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Wild Mushrooms as Neuroprotective Reservoirs: Polyamine-Enriched Antioxidant and Anti-Acetylcholinesterase Activities

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INTRODUCTION & AIM

The human brain is highly susceptible to oxidative damage due to its elevated oxygen demand and lipid content. Excessive reactive oxygen species (ROS) and impaired cholinergic transmission—marked by acetylcholinesterase (AChE) overactivity—contribute to neuronal death and cognitive decline in Alzheimer's disease (AD) [1]. Natural compounds combining antioxidant and AChE inhibitory properties are therefore of major interest as potential neuroprotective agents.

Edible and medicinal mushrooms are recognized sources of bioactive metabolites with antioxidant, antimicrobial, and neuroprotective effects [2] .

Polyamines (putrescine, spermidine, spermine) are low-molecular-weight amines essential for cellular growth, redox regulation, and neuronal function, with spermidine showing promising anti-aging and neuroprotective properties [3]. However, data on polyamine occurrence and diversity in wild mushrooms remain scarce [4].

This study presents the first integrated biochemical and functional assesment of *Cortinarius trivialis*, *Mycena pura*, and *Mycena rosea.*

Total phenolic (TPC) and flavonoid (TFC) contents were quantified, alongside *in vitro* antioxidant capacity and acetylcholinesterase (AChE) inhibitory activity relevant to neurodegenerative disease management. Targeted metabolite profiling revealed polyamine composition, offering new insights into their chemistry and the potential role of polyamines in the observed bioactivities.

METHOD

Fruiting bodies of three selected fungal species (**Figure 1**) were collected at full maturity from Mountain Tara (Republic of Serbia) and identified based on their macro- and microscopic features by Dr. Milana Rakić. The specimens were stored and deposited in the ProFungi Laboratory, Department of Biology and Ecology, University of Novi Sad (Serbia), under the assession numbers listed in **Table 1**.

Figure 1. Analyzed fungal species: a) *Cortinarius trivialis*; b) *Mycena pura*; c) *Mycena ro*sea. Photo credits: Dragiša Savić (https://www.naturefg.com/)

Table 1. Analyzed fungal species, localities, sampling dates, and voucher numbers

Species name	Locality	Sampling date	Voucher number
Cortinarius trivialis	Tara mountain	08 October 2022	12-01550
Mycena pura	Tara mountain	08 October 2022	12-00870
Mycena rosea	Tara mountain	08 October 2022	12-00879

This study investigated the **mycochemical composition** and **bioactive potential** of three wild mushroom species—*Cortinarius trivialis*, *Mycena pura*, and *M. rosea*—sampled from Tara Mountain, Serbia. The focus was on their polyamine content, total phenolics, total flavonoids, antioxidant capacity (DPPH, ABTS, NO, and FRAP assays), and anti-AChE activity.

Mycochemical profile:

Polyamines (PAs) (putrescine, spermidine, spermine) were quantified in lyophilized fungal samples using high-performance liquid chromatography with fluorescence detection (HPLC-FD).

Total phenolic content (TPC) and total flavonoid content (TFC) were determined spectrophotometrically from 80% methanolic (MeOH) extracts.

Biological potential:

In vitro antioxidant capacity (DPPH, ABTS, FRAP and NO assays), and anti-AChE activity were evaluated in 80% MeOH extracts using previously established spectrophotometric protocols.

RESULTS & DISCUSSION

Quantification of putrescine (PUT), spermidine (SPD), and spermine (SPM) revealed *C. trivialis* as particularly enriched in PUT (47.51 ± 15.92 mg/kg d.w.) and SPD (41.58 ± 18.06 mg/kg d.w.), while *M. pura* and *M. rosea* contained lower amounts (**Figure 2a**).

M. pura stood out for its high TPC and TFC (**Figure 2b**), driving strong antioxidant activity across DPPH, ABTS, FRAP, and NO radical assays (**Figure 2c**). *M. rosea* displayed selective ABTS scavenging and the strongest AChE inhibition (93.24 ± 7.90%), whereas *C. trivialis*, despite modest antioxidant activity, combined rich polyamine levels with notable AChE inhibition. Principal component analysis underscored distinct metabolic signatures: phenolic-driven antioxidant defense in *M. pura*, SPD-associated neuroprotection in *M. rosea*, and high PUT accumulation in *C. trivialis*.

To the best of our knowledge, this is the first report linking polyamine profiling with AChE inhibition in these mushroom species.

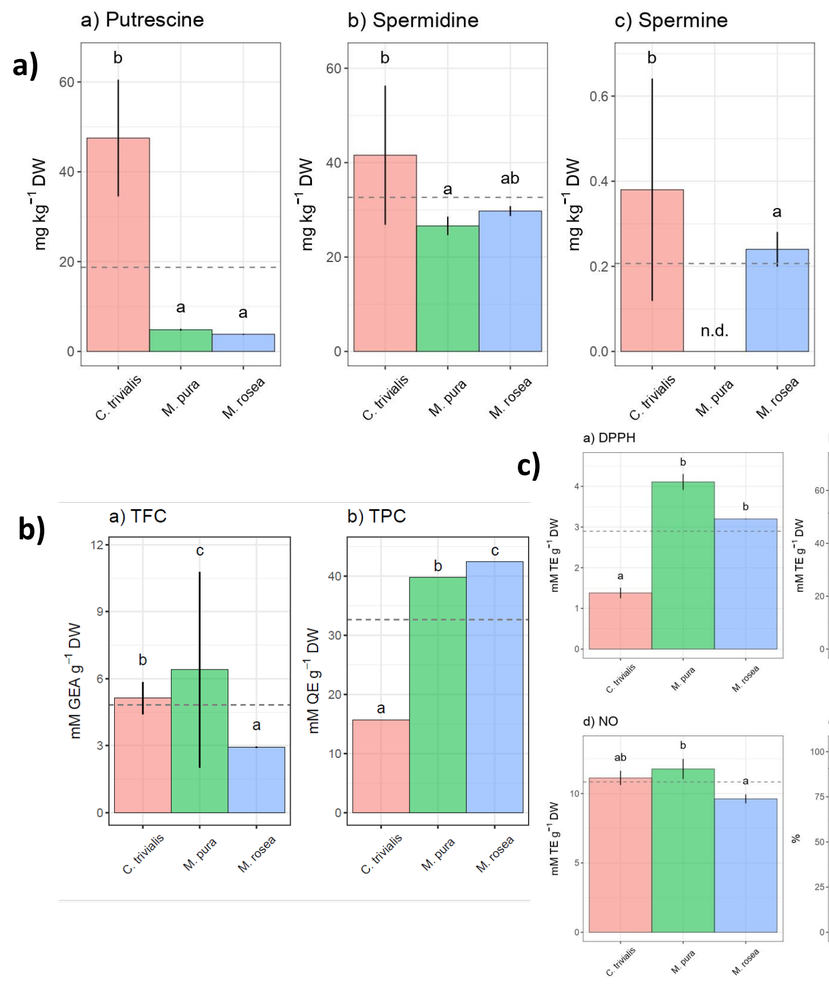

Figure 2. Mycochemical profile and biological activity of the tested species: a) polyamine profile; b) total phenolic (TPC) and total flavonoid content (TFC); c) antioxidant capacity and anti-AChE activity.

CONCLUSION

The findings highlight a species-specific interplay of polyphenols and polyamines in shaping antioxidant and neuroprotective activities, positioning these inedible fungi as promising reservoirs for bioactive compounds with potential applications in functional foods, nutraceuticals, and neuroprotective strategies.

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