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Identification and Distribution of Wild Toxic *Inocybe* spp., and Edible *Tricholoma* Mushrooms in Jordan

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ABSTRACT

A survey and collection of wild mushroom samples from Jordan was done for two consecutive years. Woodlands, grasslands as well as lawns and gardens were included in the study. All mushroom samples were classified according to morphological characteristics of the cap, stipe, gills, attachment of the cap to the stipe, and spore dimensions. Nine Inocybe species as I. atripes. I. cincinnata, I. cookie, I. corydaline, I. flocculosa, I. geophylla, I. hirtella, I. lacera, and I. rimosoides were found in north and middle Jordan and all of them were poisonous. While seven Tricholoma species T. myomyces, T. portentosum, T. sejunctum, T. terreum, T. pardinum, T. venenatum, and T. virgatum were found in different locations in Jordan one of them was poisonous which was Tricholoma pardinum and the other one Tricholoma myomyces was not edible. Seven Inocybe spp. and two Tricholoma spp. were reported for the first time as new records from Jordan. The most important mushroom that was found everywhere in Jordan was Tricholoma terreum. These wild nutritious mushrooms play an important role in the ecosystem and food security. This study shows the wide biodiversity of wild mushrooms in Jordan.

Keywords: *Inocybe* spp., Mushroom, Tricholoma spp., Agricultural sustainability, Fungi

INTRODUCTION

Mushrooms are the fruiting body of the fungus which produces basidiospores or ascospores for reproduction and dispersal. More than 5,000 species of mushrooms exist in nature but only approximately 25 species are intensively cultivated for commercial purposes on ground or wood and utilizing environmental and nutritional conditions (Lindequist et al. 2005). The consumption of wild edible mushrooms is increasing due to their good content of proteins, dietary fibers, and trace elements (Al-Momany & Gucel 2009; Thimmel and Kluthe, 1998).

Mushrooms have become attractive as a functional food and as a source for the development of drugs. Wild mushrooms have many advantages even the toxic species. Most of them can be used to eliminate heavy metals from the contaminated fields, for example, high concentrations of arsenic were found in *Tricholoma matsutake* and *Agaricus blazei* (Chen & Liu, 2023; Liu et al 2021), and low concentrations of mercury were found in cap and stems of *T. portentous, T. columbeta, and T. terreum* with greater concentrations of mercury in the caps relative to the stems (Siric & Falandysz, 2020). Mushrooms are good sources of digestible proteins, carbohydrates, dietary fibers, and all essential amino acids (Barros et al, 2007; Ananbeh and Al-Momany, 2008; Al-Momany and Ananbeh, 2011). The highest protein content was found in *Tricholoma terreum* was 17.4%. (Al-Momany, 2013). Mushrooms are not only sources of nutrients but are also useful in preventing diseases such as hypertension, hypercholesterolemia, and cancer (Jadhao et al., 2022).

Fungi do not contain chlorophyll and cannot carry out photosynthesis. In the environment, mushrooms are the

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primary decomposers of organic matter, responsible for turning dead plants into small nutrient building blocks that other organisms can use (Ananbeh and Al-Momany, 2008). In tropical rainforests, around 50% of the dead plant and animal matter is degraded by fungi. Most fungi grow in the soil or on wood and other plant material. Some species live on dung and can be found in grazing grassland, some species grow in woodlands, either parasitizing tree roots, rotted fallen leaves, or woods or tree stumps. Little is known about the taxonomy of wild mushroom species in Jordan.

The purpose of this study was to identify *Inocybe and Tricholoma* spp. of Jordan in addition to studying their ecology, distribution, and toxicity. The information from this survey will help mushroom collectors to differentiate between edible, non-edible, and toxic mushrooms.

Materials and Methods:

Mushroom Collection and Morphological Identification:

A survey was conducted in 2011-2012 by collecting wild mushrooms from different places in Jordan including forests, and gardens. Several field trips were scheduled for the whole period to visit certain locations in Jordan to collect mushroom samples taking into consideration the availability of vegetation in every collection site. Most of the samples were collected in the period from September to June.

For morphological characterization, each sample was studied in the field by taking measurements of the cap (shape, size, color), the texture (smooth, fibrous, sticky, and scaly), the stem (height, diameter, color, and texture, ring, volva, basal bulb, and roots), gills (color, shape, and attachment to stem), flesh (color, texture, exude milk, smell and taste), spore (color, shape, spore print, and measurements of length and width). Spore print and spores were microscopically tested by recording the shape, color, and size of more than thirty arbitrarily chosen spores.

Mushroom samples were morphologically classified according to Buczacki, 2012; Phillips 2006; Benjamin,1995; Bresinsky, Besl, 1990 and Lincoff, 1981 and. by using the Fungal Databases Nomenclature and species Banks (https://www.mushroomthejournal.com). Documentation of each mushroom to class, order, and family was performed according to fungal databases, nomenclature, and species bank which is the official website of the International Mycological Association, Species Fungorum (CABI Bioservices) and the Index Fungorum, the global fungal nomenclature coordinated and supported by the Index Fungorum Partnership (CABI and Landcare Research-NZ).

Spore print for each fresh mature sample was also defined by laying the fruiting body over a glass sheath and by covering it overnight with a beaker to avoid drying. Spores of each mushroom body were microscopically investigated and photographed.

Results

Morphological Characteristics of Jordanian *Inocybe* and *Tricholoma* mushrooms.

Both *Inocybe* and *Tricholoma* belong to Phylum Basidiomycota, Class Agaricomycetes (Homobasidiomycetes) which is the largest group in the subdivision Basidiomycotina, Order Agaricales, *Inocybe* belongs to family Cortinariaceae, but *Tricholoma* belongs to family Tricholomataceae. Nine *Inocybe* species were found in Jordan and all of them were poisonous according to Buczacki, 2012; Phillips 2006 and Benjamin,1995, while five *Tricholoma* species found in this study were edible and only one was poisonous, and one species with unknown edibility (Buczacki, 2012; Phillips 2006). All *Tricholoma* species were growing mycorrhizal and only *Inocybe lacera* and *Inocybe geophylla* were mycorrhizal.

***Inocybe atripes* G.F. Atk.**

This mushroom grew singly on soil in mixed woodland under pine trees. Cap with bell-shaped then convex, buff to dark honey in the center, margin broken towards the center, smooth, crumply, finely striated from the margin, 2-3 cm across. Flesh buff, thin, and fibrous. Gills free, close, buff to brown honey, gill surface decorated with long hairs bearing a mass of spores. Stem centrally attached, hollow, white then buff, fibrous, and

curved downward, some specimens showed swallowing at the base, 2-3.5 cm high and 4-6 mm thick (Figure 1). Smell pleasant and poisonous (Buczacki, 2012; Phillips 2006). Spore print brown, broadly oval to bean-shaped spores with prominent germ pore and red cell wall, smooth, truncate from one side, 9.0-10.2 µm X 5.1-6.4 µm. Found in Sakib and Alfaysaleyah on 11 April 2011.

Figure 1: *Inocybe atripes*

***Inocybe cincinnata* (Fr.) Quél.**

This mushroom was found growing singly on soil in woodland under oak trees. Cap bell-shaped then concave with umbo, brown, gray, scaly, broken from margin upon age and drying, 1.2-2.5 cm across. Flesh off-white, then brown honey and thin. Gills are uneven, free, distant, decorated, and ornamented with white patches, white then light brown (Figure 2). Stem fibrillose, white, basal bulb or swallowing at the base, 1.5-3 cm high and 3-5 mm thick. Smell mealy and is suspected to be avoided (Phillips 2006). Spore print brown, orange, elliptical to ovoid spores with germ pore and dark cell wall, smooth, 7.7-10.2 µm X 6.4-7.7 µm. Found in Sakib and Mihna on 30 March 2011 and 07 February 2012, respectively.

Figure 2: Basidiospores and caps of *Inocybe cincinnata*

***Inocybe cookei* Bres.**

Poisonous mushrooms grow singly on soil in mixed woodland under oak trees (Buczacki, 2012; Phillips 2006). Convex cap then flattened with prominent umbo, light brown, fibrillose from margin towards the center, finely fibrous, cracked at the margin, scaly, 1.9-3.2 cm across. Flesh thin, fibrous, white then yellow-brown with age. Gills honey brown to gray, brown then cinnamon, adnexed, with toothed edge. The stem is centrally attached, slightly curved at the swallowed base, white then ochraceous at the apex due to spore deposit, 2.5-5.5 cm high and 4-7 mm thick (Figure 3). Smell mushroomy. Spore print ochre brown, broadly elliptical to bean-shaped spores, reticulate with prominent germ pore, 6.4-9.0 µm X 3.8-6.4 µm. Found in Umelyanabee and Mihna (Ajloon) on 07 February 2012.

Figure 3: ***Inocybe cookei***

***Inocybe corydalina* Quél.**

Poisonous mushroom contains psilocybin growing singly on soil in mixed woodland under pine trees (Buczacki, 2012). The shape of the cap is convex then more flattened dark honey to honey gray, and convoluted upward, umbonate, scaly, striated from margin towards the center, cracked from the margin, 2.4-6 cm across. Flesh white then honey at the stem apex, moderate and fibrous. Gills creamy white, then honey cinnamon, uneven, crowded, adnexed, both gill surfaces covered with orange powder dots and irregular edge. Stem centrally attached, cylindrical with slight thickening at the base, ochraceous buff at the upper part and decorated with white down in the lower part, fibrous lined, stout, 2-5 cm high, and 6-9 mm thick (Figure 4). Smell pleasant. Spore

print orange to clay ochre, oval to bean-shaped spores, smooth, prominent germ pore, 10.2-11.5 µm X 5.1-6.4 µm. Found at the Royal Botanic Garden on 05 March 2012.

Figure 4: ***Inocybe corydalina***

***Inocybe flocculosa* Sacc.**

Poisonous mushrooms grow singly on soil in mixed woodland under pine trees. Common name called as fleecy fibrecap according to Buczacki, 2012 and Phillips 2006. Cap convex then broadly flattened centrally depressed, gray, brown, wavy margin and enrolled downward, initially smooth then fibrous and scaly, 1.5-5 cm across (Figure 5). Flesh white then cinnamon gray, fibrous and thin. Gills white then light gray to cinnamon, condense unevenly. Gills adnexed and later free with white edge. Stem centrally attached, cylindrical with slight basal bulb, lower part is white and upper part is ochre, 2-4.5 cm high and 4-10 mm thick. Smell smoky. Spore print has an orange-brown color, oval to almond-shaped spores, rough with orange cell wall and olivaceous contents, clear germ pore, 8.9-11.5 µm X 5.1-6.4 µm. Found in Um Butaimah and Naoor Children Forest on 14 February 2012 and 14 March 2012, respectively. The synonym is *Agaricus flocculosus* Berkeley 1836.

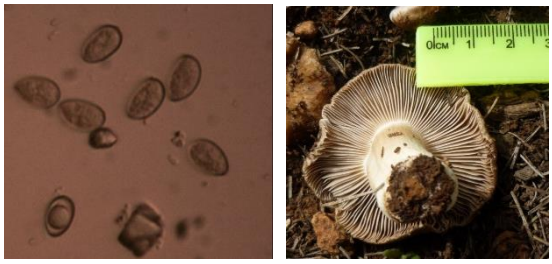

Figure 5: Basidiospores and cap of *Inocybe flocculosa*

***Inocybe geophylla* (Sowerby) P. Kumm.**

Poisonous mycorrhizal mushrooms grow singly on soil in mixed woodland under oak trees (Buczacki, 2012; Natour, 2006 Phillips 2006). Cap convex then flattened with broad umbo, brown, gray to buff gray, smooth, fibrous, sticky in moist weather, surface when young silky, later radially fibrillose, the center mostly pale ochraceous, margin enrolled inward, cap surface wavy and shiny, 1.8 cm across (Figure 6). Flesh buff, thin, and fibrous. Gills honey to light gray, attached to the stem, uneven, with a whitish (fibrillose) edge; dense. Stem centrally attached, hollow, brittle, cylindrical with small basal bulb, white towards the apex and buff towards the base, 2.5 cm long and 4 mm thick. It smells mealy and contains muscarine. Spore print gray snap brown, broadly elliptical to oval spores, smooth, thick red cell wall with silvery vacuole, germ pore at the fusiform side, 7.6-11.5 µm X 5.1-6.4 µm. Found in Ajloon on 11 April 2011. Obligate synonyms are 1. *Agaricus geophilus* Persoon 1801. 2. *Gymnopus geophilus* Gray 1821. 3. *Agaricus geophyllus* Sowerby 1799. 4. *Gymnopus geophyllus* Gray 1821.

Figure 6: ***Inocybe geophylla***

***Inocybe hirtella* Bres.**

Poisonous mushrooms grow singly in woodland under oak trees and roadsides (Buczacki, 2012 and Phillips 2006). The cap is convex then flattened with a prominent umbo, margin broken towards the center, buff to ochraceous tint, fibrillose, 2.6-3.5 cm across (Figure 7). Flesh buff to brown, fibrous, and thin. Gills buff to brown, condensed hairy decorated with white edge, free and uneven. Stem centrally attached, base slightly bulbous, mealy, white tinged with flesh-color upward, covered with cottony patches, 4.5 cm long and 4 mm thick. Smell

like deteriorated fish. Spore print with red-brown color, elliptical to oval spores with prominent germ pore, 9-12.8 µm X 5.1-7.6 µm. Found in Ajloon Castle and Almashare on 11 April 2011 and 18 January 2012, respectively.

Figure 7: *Basidiospores* and cap of *Inocybe hirtella*

***Inocybe lacera* (Fr.) P. Kumm.**

Poisonous mycorrhizal mushroom growing singly on soil in woodland under oak trees and in lawns. The common name of this mushroom is torn fibrecap according to Buczacki, 2012; Natour, 2006 and Phillips 2006. Cap bell-shaped then concave, slight umbo, buff scaly, and when young smooth, 1.4-2.8 cm across. Flesh: White then brown and fibrous. Gills clay brown to honey, crowded with a white decorated toothed edge, free. Stem centrally attached, off-white to buff orange, cylindrical, hollow, covered with white cottony patches and fibrillose, 1.5-3.5 cm long and 2-5 mm thick (Figure 8). Smells peppery. Spore print chocolate brown, elliptical to oval spores, reticulate, clear germ pore, orange cell wall, 13-15.4 µm X 6.5-7.6 µm. Found in Sakib and Amman on 30 March 2011 and 11 April 2012, respectively. Obligate synonyms are 1. *Agaricus lacer* Fries 1821. 2. *Inocibium lacerum* (Fries) anon. 3. *Agaricus lacerus* Fries 1821.

Figure 8: ***Inocybe lacera***

***Inocybe rimosoides* Peck.**

Poisonous mushrooms grow on soil in mixed hard woodland under beech and oak trees (Buczacki, 2012 and Phillips 2006). The convex cap was then flattened with a prominent umbo, pink-brown with a darker margin under dry conditions, finely striated from the margin, 3-4.2 cm across (Figure 9). Flesh brown, thin, and fibrous. Gills cinnamon, spaced, uneven, adnate, edge white irregular. Stems are cylindrical, rather stout, fibrous lined, centrally attached, upper part buff ochre coinciding with gill color and white towards the base, 4-4.5 cm long and 4-6 mm thick. The smell was not distinctive. Spore print orange cinnamon, oval to bean-shaped spores, smooth, 7.7-10.2 µm X 5.1- 6.4 µm. Found in Mihna-Ajloon on 07 February 2012.

Figure 9: ***Inocybe rimosoides***

***Tricholoma* species**

1. *Tricholoma myomyces* (Pers.) J.E. Lange.

Mycorrhizal mushroom, gregarious in mixed woodland on pine roots. Cap bell-shaped then convex and later flattened, margin incurved in youth, wavy, with adhering pallid fibrils, gray, tattered margin, smooth, umbonate, 1-7 cm across (Figure 10). Flesh white, crumbly, and thin. White gills to pallid with age, crowded, broad, uneven, free to adnate. Stem centrally attached, white to pale gray, equal, crumbly, partial veil fibrillose, evanescent, leaving remnants high on the stipe or the young cap margin, 2-6 cm long and 5-11mm thick. Smell pleasant. Edibility was unknown by Buczacki, 2012 but Phillips, 2006, reported that it is edible. Spore print white, oval to bean-shaped, spores with germ pore and round vacuole, smooth to finely reticulate, 7.7-8.9 µm X 3.8-6.5

µm. Found in Sakib, Marse Forest, and Amman National Park on 30 March 2011, 10 and 14 March 2012, respectively. Remarks: Obligate synonyms are: 1. *Agaricus myomyces* Pers. 2. G*ymnopus myomyces* (Pers.) Gray.

Figure 10: *Tricholoma myomyces*

2. *Tricholoma portentosum* (Fr.) Quél.

Edible mushrooms grow mycorrhizal in clusters on pine roots in mixed woodland forest. (Buczacki, 2012; Phillips, 2006). The cap is bell-shaped then concave, dark gray, curled margin upward and downward, tattered from margin towards the center, surface smooth, slightly viscid when moist, glossy, acute, with age rimose, 2.5 - 7 cm across (Figure 11). White flesh to watery gray, fibrous, and crumbly. White gills, uneven, condensed, broad, somewhat thick, adnate and slightly notched, edge smooth. Stem centrally attached, tapering downward, white, 2.6-6 cm long and 1-3 cm thick. Smell mushroomy and pleasant. Spore print White, reticulate, elliptical to oval-shaped, vacuolated, 3.9-7.7 µm X 4.5-5.1 µm. Found in Um Butaimah and Naoor Children Forest on 08 February and 14 March 2012, respectively. Remarks: Obligate or homotypic synonym are: 1. *Agaricus portentosus* Fr. 2. *Gyrophila portentosa* (Fr.) Quél. 3. *Gyrophila sejuncta var. portentosa* (Fr.) Quél. Comptes Ren. 4. *Melanoleuca portentosa* (Fr.) Murrill.

Figure 11: *Tricholoma portentosum*

3. *Tricholoma sejunctum* (Sowerby) Quél

An edible mushroom grows in groups, mycorrhizal on roots in coniferous forests under oak and conifer trees (Buczacki, 2012; Phillips, 2006). The shape of the cap is concave then flattened, light gray with darker center, fleshy, umbonate, slightly viscid, cap surface covered with fine scales toward the margin. Flesh white or tinged yellow, crumbly and thin. Gills white then white-yellowish, uneven, broad, crowded, adnate becoming notched at the stipe. Stem white to straw-colored, tapering at the base, often curved, smooth, 3.7- 4.5 cm long, and 9-15 mm thick (Figure 12). Smell mealy. Spore print: White, elliptical to kidney-shaped, smooth, spores with clear germ pore and transparent vacuole, 6.4-8.9 µm X 3.9-6.4 µm. Found in Mihna-Ajloon and Marse Forest on 07 February and 10 March 2012, respectively. Remarks: Obligate or homotypic synonyms are: 1. *Agaricus leucoxanthus var. sejunctus* (Sowerby) Pers. 2. *Agaricus sejunctus* Sowerby. 3. *Gyrophila sejuncta* (Sowerby) Quél. 4. *Melanoleuca sejuncta* (Sowerby) Murrill, N.

Figure 12: *Tricholoma sejunctum*

4. *Tricholoma terreum* (Schaeff.) P. Kumm.

An edible mushroom grows mycorrrhizal on the roots of pine trees in woodland forests (Buczacki, 2012; Phillips, 2006). The convex cap then flattened and tattered from the margin towards the depressed center, broken into fibril scales, curled upward, gray or mouse-colored, 1.5-6 cm across (Figure 13). The mushroom has white flesh then gray below the cuticle, crumbly and thin. Gills are white to dingy, uneven, adnexed, condensed, and moderately broad. Stem centrally attached, crumbly, curled, equal, white at the base then buff after touch, 2-6 cm long and 10-18 mm thick. Smell mushroomy. Spore

print has white color, oval to broadly elliptical spores, clear germ pore, 7.5-10.2 µm X 6.4-7.7 µm. Found in Thugretasfour and Sakib on 09 and 30 March 2011, respectively. Remarks: Obligate or homotypic synonyms are 1. *Agaricus pullus* Batsch. 2. *Agaricus terreus* Schaeff.

Figure 13: *Tricholoma terreum*

5. *Tricholoma pardinum* (Pers.) Quél.

A poisonous mushroom grows mycorrhizal on pine roots in hard woodland (Buczacki, 2012). Cap convex then flattened with depressed center, tattered margin and curled upward, white to gray-brown, fibrous, 6 cm across (Figure 14). The flesh is whitish, firm, thin, and crumbly. Gills pure white, free, and crowded. Stem centrally attached or occasionally somewhat eccentric, off-white, thickening towards the base, 8 cm long and 2.5 cm thick. From the base to about the middle of the stipe covered with brownish ochre fibrils and scales. Smell pleasant. Causes severe vomiting, thirst, and diarrhea, but with appropriate treatment, recovery is normally rapid (Buczacki, 2012). Spore print white, smooth spores, oval, 8.9-10.2 µm X 5-6.4 µm. Found in Dibeen Forest on 23 March 2011. Remarks: Synonyms are: 1. *Tricholoma tigrinum.* 2. *T. pardalotum.* 3. *Agaricus myomyces var. pardinus* Pers.

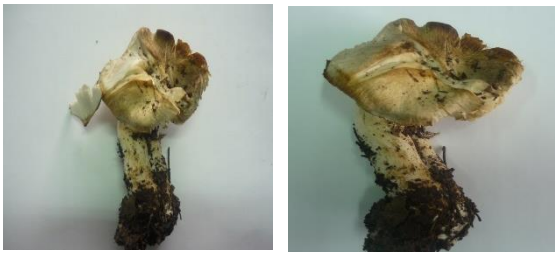

Figure 14: *Tricholoma pardinum*

6. *Tricholoma venenatum* G.F. Atk.

Edible fungus grows mycorrhizal on pine roots in woodland. Concave cap then broadly flattened, dark gray with a darker center, fibrillose, broken from the margin towards the center, crumbly, 4.5 cm across (Figure 15). Flesh white, thick, and crumbly. Gills whitish yellow to whitish honey, descending with stem, uneven. Stem centrally attached, whitish yellow, tapering toward the base, 5 cm long and 6 mm thick. Smell pleasant. Spore print whitish, oval to pear-shaped spores, vacuolated, smooth, 7.6-8.9 µm X 5-6.4 µm. Found in Marse Forest on 10 March 2012. Remarks: Synonyms are: *Tricholoma venenata. Melanoleuca venenata* (G.F. Atk.) Murrill.

Figure 15: *Tricholoma venenatum*

7. *Tricholoma virgatum* (Fr.) P. Kumm.

Non edible mushroom grows mycorrhizal on pine roots in woodland (Buczacki, 2012; Phillips, 2006). The cap is bell-shaped to concave, dark gray to light brown, peeled easily, curled margin inward, and 2-7 cm across (Figure 16). Flesh white, thin, and crumbly. Gills are white, uneven, free, and crowded. Stem: Centrally attached, whitish, thick at apex, fleshy, annulus is absent, 2-5.5 cm long and 6-20 mm thick. Smell mouldy and unpleasant. Spore print white, elliptical to subglobose, smooth, and vacuolated, 6.4-10.2 µm X 5-7.7 µm. Found in Um Butaimah-Almafraq on 08 and 14 February 2012. Remarks: Obligate or homotypic synonyms are: 1. *Agaricus fumosus subsp. virgatus* (Fr.) Pers. 2. *Agaricus virgatus* Fr. 3. *Gyrophila virgata* (Fr.) Quél.

Figure 16: *Tricholoma virgatum*

Discussion:

Although taxonomic knowledge on *Tricholoma* is fairly comprehensive in northwest Europe, knowledge of the global diversity and distribution of *Tricholoma* spp. is still sparse (Reschke et al 2018). *Tricholoma* is a fairly large genus of mycorrhizal gilled mushrooms with white spore prints. Mushrooms tend to like cooler conditions and are mostly found in February and March. In this study, the diversity and distribution of *Tricholoma* and *Inocybe* spp. were identified by morphological characteristics. Nine *Inocybe* spp. were extensively covered in this study where two of them were earlier reported by N. 2006 and the rest seven species were recorded for the first time in Jordan. Two new T*richoloma* species ***T. virgatum*** and ***T. venenatum*** were reported for the first time in Jordan in addition to the five spp. reported earlier (N. 2006).

Tricholoma terreum contained three important terpenoids that showed certain toxicities against four human tumor cell lines (Feng et al; 2015), steroids, tricholosterols, and polyketide derivatives (Jin., et al., 2023.). *Tricholoma ustaloides* extract was helpful against different types of human cell cancers by containing tricholidic acids B & C derivatives (Gilardoni et al., 2023).

The genus *Inocybe* contains both edible and toxic mushrooms, therefore accurate identification keys should be followed to avoid any toxicity. Even the toxic mushroom may contain anticancer compounds such as *Inocybe umbrinella* which contains lectin and this extract inhibits the proliferation of tumor cells including hepatoma HepG2 cells and breast cancer MCF7 cells (Zhao et al.,2009). Consumption of *Inocybe* species should be avoided where *Inocybe serotina* contains muscarine and causes chills, vomiting, sweating, hypersalivation, hypotension, tremor, and diarrhea as clinical manifestations (Patocka et al., 2021., Xu, et al., 2020., Latha, et al., 2020). These symptoms may develop from 15 minutes to two hours after consumption (Lurie et al., 2009). Five *Inocybe* species were identified from woody steppe in Hungary while in Turkey 64 species were well documented. (Seress et al., 2016; Solak., et al., 2009). Even poisonous mushrooms such as *Tricholoma pardinum* may contain antibiotics against *Staphylococcus, Escherichia, and Tetranychus* (Clericuzio, et al., 2021; Shi. et al., 2021 and Yang. et al., 2021). Some *Tricholoma* and *Inocybe* species are used for their medicinal effects as lectin (Zhao, et al., 2009).

Mushrooms play an active part in natural decomposition and in this way, they indirectly influence many fields of human activity. The decay of organic matter is caused by the joint activity of bacteria and fungi, particularly microscopic fungi, which are to be found everywhere in the soil in large numbers. They participate in the breakdown of vegetable matter, in the creation of compost, and the treatment of some agricultural products. Thus, fungi provide a service within the ecosystem of recycling the important complex nutrients into smaller more easily absorbed compounds. It is estimated that approximately 50% of all organic material is decomposed by fungi. Both *Tricholoma* and *Inocybe* species are mycorrhizal and build a symbiotic relationship with their hosts which facilitates their survival even under stressful conditions (Al-Momany 2018).

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التعرف على وتوزيع الفطر البري السام من نوع Inocybe spp. والفطريات الصالحة للأكل من نوع Tricholoma في الأردن

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ملخص

أجري مسح وجمع عينات من الفطر البري في الأردن لمدة عامين متتاليين. وقد شملت الدراسة الغابات والمراعي وكذلك المروج والحدائق. وقد تم تصنيف جميع عينات الفطر وفقًا للخصائص المورفولوجية للغطاء والساق والخياشيم وارتباط الغطاء بالساق وأبعاد الأبواغ. وقد تم العثور على تسعة أنواع من الفطر السام من نوع Inocybe وهي I. atripes و I. cincinnata و I. cookie و I. corydaline و I. floccolosa و I. geophylla و I. hirtella و I. lacera و I. rimosoides في شمال ووسط الأردن وكانت جميعها سامة. بينما تم العثور على سبعة أنواع من فطريات الترايكولوما وهي: تريكولوما مياوميسيس، تريكولوما بورتينتوسوم، تريكولوما سيجونكتوم، تريكولوما تيريوم، تريكولوما باردينوم، تريكولوما فينينوم، تريكولوما فيرجاتوم في مواقع مختلفة في الأردن، كان أحدها سامًا وهو تريكولوما باردينوم والآخر تريكولوما مياوميسيس غير صالح للأكل. تم الإبلاغ عن سبعة أنواع من فطريات الإينوسيب واثنين من فطريات الترايكولوما لأول مرة كسجلات جديدة في الأردن. كان أهم فطر تم العثور عليه في كل مكان في الأردن هو فطر الترايكولوما تيريوم. تلعب هذه الفطريات البرية المغذية دورًا مهمًا في النظام البيئي والأمن الغذائي. توضح هذه الدراسة التنوع البيولوجي الواسع للفطريات البرية في الأردن.

الكلمات الدالة: فطريات الإينوسيب، فطر، الترايكولوما، الاستدامة الزراعية، الفطريات.

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