivated. However, the global mushroom cultivation industry and economy is based on five species: button mushroom *Agaricus bisporus* (J.E. Lange) Imbach, oyster mushroom *Pleurotus ostreatus* (Jacq.) P. Kumm., shiitake mushroom *Lentinula edodes* (Berk.) Pegler, wood ear mushroom *Auricularia auricula-judae* (Bull.) Quél., enoki mushroom *Flammulina velutipes* (Curtis) Singer and its cultivars (Mleczek et al., 2020). According to the FAO data, global mushroom cultivation amounted almost 9 million tons in 2018, indicating that it was one of the fastest growing branches of horticulture. In the last 10 years, the harvest of fruiting bodies has doubled together with an increase in species diversity (FAO, 2018).

The genus *Pleurotus* (Fries) Kummer (Basidiomycota, Agaricales) is probably the best known edible mushroom genus in the world due to its gastronomic, nutritional importance and also medicinal properties (Knop et al., 2015; Correa et al., 2016), as much as they achieved the second position in the production of edible mushrooms (Royse et al., 2017). It is estimated that there are more than 200 species of fungi of the genus *Pleurotus* spp., all of which are edible and appreciated for their taste, aroma, and texture, as well as the health enhancing bioactive potentials (Bazanella et al., 2013; Valverde et al., 2015). The most important *Pleurotus* species cultivated in large scale are *P. ostreatus* and *P. pulmonarius*. The second often marketed by spawn manufacturers and cultivators under the incorrect name "*P. sajor-caju*". The real *P. sajor-caju* is in fact a separate species of mushroom, which was returned to the genus *Lentinus* by Pegler (1975), and is correctly named *L. sajor-caju* (Buchanan, 1993).

*P. pulmonarius*, also known as the Indian Oyster, Italian Oyster, Phoenix Mushroom, or the Lung Oyster, is most commonly known as the grey oyster mushroom, which is characterized by a grayish colored sporophore, which has a fleshy texture and produces an aromatic, not anise-like aroma (Stamets, 2010). It is widely marketable and sells well in several other countries (Lechner et al., 2004; Li et al., 2015; Wu et al., 2019).

The most produced commercial mushroom in Turkey, which known and constituting market share, are

generally *A. bisporus* and *P. ostreatus*. Although the *P. pulmonarius*, known as *P. sajor-caju*, has been studied in the academic field for years, it is not sufficiently recognized by consumers and has no market share. The simplicity of cultivation of this species, its completion in a short time (2 months), as a result of obtaining 4 harvests, spreading it in terms of earliness and diversity and increasing its market share are important for producers. Determining that it has important nutritional values as a food source increases the importance of the subject.

In this study, it was aimed to determine the nutritional values of the *P. pulmonarius* by evaluating the *Medicago sativa* L. straw, *Prangos pabularia* Lindl. wastes and Poplar sawdust residues, which can be provided abundantly and cheaply in our region, and to spread the production of this species as a cultivated mushroom and to establish a market share.

## MATERIAL and METHODS

### Obtaining The Materials

The mushroom samples used in this study were obtained from the previous culture work (Akyuz et al., 2019). For the formation of basidiocarp, *Medicago sativa* L. (MS), *Prangos pabularia* Lindl. (PP) and *Poplar sawdust* (PS) were used as culture media. These local lignocellulosic wastes were obtained from the vicinity of Bitlis, Turkey. Three types of compost were prepared, consisting of a mixture of MS-PP (1:1), MS-PS (1:1) and MS. In addition, MS was used as the control treatment. The samples were harvested, dried at room temperature for 15 days, placed in locked bags, stored at 25°C in lab, and then samples used in this study.

### Methods

The energy, nutrient contents (moisture, protein, ash, fat, carbohydrate) and lignocellulosic content (hemicellulose, cellulose, lignin) were performed in the Faculty of Veterinary Medicine, Firat University, Turkey. The selected biochemical properties moisture, ash, crude protein, fat, ash (AOAC, 1990) crude cellulose (Crampton and Maynard, 1983) and lignocellulosic contents (Vansoest et al., 1991) were determined by appropriate methods. The lipid content was analysed by the Soxhlet extraction method using ethyl ether as the extraction solvent. Protein content was determined by the Kjeldahl method using 6.25 as converting factor to protein. Calculations were made with the following formulas:

$$\text{Nitrogen-free extract: \% dry matter} - (\% \text{ crude fat} + \% \text{ crude ash} + \% \text{ crude protein} + \% \text{ crude cellulose}) \quad (1)$$

$$\text{Organic matter: \% dry matter} - \% \text{ crude ash} \quad (2)$$

$$\text{The energy (kcal): } 4 \times (\text{protein} + \text{carbohydrate}) + 9 \times \text{fat} \quad (3)$$

$$\text{Cellulose: ADF} - \text{Lignin} \quad (4)$$

$$\text{Hemicellulose: NDF} - \text{ADF} \quad (5)$$

## RESULTS and DISCUSSION

Nutritive value of various lignocellulosic residues are changeable in dry matter, moisture, crude proteins, ash, nitrogen free extract, polymeric substances, organic matter and energy values. They have high lignocellulosic content, but have low fat contents. The nutritional value and bioactive compounds content of mushrooms are change according to the species, the stage of maturation, the substrate and used the growing conditions. Various lignocellulosic wastes used in this study are contained 92.1-94.5% dry

matter, 112-161 kcal energy, 8.2-15.9% crude protein, 1.4% crude fat, 3.4-10.3% crude ash, 81.8-91.1% organic matter and 12.7-24.4% nitrogen free extract. They are also contained the polymeric substances, cellulose, hemicellulose and lignin in the range of 37.2-51.8%, 12.9-17.6% and 12.6-23.1%, respectively (see Table 1). The dry matter, moisture, energy, crude protein, crude fat, crude ash, nitrogen free extract, organic matter, cellulose, lignin and hemicellulose content of lignocellulosic wastes were significantly different among substrates ( $p < 0.05$ ) shown in Table 1.

Table 1. Nutritive values of *P. pulmonarius* grown on some lignocellulosic residues (% , air-dried basis)

Çizelge 1. Bazı lokal lignoselülozik atıklar üzerinde kültürü yapılan *P. pulmonarius*'un besin içeriği (% , havada kuru esasında)

Material	Dry Matter	Moisture	Energy (kcal)	Crude Protein	Crude Fat	Crude Ash	Organic Matter	Nitrogen-Free Extract	Lignocellulosic content (%)		
									Hemicellulose	Cellulose	Lignin
Nutrient content of substrates											
PP	94.5±0.3 <sup>b</sup>	5.5±0.3 <sup>a</sup>	143.2±1.9 <sup>b</sup>	8.2±0.3 <sup>a</sup>	1.4±0.3 <sup>a</sup>	3.4±0.1 <sup>a</sup>	91.1±0.4 <sup>c</sup>	24.4±0.6 <sup>c</sup>	17.6±0.2 <sup>c</sup>	51.8±0.3 <sup>c</sup>	12.6±0.1 <sup>a</sup>
PS	94.2±0.2 <sup>b</sup>	5.8±0.2 <sup>a</sup>	112.4±1.3 <sup>a</sup>	12.3±0.1 <sup>b</sup>	1.4±0.2 <sup>a</sup>	5.7±0.3 <sup>b</sup>	88.5±0.4 <sup>b</sup>	12.7±0.5 <sup>a</sup>	12.9±0.3 <sup>a</sup>	48.2±0.2 <sup>b</sup>	23.1±0.1 <sup>c</sup>
MS	92.1±0.9 <sup>a</sup>	7.9±0.9 <sup>b</sup>	161.0±1.3 <sup>c</sup>	15.9±0.2 <sup>c</sup>	1.4±0.3 <sup>a</sup>	10.3±0.6	81.8±0.4 <sup>a</sup>	21.1±0.3 <sup>b</sup>	13.8±0.3 <sup>b</sup>	37.2±0.2 <sup>a</sup>	13.7±0.1 <sup>b</sup>
F values	17.7	17.7	788.8	1164.9	0.048	278.3	442.6	455.6	336.8	2970.9	9702.8
p values	0.003	0.003	0.000	0.000	0.953	0.000	0.000	0.000	0.000	0.000	0.000
Nutritive value of <i>P. pulmonarius</i> grown on some local residues											
MS PP (1:1)	91.8±0.3 <sup>x</sup>	8.2±0.3 <sup>y</sup>	311.3±4.9 <sup>x</sup>	30.9±2.7 <sup>x</sup>	1.5±0.6 <sup>x</sup>	5.3±0.2 <sup>x</sup>	86.4±0.2 <sup>x</sup>	43.6±3.5 <sup>y</sup>	20.4±2.1 <sup>x</sup>	16.2±1.6 <sup>y</sup>	0.1±0.1 <sup>x</sup>
MS-PS (1:1)	92.4±0.1 <sup>y</sup>	7.6±0.1 <sup>x</sup>	313.9±4.4 <sup>x</sup>	27.3±1.6 <sup>x</sup>	1.9±0.6 <sup>x</sup>	6.4±0.1 <sup>y</sup>	86.0±1.0 <sup>x</sup>	46.8±1.1 <sup>y</sup>	20.4±1.6 <sup>x</sup>	13.6±0.2 <sup>x</sup>	0.3±0.1 <sup>x</sup>
MS	92.5±0.2 <sup>y</sup>	7.5±0.2 <sup>x</sup>	313.5±5.1 <sup>x</sup>	38.6±1.1 <sup>y</sup>	1.7±0.2 <sup>x</sup>	5.4±0.4 <sup>x</sup>	87.1±0.4 <sup>y</sup>	35.9±2.1 <sup>x</sup>	21.8±1.0 <sup>x</sup>	15.2±0.7 <sup>xy</sup>	0.1±0.1 <sup>x</sup>
F value	9.2	9.2	0.2	27.2	0.7	34.5	12.4	15.6	0.7	4.8	4.8
p value	0.015	0.015	0.785	0.001	0.514	0.001	0.007	0.004	0.534	0.046	0.057

MS: *Medicago sativa* L., PP: *Prangos pabularia* Lindl., PS: *Poplar* sawdust.

Each value is expressed as mean ± SD of triplicate analysis (n=3).

Values with different small letters in the same column are significantly different at the level of 0.05 ( $p < 0.05$ )

Nitrogen free extract: % dry matter - (% crude fat + % crude ash + % crude protein + % crude cellulose)

Organic matter: % dry matter - % crude ash

Cellulose: ADF- Lignin, Hemicellulose: NDF - ADF

<sup>a,b,c</sup> : Comparison between substrates, <sup>x,y,z</sup> : comparison in different culture media

The energy (kcal): 4 x (protein + carbohydrate) + 9 x fat

The fruit bodies of *P. pulmonarius* grown on culture medium obtained from different agricultural wastes and their mixture in the present study were determined 91.8-92.5% dry matter, 311.3-313.9 kcal energy, 27.3-38.6% crude protein, 1.5-1.9% crude fat, 5.3-6.4% crude ash, 86.0-87.1% organic matter and 35.9-46.8% nitrogen free extract of dry weight, respectively. At the same time cellulose, hemicellose and lignin contents were determined as 13.6-16.2%, 20.4-21.8% and 0.1-0.3% (see Table 1). The crude fat, energy, lignin and hemicellulose contents of fruiting bodies were not significantly different among substrates ( $p > 0.05$ ), but can changeable in other nutrient composition and polymeric substance ( $p < 0.05$ ) as shown in Table 1. Because analysis of the main components of *P. pulmonarius* has been revealed differences in their values as depending on the nature of the cultivation substrates.

The highest value of dry matter contents was obtained from MS (92.5%) and MS-PS (1:1) (92.4%), while lowest value was obtained from MS-PP (1:1) substrate (91.8%). In previous studies, it was reported that fresh mushrooms have approximately 90% moisture and 10% dry matter, and dried mushrooms have approximately 90% dry matter and 10% moisture (Ragunathan et al., 1996; Manzi et al., 1999; Ragunathan and Swaminathan, 2003; Kırbağ and Volkan, 2014; Sardar et al., 2017; Finimundy et al.,

2018). It is seen that the values obtained in the study are consistent when compared with the previous reports. The variation in the moisture percentage of the mushroom depends on the species, time of harvest, growth, storage condition, substrate and other parameters related to the growth environment such as temperature and relative humidity (Guillamon et al., 2010; Reis et al., 2012).

Ash contents ranged from 5.3% to 6.4% and were significantly different on all substrates ( $p < 0.05$ , see Table 1). Ash contents were previously reported 4.4-13.7% in *Pleurotus* spp., *A. bisporus* and *L. edodes* (Ragunathan et al., 1996; Mau et al., 1998; Manzi et al., 1999; Yang et al., 2001; Wang et al., 2001; Rashad and Abdou, 2002; Ragunathan and Swaminathan, 2003; Oyetayo and Akindahunsi, 2004; Furlani and Godoy, 2007; Akyüz and Kırbağ, 2009; Akyüz and Kırbağ, 2010ab; Kırbağ and Volkan, 2014; Finimundy et al., 2018). It has been observed that the ash content of *P. pulmonarius* was similar to with the ash content in those studies.

In general, mushrooms are very low in fat; the fat fraction is mainly composed of unsaturated fatty acids. The crude fat contents of *P. pulmonarius* were not significantly different among substrates ( $p > 0.05$ , see Table 1). Minimum fat level was 1.5% on MS-PP (1:1) and maximum was 1.9% on MS-PS (1:1) as seen in Table 1. Fat contents were previously reported



0.95-3.16% in *Pleurotus* spp. (Ragunathan and Swaminathan, 2003), 0.3-4.1% in *P. eryngii* var. *eryngii* and *P. eryngii* var. *ferulae* (Akyüz and Kırbag, 2009; Akyüz and Kırbag, 2010a), 0.5-4.5% in *Pleurotus* spp. (Kırbag and Volkan, 2014), 1.1-4.0% in *Pleurotus* spp. (Ragunathan et al., 1996), 1.16% in *P. sajor-caju* (Finimundy et al., 2018), 2.6-4.7% in *P. sajor-caju* (Oyetayo and Akindahunsi, 2004), 2.16% in *P. ostreatus* (Yang et al., 2001), 4.36-6.4% in *P. ostreatus* (Rashad and Abdou, 2002), 4.3-4.7% (Wang et al., 2001), 4.30-5.42% in *Pleurotus* spp., *A. bisporus* ve *L. edodes* (Furlani and Godoy, 2007). It has been observed that the fat content of *P. pulmonarius* was similar to with the fat contents in those studies.

Organic matters were determined the highest (87.1%) on MS substrate, while the minimum values (86.0% and 86.4%) were determined from MS-PP (1:1) and MS-PS (1:1) substrates ( $p < 0.05$ , see Table 1). Organic matters contents were previously reported 76.0-84.0% in *A. bisporus* and *Pleurotus* spp. (Akyüz and Kırbag, 2010b), 85.1-87.4% in *P. eryngii* var. *eryngii* and *P. eryngii* var. *ferulae* (Akyüz and Kırbag, 2009; Akyüz and Kırbag, 2010a). The findings obtained were supported by previous findings in the aforementioned studies.

Recently, mushroom origin proteins have been gained the attention of food industry players and scientific community, their rich essential amino acid and high nutritional value when compared to vegetables (Bach et al., 2017). Therefore, the use of edible mushrooms for the development of protein-rich food products can encourage its utilization while offering an attractive alternative to an animal protein source (Gonzales et al., 2021). In this study, the highest value of crude protein (38.6%) was obtained from MS while the lowest value (27.3% and 30.9%) was obtained from MS-PS (1:1) and MS-PP (1:1) substrates and was found to be significantly different ( $p < 0.05$ , see Table 1). Protein contents were previously reported 25.6-44.3% in *Pleurotus* spp. (Ragunathan and Swaminathan, 2003), 8.5-29.9% in *P. eryngii* var. *eryngii* and (Akyüz and Kırbag, 2009; Akyüz and Kırbag, 2010a), 26.3-39.3% in *Pleurotus* spp. (Kırbag and Volkan, 2014), 27.8-41.6% in *A. bisporus* and *Pleurotus* spp. (Akyüz and Kırbag, 2010b), 26.9-42.5% in *Pleurotus* spp. (Ragunathan et al., 1996), 17.29% in *P. sajor-caju* (Finimundy et al., 2018), 14.55-26.34% in *P. sajor-caju* (Oyetayo and Akindahunsi, 2004), 23.9% in *P. ostreatus* (Yang et al., 2001), 29.91-38.01% in *P. ostreatus* (Rashad and Abdou, 2002), 41-53% in *P. ostreatus* (Wang et al., 2001), 18.98-28.45% in *Pleurotus* spp., *A. bisporus* and *L. edodes* (Furlani and Godoy, 2007). In this study, it is seen that the crude protein value of *P. pulmonarius* is higher than some (Yang et al., 2001; Rashad and Abdou, 2002; Oyetayo and Akindahunsi, 2004; Furlani and Godoy, 2007; Akyüz and Kırbag, 2009; Akyüz and Kırbag,

2010; Finimundy et al., 2018) and more variable than some (Ragunathan et al., 1996; Wang et al., 2001; Ragunathan and Swaminathan, 2003; Akyüz and Kırbag, 2010; Kırbag and Volkan, 2014) compared to previous studies. It is known that the protein content of mushrooms varies according to the genetic structure of the species, physical and chemical differences in the growing environment, the nature and nutrient content of the substrate used for cultivation, the mushroom strain, the post harvest analysis time, and the development stage (Jiskani, 2001; Gothwal et al., 2012).

Edible mushrooms are highly valued as a good source of carbohydrate and their contents varies usually range from 26.7% to 76.2% of dry weight (Ragunathan et al., 1996; Yang et al., 2001; Wang et al., 2001; Rashad and Abdou, 2002; Ragunathan and Swaminathan, 2003; Oyetayo and Akindahunsi, 2004; Furlani and Godoy, 2007; Akyüz and Kırbag, 2010ab; Kırbag and Volkan, 2014; Finimundy et al., 2018). The highest value (46.8% and 43.6%) for nitrogen free extract contents were obtained from MS-PS (1:1) and MS-PP (1:1) and was significantly different from other substrate ( $p < 0.05$ ), while the lowest value (35.9%) for nitrogen free extract content was obtained from MS substrate (Table 1). Nitrogen free extracts are similar to that reported in the previous studies (Ragunathan et al., 1996; Wang et al., 2001; Rashad and Abdou, 2002; Ragunathan and Swaminathan, 2003; Oyetayo and Akindahunsi, 2004; Kırbag and Volkan, 2014), lower than that reported earlier (Yang et al., 2001; Furlani and Godoy, 2007; Finimundy et al., 2018), and higher than previously reported (Akyüz and Kırbag, 2010ab).

Based on the crude protein, carbohydrate and fat contents, the energy value of fruit bodies of *P. pulmonarius* were calculated ( $p > 0.05$ , see Table 1). The energy values of *P. pulmonarius* were calculated to be 311.3, 313.5 and 313.9 (kcal), for MS-PP (1:1), MS and MS-PS (1:1), respectively. The energy values were observed to be 272, 316, 288, and 304 kcal for *P. sajor-caju*, 280, 298, 287, and 284 kcal for *Pleurotus platypus* Sacc., and 295, 274, 307, and 325 kcal for *Pleurotus citrinopileatus* Singer (Ragunathan and Swaminathan, 2003), 267, 292, 308, 285, and 329 kcal for *P. sajor-caju*, 298, 302, 286, 291, and 293 kcal for *P. platypus*, and 277, 319, 269, 313, and 327 kcal for *P. citrinopileatus* (Ragunathan et al., 1996), 384 kcal for *P. sajor-caju* (Finimundy et al., 2018). When the obtained results are compared with previous studies (Ragunathan et al., 1996; Ragunathan and Swaminathan, 2003), it has been observed that the energy value of *P. pulmonarius* is higher. But some values are different than those reported by other researchers (Ragunathan et al., 1996; Ragunathan and Swaminathan, 2003; Finimundy et al., 2018).

The highest lignin content of *P. pulmonarius* was seen in the MS-PS (1: 1) substrate (0.3%), while the lowest value was seen in the MS and MS-PP (1: 1) substrate (0.1%). Cellulose contents ranged from 13.6% to 16.2% and was changeable on all substrates ( $p < 0.05$ , see Table 1). Hemicellulose were determined to be the highest (21.8%) on MS substrate, while the minimum values (20.4%) were determined from MS-PP (1:1) and MS-PS (1:1) substrates ( $p > 0.05$ , see Table 1). In previous studies, cellulose, hemicellulose, and lignin of the fruit bodies contents were reported as 28.4-44.8%, 27.3-41.2% and 13.0-20.0% respectively (Ragunathan et al., 1996). In another study, the same values were reported 27.4-46.2%, 23.40-40.30%, and 14.00-20.40% (Ragunathan and Swaminathan, 2003). The levels of polymeric substance of fruit bodies of *P. pulmonarius* were relatively low compared to earlier published reports (Ragunathan et al., 1996; Ragunathan and Swaminathan, 2003).

### CONCLUSION and RECOMMENDATION

In the present study, it was observed that the type of substrate used for cultivation of *P. pulmonarius* could influence the nutrient composition such as energy, crude protein and nitrogen free extract of the fruit bodies (shown Table 1). *P. pulmonarius* contain different amounts of energy, protein, nitrogen free extract, polymeric substance such as cellulose and lignin depending on the composition of the substrates used for cultivation. The use of *P. pulmonarius* as food or ingredient for processing functional products is promising because of its nutritional attributes and potential benefits on health.

### ACKNOWLEDGMENTS

The second author thanks to Turkey's Council of Higher Education (YÖK) for 100/2000 PhD National Scholarship Program.

### Researchers' Contribution Rate Statement

The authors declare that they have contributed equally to the article.

### Conflict of Interest Statement

The article authors declare that they do not have any conflict of interest.

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