Contributions to the distribution of Phallales in Turkey

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Abstract: New specimens of four previously reported members of the family Phallaceae, Clathrus ruber P.Micheli ex Pers., Mutinus caninus (Huds.) Fr., Phallus impudicus L., and Pseudocolus fusiformis (E. Fisch.) Lloyd, were collected from Eastern Black Sea region of Turkey. The samples were identified and brief descriptions were prepared. Current and newly determined localities of the collected species were provided together with the photographs related to their macro and micromorphologies.

Key words: Biodiversity, Phallaceae, stinkhorn fungi, Turkey.

1. Introduction
Phallales E.Fisch. is an order of fungi in the phylum Basidiomycota. According to Kirk et al., (2008) the order comprises 88 species belonging to 26 genera and 2 families, but Index Fungorum (accessed 10 June 2019) currently list 173 taxa within 39 genera. Phallaceae Corda is a well-known family of the order Phallales and commonly known as “stinkhorns”. Members of the family are generally characterized by a simple hollow pseudostipe and a slimy spore mass which is usually supported by a campanulate receptacle or spread over the pseudostipe surface (Gaona et al., 2017).

Until the end of 2018, 44 records, belonging to 7 species of the Phallaceae within the genera Anthurus Kalchbr. & MacOwan, Clathrus P.Micheli ex L., Colus Cavalier & Séchier, Mutinus Fr., Phallus Junius ex L. and Pseudocolus Lloyd have so far been presented from Turkey (Sesli and Denchev, 2014; Akata and Gürkanlı, 2018). These samples were collected from 30 different provinces of Turkey. During our routine field studies fruit bodies of stinkhorn species were collected from Eastern Black Sea Region of Turkey and determined as Clathrus ruber P. Micheli ex Pers., M. caninus (Huds.) Fr., P. impudicus L., and P. fusiformis (E. Fisch.) Lloyd.

The study aims to make a contribution to the mycobiota of Turkey by presenting new distributions for some stinkhorn fungi.

2. Materials and Method
Stinkhorn fungi samples were collected from Artvin, Giresun, Rize and Trabzon provinces during routine field studies between 2015 and 2018 within the Eastern Black Sea Region of Turkey. Required characteristics of the samples were recorded and they were photographed in their natural habitat. The samples were dried in air conditioned room and prepared as fungarium materials. Measuremental evaluations were performed in the fungarium. Micromorphological investigations were carried out under a Nikon eclipse Ci-S trinocular light microscope and the photographs related to micromorphology were taken by a DS-Fi2 digital camera aided by a Nikon DS-L3 displaying apparatus. The specimens were identified with the help of Bessette et al., (1995, 1997), Philips (2010), McKnight and McKnight (1987), Sterry and Hughes (2009), Buczacki (2012), Lincoff. (1981), Pegler et al., (1995), Roberts and Evans (2013), Watling (1973), Akata and Doğan (2011), Miller and Miller (1988), Jordan (1995), Breitenbach and Kränzlin (1986) and Ellis and Ellis (1990).

The specimens are deposited at Biology Department, Kamil Özdağ Science Faculty, Karamanoğlu Mehmetbey University.

3. Results
Basidiomycota R.T.Moore
Phallales E.Fisch.
Phallaceae Corda
Clathrus P.Micheli ex L.
Clathrus ruber P.Micheli ex Pers., Syn. meth. fung. (Göttingen) 2: [241] (1801).
[Syn]: Clathrus cancellatus Tourn. ex Fr., Clathrus cancellatus c albus Fr., Clathrus flavescens Pers., Clathrus kusanoi (Kobayasi) Dring, Clathrus ruber * columnatus Schwein., Clathrus ruber f. kusanoi Kobayasi, Clathrus ruber P. Micheli ex Pers. f. ruber, Clathrus ruber var. albus (Fr.) Quadr. & Lungnhi, Clathrus ruber var. flavescens (Pers.) Quadr. & Lungnhi, Clathrus ruber P. Micheli ex Pers. var. ruber]

Macroscopic and microscopic features: Immature fruit body 30-60 mm in diam., egg-shaped (Figure 1a), sub-hypogeous to epigeous, consists of an olive-green gleba, a compressed lattice surrounding the gleba (Figure 1b), and a white to creamy and leathery outer membrane (exoperidium), enclosing the gleba and the lattice. Surface
smooth, marked by reticulations indicating the site of insertion of the lattice (Figure 1a), and rooted by a thick mycelial strand at the base (Figure 1b,c). Later on the peridium ruptures at the apex letting the lattice-shaped receptaculum rise (Figure 1c). Receptaculum 90-120 × 65-85 mm, hollow, spherical to globose or somewhat elongated lattice-like network of meshes (Figure 1c,d); arms about 15 mm thick with a spongy structure, salmon-pink to scarlet red, somewhat paler towards the base. The mature fruit body smells like a carrion. Basidia and cystidia not observed. Basidiospores 4.5-6 × 1.5-2 µm, cylindrical to bacilloid, hyaline to pale greenish, smooth, thin-walled (Figure 1e).

*Clathrus ruber* was reported to grow on soil amongst leaf litter in gardens, shrubberies and grassy places at the edge of woodlands (Breitenbach and Kränzlin, 1986; Jordan, 1995; Pegler et al., 1995).

*Clathrus ruber* is the only clathroid species of *Clathrus* known in Turkey.

**Specimen examined:** Rize, Ardeşen, Ortaalan village, roadside, on soil, 41°10′N-41°06′E, 340 m, 09.07.2017, Yuzun 5637; Güneyköy village, roadside and bean garden, on soil, 41°08′N-41°07′E, 860 m, 11.08.2017, Yuzun 5741; Pazar, Hasköy village, house garden, on soil, 41°06′N-40°51′E, 420 m, Yuzun 6968; Trabzon, Tonya, Hoşarlı village, around bean garden, on soil, 40°56′N-39°18′E, 740 m, 22.05.2016, Yuzun 5129; Karaağaçlı village, hazelnut garden, on soil, 40°55′N-39°17′E, 640 m, 20.06.2016, Yuzun 5147.

*Clathrus ruber* was reported previously from fourteen localities in Antalya, Aydın, İstanbul, İzmir, Kahramanmaraş, Kocaeli, Muğla, Osmaniye, Samsun, Sinop, Trabzon, Uşak, and Yalova province (Afyon and Yağız, 2004; Ali et al., 2007; Baydar and Sesli, 1994; Pekşen and Karaca, 2003; Güny and Demirel, 2006; Türkoğlu and Yağız, 2012; Akata et al., 2014, 2018; Solak and Yılmaz Ersel, 2005; Yılmaz Ersel and Solak, 2004; Solak et al., 2014; Kaya, 2009; Ünal et al., 2016; Ali et al., 2017; Güngör et al., 2016; Akata, 2017).

*Mutinus* Fr.

**Mutinus caninus** (Huds.) Fr., Summa veg. Scand., Sectio Post. (Stockholm): 434 (1849).
[Syn: Aedycia canina (Huds.) Kuntze, Cynophallus caninus (Huds.) Fr., Ithyphallus inodorus Gray, Mutinus caninus var. albus Zeller, Mutinus caninus (Huds.) Fr. var. caninus, Mutinus caninus var. levonensis Noell, Phallus caninus Huds., Phallus caninus Huds. var. caninus, Phallus caninus var. felina Schumach., Phallus inodorus Sowerby]

Macroscopic and microscopic features: Immature fruitbody 15–35 x 15–30 mm, elongate ovoid to pyriform or egg shaped, at first hypogeous then epigeous, white to dirty white or yellowish rubbery outer exoperidium encloses the gelatinous endoperidium in which the pale green embryonic spore mass (gleba) and the stalk (receptacle) are kept, basally attached by a white rhizomorph (Figure 2a,b). Following the rupture of the egg, the receptacle becomes volvate (Figure 2d). Receptacle 90-120 x 10-15 mm, cylindrical to tapering above, hollow, spongy, brick-red to orange-red, somewhat paler towards the base. Olive green to dark greyish and slimy-soft glebiferous dissapears in a short time and leaves the empty, orange-brown glebal chambers (Figure 2c,d). Basidia cylindrical, 6-spored. Cystidia not observed. Basidiospores 3.5-5 x 1-2 µm, cylindrical to ellipsoid, smooth, hyaline (Figure 2e).

Figure 2. Basidiocarps (a-d) and basidiospores (e) of Mutinus caninus (bar 10 µ).
**Phallus impudicus** was reported previously from Antalya, Aydın, Balıkesir, Bingöl, Bitlis, Bolu, Denizli, Elazığ, Gümüşhane, Hatay, İstanbul, İzmir, Kastamonu, Kayseri, Kocaeli, Malatya, Mersin, Muğla, Samsun, Trabzon and Uşak (Vlaev, 1915; Gücü, 1990; İşloğlu ve Öder, 1995a,b; Aşkun ve İşloğlu, 1997; İşloğlu, 1997; 2001; Kaya, 2000; Kaşık et al., 2002; Solak et al., 2002; Öztürk et al., 2003; Pekşen ve Karaca, 2003; Yılmaz Ersel and Solak, 2004; Yağız et al., 2006a; 2006b; Selili, 2007; Alli et al., 2017; Akata, 2017).
Pseudocolus fusiformis was reported previously from only one locality in Trabzon (Akata ve Doğan, 2011).

4. Discussions

New localities were added to the existing localities of four stinkhorn species within the boundaries of Artvin, Giresun, Rize and Trabzon provinces. Pseudocolus fusiformis was previously reported only from Yomra district of Trabzon province. Three new localities were also presented within Giresun, Rize and Trabzon provinces. Mutinus caninus have 9 previously presented localities in Turkey. Two new localities were added in Trabzon. Compared to previous two species, Clathrus ruber seems to have more distribution in Turkey. This species were previously reported from 13 provinces of Turkey. Five new distribution localities were also presented for it in Rize and Trabzon provinces. Phallus impudicus is the most cosmopolitan species in Turkey.
Figure 4. Basidiocarps (a-d) and basidiospores (e) of *Pseudocolus fusiformis* (bar 10 µ).
among the four taxa. This species has been cited in 3 studies carried out within the boundaries of 2 provinces of Turkey. Two new localities were also presented for this species from Artvin and Rize provinces from which it was not reported before.

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