RESEARCH ARTICLE

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Antioxidant potential and Element contents of Natural Mushroom *Hygrocybe conica*

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ABSTRACT: Mushrooms are natural materials that spread in all ecosystems. In this study, the antioxidant potential and heavy metal contents of *Hygrocybe conica* (Schaeff.) P. Kumm. were determined. Total antioxidant status (TAS), total oxidant status (TOS) and oxidative stress index (OSI) were determined using Rel Assay Diagnostics kits. Fe, Zn, Cu, Pb and Ni contents were determined using atomic absorption spectrophotometer. As a result of the studies, the TAS value of *H. conica* was 3.143±0.146, the TOS value was 10.355±0.233, and the OSI value was 0.331±0.021. Fe content of the mushroom was determined as 657.75±14.53, Zn content as 20.45±0.36, Cu content as 94.97±2.58, Pb content as 3.53±0.24 and Ni content as 0.83±0.12. As a result of the studies, it was determined that *H. conica* has antioxidant potential. Element contents were found to be at normal levels.

Keywords: Antioxidant, Element content, Medicinal mushroom, Wild mushroom

INTRODUCTION

For centuries, mushrooms have been widely used by humans for food purposes (Sevindik, 2021a). It stands out with its taste, texture, aroma and nutritional properties. In addition to these features, they are natural products with medicinal value (Islek et al., 2021). On the other hand, awareness that mushrooms are an important source of biologically active substances with medicinal value has only emerged in recent years (Smolskaite et al., 2015; Saridoğan et al., 2021). Mushrooms have a high phytochemical content. According to literature data, it has been reported in previous studies that mushrooms have antioxidant, antimicrobial, anticancer, antitumor, anti-inflammatory and DNA protective effects (Khatua et al., 2013; Sevindik et al., 2016; Chen et al., 2018; Lu et al., 2018; Bal et al., 2019; Olawuyi and Lee, 2019; Pandya et al., 2019; Baba et al., 2020; Selamoğlu et al., 2020; Umaña et al., 2020; Zhang et al., 2020; Sevindik et al., 2020; Sevindik et al., 2018d).

Hygrocybe (Fr.) P. Kumm genus has a worldwide distribution except in arid ecozones. *Hygrocybe* (waxcaps) are found in forests, grasslands, swamps (Krieglsteiner and Gminder 2001; Boertmann, 2010). *H. conica* is called a witch's hat or a conical waxy cap and is known as an ectomycorrhizal species (Arora, 1986; Mueller et al., 2006). In this study, it was aimed to determine the TAS, TOS, OSI values and heavy metal contents of *H. conica* mushroom.

MATERIALS AND METHOD

H. conica mushroom was collected from Antalya (Turkey). After the identification process of the mushroom, it was dried in a drying device in a laboratory environment. It was then pulverized with a mechanical grinder. Then, 30 g of mushroom samples were extracted with ethanol (EtOH) at 50^0C for about 6 hours using a soxhlet device. The obtained extracts were concentrated with a rotary evaporator (Heidolph Laborota 4000 Rotary Evaporator) (Akgül et al., 2021).

Antioxidant, Oxidant and Oxidative Stres Tests

Antioxidant and oxidant values of *H. conica* samples were determined using Rel Assay TAS and TOS kits. Trolox was used as a calibrator when performing TAS tests, and hydrogen peroxide was used as a calibrator when performing TOS tests (Erel, 2004; Erel, 2005). In the determination of the OSI value, the units of TAS and TOS values were equalized and the value was expressed as a percentage. The following formula was applied to determine the OSI (Arbitrary Unit=AU) value (Sevindik, 2021b).

Heavy Metal Analyses

To determine the heavy metal contents (Fe, Zn, Cu, Pb and Ni) in the fruiting bodies of *H. conica*, the samples were dried at 80 ºC to constant weight. 0.5 g of the mushroom samples were taken and mineralized in a mixture of 9 mL HNO_3 + 1 mL H_2O_2

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in a microwave dissolution device. Then, Fe, Zn, Cu, Pb and Ni contents of the mushroom were scanned in an atomic absorption spectrophotometer device (Agilent 240FS AA) (Akgül et al., 2016).

RESULTS and DISCUSSION

Antioxidant Activity

Reactive oxygen species (ROS) are oxygen-containing molecules produced during normal metabolism. Organisms have an antioxidant defense system that neutralizes the harmful effects of endogenous ROS products (Halliwell, 1994; Aruoma, 1996; Galli et al., 2005; Sevindik, 2018c). In living organisms, free radicals can damage important substances such as DNA, protein, carbohydrates and lipids that play a role in metabolic activities. If oxidants increase under certain conditions, the antioxidant defense system becomes insufficient. As a result, oxidative stress occurs, which leads to many diseases (Sevindik et al., 2018e; Gürgen et al., 2020; Sevindik, 2021c). Supplementary antioxidants can be used to reduce the effects of oxidative stress. In this study, antioxidant and oxidant potential of *H. conica* mushroom was determined. In addition, oxidative stress index was determined based on these values. The obtained results are shown in Table 1.

Table 1. *TAS, TOS and OSI values of H. conica*

	TAS	TOS	OSI
H .conica	3.143±0.146	10.355±0.233	0.331±0.021

In previous studies, it was determined that the TAS, TOS and OSI values of *H. conica* were not determined. It has been reported that n-haxane extract has antioxidant potential using DPPH, ABTS, FRAP assays methods of *Hygrocybe conica* (Chong et al., 2014). In our study, the antioxidant potential of *H. conica* was determined for the first time using Rel Assay kits. In studies on different wild mushrooms in the literature, TAS values of *Helvella leucomelaena* and *Sarcosphaera coronaria* were reported as 2.367 and 1.066, TOS values as 55.346 and 41.672, and OSI values as 2.338 and 3.909, respectively (Sevindik et al., 2018a). The TAS value of *Cantharellus cibarius* has been reported as 5.268, TOS value as 6.380 and OSI value as 0.121 (Sevindik, 2019). The TAS value of *Lepista nuda* has been reported as 3.1028, TOS value as 36.92 and OSI value as 1.190 (Bal et al., 2019). The TAS value of *Ramaria stricta* was reported as 4.223, TOS value as 8.201 and OSI value as 0.194 (Krupodorova and Sevindik, 2020). The TAS value of *Tricholoma virgatum* has been reported as 3.754, TOS value as 8.362 and OSI value as 0.223 (Selamoglu et al., 2020). The TAS value of *Agaricus xanthodermus* was reported as 4.229, TOS value as 29.065 and OSI value as 0.688 (Özaltun and Sevindik, 2020). The TAS value of *Terfezia boudieri* was reported as 2.332, TOS value as 26.945 and OSI value as 1.156 (Sevindik et al., 2018b). The TAS value of *Macrolepiota procera* has been reported as 2.805, TOS value as 6.596 and OSI value as 0.235 (Sevindik et al., 2016). Compared to these studies, the TAS value of *H. conica* was found to be higher than *H. leucomelaena, S. coronaria, L. nuda, T. boudieri, M. procera*, and lower than *C. cibarius, R. stricta, T. virgatum, A. xanthodermus*. TAS value shows all of the antioxidant compounds found in living organisms (Sevindik et al., 2021a). In our study, it is seen that *H. conica* has antioxidant potential due to its significant TAS value.

TOS value shows the whole of the oxidant compounds produced in living organisms (Sevindik et al., 2021b). In our study, it was determined that the TOS value of *H. conica* was lower than H. *leucomelaena, S. coronaria, L. nuda, T. boudieri, A. xanthodermus,* and higher than *C. cibarius, R. stricta, T. virgatum* and *M. procera.* According to these results, it was observed that the TOS value of *H. conica* was at high levels. It is seen that oxidant compounds produced especially with environmental effects are at high levels in *H. conica.*

The OSI value shows how much the endogenous oxidant compounds produced in the organism are suppressed with the help of the antioxidant defense system. OSI value increases as a result of high oxidant value and insufficient antioxidant defense system (Mushtaq et al., 2020; Eraslan et al., 2021). In our study, it was determined that the OSI value of *H. conica* was lower than *H. leucomelaena, S. coronaria, L. nuda, A. xanthodermus, T. boudieri,* and higher than *C. cibarius, R. stricta, T. virgatum, M. procera.* In this context, it has been observed that the antioxidant defense system of *H. conica* is effective at normal levels in suppressing oxidant compounds.

Heavy Metal Contents

Mushrooms are play a role in decomposing organic cover in natural ecosystems. They contain the elements found in the organic material they decompose at different levels (Sevindik, 2018b). In this context, mushrooms can be used as element indicators. In our study, Fe, Zn, Cu, Pb and Ni contents of *H. conica* were determined. The obtained results are shown in Table 2.

Table 2. *Heavy metal contents of H. conica*

	Fe	Zn	Cu	Pb	Ni
H.conica (mg.kg-1)	657.75±14.53	20.45±0.36	94.97±2.58	3.53±0.24	0.83±0.12

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

The lowest and highest levels of Fe (14.6-835), Zn (29.8-168.3), Cu (49.1-95), Pb (2.86-16.54) and Ni (0.67-5.14) contents have been reported in different wild mushrooms (Kalač and Svoboda, 2000; Zhu et al., 2010; Sevindik et al., 2017). In this context, it was determined that the Fe, Cu, Pb and Ni contents of *H. conica* were lower than the literature values, while the Zn content was lower than the literature values compared to the literature data. As a result, element levels of *H. conica* were found to be at normal levels.

CONCLUSION

In this study, antioxidant and oxidant potentials and element levels of *H. conica* mushrooms collected from Antalya province were determined. At the end of the study, it was seen that *H. conica* has antioxidant potential. In addition, element levels were found to be at normal levels. As a result, it's thought that *H. conica* can be used as a natural antioxidant material.

CONFLICT OF INTEREST

No conflict of interest was declared by the authors.

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