Allergen *Alternaria* and *Cladosporium* Spores Concentration in the Atmosphere of Çamkoru (Ankara - Turkey), 2003 - 2004

Alerjen *Alternaria* ve *Cladosporium* Sporlarının 2003-2004 Yıllarında Çamkoru (Ankara-Türkiye) Atmosferindeki Konsantrasyonları

Research Article

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ABSTRACT

Alternaria and *Cladosporium* spores have been shown to be important aeroallergens in many regions throughout the world and the densities of these spores show considerable differences according to the years. Therefore, *Alternaria* and *Cladosporium* spores were collected with a Durham sampler in the atmosphere of Çamkoru (Ankara), between September 2003 to August 2004. Spores/cm^2 of *Alternaria* and *Cladosporium* were recorded daily. Monthly total spores/cm2 of *Alternaria* and *Cladosporium* were corralated with the monthly meteorological factors (temperature, rainfall, wind speed) of the same period by using Spearman correlation analysis. During this period, a total of 684 spores/cm^2 belong to *Alternaria* and *Cladosporium* genera were determined. 406 (59.36%) spores/cm^2 of this total belong to *Cladosporium* and remaining 278 (40.64%) spores/cm^2 to *Alternaria*. The concentration of *Alternaria* and *Cladosporium* spores reached to highest ratios in May, 2004. According to Spearman correlation analysis the quantity of *Alternaria* ve *Cladosporium* spores shows significant positive relationship with the temperature and the wind speed, but showed insignificant negative relationship with the rainfall. These findings will help to the allergist for the diagnosis, tracing and treatment of the respiratory system diseases.

Key Words
Aeroallergen, *Alternaria; Cladosporium;* Durham sampler; meteorological factors; Spearman correlation analysis; Çamkoru (Ankara).

ÖZET

Alternaria ve *Cladosporium* cinslerine ait sporlar, dünyanın birçok bölgesinde önemli aeroallerjenler olarak görülmektedir, ancak bu sporların yoğunlukları yıllara göre önemli farklılık gösterir. Bu yüzden *Alternaria* ve *Cladosporium* cinslerine ait sporlar, durham aleti ile Çamkoru (Ankara) atmosferinden 2003 yılının eylül ayından 2004 yılının ağustos ayına kadar toplandı. *Alternaria* ve *Cladosporium*'a ait spor miktarı/cm^2 günlük olarak kaydedilmiştir. *Alternaria* ve *Cladosporium* sporlarının aylık miktarları/cm^2 ile aynı döneme ait meterolojik faktörler (sıcaklık, yağış, rüzgar hızı) arasındaki ilişki Spearman korelasyon analizi kullanılarak belirlenmiştir. Bu süre içerisinde *Alternaria* ve *Cladosporium* cinslerine ait 684 spor tanesi belirlenmiştir. 406 (%59.36) spor tanesi *Cladosporium*'a, 278 (% 40.64)'inin ise *Alternaria*'ya ait olduğu belirlenmiştir. *Alternaria* ve *Cladosporium*'a ait sporlar en yüksek miktara, 2004 yılının mayıs ayında ulaşmıştır. Spearman korelasyon analizine göre *Alternaria* ve *Cladosporium*'a ait spor sayıları sıcaklık ve rüzgar hızı ile önemli pozitif ilişki göstermiş, ancak yağış ile arasında bir ilişki bulunamamıştır. Bu bulgular, solunum sistemi hastalıkların teşhis, izleme ve tedavisinde alerji hekimlerine yardımcı olabiliriz.

Anahtar Kelimeler
Aeroalerjen, *Alternaria* sp.; *Cladosporium* sp.; durham aleti; meteorolojik faktörler; Spearman korelasyon analizi; Çamkoru (Ankara).

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INTRODUCTION

The spores reproduced by nonflowering plants, as well, are at least as intense as the pollens in the atmosphere and they induce allergy [1,2]. Fungus spores are more allergic in comparison to other Cryptogam plant spores [3]. According to intradermal tests results, the prevalence of fungal allergy at a world level could vary between 3% and 10% [4-5]. Therefore, air fungal spores studies were made [6-18]

Çamkoru is one of the most important recreation area of Ankara, the capital city of Turkey. According to the 2007 population census the city has approximately a population of 4.5 million which includes eight districts under the city's administration [19]. So many people go to picnic areas of Çamkoru at weekends. For this reason in our study, *Alternaria* Nées and *Cladosporium* Link known as the most allergenic spores, were collected by means of a Durham sampler from the Çamkoru (Ankara) atmosphere from September 2003 to August 2004. The monthly variations in spores/cm^2 of *Alternaria* and *Cladosporium* were determined. The effects of some climatological factors such as temperature, rainfall, and wind speed on variations of spore concentrations have been investigated.

MATERIAL AND METHODS

Study area

Çamkoru takes place between 40° 34′ 30″, 40°36′ 30″ north latitude and 32° 29′ 30″, 32° 31′ 30″ east longitude (Figure 1). Altitude of Çamkoru region becomes different from 1350 m to 1699 m [20].

Çamkoru region is a place of *Pinus sylvestris* L. and *Pinus nigra* Arnold, forest which continue from Aladağ and Köroğlu mountains to direction of northwest although the steppe vegetation of Ankara [21].

Sampling procedure

Allergen *Alternaria* and *Cladosporium* spores were collected by Durham sampler. The Durham sampler was placed 15 m above the ground at the roof of Hacettepe's social facility in Çamkoru.

Slides placed on the Durham sampler were changed daily. The collected slides were covered with glycerin jelly containing basic fuchsin before identification. The slides were examined under the light microscope daily. The counts were made under the microscope were converted into atmospheric concentrations and expressed as spores/cm^2.

Meteorological data

The meterological data were derived from the records of the Meterological Station in Kızılcahamam (Ankara) between September 2003 to August 2004.

Statistical methods

Statistical analyses were done with SPSS 15 for Windows (Chicago, IL, USA). The relation between the monthly total amount of *Alternaria* and *Cladosporium* spores in the atmosphere of Çamkoru (Ankara) between September 2003 to August 2004 have been investigated in relation to the monthly average temperature, wind speed and rainfall values using the Spearman correlation analysis. The significance threshold has been accepted to be $p < 0.005$.

RESULTS AND DISCUSSION

A total of 684 fungal spores from 2 taxa, comprising 140 grains in 2003 and 544 grains in 2004, was identified in the atmosphere of Çamkoru (Table 1). 406 (59.36%) of these spores belong to *Cladosporium* and remaining 278 (40.64%) spores to *Alternaria* (Table 1, Figure 2).

In our study, *Cladosporium* spores concentrations were higher than those of *Alternaria* (Figure 2). This is a because of the character of the vegetation and geographical location of the study area. In addition, many surveys in the different region of the world have shown *Cladosporium* spores of dominance in comparison with other spores [22-26].

Dixit et al. [27] show that spores were usually more abundant between late spring and late summer in each calendar year, when several major deuteromycetes, such as *Cladosporium*, *Alternaria*, *Aspergillus*, *Penicillium*, and *Nigrospora* spores, approached peak levels.

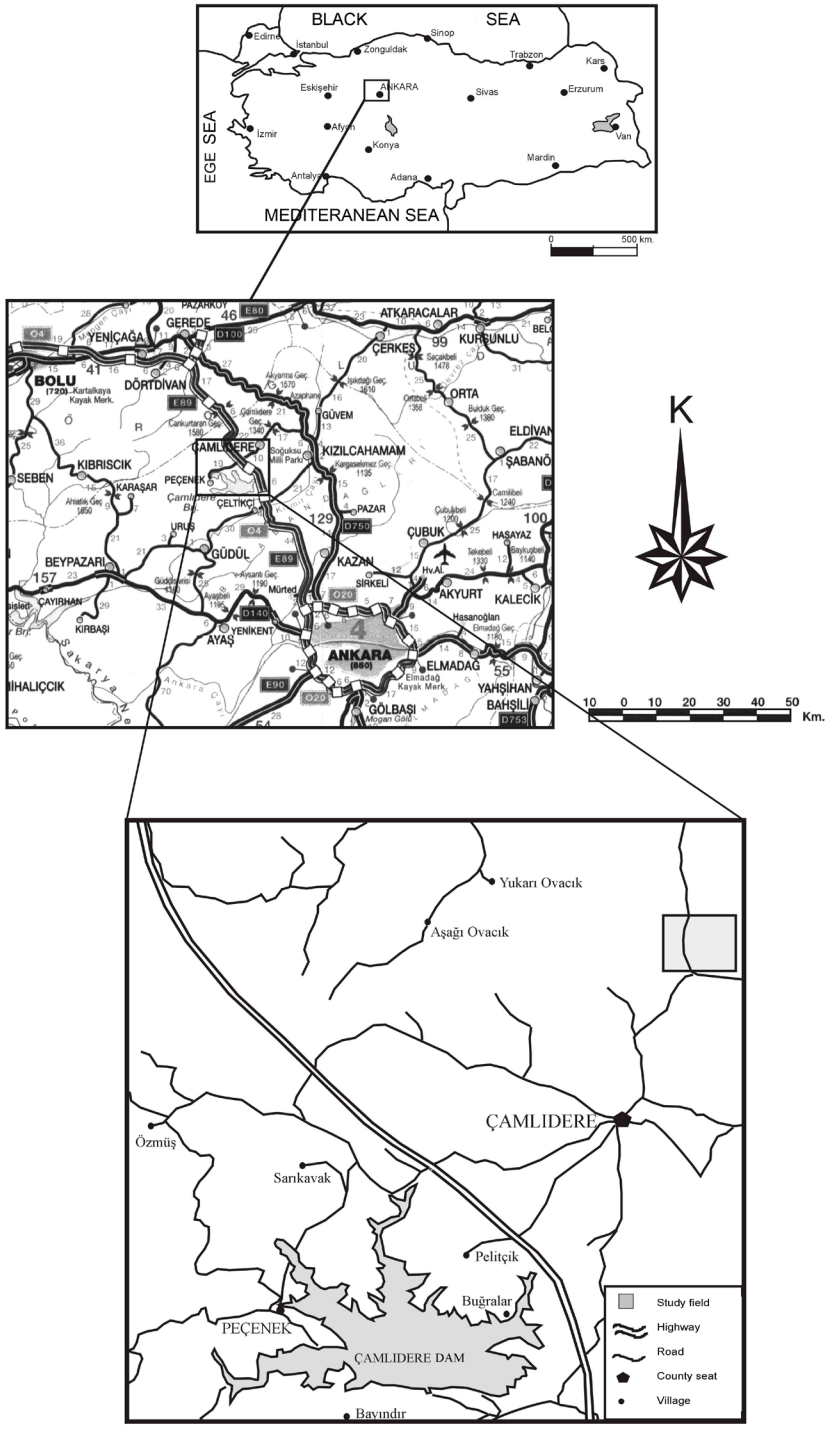

Figure 1. Map of Turkey showing the localization of Çamkoru (Hacısalioğlu 1999).

Table 1. Seasonal and monthly distribution and number of colonies of airborne fungi isolated in Çamkoru.

MONTHS / FUNGI	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Total of the fungi
Alternaria	31	29	2	-	-	-	-	1	140	30	34	11	278
Cladosporium	55	21	2	-	-	-	-	1	141	27	30	36	406
TOTAL	86	50	4	-	-	-	-	2	281	57	64	47	684

Sabariego et al. [22] explained that correlation between climatic factors and the daily content of certain fungal spores (*Alternaria*, *Ustilago* and *Cladosporium*) in the atmosphere of the city of Granada (southern Spain) in 1994. They analyzed the Spearman correlation coefficients between the spore concentrations and the meteorological parameters showing that *Alternaria* and *Cladosporium* are significantly correlated with temperature and hours of sunlight, while *Ustilago* shows positive correlation indices with relative humidity and negative indices with wind speed.

Troutt and Levetin [28] examined to correlate fungal spore concentrations with meteorological data from Tulsa, Oklahoma during May 1998 and May 1999. They were identified the most abundant spore types *Cladosporium*, ascospores, and basidiospores during the study period.

Hollins et al. [29] analyzed two different time series of *Cladosporium* conidia observed in England and Wales over 27 years; the results demonstrated that the number of days in summer when the *Cladosporium* spores are above the allergenic concentration was positively correlated with regional temperature and negatively correlated with precipitation for both sites over the study period.

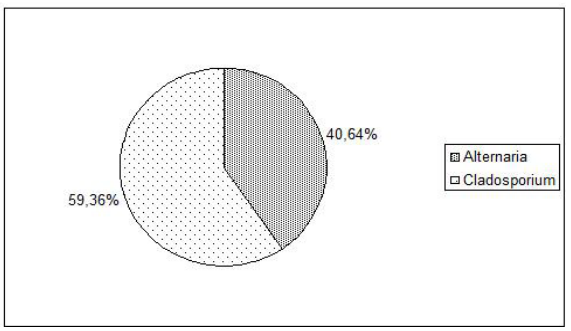

Figure 2. Percentages of *Alternaria* and *Cladosporium* spores the region of Çamkoru for the period 2003-2004.

Peternel et al. [30] analyse the relationship between meteorological conditions and *Alternaria* and *Cladosporium* spore concentrations in the air of Zagreb in August 2002 and August 2003. They showed that a strong association between average daily temperature and average daily *Alternaria* and *Cladosporium* concentrations in Zagreb.

Grinn-Gofron and Rapiejko [31] investigated the concentration of airborne spores of *Cladosporium* and *Alternaria* at three monitoring stations situated along the west-north and central-east transect in Poland. *Cladosporium* spores were dominant at all the stations. The highest *Cladosporium* and *Alternaria* numbers of spores were observed at all the cities (Szczecin, Olsztyn, Warszawa) in July and August. Statistically significant correlations have been found between the *Cladosporium* and *Alternaria* concentration in the air and the mean air temperature, amount of precipitation, air pressure and relative air humidity.

Oliveira et al. [32] studied the seasonal distribution of fungal spores continuously (2005–2007) using volumetric spore traps in Porto and Amares. To determine the effect of meteorological factors (temperature, relative humidity and rainfall) on spore concentration, the Spearman rank correlation test was used. *Alternaria* and *Cladosporium*, had positive correlations with temperature and negative correlations with relative humidity and rainfall.

In this study, the statistical analysis demonstrated significant relationship between the spore concentrations of *Alternaria* and *Cladosporium* and 2 of the 3 meteorological parameters are important, as temperature (positive) and wind speed (positive). No statistically significant correlation was observed between the

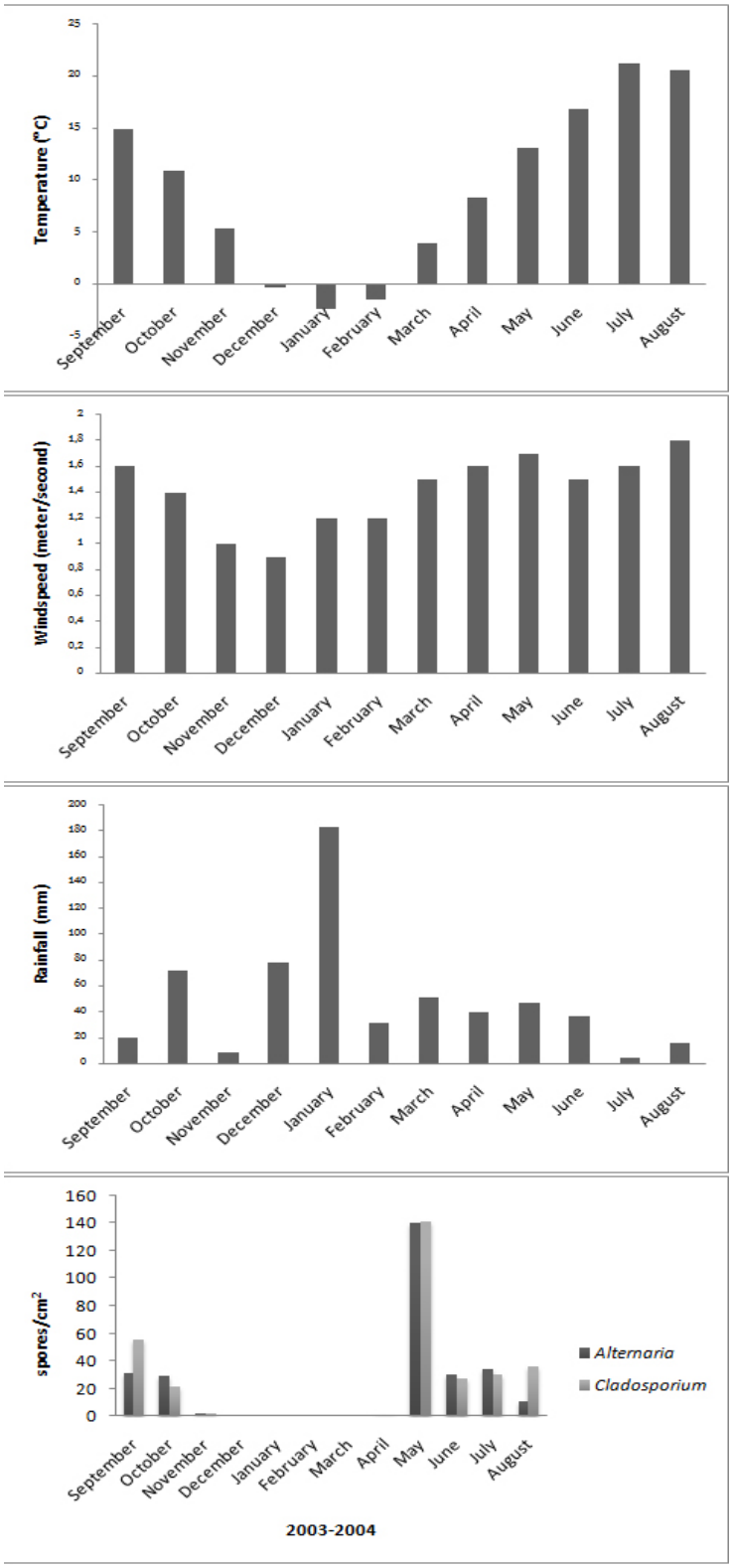

Figure 3. Monthly variations in atmospheric *Alternaria* and *Cladosporium* spores and weather conditions over the period Sep. 2003- Aug. 2004.

Table 2. Relationship between total spores of Alternaria and Cladosporium and meteorological parameters.

	Alternaria		*Cladosporium*	
	Corelation	p	Corelation	p
Temperature	0.847**	0.001	0.854**	0.000
Wind speed	0.646 *	0.023	0.757**	0.004
Rainfall	-0.466	0.127	-0.502	0.096

spore concentrations and rainfall in any of the analysed season (Table 2). In addition to, spores of *Alternaria* and *Cladosporium* showed a correlation with some meteorological parameters, such as temperature, wind speed and rainfall (Figure 3).

During December 2003, January, February and March 2004, *Alternaria* and *Cladosporium* spores has not been found in the slides of Çamkoru atmosphere.

This is due to the increased amount of rain, decrease in tempature and speed of wind in November 2003 and January, February, March 2004.

In rainy days the bioparticulles of atmosphere are getting heavy so they drop to the ground. This circumstance is called "rain washing" [33-35]. In May 2004, the amount of spores of *Alternaria* and *Cladosporium* reached the maximum since tempature, rain and wind speed were optimum.

In September, October 2003 and June, July, August 2004, *Alternaria* and *Cladosporium* spores were observed in intensively high amounts in Çamkoru region (Table 1). Because temperature, rainfall and wind speed were suitable in these months.

The high concentration of *Cladosporium* spores affects the human health by increasing the incidence of asthma and bronchial ailments [36].

Epidemiological studies from a variety of locations worldwide indicate that *Alternaria* sensitivity is closely linked with the development of asthma. In addition, up to 70% of mold-allergic patients have skin test reactivity to *Alternaria*, so its sensitivity has been shown to be a risk factor for asthma [37]. More people are allergic to *Alternaria* than *Cladosporium*. *Alternaria* also produces more strongly positive reactions, while the *Cladosporium* generally only produces a mild allergic reaction [38].

We believe that in our opinion the results obtained from the study can help the allergy doctors for the diagnosis, tracing and treatment of the respiratory system diseases that caused from *Alternaria* and *Cladosporium* spores.

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