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Auricularia nigricans (*Auriculariaceae*, Basidiomycota) is First Introduced from Halabja Province, Iraq

Hawrez A. NADIR[1*], Ari J. ALI[1], Salah A. SALIH[2]
*Corresponded email: hawrez.nadir@spu.edu.iq

[1] Sulaimani polytechnic university, technical college of applied sciences, Horticulture and landscape design, Halabja, IRAQ / Orcid ID:0000-0003-2098-648X / hawrez.nadir@spu.edu.iq
[2]Sulaimani polytechnic university, technical college of applied sciences, Natural resources and environmental science, Halabja, IRAQ
salah.salh@spu.edu.iq

Abstract: Surveys are being conducted in Halabja province located north of Iraq to determine the distribution of wild mushrooms and finding new record species. During the study both species of *Auricularia nigricans* and *Auricularia auricula-judae* were found in the growing area. *Auricularia nigricans* is new to Iraq and described very well in this paper, but *Auricularia auricula-judae* was mentioned in a paper previously, but not described and even was not found in Halabja province. However, full description for both species are given along with photographed of fruiting bodies, with hyphae and spore illustrated for the new recorded species with given the information on general distribution and the ecology.

Key words: *Auricularia,* Halabja Province, Mediterranean climate, Mushrooms, Saprobic, Spore

Auricularia nigricans (*Auriculariaceae*, Basidiomycota) Halabja Eyaleti, Irak'tan İlk Kez Belirlendi

Öz: Doğal mantarların dağılımını belirlemek ve yeni kayıt türleri bulmak için Irak'ın kuzeyinde bulunan Halabja'da çalışmalar yapılmaktadır. Araştırmada, hem *Auricularia nigricans* hem de *Auricularia auricula-judae* türleri yetişme alanında bulunmuştur. *Auricularia nigricans* Irak'ta ilk kez elirlenmiş ve bu çalışmada detaylı tanımlanmıştırve, fakat *Auricularia auricula-judae* daha önce bir makalede bahsedildiğinden tanımı yapılmamış, ancak Halabja ilinde ilk kez bulunmuştur. Bununla birlikte, her iki tür için tam deskripsiyonları, fruktifikasyonlarının fotoğraflarıyla verilmiştir, yeni kayıtın genel yayılışı ve ekolojisinin açıklamasıyla birlikte spor ve hiflerin fotoprafları da verilmiştir.

Anahtar kelimeler: *Auricularia,* Halabja Eyaleti, Akdeniz iklimi, Mantarlar, saprobik, Spor

Introduction

Auricularia Bull. ex Juss. is a genus of jelly fungi belonging to *Auriculariaceae* family. The member of genus usually found on decaying wood in humid area and it is cosmopolitan genus (Malysheva & Bulakh, 2014). In the last decade, the wild edible and cultivated mushrooms can be used as a source of human food due to containing many benefit elements and vitamins. As (Nadir *et al.,* 2016) conducted that mushrooms contain many important substances, such as carbohydrate, protein, fiber and a little

amount of fat with vitamins. This usable depends on the cultures are mushrooms used as a dietary food (Berheret, 1997).Moreover, mushrooms can be considered as functional food which provides health benefits in addition to nutritional value (Rathee*et al.,* 2012). For instance, some of the species of *Auricularia* are used for drug extraction widely (Zou *et al.,* 2013). Mushrooms are distributed in the worldwide which each country have recorded their species, the number of species are estimated in the world approximately 1.5 million and 5 percent of the species described (Ostry*et al.,* 2011). Additionally, most of them are distributed in temperate regions and tropical region because of their appropriate habitat which is hosting the highest and various number co-diversity has been insufficiently sampled and the mycoflora scarcely recorded (Hawksworth, 2001). The collections and identification of mushrooms accurate and collected in a different seasons as Laessoe (1998) indicated that In late autumn, late winter and early spring are very good times to see many of the mushrooms. The wet places are suitable for growing mushrooms and natural forest especially under or at the base of oak trees are actually the best location to see common edible and rare fungi. Srivastava (2010) as cited that mushrooms are seasonal fungi, which occupy additional lists occurred in among culminating with the different niches in nature in the forest ecosystem. The climate and habitat have the huge impacts that indicate biodiversity, characterized by diverse morphological traits, such as cap shape, pileus length, color, gills, scale, rings on stem, etc. These characters are detected in the mushrooms species.

The existing morphological classification of *Auricularia* is based on the internal stratification of diverse layers and abhymenial hairs on the basidiomata (Kobayashi, 1981, Lowy, 1951). The species were described worldwide by Lowy (1952) was 10 species. After that on mating studies (Duncan & MacDonald, 1967) and various in spore sizes (Parmasto&Parmasto,1987) were utilized to classify species. Fifteen species and five variants of *Auricularia* were studied by Kobayashi (1981). The estimation of Current study for the genus includes 10–15 species throughout the world (Looney et al., 2013), while Kirk et al. (2008) estimated there are eight species distributed in worldwide. Moreover, about the estimation species of *Auricularia* Twenty-eight species are considered valid (Kirk, 2015), which mostly found in temperate zones tropical and subtropical. Classification system has been developed by Lowy (1951) that based on identifying zones in the basidioma, which are observed after cross-sectioning, a technique still utilized as the essential taxonomic method for the genus, as spotted in research studies by Lowy (1952, 1971), Batista et al. (1966), Góes-Neto (1996), Sobestiansky (2005), and Looney et al. (2013). *Auricularia auricula* was first reported and described in China in 1881 (Kalchbrenner and Thümen1881) and in most Chinese publications subsequently the name was applied to“Heimuer” for the mushroom species (Teng 1939,1963; Tai 1979; Mao 1998; Dai and Yang 2008). Also (Kobayasi, 1942, 1981; Lowy, 1951; Montoya-Alvarez et al., 2011) these researchers conducted that *Auricularia auricula-judae* (Bull.) Quél. (=*Auricularia auricula* (L.) was originally described from Europe and it is a common species in central Europe and was recorded to have a wide distribution in the Northern Hemisphere.

The *Auricularia auricula-judae* species morphologically are complex varies from other species in the genus by its smooth hymenophore and dark brownish basidiomata. This complex of morphology lead the distinguish species are difficult because of similar morphological features, that is why the American and Asian taxa were previously reported as *A.auricula-judae* (Wu*et al.,* 2015) which called wood ear. In addition, *Auricularia nigricans* another species that is complex structure and in some resources mention a cousin with *A. auricula,* which this species is used widely from human as Irawati *et al.,* (2012) cited that *A. nigricans* is an edible mushroom which known as black Chinese fungus and becomes rough when it’s dry.

Morphologically *A.nigricans* is a macrofungus that is located in a class of *Basidiomycota* and belongs to Auriculariaceae family (Lowy, 1951). They grow in tropical America, Asia and other regions of the world (Yu *et al.,*2008)The spread of fungal spores of *A.nigricans* are existing in high amount during late of July (Jonathan, 2002).It is a wild or cultivated by human the culturing of this fungus is not difficult but need more care and slow like some other fungi (Irawati*et al.,*2012). The mushroom when it is fresh, the structure is gelatinous, rubbery, and ear-like so called cloud ear fungus. However, it becomes shapeless and brittle during dried (Zoberi, 1972, Jonathan et al.2009). There is a few scientific literature on *Auricularia* in Iraq, as the field guides that report *A. auricular-judae* (Farid *et al.,*2015), but not described the species very clearly, and

was not in the area of this study in. This study is investigated the fruiting morphology which is include both macroscopic and microscopic features for introducing a novel species of *Auricularia nigricans,* which is first record from Iraq. Also, the purpose of this study is adding this species to Iraqi fungi checklist.

Materials and Methods

The survey was carried out during the year 2018 in diverse places of Halabja province /north of regional government-Iraq. The survey involved 9 location around Halabja province (Bawakochak, Trefa, Presi Khwaru, PresiSarw, Gorga chia, Anab, Ababele, Jalela, Zamaqe). The fields of collection located between (35° 13' 7.1076" N, 45° 53' 31.7148" E and 35° 12' 31.554" N, 46° 0' 50.544" E). These places are more liable to grow fungi because of wet and include conifer forest, stream, lawn, grasslands and pasture land. The methods of collection were carried out by keeping the species in a bag with the label until lab beside the collection each specimen has been photographed in colored by digital camera. Additionally, the information about the habitat and features of each specimens morphologically have been recorded to which is used during identification. The identification of fungi are recorded depending on the morphological characteristic of fungi with microscopic features which include (The shape of cap and size, gills color with spacing lamellae and different illustration like sieve gills, the stem to the caps with rings or without, the stem size, shape, surface texture, the presence or absence and spores with hyphae) and the habitat which mushroom found. The various methods have been used for identifying the specimens. Most of these books contain key for species and illustrations which help for identification. The nomenclature is given in accordance with Mycobank (2019).

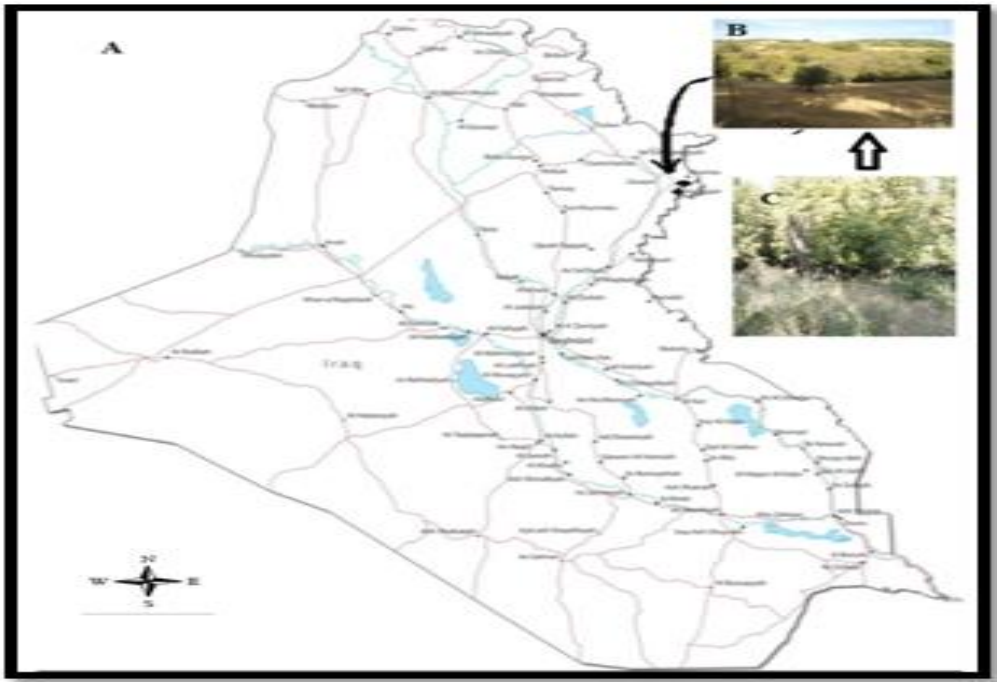

Figure 1. Iraq map. (A); Halabja location bolded, (B); illustrated Habitat, (C); the species Habitat.

Results

Species:*Auricularia nigricans* (Sw.) Birkebak, Looney & Sánchez-García, in Looney, Birkebak & Matheny, *N. Amer. Fung.* 8(6): 12 (2013) (Fig. 2), (MB.15625).

Macroscopic features: The mushroom found growing on dead trunk and branches of populous tree. The fungi are sessile which is less stem cup like shape or may appear like ear on trees. Appear as aggregate beside each other. The inner surface is black according the sample present in (Fig.2 a) and the outer surface is slightly brownish rough with cover by hair and wrinkled during mature the cups of mushroom are curved. Basidiocarps surface frequently having a strongly convex dorsal, densely

pileus. The fungi fruit are nearly 5-6 cm broad, 1-1.5 mm thick.

Microscopic features: Hyaline organized in dense with a prominent central strand, hyphae arranged perpendicular to the surface. Another character is basidia cylindrical 5-6µm. The spore kidney bean shapes allantoid.

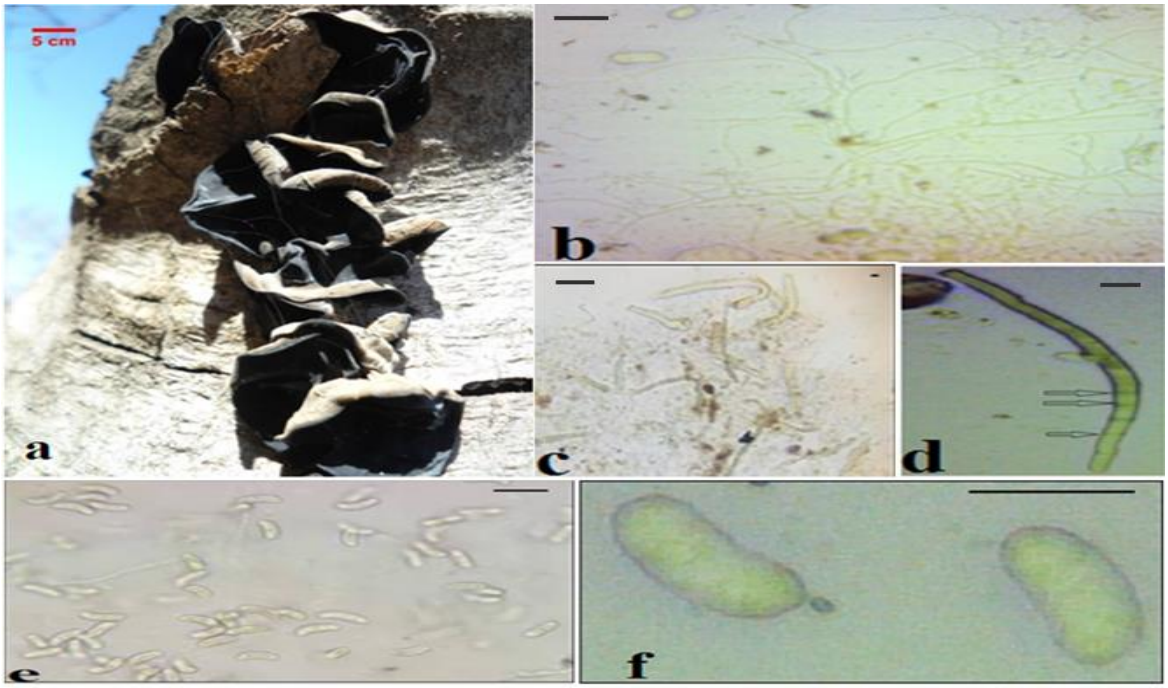

Figure 2. *Auricularia nigricans*. (a);The fruiting body of fungi (b); Mycelium, Hyphae a tubular filament growing and new hyphae form by branching. (C);Basidium that are separated. (d);Phragmobasidium, the septa are indicated by black arrows. (e); the aggregate spores. (f); showing spore shape. (a) Scale bare= 5cm, others scales = 6µm.

Species: ***Auricularia auricula-judae*** (Bull.) J. Schröt., Kryptogamen-Flora von Schlesien 3-1(4): 386 (1888). (Fig. 3), (MB. 102281)

Macroscopic features: It is found on dead tree was burned, Saprobic on hardwoods. Fruiting body: Wavy and irregular; typical year-shaped to irregularly disc-shaped, sometimes fused together, less stem directly joined to woods and the consistency of the flesh is rubbery and gelatinous, the outer surface is usually yellowish- brown to reddish brown or grayish-brown the color becomes darker with age; minutely hairy; often ribbed or veined. The body is sometimes wrinkled in places. The inner surface is a lighter grey brown in color and smooth or some time wrinkled, also the upper, fertile surface brown to reddish brown. The fungi normally 3 to 8 centimeters and it can be as much as 12 cm in diameter by 1 – 2 mm thick.

Figure 3. *Auricularia auricula-judae* fungi. (a); The fungus grows on wood. (b); The fungi habitat and illustration on wood, a& b scale bare = cm.

Discussions

The number of species is belonging to *Auricularia* genus was discussed by many researchers according to Kirk *et al.* (2008) estimated there are eight species distributed in the worldwide. However, after 7 years in which Kirk (2015) indicate another estimation that the number of species belonging to *Auricularia* increased to twenty-eight, species this due to presenting new research papers which are recorded new species in the worldwide. North of Iraq records two species after the survey have been done in 9 locations. The two species are *Auricularia nigricans* found on a populous tree in Bawa kochak area, and *Auricularia auricula-judae* found on dead and burned tree in Ababaele as clearly shown in (Figures. 2&3). These two species obviously separated by morphological characteristics and the spore of *Auricularia nigricans* illustrated in (Figure 1 e and f) which has slight kidney shape which is new to Iraq and Halabja province, but *Auricularia auricula-judae* is new to Halabja province and recorded to Iraq previously. Iraq one of the countries that have appropriate weather to grow these kinds of mushrooms in particular north part, occurrence these two species are referee to the suitable climate. The climatic of Iraq is continental, subtropical semi-arid type, with the north and north-eastern mountainous regions having Mediterranean climate. Rainfall is very seasonal and occurs in the winter from October to May (FAO, 2008). This climate is suitable for these species two grow in that agreed with Kirk (2015) cited that most of the species of *Auricularia* found in temperate zones tropical and subtropical. .

Previously in Iraq there were some papers that cited many species of fungi, but not include descriptions for these two species *Auricularia auricula-judae* and *Auricularia nigricans* exception of Farid *et al.*(2015) in the paper just mentioned the *Auricularia auricula-judae* without description also was not in Halabja . However, this study is introduced *Auricularia nigricans* for the first time in Iraq with described the morphology of fruiting body and spores description with habitat of both species very well based on superficial characteristics (Lowy, 1952). In addition, both species of fungi are used commercially for drug extraction in particular *Auricularia nigricans* is used widely (Alves et al., 2012; Yıldırım et al., 2012). The researchers cited that *Auricularia nigricans* has rich in antioxidant, antitumor lowering blood-fat, and immunomodulatory activities (Luo et al. 2009; Yang et al.2002). This means these two species have a great value in terms of medicinal uses.

Conclusions

To conclude that the region is rich in biodiversity to find new species of macrofungal because it is located north of Iraq which the climatic conditions are appropriate. So this research paper is important in diagnosing and identifying the species of *Auricularia auricula-judae* and *Auricularia nigricans* that distributed in the different locations of Halabja province with recorded *Auricularia nigricans* as a new species to Iraq. Hence conducting a further survey of this group of fungi in this region is of great importance towards finding new species and creating a checklist of macrofungi to Iraq.

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