

## Taxonomic Investigations on the Epiphytic Lichens on *Quercus* sp. of Uludag (Bursa – Turkey)

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### ABSTRACT

In this study, 85 lichen taxa belonging to 34 genera and 15 families were determined from 772 lichen samples collected from 30 stations from 06.06.2004 to 24.05.2006. Seven lichen taxa for Bursa are new records. The epiphytic lichen taxa are collected from *Quercus cerris* L. var. *cerris*, *Quercus frainetto* Ten., *Quercus infectoria* Oliver subsp. *infectoria*, *Quercus petraea* (Mattuschka) Liebl. subsp. *iberica*, *Quercus petraea* (Mattuschka) Liebl. subsp. *petraea*, *Quercus pubescens* Willd. and *Quercus robur* L. subsp. *robur* L. which spread all over Uludag. The aims of this study is to investigate the epiphytic lichen diversity based on their substrate specificity that are grown on the *Quercus* species in Uludag mountain. The different epiphytic lichen species from different *Quercus* taxa at the same locality or same substrat at the different locality were determined. From these results, we think that the various properties of substrats change at the different levels because of the environment factors and this changing is effected the diversity and composition of the epiphytic lichen species on *Quercus* taxa.

**Key Words:** Bursa, Lichen, *Quercus*, Turkey, Uludag.

### INTRODUCTION

Lichens are widely used as an indicator organisms in various countries that affected by air pollution (Özdemir 1986). There are many studies on this features of lichens. The studies on lichens in Turkey mainly deals with the taxonomy or the chemical contents of lichens. The studies on the substrate indications or preferences of lichens are rare in Turkey. John and Turk (2006) identified 35 lichen taxa, that develops on the soil containing gypsum, from the Central Anatolia Region. Among these lichen taxa, six of them are the new records for Turkey.

In recent years, studies on the lichen distrubition on different substrata are increasing. Pirintsos et al. (1996) investigated the relationship between the distrubition and the abundance of epiphytic lichens in Olympus Mountain in Greece. Zedda (2002) studies the ecological indicator features of the epiphytic lichens that develops on *Quercus* species in Sardinya Island. Species specific features of lichen diversity were analyzed in these studies. Loppi et al. (1997) investigated the distrubitions of epiphytic lichens that develops on *Quercus pubescens*, through the different altitudes in Tuscany region of Italy. In similar study, Wolseley and Pryor (1999) investigated the lichens that develops on the thin branches of *Quercus petraea*. Larsen et al. (2007) studied epiphytic lichen and bryophyte distribution and frequency on the trunks of oak trees in London and surrounding counties to compared with pollution levels and bark pH. Pinokiyo et al. (2008) researched diversity and distribution of lichen in relation to altitude in India.

*Quercus* species, with very long life span that are considered as monumental trees at various locations of Turkey, are represented with 18 species in flora of Turkey. Due to their barks and their long life, these trees are highly suitable for lichen development. Floristic studies on the distrubition of *Quercus* species in Uludag mountain (Bursa-Turkey) identified *Quercus cerris* var. *cerris*, *Q. coccifera* L., *Q. frainetto*, *Q. infectoria* Oliver subsp. *boissieri* (Reut.) O. Schwarz, *Q. infectoria* subsp. *infectoria*, *Q. petraea* subsp. *iberica*, *Q. pubescens*, *Q. robur* subsp. *robur* and *Q. trojana* Webb as the main *Quercus* species in this region (Daşkın, 2008). During the field studies on these *Quercus* species in Uludag, it was seen that *Q. cerris* var. *cerris*, *Q. frainetto*., *Q. infectoria* subsp. *infectoria*, *Q. petraea* subsp. *iberica*, *Q. petraea* subsp. *petraea*, *Q. pubescens* and *Q. robur* subsp. *robur* taxa are highly rich for lichen presence. Therefore, lichen samples were collected from these *Quercus* species. Nonetheless, we did not identified any lichens on the trunks and also on the branches of the oak species *Q. coccifera*, *Q. infectoria* subsp. *boissieri* and *Q. trojana*, since they are very young with respect to other oak trees on the same region. The aim of this study was to compare epiphytic lichen diversity between different *Quercus* species.

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## MATERIALS AND METHODS

### *Study area*

Bursa is located at latitude 39–40° N, longitude 28–29° E in the north-west of Turkey, south-west of the Marmara Region. Bursa is affected by a A Mediterranean climate (Akman 1999). The mean annual rainfall is 731,1 mm, and the mean maximum temperature is 30,9 °C in August, while the mean minimum temperature is 1,7 °C in January (DGIGM 1974). Uludag mountain, which is the study area, is located at latitude 40° N and longitude 29° E in the south of Bursa. It is the highest mountain in Western Anatolia, with its peak at Uludag Tepe (2543m). Sarıalan Yaylası, Kirazlıyayla, Kadiyayla, Sobra Yaylası which high plateaus are on the northern side of the Uludag. There are some glacial lakes on the high summits of the mountain such as Aynalıgöl, Buzlugöl, Karagöl, Kilimligöl (Kaynak et al. 2005). Uludag is affected by a Mediterranean climate type and frozen in winter. Uludag's climate changes from lower to higher altitudes (Akman 1999).

Uludag have 5 vegetation zones; Lauretum (up to 350 m), Castanetum (up to 350–700 m), Fagetum (750–1500 m), Abietum (1500–2100 m), Alpinetum (up to 2100 m) (Özhatay and Çırpıcı 1987). Mediterranean vegetation such as maquis and frigana is present up to 350 m on Uludag (Çetin 1999).

### *Collecting samples and identification*

85 lichen taxa belonging to 34 genera and 15 families were determined from 772 lichen samples collected from 30 stations between 06.06.2004 and 24.05.2006 (Table 1).

The lichen samples were examined with a stereomicroscope (Olympus SZ 40) and a high power microscope (Olympus CH–2) for external morphology and anatomical observations. The lichen samples were identified with the aid of several flora books and identification keys (Clauzade and Roux 1985, Jahns 1987, Purvis et al. 1994, Wirth 1995, Brodo et al. 2001, Giralt 2001, Blanco et al. 2004, Nash III et al. I-II, 2004). Specimens are deposited in the Herbarium of the Biology Department (BULU) of the Faculty of Art and Sciences Uludag University in Bursa. Authors names are abbreviated according to Brummitt and Powell (1992).

The *Quercus* spp. were identified with several flora books and identification keys (Davis et al. 1982, Yaltırık 1984, Mataracı 2004).

## RESULTS

In this study, 772 lichen samples were determined on *Quercus* spp. (Table 2). 85 lichen taxa belong to 34 genera are reported on *Quercus* spp. of these specimens, 61 taxa were found on *Q. cerris* var. *cerris*, 59 on *Q. petraea* ssp. *iberica*, 56 on *Q. petraea* ssp. *petraea*, 32 on *Q. pubescens*, 21 on *Q. frainetto*, 21 on *Q. infectoria* ssp. *infectoria* and 19 on *Q. robur* ssp. *robur* (Table 3). According to the literatures, 7 taxa are recorded first time from Bursa. These species are *Candelariella reflexa* (Nyl.) Lettau, *Lecanora allophana* (Ach.) Rühl., *L. expallens* Ach., *L. glabrata* (Ach.) Malme, *Cladonia digitata* (L.) Hoffm., *Lecanora intumescens* (Rebent.) Rabenh. and *Usnea chaetophora* Stirt.

It was observed that seven lichen species grow on all examined *Quercus* spp. (Table 2). According to the literature, these species are cosmopolite. In our study, it was identified that these species have no selectivity for substrate and have high tolerance for *Evernia prunastri* (L.) Ach., *Lecanora carpinea* (L.) Vain., *L. subcarpinea* Szatala, *Lecidella elaeochroma* (Ach.) M. Choisy, *Melanelixia fuliginosa* ssp. *glabrata* (Lamy) Coppins, *Pleurosticta acetabulum* (Neck.) Elix & Lumbsch and *Pseudevernia furfuracea* var. *furfuracea* (L.) Zopf.

**Table 1.** List of the localities.

	Localities and substrates	Altitude (m)	Coordinate (N-E)	Date
1	İnegöl Soğukdere-Hamidiye, 1 km from Kestanealanı, <i>Q. p. ssp. iberica</i> , <i>Q. p. ssp. petraea</i> .	475–666	40°02' - 29°28'	06.06.2004
2	İnegöl in the vicinity of Gülbahçe, <i>Q. p. ssp. petraea</i> .	696–740	40°01' - 29°26'	06.06.2004
3	İnegöl Çayyaka-Lütfiye, after 1. km from Çayyaka, <i>Q. r.ssp. robur</i> .	489–565	39°59' - 29°28'	06.06.2004
4	İnegöl Çayyaka-Lütfiye, 1 km to Lütfiye, <i>Quercus</i> sp. forest, <i>Q. p. ssp. iberica</i> .	743	39°59' - 29°27'	06.06.2004
5	İnegöl İnegöl-Keles, 3. km from Çayyaka, <i>Q. r. ssp. robur</i> .	693	39°59' - 29°27'	06.06.2004
6	İnegöl İsaören -Karakadı, 1. km from İsaören, on <i>Q. c. ssp. cerris</i> .	453–532	40°01' - 29°30'	13.06.2004
7	İnegöl İsaören-Kestanealanı, 1. km from Karakadı, on <i>Q. r ssp. robur</i> .	611	40°00' - 29°29'	13.06.2004
8	İnegöl Kestanealanı-İclaliye, 1. km from Kestanealanı, <i>Q. p. ssp. iberica</i> , <i>Q. p. ssp. petraea</i> .	704–715	39°59' - 29°29'	13.06.2004
9	İnegöl Soğukdere-Hamidiye, 1 km from Kestanealanı, <i>Q. p. ssp. iberica</i> , <i>Q. p. ssp. petraea</i> .	475–666	39°58' - 29°31'	13.06.2004
10	İnegöl in the vicinity of Hayriye, forest and rocky area, <i>Q. c. ssp. cerris</i> .	739–773	39°57' - 29°33'	20.06.2004
11	İnegöl in the vicinity of Bahariye, <i>Quercus</i> sp. forest, <i>Q. c. ssp. cerris</i> .	629–646	39°57' - 29°35'	20.06.2004
12	İnegöl in the vicinity of Mezit, <i>Fagus</i> sp. and <i>Quercus</i> sp. forest, <i>Q. c. ssp. cerris</i> .	648–779	39°56' - 29°44'	11.07.2004
13	İnegöl Sulhiye-Osmaniye road, 1 km from Sulhiye, <i>Q. frainetto</i> .	671	39°56' - 29°42'	11.07.2004
14	İnegöl in the vicinity of Akıncılar, <i>Quercus</i> sp. forest, <i>Q. p. ssp. iberica</i> .	426	40°06' - 29°23'	11.07.2004
15	İnegöl in the vicinity of Çürüksu, <i>Q. c. ssp. cerris</i> .	789	39°55' - 29°37'	19.09.2004
16	İnegöl in the vicinity of Elmaçayır, <i>Quercus</i> sp. forest, <i>Q. c. ssp. cerris</i> .	850–885	40°01' - 29°23'	19.10.2003
17	Uludag 1 km to Hüseyinalan, <i>Q. p. ssp. petraea</i> .	960	40°08' - 29°01'	09.06.2005
18	Uludag 1 km to Kirazlı, <i>Q. p. ssp. petraea</i> .	1000	40°07' - 29°02'	16.06.2005
19	Uludag 1 km from Hüseyinalan, <i>Q. p. ssp. petraea</i> .	900	40°07' - 29°01'	16.06.2005
20	Uludag 5m to Hüseyinalan, <i>Q. p. ssp. petraea</i> .	900	40°08' - 29°01'	16.06.2005
21	Uludag in the vicinity of Highway fountain, <i>Q. p.ssp. petraea</i> .	1008	40°07' - 29°02'	28.08.2005
22	Uludag Uludag road, <i>Quercus</i> sp. forest, <i>Q. p. ssp. petraea</i> .	852	40°08' - 29°01'	14.09.2005
23	Uludag Hüseyinalan village road, <i>Quercus</i> sp. forest, <i>Q. p. ssp. petraea</i> .	897	40°07' - 29°02'	14.09.2005
24	Uludag Exit of Hüseyinalan village, <i>Q. c. ssp. cerris</i> , <i>Q. p. ssp. iberica</i> , <i>Q. p. ssp. petraea</i> .	969	40°06' - 29°01'	14.09.2005
25	Uludag Bağlı picnic area, <i>Q. c.ssp. cerris</i> , <i>Q. pubescens</i> .	1177	40°04' - 29°05'	24.05.2006
26	Uludag 5 km from Bağlı picnic area, <i>Q. c. ssp. cerris</i> , <i>Q. pubescens</i> .	1102	40°04' - 29°06'	24.05.2006
27	Uludag 2 km to Soğukpınar, <i>Q. frainetto</i> , <i>Q. pubescens</i> .	1063	40°03' - 29°06'	24.05.2006
28	Uludag Soğukpınar-Keles, exit of Soğukpınar, 2 km, <i>Q. i. ssp. infectoria</i> .	841	40°01' - 29°07'	24.05.2006
29	Uludag Bursa-Keles, 2 km from Çaybaşı, near the roadside, <i>Q. i. ssp. infectoria</i> .	549	40°03' - 29°03'	24.05.2006
30	Uludag Keles-Bursa, <i>Q. c. ssp. cerris</i> , <i>Q. pubescens</i> .	418	40°04' - 29°00'	24.05.206

In this study, *Q. cerris* var. *cerris*, which found in 10 different localities is the richest lichen flora (Table 3). It is known that the age of tree is importance factor on the lichen diversity (Brodo et al. 2001). *Agonimia allobata*, *Caloplaca cerina* var. *cerina*, *Ochrolechia arborea*, *O. turneri*, *Parmelina pastillifera*, *Pertusaria pertusa*, *Usnea chaetophora*, *U. florida* and *U. fulvoviregens* were found only on *Q. cerris* var. *cerris* (Table 2). *Usnea chaetophora* which growing on the trunk of *Q. cerris* var. *cerris* and is found at 850 – 885 m, is the new record for Uludag.

*Q. petraea* ssp. *iberica* has a lichen flora of 59 taxa which found in 6 localities in Uludag (Table 3). Six lichen species were found only *Q. petraea* ssp. *iberica*. These are *Caloplaca cerinelloides*, *Lobaria pulmonaria*, *Ochrolechia tartarea*, *Peltigera canina*, *Pertusaria coronata* and *Phaeophyscia ciliata*.

56 lichen species were determined on *Q. petraea* ssp. *petraea*. Six lichen species were found only *Q. petraea* ssp. *petraea*. These are *Cladonia digitata*, *Lecanora allophana*, *L. expallens*, *L. glabrata*, *Peltigera horizontalis* (Huds.) Baumg and *Tephromela atra* (Huds.) Hafellner. *Cladonia digitata*, *Lecanora allophana*, *L. expallens* and *L. glabrata* are the first record from Uludag where the species are found at 850–900 m, 900–1010 m, 900–960 m and 897 m at respectively, on the trunk of *Q. petraea* ssp. *petraea*. *Q. pubescens* has 32 taxa. *Caloplaca cerinella* and *Collema subflaccidum* were found only on *Q. pubescens*. *Q. infectoria* ssp. *infectoria* and *Q. frainetto* has 21 taxa and therefore lichen diversity of these is poorer than the other species. *Physconia detersa* were found only on *Q. frainetto*. *Q. robur* ssp. *robur* has the poorest lichen flora with 19 taxa.

*Lecanora intumescens* is the first record from Uludag. It was found on the trunk of *Q. petraea* ssp. *petraea* and *Q. cerris* var. *cerris*. *Caloplaca holocarpa*, *Candelariella vitellina*, *Physcia adscendens* and *Xanthoria parietina* were found on all *Quercus* spp substrates except for *Q. robur* ssp. *robur* (Table 2).

**Table 2.** The number of identified lichen taxa on *Quercus* spp.

**A:** *Q. cerris* L. var. *Cerris*, **B:** *Q. frainetto* Ten., **C:** *Q. infectoria* Oliver subsp. *infectoria*, **D:** *Q. petraea* (Mattuschka) Liebl. subsp. *iberica*, **E:** *Q. petraea* (Mattuschka) Liebl. subsp. *petraea*, **F:** *Q. pubescens* Willd., **G:** *Quercus robur* L. subsp. *robur* L.

Taxa	A	B	C	D	E	F	G	Total lichen samples
<i>Agonimia allobata</i> (Stizenb.) P. James	1							1
<i>Anaptychia ciliaris</i> (L.) Körb. ex A. Massal.	3			3	5	1		12
<i>Bryoria fuscescens</i> (Gyeln.) Brodo & D. Hawksw.	1			1	4			6
<i>Buellia disciformis</i> (Fr.) Mudd	2				3			5
<i>Caloplaca cerina</i> (Ehrh. ex Hedw.) Th. Fr. var. <i>cerina</i>	2							2
<i>Caloplaca cerinella</i> (Nyl.) Flagey						1		1
<i>Caloplaca cerinelloides</i> (Erichsen) Poelt				1				1
<i>Caloplaca flavorubescens</i> (Huds.) J.R. Laundon	1							1
<i>Caloplaca holocarpa</i> (Hoffm.) A. E. Wade	4	2	1	2	4	6		19
<i>Candelariella reflexa</i> (Nyl.) Lettau	1				1			2
<i>Candelariella vitellina</i> (Hoffm.) Müll. Arg.	3	1	3	2	4	3		16
<i>Cladonia coniocraea</i> (Flörke) Spreng.			1		1			2
<i>Cladonia digitata</i> (L.) Hoffm.						3		3
<i>Cladonia fimbriata</i> (L.) Fr.	2			2	7			11
<i>Collema subflaccidum</i> Degel.						1		1
<i>Evernia prunastri</i> (L.) Ach.	4	3	2	7	9	4	3	32
<i>Hypogymnia farinacea</i> Zopf	1					1		2
<i>Hypogymnia physodes</i> (L.) Nyl.		1		3	8		2	14
<i>Hypogymnia tubulosa</i> (Schaer.) Hav.	7	2		3	6	1		19
<i>Lecanora allophana</i> (Ach.) Rühl.					3			3
<i>Lecanora carpinea</i> (L.) Vain.	8	2	1	3	8	3	2	27
<i>Lecanora chlarotera</i> Nyl.	7		1	5	8	4	1	26
<i>Lecanora expallens</i> Ach.					2			2
<i>Lecanora glabrata</i> (Ach.) Malme					1			1
<i>Lecanora hagenii</i> (Ach.) Ach.			1			1		2
<i>Lecanora intumescens</i> (Rebent.) Rabenh.	1				1			2
<i>Lecanora subcarpinea</i> Szatala	4	2	1	1	5	4	2	19
<i>Lecidella elaeochroma</i> (Ach.) M. Choisy	10	2	1	13	20	5	1	52
<i>Lepraria incana</i> (L.) Ach.	2			1	3		1	7
<i>Lepraria lobificans</i> Nyl.				2	1	1	3	7
<i>Lobaria pulmonaria</i> (L.) Hoffm.				1				1
<i>Melanelixia fuliginosa</i> subsp. <i>glabratula</i> (Lamy) J.R. Laundon	1	1	1	2	7	1	2	15
<i>Melanelixia glabra</i> (Schaer.) O. Blanco et al.	7			6	7			20
<i>Melanelixia subaurifera</i> (Nyl.) O. Blanco et al.	2			2	4	2		10
<i>Melanohalea exasperata</i> (De Not.) O. Blanco et al.	6			2	3	1		12
<i>Melanohalea exasperatula</i> (Nyl.) O. Blanco et al.	1	2	1	1		3		8
<i>Ochrolechia arborea</i> (Kreyer) Almb.	1							1
<i>Ochrolechia pallescens</i> (L.) A. Massal.	1			1	2			4
<i>Ochrolechia szatalaensis</i> Versegny				1	3			4
<i>Ochrolechia tartarea</i> (L.) A. Massal.				1				1
<i>Ochrolechia turneri</i> (Sm.) Hasselrot	1							1
<i>Parmelia sulcata</i> Taylor	10	1		6	13		3	33
<i>Parmelina pastillifera</i> (Harm.) Hale	3			1				4
<i>Parmelina quercina</i> var. <i>carporrhizans</i> (Taylor) V. Wirth	3			1	6			10
<i>Parmelina quercina</i> var. <i>quercina</i> (Willd.) Hale	7	2		4	3	1	1	18
<i>Parmelina tiliacea</i> (Hoffm.) Hale	5			4	7			16
<i>Peltigera canina</i> (L.) Willd.				1				1

**Table 2.** Continued.

Taxa	A	B	C	D	E	F	G	Total lichen samples
<i>Peltigera horizontalis</i> (Huds.) Baumg					2			2
<i>Peltigera polydactylon</i> (Neck.) Hoffm.	1			1	2			4
<i>Peltigera praetextata</i> (Flörke ex Sommerf.) Vain.	1			3	4		2	10
<i>Peltigera rufescens</i> (Weiss) Humb.				2	4			6
<i>Pertusaria albescens</i> (Huds.) M. Choisy & Werner	4	1		2	5			12
<i>Pertusaria coronata</i> (Ach.) Th. Fr.				2				2
<i>Pertusaria flavida</i> (DC.) J.R. Laundon	3			1				4
<i>Pertusaria pertusa</i> (Weigel) Tuck.	1							1
<i>Phaeophyscia ciliata</i> (Hoffm.) Moberg				1				1
<i>Phaeophyscia orbicularis</i> (Neck.) Moberg	1			2				3
<i>Phlyctis argena</i> (Spreng.) Flot.	3			2	9		3	17
<i>Physcia adscendens</i> (Th. Fr.) H. Olivier	2	1	3	5	2	1		14
<i>Physcia aipolia</i> (Ehrh. ex Humb.) Fűrnr.	2		1	5	9	1		18
<i>Physcia leptalea</i> (Ach.) DC.	1		2	1	3	2		9
<i>Physcia stellaris</i> (L.) Nyl.	4		2	1	2	5	1	15
<i>Physcia tenella</i> (Scop.) DC.	2		1			3		6
<i>Physconia detersa</i> (Nyl.) Poelt		1						1
<i>Physconia distorta</i> (With.) J.R. Laundon	5			5	10		1	21
<i>Physconia enteroxantha</i> (Nyl.) Poelt	2	1		4	8	1		16
<i>Physconia perisidiosa</i> (Erichsen) Moberg				1	3	1		5
<i>Platismatia glauca</i> (L.) W.L. Culb. & C.F. Culb.	2			1	4			
<i>Pleurosticta acetabulum</i> (Neck.) Elix & Lumbsch	5	1	1	6	10	2	1	
<i>Pseudevernia furfuracea</i> var. <i>ceratea</i> (Ach.) D. Hawksw.				1	3			4
<i>Pseudevernia furfuracea</i> var. <i>furfuracea</i> (L.) Zopf	8	1	1	4	5	2	1	22
<i>Ramalina farinacea</i> (L.) Ach.	2		3	3	5		1	14
<i>Ramalina fastigiata</i> (Pers.) Ach.	2			1		1		4
<i>Ramalina fraxinea</i> (L.) Ach.	3			2	1	1		7
<i>Rinodina exigua</i> Gray	2	1	2			4		9
<i>Rinodina sophodes</i> (Ach.) A. Massal.	8	1		1				10
<i>Tephromela atra</i> (Huds.) Hafellner					2			2
<i>Usnea chaetophora</i> Stirt.	1							1
<i>Usnea filipendula</i> Stirt.	2			2	4			8
<i>Usnea florida</i> (L.) Weber ex F.H. Wigg.	1							1
<i>Usnea fulvovireagens</i> (Räsänen) Räsänen	1							1
<i>Usnea glabrescens</i> (Nyl. ex Vain.) Vain.	2			1	2			5
<i>Usnea hirta</i> (L.) F. H. Wigg.	1			2			1	4
<i>Xanthoria fulva</i> (Hoffm.) Poelt & Petut.				1	1			2
<i>Xanthoria parietina</i> (L.) Th. Fr.	5	1	4	4	2	5		21
Total lichen taxa	61	21	21	59	56	32	19	
Total lichen samples								772

Our study indicated that among the lichen growth forms of 85 lichen taxa, foliose lichens (40,00 % of all lichen species) were predominately followed by crustose (36,47 %), fruticose (17,64 %), dimorphic lichens (3,52 %) and leprose (2,35 %).

35 taxa of foliose lichens and 15 taxa of crustose lichens were determined on *Q. petraea* ssp. *iberica*. 33 taxa of foliose lichens and 16 taxa of crustose lichens were determined on *Q. petraea* ssp. *petraea*. While the crustose lichens and fruticose lichens are dominant on *Q. cerris* var. *cerris*, these are less on *Q. robur* ssp. *robur*. Foliose lichens are dominant on *Q. petraea* ssp. *iberica* (Table 4).

**Table 3.** The Percent and The Number of Total Epiphytic Lichens on *Quercus* Taxa.

The number of total epiphytic lichens on <i>Quercus</i> taxa	% Lichen taxa	
<i>Quercus cerris</i> L. var. <i>cerris</i>	61	22,76
<i>Quercus frainetto</i> Ten.	21	7,83
<i>Quercus infectoria</i> Olivier subsp. <i>infectoria</i>	21	7,83
<i>Quercus</i> (Mattuschka) Liebl. subsp. <i>iberica</i>	59	22,01
<i>Quercus</i> (Mattuschka) Liebl. subsp. <i>petraea</i>	56	20,89
<i>Quercus pubescens</i> Willd.	32	11,94
<i>Quercus robur</i> L. subsp. <i>robur</i> L.	19	7,08
<b>Total number</b>	<b>268</b>	<b>100</b>

**Table 4.** The distribution of the lichen growth forms on *Quercus* Taxa.

The lichen growth forms	<i>Quercus cerris</i> L. var. <i>cerris</i>	<i>Quercus frainetto</i> Ten.	<i>Quercus infectoria</i> Oliver subsp. <i>infectoria</i>	<i>Quercus petraea</i> (Mattuschka) Liebl. subsp. <i>iberica</i>	<i>Quercus petraea</i> (Mattuschka) Liebl. subsp. <i>petraea</i>	<i>Quercus pubescens</i> Willd.	<i>Quercus robur</i> L. subsp. <i>robur</i> L.
Fruticose	10	-	1	7	5	2	1
Foliose	29	13	11	35	33	19	11
Crustose	20	8	8	15	16	9	5
Dimorphic	1	-	1	-	-	-	-
Leprose	1	-	-	2	2	1	2
<b>Total</b>	<b>61</b>	<b>21</b>	<b>21</b>	<b>59</b>	<b>56</b>	<b>31</b>	<b>19</b>

## DISCUSSION

When the results of this study were compared to the studies on similar substrates in Mediterranean region, there are several similarities to the collected lichen taxa. 6 species (*Anaptychia ciliaris*, *Caloplaca holocarpa*, *Evernia prunastri*, *Melanohalea exasperata*, *Physcia adscendens*, and *Xanthoria parietina*) were determined by Pirintsos et al. (1996) at *Q. pubescens* from Olympos Mountain in Greece. We have found same species on *Q. pubescens* too at Uludag Mountain, Bursa-Turkey.

17 taxa (*Anaptychia ciliaris*, *Collema subflaccidum*, *Evernia prunastri*, *Lecanora carpinea*, *L. chlarotera*, *Lecidella elaeochroma*, *Melanelia fuliginosa* subsp. *glabratula*, *Parmelina quercina* var. *quercina* (Willd.) Hale, *Physcia adscendens*, *P. leptalea* (Ach.) DC., *P. tenella*, *Physconia perisidiosa* (Erichsen) Moberg, *Pleurosticta acetabulum*, *Pseudevernia furfuracea*, *Ramalina fastigiata* (Pers.) Ach., *R. fraxinea* (L.) Ach., *Xanthoria parietina*) were found on the studies of epiphytic lichen distribution on *Q. pubescens* in Tuscany region of Central Italy which made by Loppi et al. (1997). These species were also determined on *Q. pubescens* in our study.

Wolseley et al. (1999) studied the lichen flora of *Q. petraea* at the Gali area, and found about 27 epiphytic lichen taxa. In the contrary, 51 lichen taxa were identified on *Q. petraea* ssp. *petraea* and *Q. petraea* ssp. *iberica* in our study to as shown at Table 2.

Andres et al. (1999) reported 263 lichen taxa for the *Q. robur* ssp. *robur* in Galicia area, northwest part of the Spain. Unlike these results, in this study, *Lecanora subcarpinea*, *Lepraria lobificans* Nyl., *Peltigera rufescens* and *Pleurosticta acetabulum* were found on *Q. robur* ssp. *robur* in Uludag.

The epiphytic lichen flora on *Quercus* spp. in Sardinia (Italy) were studied by Zedda (2002). 207 taxa were found on *Q. pubescens*. Similarly, 28 lichen taxa which were collected on *Q. pubescens* in Sardinia were found on *Q. pubescens* from Uludag too. These species are *Anaptychia ciliaris* ssp. *ciliaris*, *Caloplaca cerinella*, *C. holocarpa*, *Candelariella vitellina*, *Collema subflaccidum*, *Evernia prunastri*, *Lecanora carpinea*, *L. chlarotera*, *L. hagenii*, *Lecidella elaeochroma*, *Lepraria lobificans*, *Melanohalea exasperata*, *M. exasperatula*, *Melanelia fuliginosa* ssp. *glabratula*, *Melanelixia subaurifera* (Nyl.) O. Blanco et al., *Parmelina quercina* var. *quercina*, *Physcia adscendens*, *P. aipolia*, *P. leptalea*, *P. stellaris*, *P. tenella*, *Physconia enteroxantha*, *P. perisidiosa*, *Pseudevernia furfuracea* var. *furfuracea*, *Ramalina fastigiata*, *R. fraxinea*, *Rinodina exigua* (Ach.) Gray and *Xanthoria parietina*. In addition, 3 different lichen species (*Hypogymnia farinacea* Zopf, *Lecanora subcarpinea* and *Pleurosticta acetabulum*) were found on *Q. pubescens* in Uludag.

It is known as characteristic acidophytes for acid barks (Van Herk 2001, Larsen et al. 2007), *Evernia prunastri*, *Hypogymnia physodes*, *H. tubulosa*, *Lepraria incana*, *Pseudevernia furfuracea* were frequently observed on the seven *Quercus* taxa in studied localities. Also nitrophytic species such as *Melanelixia subaurifera*, *Physcia adscendens*, *P. orbicularis*, *P. tenella*, *Xanthoria parietina* are widespread on the studied *Quercus* taxa. This result indicated that the acidic property of *Quercus* taxa bark may be influenced various factors such as fertilization, air pollution, dust etc. and effected microclimate. *Lecanora chlarotera* is a characteristic species of *Lecanoretum subfuscae* association on turnks of young oak (Lukošiene and Naujalis 2006). In spite of *Lecanora chlarotera* were determined widespread and frequent at the six *Quercus* taxa, this species wasn't observed at *Quercus frainetto*.

The nature of the tree canopy may influence the composition of the lichen flora on the trunk, both directly by controlling light intensity and indirectly by modifying micro-gradients of humidity. Leppik and Jürriado (2008) indicated that more lichens of foliose and fruticose growth forms occurred in the open habitats than in the overgrown stands.

Our study indicated that among the lichen growth forms of 85 lichen taxa, foliose lichens (40,00 % of all lichen species) were predominatly followed by crustose (36,47 %), fruticose (17,64 %), dimorphic lichens (3,52 %) and leprose (2,35 %). *Quercus* taxa which collected epiphytic lichen species occurred in the open habitats. We think that, this habitats and deciduous oak species are suitable for growing foliose lichens, so the percent of foliose lichens are more from the different growth forms.

In this research, the epiphytic lichens of Uludağ were studied. These lichens develop on seven *Quercus* taxa belong to *Quercus* genus presented with eighteen taxa in Turkey. Since *Quercus* taxa located on various locations are old trees, it is an important factor in distribution and diversity of lichen species. Identified lichen taxa show similarity to results on same substrata. This situation confirms similarity of lichens developed on trees with similar ecological requirements in different locations.

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