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Short Communication

Isolation of *Pisolithus* sp., (Sclerodermataceae) - First recording in western Iraq

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Abstract

Pisolithus is a rare macro-fungal genus belonging to the family Sclerodermataceae and has been identified for the first time in Anbar. This puffball grew associated with *Eucalyptus* sp. tree and was collected during October 2013 at the campus of University of Anbar (UOA), Ramadi, which lies at 33.403457° N and 43.262189° E in dry conditions. This mushroom is considered to be ectomycorrhizal (ECM) and has an essential role in the physiology of *Eucalyptus* sp. This study added a new species to the biodiversity of macro-fungi in the arid and semi-arid area in Iraq.

Keywords: biodiversity, EMC fungi, Ramadi, classification, *Eucalyptus*, ultramafic soil

1. Introduction

Fungi are eukaryotic organisms comprising of fine hyphae, which together form a mycelium. Fungi play significant environmental roles as decomposers, and as mutualists with, and pathogens of plants and animals. Fungi drive carbon cycling in the soils by secreting enzymes which can decay cellulose, hemicellulose, and lignin. Fungi play an indispensable role in the life cycle of the biosphere since all plant debris generated over time is mineralized and changed (Martins, 2017). Many mushroom species were isolated from northen Iraq (in Suliamaniya forests which are rich in tree *Quercus* spp. and *Juglans* sp.) which considered a suitable habitat to grow macrofungi naturally (Alkhesraji, 2016).

Ectomycorrhizal (ECM) fungus is an essential part of the physiology of some plants (Bechem, 2014). Additionally, the ECM *Pisolithus albus* collected from some sites in New Caledonia featured the identification of ultramafic nickel-tolerant ecotype, indicating particular and adaptive sub-atomic reaction to nickel. In this way, this fungus plays a critical part in *Eucalyptus* adapted to the high concentrations of nickel in soils (Jourand *et al.*, 2014).

The Iraqi desert in Anbar province is rich in the desert truffle (Alsheikh & Trappe, 1983; Owaid, 2018). In northern Iraq, many wild mushroom species were collected and identified from mountains of Sulsaimani and Erbil provinces in Kurdistan Region Governorate up to more than 3,000 meters above sea level (Aziz & Toma, 2012; Toma, Ismael, & Abdulla, 2013). Ten macro-fungal genera were recorded in Hit and Fallujah in Anbar Governorate (Muslat & Owaid, 2015; Owaid, Muslat, & Tan, 2014; Owaid, Seephueak, & Attallah, 2018). Recently, about six genera were collected from Tikrit district in Salahadin Governorate (Al-Khesraji, Shugran, & Augul, 2017). Also, some Basidiomycota species were recorded in Baghdad and Salahadin Governorate including *Cyathus olla*, *Coprinellus micaceus*, *Entoloma* sp., *Panaeolus papilionaceus*, *Conocybe watlingii*, *Agrocybe pediades*, *A. pediades*, *Psathyrella candollena*, *P. candollena*, and *Panaeolus guttulatus* (Al-Khesraji & Suliaman, 2019; Al-Khesraji, Suliaman, Al Hayawi, & Sadiq, 2019). Nevertheless, nine macro-fungal

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genera have been recorded in the regions of Anbar from November to February annually (Owaid *et al.*, 2014).

This work was aimed to identify fungi that grow naturally in gardens of University of Anbar (The Campus) Ramadi district, Anbar Governorate, Iraq. This is the first study macrofungi in Ramadi, capital of Anbar, western Iraq.

2. Materials and Methods

Different samples of puffball mushroom were collected from various places under *Eucalyptus* sp. tree (approx. 10 years old) at campus's gardens of University of Anbar (between College of Science and College of Sport) during October month 2013. The standard method was followed to collect and identify mushroom samples (Matny, 2008). The mushroom atlas and taxonomic keys (Hall, Stephenson, Buchanan, Yun, & Cole, 2003) were used for identification of this macro-fungus. The location of this area was recorded via GPS.

University of Anbar lies at 33.403457° N and 43.262189° E as in Figure 1. The climate of this region (the campus of UOA) is semi-dry to dry with low precipitation and high evaporation rates (MOE, 2012). *Pisolithus* sp. fruitbodies were collected in October 2013 under *Eucalyptus* sp. tree near its roots and identified according to the fungal dictionary of Hall *et al.* (2003). However, the weather in this month was as following: temperture 30-35 °C maximum and 14-20 °C minimum, humidity 35-50%, and rain fall ≤8mm. Generally, the soil type of this region is lean clay with sand (Mahmood & Abdul Kareem, 2010).

3. Results and Discussion

Mushrooms play a vital ecological role by decomposing organic residues in nature, and can reduce effects of pollutants (Carlile, Watkinson, & Goody, 2001). They are found in suitable habitat; therefore, the mycologists focused on the wild mushrooms which naturally appeared in Iraq to encourage mushroom collectors in this region (Owaid *et al.*, 2014). In autumn season, leaves of trees die and fall, dew and fogs provide more water; mushrooms start to develop on the ground, on logs and stumps, and on fallen branches (Hall *et al.*, 2003).

Pisolithus sp. (Figure 2) is a rare macro-fungal genus belongs to the family Sclerodermataceae and has been identified for the first time in Anbar. This puffball grew under *Eucalyptus* sp. tree and was collected during October 2013 at the campus of University of Anbar (UOA), Ramadi, in dry conditions. This study added a new datum to the biodiversity of macro-fungi in the arid and semi-arid area in Iraq. This association with aridity is consistent with the finding of *Pisolithus* sp. in New Zealand at geothermal areas (Moyersoen & Beever, 2004). Furthermore, the first recording in Iraq was in Tikrit city north of Baghdad in 2008 (Matny, 2008). The association of *Pisolithus albus* with *Eucalyptus* sp. has also been reported from India (Singla, Reddy, Marmeisse, & Gay, 2004) and New Caledonia (Jourand *et al.*, 2014). Almost all reports suggested that the *Pisolithus* isolates associated with *Eucalyptus* sp. with are *Pisolithus albus* (Jourand *et al.*, 2014; Singla *et al.*, 2004). Its scientific classification is below:

Kingdom: Mycota
Division: Basidiomycota
Class: Agaricomycetes
Order: Boletales
Family: Sclerodermataceae
Genes: *Pisolithus* (Jourand *et al.*, 2014).

Pisolithus sp. is a puffball in which the gleba has been fragmented into individual chambers (Wilson, Binder, & Hibbett, 2011). Shape of its sporocarp and the surface

Figure 1. University of Anbar site, Ramadi (Google, 2017)

Figure 2. *Pisolithus* sp. samples under *Eucalyptus* sp. tree, at the Campus of University of Anbar (UOA), fruiting bodies (a, b, c), the mushroom from inside (d, e), and fallen leaves of *Eucalyptus* sp. tree beside the mushroom (f)

ornamentation of the basidiospores (van der Westhuizen & Eicker, 1989) are important distinguishing features. These spores have *coarse*, crowded, and blunted spines with three to eight basidiospores per basidium (Kasuya, Coelho, Tamai, Miyamoto, & Yajima, 2008).

Ectomycorrhizal (ECM) symbiosis can play a critical part in the adaptation of plants to raised soil concentrations of heavy metals like nickel (Jentschke & Godbold, 2000). Some experiments with *Pisolithus albus* have been made to find out how the symbiotic interaction with the host plant increased its tolerance to nickel in nickel-rich soils. In New Caledonia, Ectomycorrhizal *P. albus* collected from nickel-rich ultramafic and non-ultramafic soils. To study ectomycorrhizal symbiosis, ECM *P. albus* showed adaptive nickel tolerance in the presence of *Eucalyptus globulus* L. (as a plant-host model) *in vitro* (Jourand *et al.*, 2014). The fungal sheath covers *Eucalyptus* sp. roots as a substantial barrier and reduces the absorption of nickel by root tissues. Further characterization of ECM fungal communities in Iraq would build learning about fungal variety and distinguish fungal species that may be significant for plant inoculation reason and their immediate implications in reclamation systems.

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