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Research article

Additional new records of *Lactarius* Pers. from Aegean Region for Turkey

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Abstract: This study was done during the 2013-2015 years to determine the diversity of the *Lactarius* taxa in the Aegean region of Turkey. Thirteen new records which are; *Lactarius chelidonium* Peck., *L. cyanopus, L. salmoneus* Peck., *L. pseudodeliciosus* Beardslee & Burl., *L. fennoscandicus* Verbeken & Vesterh., *L. thyinos* A.H. Sm. that generally have orange, yellowish-orange or natural orange coloured latex and changing to green or blue or vinaceous when dry; *L. barrowsii* Hesler & A.H. Sm., *L. subpurpureus* Peck., and *L. rubrilacteus* Hesler & A.H. Sm. that have brown, reddish-brown or vinaceous coloured latex; *L. badiosanguineus* Kühner & Romagn., *L. hygrophoroides* Berk. &M.A. Curtis., *L. subumbonatus* Lindgr., and *L. serifluus* (DC: Fr.) Fr. that have white and watery white latex. According to literature data, a total of eight species have been recorded in the region. Now, number species increased to 37 due to newly seen literature species and additional records in this study. Description of newly recorded *Lactarius* taxa are given with the knowledge of their habitats, macroscopic and microscopic features were given for each record species in the study.

Keywords: New Records, *Lactarius*, Aegean region, Turkey.

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Introduction

Mushrooms are getting increasing importance to all human lifestyles and have been used in very different areas. During ancient times, wild-grown mushrooms have been used in traditional medicine, but, nowadays important material which is obtained from them is used in the pharmacology, medicine, economically, beauty sector, and food supplement. In addition, mushrooms can cycle the waste materials, also, include a high measure of protein, vitamin, minerals, and fibre which are very crucial for human health.

Turkey has a great biological diversity which includes the diversity of fungi, besides that great potential of wild-growing edible mushroom species because of different geographical structures and a wide range of climate features. Among these wild grow edible mushroom species, *Lactarius* have different importance because they are used economically and food industry which is a very wide range of grown habitats in Turkey in the Aegean region (Sesli and Denchev, 2008; Solak et al., 2007; 2015). The urban people are also eating and selling them.

Aegean region is located west part of Turkey and approximately 10.6% of all of Turkey, which covers 82.251 km^2. The whole of İzmir, Manisa, Aydın, Uşak and Kütahya provinces, a large part of Muğla, Denizli and Afyon provinces, and a small part of Balıkesir and Bursa provinces are located within the borders of the Aegean Region. Typically, Aegean climate features and vegetation are seen in the west part of the region and terrestrial climate features are seen in the inner part of the region too (Anonymus, 2015). The Region's vegetation types have been seen the diverse type, while generally coniferous forest type is seen in the region, deciduous forest type are seen mixed with them, *Lactarius* species are mycorrhizal with *Pinus*, *Quercus*, *Juniperus*, *Cistus* sp., etc. In addition to mushrooms, samples were generally

being collected from around these coniferous and mixed type elements trees (Nuytinck, 2005).

In this study according to the literature data, thirteen *Lactarius* species are described as a new record for Turkish mycobiota. These species were given their habitat features, location, macroscopic and microscopic features in this study.

Material and Methods

The macrofungi samples were collected at the Aegean region during to the autumn and early spring seasons in 2013-2015 years. During the land works, samples macroscophical properties (like as milk and cap colour, smells, taste, etc.), ecological information and samples digital images were taken in their habitats and dried in the laboratory situation and kept in the polimer plastic bag to identified.

Micromorphological characters were studied with Leica DFC 295 light microscope and photographed digitally. In addition to mushroom tissues were detected in Melzer's reagent, %2-5 KOH, %5-10 Amonium and Kongo red reagent. At each mushroom samples 20 spores were measured and the specimens were identified according to Burlingham 1907; 1910, Hesler and Smith 1979, Moser 1983, Heilmann- Clausen et all. 1998, Breintenbach and Kränzlin 2000, Dähnche 2006, Nuytinck 2005, Phillips 2006, Buyck et all. 2007, and current species names checked from the indexfungorum.

Results

In line with the studies carried out in autumn and springtime in 2013-2015, 15 species and 13 new-recorded *Lactarius* species have been identified in the region along with the eight species found in the literature data. Together with these species, the number of species in the Turkish mycobiota list has increased to 65. Identification key for the newly recorded species given below.

Lactarius cyanopus Basso (Figure 1)

Pileus: 5-10 cm across; slightly convex and margin decurved when young then flattened to funnel shape and margin bent to downwards or straight, with more or less regular darker zones; surface smooth, wet or viscid; colour pale indigo blue, orange or more bluish with dark bluish dots. Lamellae: medium crowded, sometimes forked; pale cream or pale creamish orange coloured. Stipe: 2-5 × 0.5-2.5 cm, small, subcylindrical or slightly broader to the base; surface smooth with irregular scrobiculose; colour white, ochraceous orange or whitish-blue and pruinose in the zone of contact with lamellae. Latex: very scarce, orange to reddish blue at the base of stipe and bluish green coloured on the lamellae. Spores: 7.7-9.5 × 6.5-7.8 µm, subglobose or ellipsoid and generally broadly ellipsoid; ornamentation is regular and length less from 0.5 µm and with non-amyloid plage. Basidium: 4-spored, 45-65 × 6.5-11 µm; subclavate shaped with oil droplet content. Pleuromacrocystidia: 35-60 × 4-8.5 µm, abundant; fusiform or cylindrical shaped with moniliform apex and oil droplet content. Cheilomacrocystidia: 30-40 × 5.5-8 µm, fusiform with moniliform apex and needle shape content.

Habitat: collected around the *Pinus brutia, Picea* sp., *Abies* sp., *Juniperus* sp., *Cupressus* sp., *Quercus brutia* species and mix deciduous forest.

Specimens Examined: Turkey, Afyon, Başmakçı, Burgaz Mountain, between the Çal and Ahır mountain district, 850 m., 17.11.2014, HÇ 778.

Literature data: Nuytinck, 2005; Hesler and Smith, 1979.

Figure 1. *Lactarius cyanopus* and spore

Taxonomy Key

Latex, orange, light or natural orange or yellowish orange ……..KEY A
Latex, brownish orange, reddish brown or vinaceous red ……KEY B
Latex, white, watery white or cream colour ……KEY C

Key A

1. Latex orange, bright orange or yellowish orange, Cap distintly zonate ……2
- Latex natural orange, dark orange, Cap azonate or slightly zonate at margin ……3
2. Cap distinctly zonate, sticky and slimy ……..4
- Cap more or less zonate, wet or wiscid surface, colour pale indigo blue, orange or bluish with dark bluish dot. Latex orange to reddish blue at base of stipe ……....*Lactarius cyanopus*
3. Latex yellowish orange or dark carrot orange, Cap slightly azonate ……...……5
- Latex cadmium orange, Cap creamy orange or greyish green, surface smooth and felty, magrin before arched then inrolled and cottony ……..…*L. salmoneus*
4. Cap carrot orange to salmon orange color, Latex bright orange or yellowish orange and turned to vinaceous red when dry …….....*L. thyinos*
- Cap color dark orange to brownish orange, change bluish green or greenish when injured and with pale reddish brown or brownish color spot ……...…...*L. fennoscandicus*
5. Latex yellowish orange and *Chelidonium majus* colored, Cap azonate few slightly zone at magrin, color orange, greyish green, blue or yellowish colored with obvious azure blue colored dots ……*L. chelidonium*
- Latex shiny or dark carrot orange, Cap ochreceous, pale orange or creamy orange, some zonate at amrgin and have branched pleuromacrocystidia ……..……*L. pseudodeliciosus*

Key B

1. Latex dark red not change after, Cap azonate or only few zone at magrin, viscid but soon dry, cap color cream at young then cream to cinnamon or brownish orange, spore 8.5-9.5×7-7.5µm ……*L. barrowsii*
- Latex vinaceous red or brownish red, cap distinctly zonate ……..……2
2. Latex first vinacoues red then changing to brownish red, cao zonate, viscid and spotted, color pinkish orange to buff or vinaceous buff and not seen greenish color at all, spore 8-11×6.5-7.9µm …….……...*L. subpurpureus*
- Latex first brownish red then bright and dirty reddish turned derk green, cap slightly viscid, color bright orange or brownish with non regular green dots, spore 8-9.5×6-7.5µm with nonamyloid plage ……...…*L. rubrilacteus*

Key C

1. Latex white colored, cap azonate, velvety, dark dark orange brown to dark brick colored ……..……2
- Latex watery white or watery cream colored, cap dry and glabrous, reddish brown, cinnamon or brownish vinaceous colored …...…3
2. Latex white and not changing after hours, cap surface featherly or velvety color dark orange brown to cinnamon to dark brick, spore 7.5-10×6-8µm with partially amyloid plageand pleuromacrocystidia not seen ……*L. hygrophoroides*
- Latex firstly white but changing after 2-3 houra to light yellow, cap azonate with or without small umbo, smooth or velvety, dark brick to dark red or brownish orange colored, spore 8-9×6-7µm with non-amyloid plage, pleuromacrocystidia 48-66×6.8-8.7µmn ……...*L. badiosanguineus*
3. Latex watery white, cap color brownish vinaceous, reddish brown to dark brick or grayish brown at centre, at margin parts brownish red to caly buff or cinnamon, dry, galbrous with or without small umbo, pleuromacrocystidia and cheliomacrocystidia not seen ……..…*L. subumbonatus*
- Latex watery white or creamy white, cap color brownish ornage to reddish Brown or cinnamon at centre, margin yellowish brown, glabrous, pleuromacrocystidia not seen, cheliomacrocystidia 20-30×7-15µm ……...*L. serifluus*

Lactarius salmoneus Peck (Figure 2)

Pileus: 2-9 cm across; convex becoming broadly depressed or slightly funnel-shaped; margin before arched then inrolled and cottony; surface smooth, felty, azonate with creamy orange or greyish green coloured. Lamellae: narrow, sometimes forked with cadmium orange or ochraceous salmon coloured; sometimes seen whitish circle on the lamellae edge. Stipe: 1-4.5 × 1-2.5 cm, equal or expanding at aloft part and surface properties same like the cap; surface with cadmium orange coloured. Latex:

scanty, colour cadmium orange and turning to green when dry. Spores: 6.5-8 × 5.5-6.5 µm, generally ellipsoid, rarely broadly ellipsoid; ornamentation irregular and less than 0.5 µm; plage inconspicuous and small distally slightly amyloid. Basidium: 4-spored, 35-55 × 6-8.5 µm, narrow, subcylindrical with oil droplet content. Pleuromacrocystidia: 45-60 × 5-7.5 µm, abundant at lamellae edge; subfusiform with moniliform apex and needle shape oil content. Cheilomacrocystidia: 20-28 × 3.5-5 µm, fusiform with moniliform apex and needle shape oil droplet content.

Habitat: collected around the *Pinus brutia, Quercus cocciferae, Juniperus* sp.*, Astragalus* sp.*, Rosa* sp. species.

Specimens Examined: Turkey, Muğla, Ula, Çiçekli village, 02.12.2013, HÇ 280. Denizli, Kale, Karacaören village, 940 m., 08.12.2013, HÇ 313.

Literature data: Nuytinck, 2005.

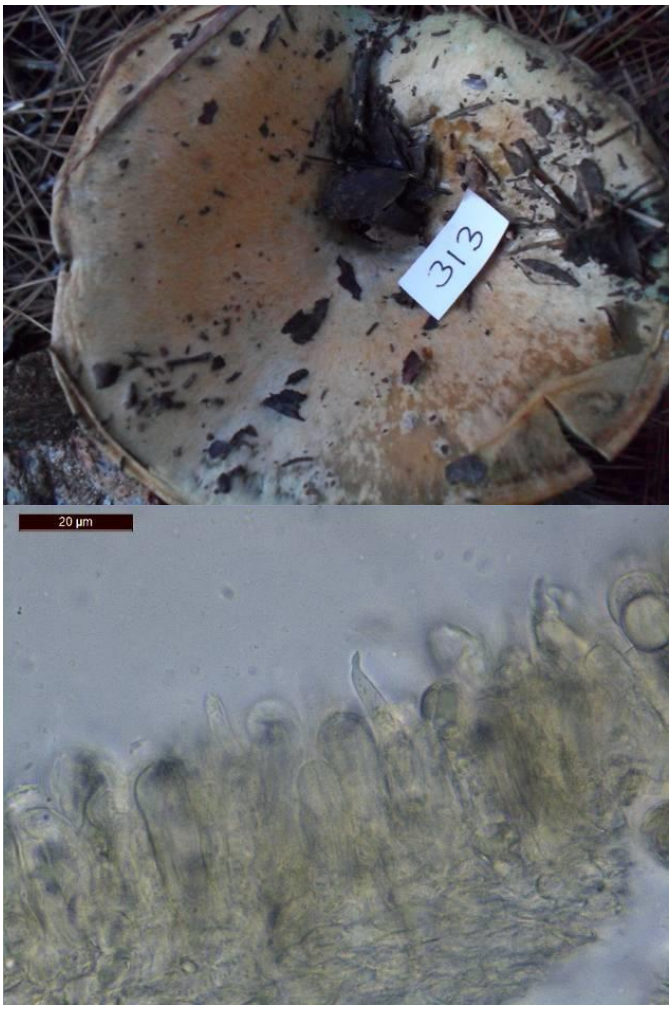

Figure 2. *Lactarius salmoneus* and cystidia structure

Lactarius thyinos A.H. Sm. (Figure 3)

Pileus: 3-9 cm across; when young convex then slightly depressed and funnel shape at the centre; margin decurved at first then bent to downwards or straight. Surface glabrous, sticky or slimy with carrot orange to salmon-orange and distinctly zonate. Zones salmon orange or pallid yellow coloured. Lamellae: when young crowded then sub-distant; colour ochraceous salmon or bright orange and change to vinaceous red or brownish red, but never staining to green at any stage. Stipe: 4-8 × 0.5-2 cm, more or less equal, sometimes expanding at the base; surface smooth, when young covered by slimy layer then dry soon. Colour bright ochraceous salmon and change to reddish-brown or red when cut; fragile and soon hollow. Latex: bright orange or yellowish-orange and turned to vinaceous red. Spores: 8.5-10.5 × 6.5-8.5 µm, ellipsoid to broadly ellipsoid; ornamentation up to 0.5 µm with no regular ridges and wide meshes; plage mostly inamyloid to slightly amyloid. Basidia: 45-60 × 8-11 µm, 4-spored or rarely 2-spored; clavate shaped with oil droplets. Pleuromacrocystidia: 45-75 × 4.5-8 µm, abundant at lamellae edge, subfusiform shaped with long moniliform apex and needle shaped content. Cheilomacrocystidia: 25-50 × 4-7 µm, subfusiform with moniliform apex.

Habitat: collected around the *Pinus* sp.*, Quercus* sp.*, Juniperus* sp. species.

Specimens Examined: Turkey, Muğla, Kavaklıdere, Nebiler, Şehit forest park, 08.12.2013, HÇ 316. Uşak centre Akse forest promenade area, 26.10.2014, HÇ 400.

Literature data: Nuytinck, 2005.

Figure 3. *Lactarius thyinos* and cystidia structure

Lactarius fennoscandicus Verbeken & Vesterh. (Figure 4)

Pileus: 3-9 cm across; centre depressed-convex; margin decurved then bent to downwards or straight; surface smooth, sticky or slimy; distinctly zonate and narrow zones more obvious than the centre. There are some pale reddish brown or brownish colour spots in the centre, colour dark orange to brownish-orange and change to bluish-green or greenish when injured. Lamellae: narrow to medium crowded, sometimes forked; colour pale orange and then change to greenish. Stipe: 3.5-10.5 × 1-2.5 cm, mostly cylindrical, straight, long; surface smooth and dry; colour carrot orange, sometimes pale creamy orange; the white circle is seen at the lamellae edge. Latex: scanty; orange, yellowish-orange and change to grayish green coloured. Spores: 7.5-10 × 6.5-8 µm, ellipsoid or broadly ellipsoid, rarely subglobose; ornamentation not regular and length up to 0.5 µm; plage distally slightly amyloid or non-amyloid. Basidia: 40-60 × 10-13 µm, 4-spored, cylindrical or subclavate with oil content. Pleuromacrocystidia: 40-58 × 6-8 µm, abundant at the lamellae edge, subfusiform with narrowing or moniliform apex and containing needle-shape oil content. Cheilomacrocystidia: 15-45 × 4-8 µm, subfusiform shape with moniliform apex.

Habitat: collected around the *Pinus brutia, P. nigra, Quercus cocciferae, Quercus* sp. species.

Specimens Examined: Turkey, Denizli, Kale, Özlüce village, 1150 m., 08.12.2013, HÇ 284. Denizli, Beyağaç, Karacaören village, 640 m., 08.12.2013, HÇ 312.

Literature data: Nuytinck, 2005.

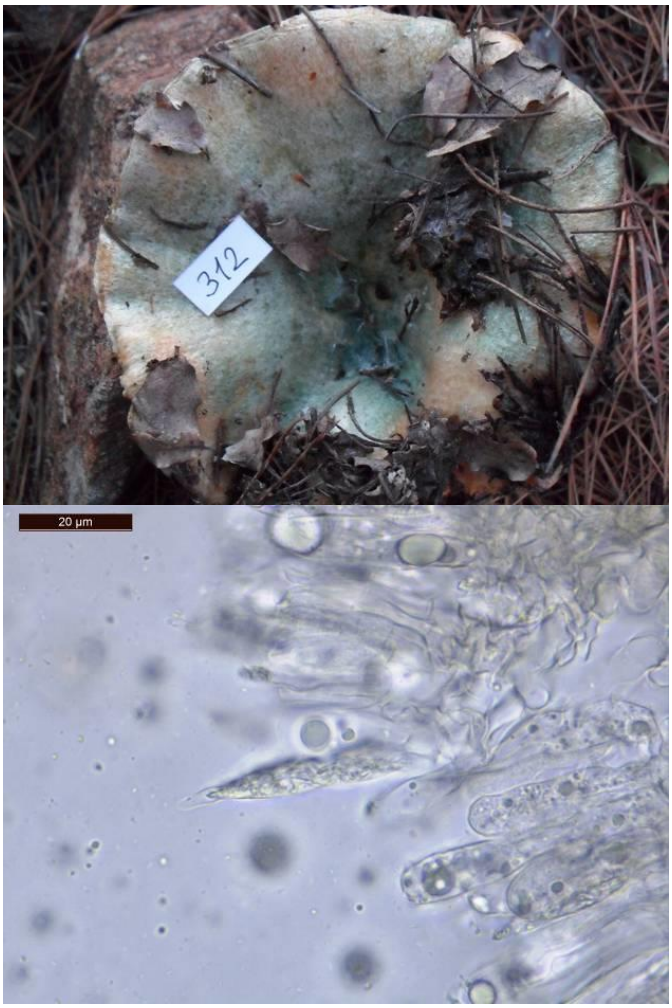

Figure 4. *Lactarius fennoscandicus* and cystidia structure

Lactarius chelidonium Peck. (Figure 5)

Pileus: 3-8 cm across; depressed when young, then expanded and become funnel-shape; surface smooth, slightly viscid; orange, greyish gren, blue or yellowish coloured with obvious bluish-green or azure blue coloured dots; generally, azonate but sometimes there are few

zoned at the margin. Lamellae: close to crowded, sometimes forked; colour greyish-yellow with dots same as cap surface. Stipe: 3-8× 1-2.5 cm, cylindrical or expanding to the base; surface smooth with bluish-green dots; colour pale yellow to yellowish-orange. Latex: scanty; colour yellowish and resembling the juice of *Chelidonium majus* species (Nuytinck, 2005). Spores: 8.5-9 × 7-8 µm, ellipsoid or broadly ellipsoid; ornamentation irregular shape and lenght up to 0.5 µm; plage weakly amyloid. Basidium: 4-spored, 40-50 × 7-8 µm; subclavate with needle shape content. Pleuromacrocystidia: 50-65 × 5-8 µm, abundant, subfusiform with moniliform apex. Cheilomacrocystidia: 40-45 × 5-6 µm, scanty, subfusiform with moniliform apex and needle shape content.

Habitat: collected around *Picea* sp., *Cedrus* sp., *Abies* sp., *Pinus brutia, P. nigra, Quercus* sp., *Juniperus* sp., *Astragalus* sp., species.

Specimens Examined: Turkey, Muğla, Yılanlı Mountain, Düzen district, 820 m., 19.11.2013, HÇ 144. Denizli, Kale district, 1080 m., 25.10.2014, HÇ 388.

Literature data: Nuytinck, 2005; Hesler and Smith, 1979.

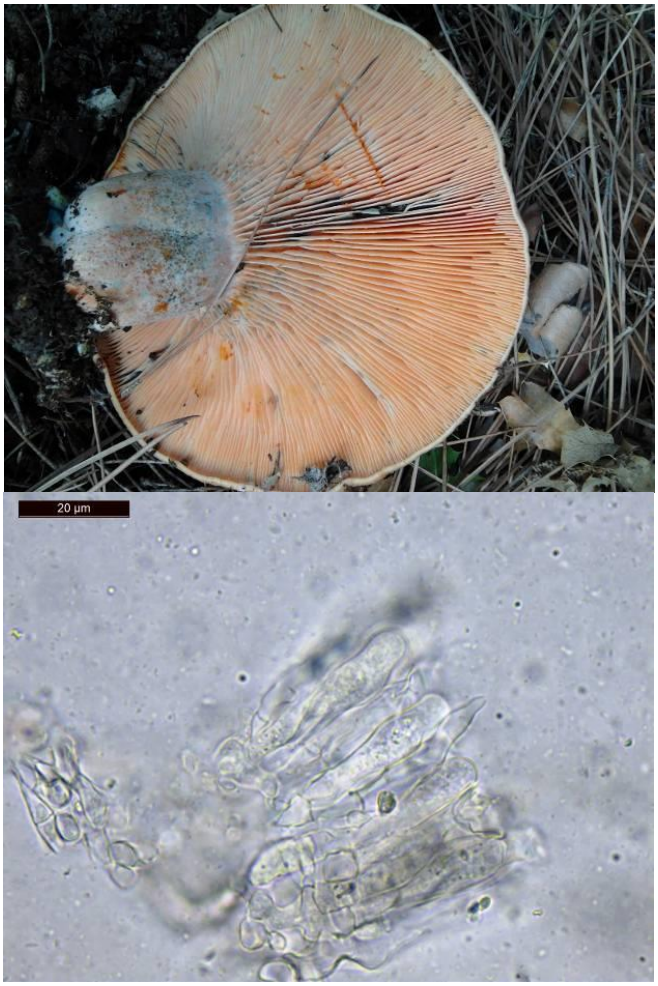

Figure 5. *Lactarius chelidonium* and cystidia structure

Lactarius pseudodeliciosus Beardslee & Burl. (Figure 6)

Pileus: 6-9 cm across; first expanded convex then become slightly funnel-shaped; margin decurved; surface viscid, azonate or seen some zonate near the margin; white to cream, pale orange or creamy orange colour. Lamellae: intervenose, sometimes forked; colour change from pale orange to honey yellow. Stipe: 1.5-2.5 × 1-2.5 cm, short, sometimes scrobiculate, extending to root like point at one side at the solid part and white hairy are seen. Latex: scanty; colour shiny or dark carrot orange. Spores: 7.8-9 × 6.5-7.5 µm, ellipsoid or broadly ellipsoid; ornamentation not regular and length up to 0.5 µm; plage distally slightly amyloid. Basidia: 44.3-50.4 × 8-9 µm, 4-spored, subfusiform shaped and with oil content. Pleuromacrocystidia: 50-70 × 6-7 µm, scarce, subfusiform shape, sometimes branched long moniliform apex with needle shape content. Cheilomacrocystidia: 30.2-40.3 × 4.6-6.4 µm, fusiform shape with moniliform apex and needle shape oil content.

Figure 6. *Lactarius pseudodeliciosus* and cystidia structure

Habitat: collected around the *Pinus brutia, Quercus cocciferae*.
Specimens Examined: Turkey, Muğla, Yılanlı Mountain, Düzen district, 19.11.2013, HÇ 129, 132, 134.
Literature data: Nuytinck, 2005; Hesler and Smith, 1979.

Lactarius barrowsii Hesler & A.H. Sm. (Figure 7)
Pileus: 5-10 cm across; when young convex then depressed, margin decurved; surface smooth, viscid but soon dry, azonate or only a few zones at the margin; cream at young then cream to cinnamon, brownish-orange colour. Lamellae: crowded; colour ochraceous to pinkish-cream, become green when injured. Stipe: 2-3 × 1-3 cm, surface smooth, colour yellowish to orange with white bloom, soon hollow. Latex: scanty and dark red. Spores: 8.5-9.5 × 7-7.5 µm, ellipsoid to broadly ellipsoid, ornamentation not regular and up to 0.5 µm; plage distally weakly amyloid. Basidium: 4-spored, 45-55 × 9-11 µm, with needle shape content. Pleuromacrocystidia: 42-50 × 4-6 µm, inconspicuous, scarce, subfusiform with long moniliform apex, ochre-coloured and with needle shape cyrstals. Cheilomacrocystidia: 34-39 × 5-7 µm, abundant, subfusiform with obtuse moniliform apex and needle shape content.
Habitat: Collected around the *Picea* sp., *Abies* sp., *Pinus nigra, Quercus cocciferae, Juniperus* sp., *Cedrus* sp., *Cistus* sp. species.
Specimens Examined: Turkey, Manisa, Spil mountain natural park, 1250 m, 01.12.2013, HÇ 265.
Literature data: Nuytinck, 2005.

Lactarius subpurpureus Peck. (Figure 8)
Pileus: 4-10 cm across; before convex then become flat but never take a turn to funnel-shaped; margin bent to downwards to flattened; surface smooth, viscid, zonate and spotted; colour pinkish-orange to buff or vinaceous buff and not seen greenish colour. Lamellae: broad and sub-distant, sometimes small forked; colour vinaceous buff to dirty pinkish or pale vinaceous red. Stıpe: 3-8 × 0.5-2 cm, generally cylindrical or broader at the base, long and slender; surface smooth, dry, white cottony with pinkish or whitish orange coloured and sometimes scrobiculate, soon hollow. Latex: scanty, first time vinaceous red and changing to brownish red. Spores: 8-11 × 6.5-7.9 µm, almost ellipsoid, ornamentation up to 0.5 µm and sometimes rather thick ridges mixed isolated warts, plage slightly distally amyloid. Basidium: 4-spored, rarely 2-spored, 35-50 × 9-11 µm, subclavate with oil droplet content. Pleuromacrocystidia: 35-75 × 4-7.5 µm, abundant, inconspicuous, fusiform with branched moniliform apex and needle shape oil content. Cheilomacrocystidia: 25-35 × 3-5.5 µm, fusiform with moniliform apex and needle shape oil content.
Habitat: collected around the *Pinus brutia, P. nigra, Quercus cocciferae, Q. cerris, Cistus* sp., *Juniperus* sp. species.
Specimens Examined: Turkey, İzmir, Ödemiş, Bozdağ, Üçler geçidi, 1200 m., 22.11.2013, HÇ. 168.
Literature data: Nuytinck, 2005.

Figure 7. *Lactarius barrowsii* and cystidia structure

Figure 8. *Lactarius subpurpureus* and cystidia structure

Lactarius rubrilacteus Hesler &A.H. Sm. (Figure 9)

Pileus: 4-15 cm across, when young convex and depressed then become extended funnel-shaped; margin decurved. Surface smooth, slightly viscid and zonate; colour bright orange or brownish with non-regular green spots. Lamellae: close to crowded, narrow, sometimes forked at the lamellae edge; colour bright orange or greyish-orange, change to brownish-red and becoming green when dry. Stıpe: 2.5-8 × 1-3.5 cm, equal or thickening to the base; surface smooth to covered white hairy; dry, sometimes scrobiculate; colour bright orange, brownish-orange or greyish-red; orange hairy seen at the base soon hollow. Latex: scanty, in young species brownish-red but then bright and dirty reddish colour seen, staining to dark green when dry. Spores: 8-9.5 × 6-7.5 µm, ellipsoid or broadly ellipsoid; ornamentation up to 0.5 µm with non-regular thick warts; plage non-amyloid. Basidia: 40-55 × 8-11 µm, 4-spored, cylindrical to subclavate shaped with small brown guttles. Pleuromacrocystidia: 44-65 × 5-7 µm, scarce, fusiform shaped with moniliform apex and needle-shaped oil content. Cheilomacrocystidia: 35-45 × 4-6 µm, fusiform shaped with moniliform apex and refractive content.

Figure 9. *Lactarius rubrilacteus* and cystidia structure

Habitat: collected around the *Pinus* sp., *Quercus* sp., *Juniperus* sp., *Cistus* sp., *Astragalus* sp., species and coniferous and decidious forests.

Specimens Examined: Turkey, Manisa, Demirci, Bardakçı village, 1350 m., 23.11.2013, HÇ 193. Aydın, Kuşadası, Davutlar district, Dilek peninsula national park, 50 m., 30.11.2013, HÇ 258. İzmir, Bergama, Kozak highland, 1000 m, 19.10.2014, HÇ 362. Muğla, Marmaris, Çetibeli district, 20.10.2014, HÇ 376. Balıkesir, Kaz Mountain national park low location, 09.11.2014, 529, 531. Muğla, Ula, Çiçekli village, 29.11.2014, HÇ 858, 860, 863. Muğla, Ula, Çiçekli village, 06.12.2014, HÇ 870.

Literature data: Nuytinck, 2005; Hesler and Smith, 1979.

Lactarius hygrophoroides Berk & M.A. Curtis (Figure 10)

Pileus: 3-9 cm across; when young depressed to convex, then centre become flatten to slightly funnel-shaped; margin inrolled when young then become downwards to straight; surface featherly or velvety, dry and azonate; colour dark orange-brown to cinnamon or dark brick. Lamellae: colour white, cream or yellowish-buff and never change; not forked. Stıpe: 2-5 × 0.5-2 cm, surface dry, yellowish-cream or pale brownish-buff coloured with covered by slightly white hairy. Latex: abundant, white and colour not changing or becoming creamy yellow when dry. SPORES: 7.5-10 × 6-8 µm, ellipsoid, ornamentation is regular and length up to 0.4 µm and plage is partially amyloid. Basidium: 4-spored, 50-66 × 7-9 µm, cylindric shaped. Pleuromacrocystidia: not seen. Cheilomacrocystidia: 25-40 × 6-8 µm, scanty, subfusiform with hyaline coloured.

Figure 10. *Lactarius hygrophoroides* and spore

Habitat: collected around the *Pinus brutia, P. nigra, Quercus cocciferae, Q. cerris, Rosa* sp., *Astragalus* sp., *Juniperus* sp., *Cistus* sp. species.

Specimens Examined: Turkey, İzmir, Bergama, Kozak highland, İncecikler village, 1200 m., 08.12.2013, HÇ 511. Balıkesir, Kaz Dağı natural park, 09.11.2013, HÇ 523, 525.

Literature data: Nuytinck, 2005; Hesler and Smith, 1979.

Lactarius badiosanguineus Kühner & Romagn. (Figure 11)

Pileus: 2.5-6.5 cm across, convex when young then flat with or without small umbo, margin decurved; surface smooth or velvet, dark brick to dark red or brownish-orange coloured. Lamellae; sometimes forked and cream to yellowish coloured. Stipe; 15-50 x 5-15 mm; surface smooth or covered with white tomentose, ochraceous coloured, soon hollow. Latex: white but 2-3 hours later changing to light yellow. Spores: 8-9 × 6-7 µm, subglobose to ellipsoid; ornamentation length is 0.5 µm and not regular such as zebra-like, plage non-amyloid. Basidia: 4-spored, 35-55 × 7-9.5 µm, clavate shaped. Pleuromacrocystidia: 48-66 × 6.8-8.7 µm, abundant, cylindrical or fusiform shaped with obtuse or acute apex. Cheilomacrocystidia: 32-38 × 4-6 µm, scarce, cylindrical to a conical shape with acute or mucronate apex. Cheiloleptocystidia: 22-29 × 5.4-7.4 µm, subfusiform shaped, the apex is more swelling than the deep part.

Habitat: collected around the *Pinus brutia, P. nigra, Picea* sp., *Quercus cocciferae, Q. aucheri, Q. cerris, Astragalus, Rosa* sp., *Hedera* sp. species.

Specimens Examined: Turkey, İzmir, Bergama district, Kozak highland, 1000 m, 19.10.2014, HÇ 364.

Literature data: Nuytinck, 2005; Hesler and Smith, 1979.

Lactarius subumbonatus Lindgr. (Figure 12)

Pileus: 2-8.5 cm across; when young convex shaped with depressed centre then slightly funnel-shaped with or without small umbo. Surface dry, glabrous but slightly velvety, old specimens folded rugose and radially wrinkled; colour brownish vinaceous, reddish-brown, dark brick or greyish brown at the centre, at margin parts brownish-red to clay buff or cinnamon colour. Lamellae: medium crowded or sub-distant and not seen forked; colour pinkish clay to clay buff. Stipe: 2.5-5× 0.3-1.5 cm, cylindrical or expanding to the base; surface glabrous, dry; at first pale vinaceous then cinnamon, greyish-brown or

dirty brownish-orange colour, soon hollow. Latex: scanty, watery white and not staining when dry. Spores: 6.5-8.7 × 6-8 µm, subglobose to broadly ellipsoid; ornamentation 0.5-1.5 µm, regular, elongate warts and connected with thin strips, plage inconspicuous distally amyloid. Basidia: 35-65 × 9-11.5 µm, 4-spored, mostly clavate shaped. Pleuromacrocystidia: not seen. Cheilomacrocystidia: not seen.

Habitat: collected around the *Pinus brutia, Quercus cocciferae, Rosa* sp.*, Astragalus* sp.*, Juniperus* sp.*, Betula* sp.*, Cistus* sp. species and decidious mix forests.

Specimens Examined: Turkey, Muğla, Ula, Çiçekli village, 06.12.2014, HÇ 872.

Literature data: Nuytinck, 2005; Heilman-Clausen et al. 2000; Hesler and Smith, 1979.

Figure 11. *Lactarius badiosanguineus* and cystidia structure

Figure 12. *Lactarius subumbonatus* and spore

Lactarius serifluus (DC.) Fr. (Figure 13)

Pileus: 2-4.5 cm across; centre depressed to slightly concave with or without small umbo; margin decurved when young then bent to downwards or straight, surface glabrous and radially wrinkled, colour brownish orange to reddish-brown or cinnamon at the centre, at the margin yellowish brown. Lamellae: medium crowded, rarely forked, colour salmon to clayish pink. Stipe: 3.5-5 × 0.3-1 cm, cylindrical or thickening to the base, surface velvety when young then become glabrous, colour pinkish clay to ochraceous orange or slightly brownish orange. Latex: scanty, bright watery cream colour and never change. Spores: 6.5-9 × 6-8 µm, globose or broadly ellipsoid, ornamentation lenght up to 1.2 µm with regular warts and rigdes, plage non-amyloid. Basidia: 35-50 × 8-12 µm, 4-spored, mostly clavate shaped. Pleuromacrocystidia-Cheilomacrocystidia: not seen. Cheiloleptocystidia: 20-30 × 7-15 µm, clavate to globose shaped.

Habitat: collected around the *Pinus brutia, Quercus cocciferae, Rosa* sp.*, Astragalus* sp.*, Juniperus* sp.*, Betula* sp.*, Cistus* sp.*,* species and decidious forest.
Specimens Examined: Turkey, Muğla, Ula, Çiçekli village, 29.11.2014, HÇ 868.
Literature data: Nuytinck, 2005; Heilman-Clausen et al. 2000; Hesler and Smith, 1979.

Figure 13. *Lactarius serifluus* and cystidia structure

Discussion

This research examines all *Lactarius* taxa of the region and even listed which were not found before in the literature data too. According to the research results; 8 *Lactarius* species which are listed in literature data *Lactarius chrysorrheus, L. deliciosus, L. deterrimus, L. salmonicolor, L. sanguifluus, L. semisanguifluus, L. vellereus* species were found and also 15 *Lactarius* species which are *Lactarius cistophilus, L. blennius, L. controversus, L. musteus, L. piperatus, L. porninsis, L. pyrogalus, L. quietus, L. scrobiculatus, L. tesquorum, L. scrobiculatus, L. torminosus, L. volemus, L. zonarioides, L. zonarius* species although have been found in other parts of Turkey before, but not seen before the region range, also they have just been identified in our study area. With these species, there have 23 *Lactarius* species throughout the Aegean region (Figure 1: *Lactarius* taxa numbers in the study region). According to the updated studies; *Lactarius piperatus, L. vellereus,* and *L. volemus* species were recalled as a *Lactifluus* species, therefore total taxa numbered which were added region list is 12 (indexfungorum; Sesli and Denchev, 2014; Solak et all., 2007, 2015).

In addition, along with the 13 new record species that are the subject of our article which are *L. cyanopus, L. salmoneus, L. chelidonium, L. pseudodeliciosus, L. fennoscandicus, L. thyinos, L. subpurpureus, L. barrowsii, L. rubrilacteus, L. hygrophoroides, L. subumbonatus, L. serifluus and L. badiosanguineus*, the number of *Lactarius* species found in the region has been increased to 34. In addition to these, the number of *Lactarius* taxa in the mycobiota list of Turkey has also been increased from 52 to 65 (Table 1). Each of these new record *Lactarius* species, detailed characteristics and habitats of which are given in the Findings section, has some features that are different from each other or similar to each other. Some of them may be similar to each other in habitat, some in colour or smell, or morphologically. These differences are determined, in particular, by examining them in accordance with macroscopic or microscopic examinations and in comparison with the literature data. We can summarize some morphological or microscopic differences of the 13 species of the study subject from each other as follows.

Generally, *L. cyanopus, L. salmoneus* and *L. chelidonium* species have orange or cadmium orange coloured latex and with orange, yellowish-orange or salmon and yellow cap coloured. At differences among these species are, although *L. cyanopus* species have changing latex which turned orange to blue or bluish, *L. salmoneus* species have the same cap coloured and latex, but pseudocystidia structure which is two-branched, so different from other. However, *L. chelidonium* species have obvious bluish dots at the cap and stipe. *L. pseudodeliciosus, L. fennoscandicus* and *L. thyinos* species are the same in terms of latex colour but small differences separated from each other. For instance, *L. pseudodeliciosus* species have neutral orange or carrot

orange coloured latex and microscopical features different from others. An obvious branched pleuromacrocystidia structure is seen in this species. *L. fennoscandicus* species have a slightly funnel-shaped cap with darker zones and some pale reddish-brown or brownish coloured spots. There is a white circle near the lamellae edge at the stipe and have medium length pleuromacrocystidia structure with a moniliform apex. *L. thyinos* species have pallid yellow coloured zones and lamellae not staining green at any stage. In addition to this species have pleuromacrocystidia with a long moniliform apex. Latex is a bright orange coloured and slowly staining bright pale vinaceous red at this species too.

Lactarius subpurpureus and *L. barrowsii* species have brownish-red and vinaceous red latex, cap colour and shape differently. *L. subpurpureus* species have pinkish-brown or pinkish buff cap coloured and pleuromacrocystidia structure is branching and different from other red or reddish-brown latex species. *L. rubrilacteus* species same as other Lactarius species because of cap surface properties but different for having distinct brownish red latex. In addition to this species have different microscopical features such as basidia containing small brown guttules.

Lactarius badiosanguineus and *L. hygrophoroides* species both have brown, cinnamon brown, brownish-red cap coloured and white latex. *L. badiosanguineus* species latex is turning yellow when dry but *L. hygrophoroides* latex never changes. *L. serifluus* and *L. subumbonatus* species are the same in terms of latex colours but small differences like cap colour and cheilomacrocystidia structure are separated from each other. *L. serifluus* species have lighter cap colour than *L. subumbonatus*. Although *L. subumbonatus* have a dark brick or cinnamon-coloured cap, *L. serifluus* have an orange-brown coloured cap with a contrasting yellow-brown margin and distinct pyriform shaped cheiloleptocystidia.
In addition to, *L. cyanopus, L. salmoneus, L. chelidonium, L. pseudodeliciosus, L. fennoscandicus, L. thyinos, L. subpurpureus, L. barrowsii, L. rubrilacteus, L. hygrophoroides, L. subumbonatus, L. serifluus,* and *L. badiosanguinues* species were recorded as a new record to Turkey's mycobiota, which were not seen whether in Aegean region or the other regions. Furthermore, while the number of edible species found in the region was seven except for *L. chrysorrheus*, it was increased to 10 with the addition of *Lactifluus volemus, Lactarius porninsis* and *L. musteus* species that were previously found in other regions except for the Aegean region. The number of edible species in total has been increased to 20, excluding *L. subumbonatus, L. serifluus* and *L. badiosanguineus* species among the new record species in the article (Figure 2: An Edible species of Region's *Lactarius* taxa).

Tablo 1. The list *Lactarius* species of Turkey (+ (NR): New record for Turkey, + (NS): New record for Aegean region)

	Species	Solak et al., 2007*	Sesli & Denchev, 2014*	Solak et al., 2015*	This study
1.	*Lactarius acerrimus* Britzelm.	+	+	-	-
2.	*L. acris* (Bolton : Fr.) Gray	-	+	-	-
3.	*L. affinis* Peck	-	+	+	-
4.	*L. aurantiacus* (Pers. : Fr.) Gray	+	+	-	-
5.	*L. azonites* (Bull.) Fr.	+	+	-	-
6.	*L. barrowsii* Hesler &Smith	-	-	-	+ (NR)
7.	*L. badiosanguineus* Kühner &Romagn.	-	-	-	+ (NR)
8.	*L. blennius* (Fr. : Fr.) Fr.	+	+	+	+ (NS)
9.	*L. camphoratus* (Bull. : Fr.) Fr.	+	-	-	-
10.	*L. chelidonium* Peck.				+ (NR)
11.	*L. chrysorrheus* Fr.	+	+	+	+
12.	*L. circellatus* Fr.	-	+	-	-
13.	*L. cistophilus* Bon & Trimbach	-	-	-	+ (NR)
14.	*L. controversus* (Pers. : Fr.) Fr.	-	+	+	+ (NS)
15.	*L. cyanopus* Basso	-	-	-	+ (NR)
16.	*L. decipiens* Quél.	+	+	-	-
17.	*L. delicatus* Burl.	-	+	+	-
18.	*L. deliciosus* (L. : Fr.) Gray	+	+	+	+
19.	*L. deterrimus* Gröger	+	+	+	+
20.	*L. evosmus* Kühner & Romagn.	-	+	-	-
21.	*L. fennoscandicus* Verbeken &Vesterh	-	-	-	+ (NR)
22.	*L. flavidus* Boud.	+	+	-	-
23.	*L. fluens* Boud.	+	+	-	-

24.	*L. fuliginosus* (Fr. : Fr.) Fr.	+	+	-	-
25.	*L. fulvissimus* Romagn.	+	+	-	-
26.	*L. glyciosmus* (Fr. : Fr.) Fr.,	+	+	-	-
27.	*L. helvus* (Fr. :Fr.) Fr.	+	+	-	-
28.	*L. hepaticus* Plowr.	+	+	-	-
29.	*L. hygrophoroides* Berk. &M.A. Curtis.	-	-	-	+ (NR)
30.	*L. hysginus* (Fr. : Fr.) Fr.	+	-	-	-
31.	*L. intermedius* Krombh.	+	+	-	-
32.	*L. lacunarum* Romagn. ex Hora	+	-	-	-
33.	*L. luteolus* Peck	-	-	-	-
34.	*L. mairei* Malençon	+	+	-	-
35.	*L. mammosus* Fr.	+	+	-	-
36.	*L. musteus* Fr.	-	+	+	+ (NS)
37.	*L. pallidus* Pers.	+	+	-	-
38.	*L. payettensis* A.H. Sm.	-	-	-	-
39.	*L. porninsis* Rolland.	+	+	-	+ (NS)
40.	*L. pseudodeliciosus* Beardslee &Burl.	-	-	-	+ (NR)
41.	*L. pyrogalus* (Bull. : Fr.) Fr.	+	+	+	+ (NS)
42.	*L. quieticolor* Romagn.	+	+	+	+
43.	*L. quietus* (Fr. : Fr.) Fr.	+	+	-	+ (NS)
44.	*L. resimus* (Fr.) Fr.	+	+	-	-
45.	*L. rubrilacteus* Hesler &A.H. Sm.	-	-	-	+ (NR)
46.	*L. rufus* (Scop. : Fr.) Fr.	+	-	-	-
47.	*L. ruginosus* Romagn.	+	+	-	-
48.	*L. salmonicolor* R. Heim & Leclair	+	+	+	+
49.	*L. salmoneus* Peck.	-	-	-	+ (NR)
50.	*L. sanguifluus* (Paulet) Fr.	+	+	+	+
51.	*L. scrobiculatus* (Scop. : Fr.) Fr.	+	+	+	+ (NS)
52.	*L. semisanguifluus* R. Heim & Leclair	+	+	+	+
53.	*L. serifluus* (DC.) Fr.	-	-	-	+ (NR)
54.	*L. subdulcis* (Bull.) Gray	+	+	-	-
55.	*L. subpurpureus* Peck	-	-	-	+ (NR)
56.	*L. subumbonatus* Lindgr.	-	-	-	+ (NR)
57.	*L. tabidus* Fr.	+	+	-	-
58.	*L. tesquorum* Malençon	-	-	-	+ (NR)
59.	*L. thyinos* A.H. Sm.	-	-	-	+ (NR)
60.	*L. torminosus* (Schaeff. : Fr.) Gray	-	+	+	+ (NS)
61.	*L. uvidus* (Fr. : Fr.) Fr.	+	-	-	-
62.	*L. vietus* (Fr. : Fr.) Fr.	+	-	-	-
63.	*L. violascens* (J. Otto) Fr.	+	-	-	-
64.	*L. zonarioides* Kühner & Romagn.	+	+	+	+ (NS)
65.	*L. zonarius* (Bull.) Fr.	+	+	+	+ (NS)
66.	*Lactifluus piperatus* (L. : Fr.) Pers.	+	+	+	+ (NS)
67.	*Lactifluus vellereus* (Fr. : Fr.) Fr.	+	+	+	+
68.	*Lactifluus volemus* (Fr. : Fr.) Fr.	+	+	+	+ (NS)

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Conflicts of Interest

No potential conflict of interest was reported by the authors.

Ethical approval

No need to ethical approval for this study.

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