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A New Myxomycetes record (Myxogastria) from Turkey: *Didymium listeri* Massee

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ABSTRACT
Myxomycetes called Plasmodial slime moulds, or true slime molds are eukaryotic microorganisms. They live in a variety of ecosystems. Genus *Didymium* Schrad. (family Didymiaceae) is a myxomycete taxon containing calcareous peridia (order Physarida) and non-calcareous capillitium. *Didymium listeri* Massee were recorded in this study for the first time from Turkey. *D. listeri* sporocarp was found in the laboratory by moist chamber culture. In addition, the description, distribution, photograph and identification key of the taxon were presented.

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Türkiye'den Yeni Bir Myxomycetes Kaydı (Myxogastria): *Didymium listeri* Massee

ÖZET
Plasmodial cıvık mantarlar veya gerçek cıvık mantarlar olarak adlandırılan miksomisetler ökaryotik mikroorganizmalardır. Çeşitli ekosistemlerde yaşarlar. *Didymium* Schrad cinsi (Didymiaceae familyası), kalkerli peridia (Physarida takımı) ve kireçsiz kapillitium içeren bir miksomiset taksonudur. *Didymium listeri* Massee Türkiye'den ilk kez bu çalışmada kaydedilmiştir. *D. listeri* sporokarpı nemli oda kültürü ile laboratuvarda elde edildi. Ayrıca bu çalışmada taksonun tanımı, dağılımı, fotoğrafı ve teşhis anahtarı sunulmuştur.

Araştırma Makalesi

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INTRODUCTION
Overall, 93 species belonging to the *Didymium* genus species in the world (Lado 2020) including 25 species in Turkey were reported (Baba and Sevindik 2019; Baba and Sevindik 2020a; Baba et al., 2021a). This calcareous material, traditionally designated lime, varies somewhat in composition in the order Physarida, but is calcium carbonate in the Didymiaceae. Crystalline lime (as opposed to the granular lime seen in *Diderma* Pers. and *Physarina* Höhn.) is found in *Didymium* Schrad., *Mucilago* P. Micheli ex Adans. and *Lepidoderma* de Bary. This lime is scattered on the peridium or forms a crust (*Didymium* and *Mucilago*), or is united into distinct scales (*Lepidoderma*). *Didymium* (sporangial or plasmodiocarpic), is separated from *Mucilago* (aethalial) on the basis of sporocarp form (Clark and Haskins 2018). The peridium is the outer layer of the sporotheca. It is usually covered with stellate lime crystals, either in a loose powder or a compact smooth (eggshell) crust. There are also three basic subtypes of peridia; areolate, non-areolate, and cartilaginous with only the cartilaginous subtype correlating directly with the hypothallus and stalk subtypes (Matsumoto 1999). The capillitial threads are thin. Hyaline is to brownish and run from the peridial basal plate (columella) to the upper peridial surface. Sporadic expansions and inclusions can occur in the capillitial threads. However, there are only regular and distinct variations such as vesicles in the *Didymium serpula* Fr. These features have taxonomic importance. The spores are globose (rarely ovoid), brownish, and ornamented. There are the variations in size, color and ornamentation within a species varying more than is generally stated (Martin and Alexopoulos 1969; Clark and Haskins 2018). The species of *Didymium* are often widely distributed. Generally, form sporocarps on leafy or woody litter in temperate and tropical forest. They are probably living in the soil and litter interface and feeding on the microorganisms in this habitat. Some species appear to have more restricted habitats, such as the bark of living trees, animal dung, desert plant

litter, or the litter and plants of the snow melt zones of snow packs (Ing 1994). *Didymium* genus has a rich variety of species, the most common, most cosmopolitan. It is one of the species with the greatest distribution in the world and Turkey.

MATERIAL and METHOD

Myxomycete specimen was collected Hatay-Kırıkhan at 2019 (Figure 1). Field surveys for myxomycetes were conducted at various localities. Specimens of myxomycetes that had fruiting bodies in the field under nature conditions were collected. In addition, samples of dead plant material (forest floor litter, aerial litter, wood and bark from living trees) were obtained at a number of localities. All samples were used to prepare moist chamber cultures. Moist chambers cultures consisted of disposable plastic Petri dishes lined with filter paper. The sample material in each dish was moistened with distilled water. After a period of approximately 24 hours, excess water in each dish was removed. Cultures were kept at room temperature (24ºC) in diffuse daylight (Baba et al., 2021b). Examined with a stereomicroscope on a regular basis for a period of up to two months in order to detect plasmodia or fruiting bodies. When necessary, a small amount of water was added to each culture to maintain moist conditions. Myxomycete plasmodia or fruiting bodies were noted and recorded. Each time the cultures were checked. All fruiting bodies were removed. Air-dried and glued in small pasteboard boxes for permanent storage. The samples were photographed and identified. Identification of Myxogastria was conducted with a light microscope and a stereomicroscope. In light microscopy, the capillitium, spore, shape, color, size, ornamentation, branching shape, features was observed. In stereomicroscope observation, fructification type, structure, shape, color, macroscopic measurements, lime color, and shape could be examined (Baba and Sevindik 2020b). Myxomycetes were identified using online resources, color atlases, and reference books (Martin and Alexopoulos 1969; Farr 1976; Thin 1977; Farr 1981; Martin et al 1983; Alexopoulos et al 1996; Lado and Pando 1997; Ing 1994; Neubert et al 1995; Ergül et al 2005a; Ergül et al 2005b; Ergül and Akgül 2011; Ergül et al 2016; Lado and Eliasson 2017; Baba et al 2018; Baba et al 2020a). Samples were arranged as fungarium material and kept in the Biology Department's laboratory of Mustafa Kemal University Hatay-Turkey.

RESULTS

The taxon is listed below together with descriptions, habitats, localities, collection dates, distribution at world and comments (eumycetozoa.com).

Figure 1. Map of the study area
Şekil 1. Çalışma alanının haritası

Domain: Eukarya

Kingdom: Protozoa

Phylum: Amoebozoa

Subphylum: Mycetozoa

1. Spores borne externally; fruiting bodies erect, simple or branched, white, sometimes pink or pale yellow columns; spores attached individually by thread-like stalks 1**. Classis: Protostelia**

1. Spores borne internally **2**

2. Sporophore development is myxogastroid; can be stalked or sessile, can have capillitium and columella; there are calcareous nodes or calcareous internodes consisting of simple, branched, tubular strings; crystalline or granular lime deposits are mostly seen in sporophore or capillium .....

2. Classis: Myxogastria

2.1. Lime present in some part of the fruiting bodies; stalk, columella, capillitium or peridium; plasmodium type is Phaneroplasmodium; spores violaceous-brown, deep purplish brown to black ..... **Order Physarida**

1. Capillitium not have calcareous deposits, capillitial threads are black or dark; calcareous deposits, when present, affecting the peridium only and there are stellate lime crystals, or sometimes on the stipe ..... **Didymiaceae**

A. Peridium contains stellate or angular lime crystals, fructification mostly sporangiate, capillitium not calcareous; lime present as stellate or angular crystals over the peridium ..... ***Didymium***

a. Fruiting bodies sessile, sporangium or plasmodiocarps; columella represented by a thickened

calcareous base to the myxocarp; peridium shell-like and fragile outer peridium and membranous inner peridium; capillitial threads is more rigid and profuse, longer and wider with transverse connections betwen two neighboring threads; spores completely warted-reticulate, paler, dingy lilac, violet-brown …….. ***Didymium listeri***

Didymium listeri Massee

Description: Fruiting bodies sporangium or plasmodiocarps. Plasmodiocarp broad and flattened, sessile, pulvinate, compressed, in large, irregular, scattered patches 0.3-0.5 mm high, thick, 2-10 mm up to 15 mm long, white. Hypothallus inconspicuous or obsolete. Peridium double, the outer layer white, with a thick powdery layer of stellate crystals, rather fragile, breaking away in irregular patches, eggshell-like, the inner layer a delicate membranous, colorless, adhering closely to the outer peridium. Columella represented by a thickened calcareous base to the myxocarp (sometimes absent). Capillitium abundant, of rigid, dark brown threads connected by transverse bars, often forming acute-angled dichotomies and connected by transverse bars, joined by pale tips to the peridium without free ends. Spore-mass blackish-brown. Spores globose dingy lilac, violet-brown, 8-11 µm diam., minutely roughened. Plasmodium watery white, 3-7 mm (Figure 2).

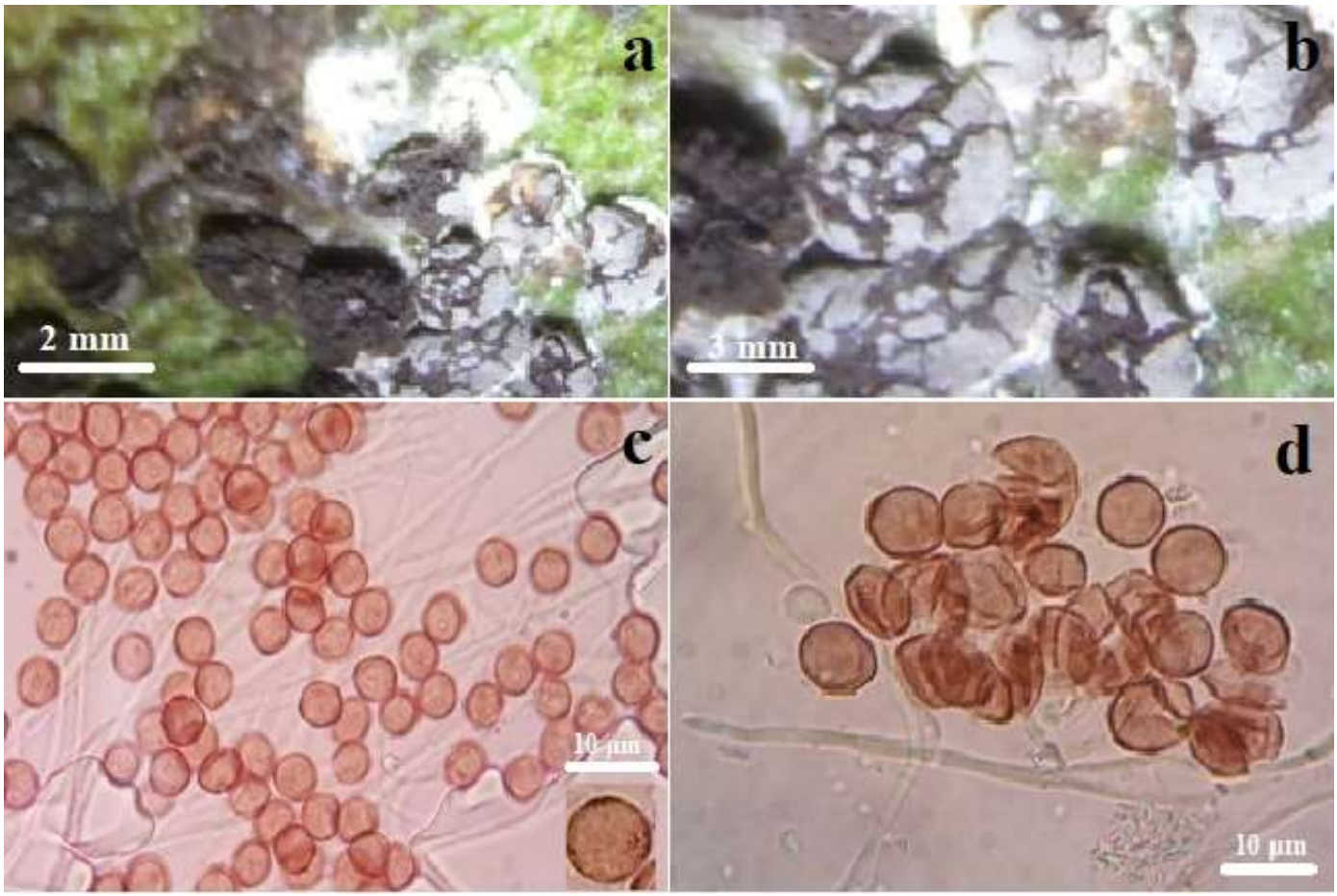

Figure 2. *Didymium listeri;* a,b: fruiting bodies; c,d: spores, lime crystals and capillitium
Şekil 2. Didymium listeri; a,b: fruktifikasyon; c,d: sporlar, kireç kristalleri ve kapillitium

Specimen examined: Hatay, Kırıkhan Eşmişek plateau, rotting green leaves, 36° 55' 92" N; 36° 38' 06" E, 850 m, 15.01.2019, Baba 24.

Distribution: Austria, Costa Rica, England, Germany, India, Mexico, Pakistan, Switzerland and USA.

Comments: This species is characterized by its shell-like and fragile outer peridium. Columella consists of a thickened calcareous base. Capillitium more rigid and profuse, longer and wider with transverse connections betwen two neighboring threads. Spores are smaller, the surface is completely warted-reticulate.

DISCUSSION

With this study a new Myxomycetes record was added to Turkey Myxobiota and previously known 287 Mycetozoa number (Baba and Sevindik, 2019; Baba et al., 2020b) now increased to 288.

D. listeri resembles to *D. dubium* Rostaf., but quite distinct in the copiously anastomosing threads of the capillitim which are entirely destitute of free, curved, spinelike branches, distinguished by its lack of

capillitial elasticity, the presence of a firm peridium composed of closely aggregated crystals and smaller paler and less warty spores (Massee, 1892).

D. listeri and *D. difforme* (Pers.) Gray have some features in common; sessile, shell-like and fragile outer peridium and membranous inner peridium. However, they have some differences. In *D. listeri* capillitial threads is more rigid and profuse, longer and wider with transverse connections betwen two neighboring threads, while the capillitial threads of *D. difforme* are usually very short, slender, usually dichotomously branched, sparse and scattered in spore mass, sometimes nearly lacking. Spores of *D. listeri* are smaller, the surface is completely warted-reticulate in contrast to the warted to subreticulate spore surface markings of *D. difforme*. (Liu and Chen, 1998).

Statement of Conflict of Interest

Author have declared no conflict of interest.

Author's Contributions

The contribution of the authors are equal.

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