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Antioxidant Activity and Element Content of *Suillus collinitus*

Celal Bal[1,a,*]

[1]*Oguzeli Vocational School, Gaziantep University, Gaziantep, Turkey*
[*]*Corresponding author*

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ABSTRACT

Mushrooms used as food have medicinal importance due to their antioxidant compounds. In this context, it is very important to determine the biological potential of fungi and to reveal these medicinal properties. In this study, it was aimed to determine the element contents, total antioxidant status, total oxidant status, oxidative stress index of *Suillus collinitus* (Fr.) Kuntze mushroom. In this context, the mushroom samples were extracted with ethanol in the Soxhlet extractor. Element contents were determined using atomic absorption spectrometry. Total antioxidant (TAS) and total oxidant (TOS) levels and oxidative stress index (OSI) were determined using Rel Assay commercial kits. As a result of the study, it was determined that the TAS value of *S. collinitus* was 2.467 ± 0.145 mmol/L, TOS value was 17.845 ± 0.273 µmol/L and OSI value was 0.677 ± 0.030. In addition, the Fe content (350.72 ± 10.23), Cu content (68.11 ± 2.51), Pb content (11.58 ± 2.43), Zn content (10.46 ± 1.28) and Ni content (1.47 ± 0.21 mg.kg-1) of *S. collinitus* measured. As a result, *S. collinitus* mushroom is thought to be a natural source of antioxidants. It has also been observed that the element contents are at normal levels.

[a] *celalbal27@gmail.com* *http://orcid.org/0000-0001-6856-3254*

Introduction

A better understanding of the high nutritional value and medicinal importance of mushrooms in recent years has led to an increased interest in mushrooms. In addition to nutritional values, it has been determined that the active ingredients in its content have a therapeutic effect (Arpaz et al., 2017). Many studies have shown that mushrooms have different biological activities. In studies on mushrooms, it has been reported to have many activities such as antioxidant, antitumor, antimicrobial, anti-aromatase activity, anti-inflammatory activity, antiproliferative activity and immunomodulatory activity (Akgul et al., 2017; Bal et al., 2017; Kikuchi et al., 2017; Sriramulu and Sumathi, 2017; Wang et al., 2018; Sevindik 2018a; Gürgen et al., 2020; Mushtaq et al., 2020). Turkey has a high diversity in terms of biodiversity. This diversity is increasing due to the different phytogeographical regions (Akata et al., 2018). In this study, *Suillus collinitus* mushroom collected from Gaziantep/Oğuzeli (Turkey) was used as a material. *Suillus collinitus*, one of the edible mushrooms, is porous and mostly spreads in pine forests. Cap height is 8-11 cm. Its surface is slippery. Their color is light brown. It has a sour smell and a different taste. It spreads in clusters (Bonfante, 1998).

Antioxidant activity studies previously performed on *Suillus* species are shown in table 1.

In this study, TAS, TOS, OSI and some element contents of *S. collinitus* mushroom were determined.

Materials and Methods

Study material *S. collinitus* samples were collected from Oğuzeli/Gaziantep (Turkey). The samples were dried in an oven at 40°C 30 g of the dry samples was weighed and extracted in the soxhlet apparatus at 50°C for about 6 hours (BUCHI Extraction System Model B-811). The dry extract was then concentrated in a rotary evaporator (BUCHI Rotavapor Model R-144).

Determination of Element Content

Fe, Zn, Cu, Pb and Ni contents of *S. collinitus* were determined by using atomic absorption spectrophotometer device (Agilent 240FS AA). Before reading, the samples were dried at 80°C to constant weight. 0.5 g of the dry

samples were mineralized using a microwave solubilizer (Milestone Ethos Easy) in a mixture of 9 mL HNO3 + 1 mL H_2O_2 (Sevindik and Akata, 2019).

TAS, TOS and OSI Tests

Total antioxidant status and the total oxidant status of study material Rel Assay brand commercial kits (Rel Assay Kit Diagnostics, Turkey) was used. The calibrator Trolox was used in antioxidant kits. Results are shown in mmol Trolox equiv./L. Calibrator hydrogen peroxide was used in oxidant kits. Results are shown as μmol H_2O_2 equiv./L (Erel, 2004, 2005). The oxidative stress index was calculated with the formula TOS / (TASx10) (Erel, 2005).

Results and Discussion

Element Contents

Fungi play a role in breaking down organic cover in the ecosystem. During the breakdown of the organic cover, they accumulate different levels of elements in their bodies depending on the substrate content they use (Baba et al., 2012; Baba et al., 2020). In our study, the Fe, Zn, Cu, Pb and Ni contents of *S. collinitus* were determined. The findings obtained are shown in Table 2.

In previous studies, the levels of elements detected in wild mushrooms have been reported in the literature These values were reported as 14.6-835.0 for Fe, 29.8-158.0 for Zn, 71.0-95.0 for Cu, 2.86-6.88 for Pb and 1.18-5.14 for Ni in mg/kg (Vetter, 1990; Sevindik et al., 2017; Krupodorova and Sevindik, 2020). Compared to these values, it was determined that the Zn, Cu and Ni contents of *S. collinitus* were lower than the literature ranges, the Pb content was higher than the literature ranges, and the Fe levels were within the literature ranges. In this context, it is seen that the element levels of *S. collinitus* are at normal levels.

TAS, TOS and OSI Values

Living organisms produce reactive oxygen species (ROS) as a result of metabolic activities. While these ROS compounds have a beneficial effect in low amounts, they cause oxidative stress when they reach high levels (Kattoor et al., 2017; Mohammed et al., 2018). As a result of oxidative stress in living things, different diseases such as cardiological disorders, Alzeihmer, Parkinson's and cancer occur (Salim, 2017; Mohammed et al., 2019). The antioxidant defense system plays a role in reducing oxidative stress. In cases where the antioxidant defense system is insufficient, supplementary antioxidant sources are used (Mohammed, 2020). In this study, TAS, TOS and OSI values of *Suillus collinitus* mushroom were determined. The findings obtained are shown in table 3.

TAS, TOS and OSI values of *S. collinitus* were not determined in previous studies. There are studies on different mushrooms. In these studies, antioxidant, oxidant and oxidative stress indexes of *Cyclocybe cylindracea* (TAS: 4.325 mmol/L, TOS: 21.109 μmol/L and OSI: 0.488), *Clavariadelphus truncatus* (TAS: 2.415 mmol/L, TOS: 3.367 μmol/L and OSI: 0.140), *Cerrena unicolor* (TAS: 6.706 mmol/L, TOS: 19.308 μmol/L and OSI: 0.288), *Infundibulicybe geotropa* (TAS: 1.854 mmol/L, TOS: 30.385 μmol/L and OSI: 1.639), *Cantharellus cibarius* (TAS: 5.268 mmol/L, TOS: 6.380 μmol/L and OSI: 0.121) and *Macrolepiota procera* (TAS: 2.823 mmol/L, TOS: 10.349 μmol/L and OSI: 0.367) mushrooms were reported (Akgül et al., 2016; Sevindik 2018b; Sevindik 2018b; Sevindik et al., 2018; Sevindik 2019; Sevindik et al., 2020). Compared to these studies, the TAS value of *S. collinitus* was higher than *C. trun*catus and *I. geotropa* and lower than *C. cylindracea*, *C. unicolor, C. cibarius* and *M. procera* mushrooms. TAS value indicates the whole of the antioxidant compounds produced in the living organisms (Mohammed et al., 2018). It was determined that *S. collinitus* used in our study has antioxidant potential. The TOS value indicates the whole of the oxidant compounds produced in the living organisms (Mohammed et al., 2019). The TOS value of *S. collinitus* was higher than *C. truncatus, C. cibarius, M. procera*, and lower than *C. cylindracea, C. unicolor, I. geotropa* mushrooms. In this context, *S. collinitus* is recommended to be consumed more carefully due to its high TOS values. The OSI value shows how much the fungus suppresses endogenous antioxidant and endogenous oxidant compounds (Mohammed et al., 2020). When we look at the OSI value of *S. collinitus*, it was found that it was higher than *C. cylindracea, C. truncatus, C. unicolor, C. cibarius, M. procera* mushrooms and lower than *I. geotropa*. As a result, it was determined that *S. collinitus* has antioxidant potential.

Table 1. Antioxidant activities of *Suillus* species

Suillus species	References
Suillus aeruginascens	Macáková et al., 2009;
Suillus bellini	Ribeiro et al., 2006; Kalogeropoulos et al., 2013;
Suillus bovinus	Robaszkiewicz et al., 2010;
Suillus collinitus	Akata et al., 2012; Heleno et al., 2010;
Suillus granulates	Macáková et al., 2009; Ribeiro et al.,2006
Suillus granulatus	Ribeiro et al., 2006; Reis et al., 2014; Tel et al., 2014; Zhou et al., 2016; Chen et al., 2018; Mushtaq et al., 2020;
Suillus grevillei	Macáková et al., 2009
Suillus lakei	Barranco et al., 2010;
Suillus luteus	Ribeiro et al., 2006; Macáková et al., 2009; Barranco et al., 2010; Jaworska et al., 2014;
Suillus luteus	Macáková et al., 2009; Keles et al., 2011;
Suillus mediterraneensis	Heleno et al., 2010
Suillus placidus	Macáková et al., 2009
Suillus variegates	Macáková et al., 2009; Robaszkiewicz et al., 2010

Table 2. Element Levels of *S. collinitus*

Elements	Fe	Zn	Cu	Pb	Ni
S. collinitus	350.72 ± 10.23	10.46 ± 1.28	68.11 ± 2.51	11.58 ± 2.43	1.47 ± 0.21

Values are presented as mean ± S.D, n=3 (Experiments were made as 3 parallel)

Table 3. TAS, TOS ve OSI Values

Material	TAS	TOS	OSI
S. collinitus	2.467 ± 0.145	17.845 ± 0.273	0.677 ± 0.030

Values are presented as mean ± S.D.; n=6 (Experiments were made as 5 parallel)

Conclusion

In this study, the antioxidant activity of *S. collinitus* and the levels of some elements were determined. As a result of the studies, it has been determined that the mushroom has antioxidant potential. Element levels were found to be at normal levels according to the stated literature values.

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