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# AN OVERVIEW OF THE ATMOSPHERIC POLLEN IN TURKEY AND THE NORTHERN CYPRUS

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**Abstract**

The qualitative and quantitative analysis of atmospheric pollen on regional basis in different countries has increased. The reason for this is that pollen grains are a major cause for allergic asthma and hay fever (pollinosis) in sensitive people in particular children. Data obtained by using gravimetric ($cm^2$/pollen grains) and volumetric ($m^3$/pollen grains) methods in Turkey and the Northern Cyprus show, pollen concentrations during March, April, May, June and July are very high, but the densities vary on monthly basis depending on the phytogeographical division investigated. In general the dominant pollens in the atmosphere belong to *Alnus glutinosa, Carpinus, Castanea sativa*, Chenopodiaceae/Amaranthaceae, Cupressaceae, Cupressaceae/Taxaceae*, Fagus orientalis, Juglans regia, Morus, Olea europaea*, Oleaceae, Pinaceae, *Pinus, Pistacia, Plantago., Platanus orientalis,* Poaceae, *Populus, Quercus* and Urticaceae. In this paper, an attempt is made to present an overview of the studies undertaken on the pollen calendars of Turkey and the Northern Cyprus during the last few decades and their allergenic effects. This will contribute in the treatment of allergic diseases as well as improve the quality of life of people sensitive to pollen allergies.

## Introduction

The pollen from the plants that cause allergic diseases depends on the flora and climatic conditions of the region in particular the air movements because wind-pollinated pollens can be transported 50-300 km. The clinical signs in susceptible individuals due to pollens also depends on the changes in the meteorological factors (Epton *et al.*, 1997). Meteorological factors are as effective in the occurrence of pollen allergen sensitization reactions in individuals who are sensitive to the allergic pollen as the region's plant diversity and biogeography. The pollens from wind-pollinated plants are usually smaller - lighter and more easily reach into the respiratory tract of humans resulting in allergenic reaction. The pollens from insect pollinated plants are generally larger and heavier, they cause allergenic reactions in the humans who are in very close contact with these. If the number of pollen grains in $1m^3$ of air is below 50, concentration is considered low, but above 200 is very high. The average size is of allergic pollen is between 15-75 microns. When the pollen reaches the respiratory tract hard exin layer is digested by enzymes, which release the proteins leading to allergic reations (Sapan, 2011). Pollen size also is an important determinant, large pollens are more efficient in upper respiratory tract. Therefore for the pollens involved in this activity, allergic sensitivity symptom score should be determined for each region (Celenk *et al.*, 2010). Information about pollen behavior during different times of the day, allows pollen sensitive patients to plan their movements and to take protective measures. Severe symptoms can occur at even very low pollen concentrations depending on the sensitivity of the person. The most frequent symptoms are allergic rhinitis, conjunctivitis and bronchial asthma. The pollen of *Olea europaea* is the most important cause of respiratory allergies such as allergic asthma and seasonal allergic rhinitis in the Mediterranean countries (Bousquet *et al.*, 1984; Barderas, 2005). Another tree species in this connection is the species of *Fraxinus*. Both these taxa are the most important aeroallergens (D'Amato, 1998). However, not every pollen is allergenic and many pollens may not cause allergic diseases because allergenic influence is weak.

Turkey has 3 different phytogeographical regions differring in climates climates as well as vegetation cover. Therefore, the density and diversity of pollen in the atmosphere show regional differences. The country possesses an enormous floristic wealth. Approximately over 10.000 plant taxa show distribution in the country which is very close to the number of taxa distributed in the whole of European continent; 25 times larger than Turkey (Bicakci *et al.*, 2005; Ozturk *et al.*, 2008, 2011; Akcin & Binzet, 2011). Nearly 95% of this diversity is composed of herbaceous species, but the aeropalinolocal studies reveal that the percentage of woody taxa in the atmosphere is more than the herbaceous ones (Bicakci *et al.*, 1996, 2009). A number of these taxa result in pollen allergy related diseases (Zeb *et al.,* 2012; Parveen & Qaiser, 2012) .This paper therefore presents an overview of the studies undertaken on the pollen distributions in different regions of Turkey and the Northern Cyprus during the last few decades. An attempt has been made to enlighten the allergenic effects which will contribute in the treatment of allergic diseases as well as improve the quality of life of people sensitive to pollen allergies.

## Material and Methods

In the earlier studies "Durham" trap was used in the aeropalinological investigations, which is less effective in catching too small pollens (Guvensen & Ozturk, 2002, 2003; Pinar *et al.*, 2008; Bicakci *et al.*, 2005; Celenk *et al.*, 2010). Presently "Lanzoni," trap is used largely to study allergic pollens in the atmosphere because, it captures pollens on hourly basis by absorbing air depending on the wind direction during the day. In Turkey the data collected for atmospheric pollen distribution during the years 1968-2010 has been recorded by gravimetric method ($cm^2$/pollen grains) but during 2003-2012 volumetric method ($m^3$/pollen grains) has been used alongwith the gravimetric method (Hirst, 1952). Gravimetric or volumetric traps have been placed at a

height of 20 m from the ground with open air circulation on all sides and slides examined microscopically using a ×40 objective (0.45 mm microscopic field) according to the methodology proposed by REA (Domínguez *et al*., 1991). Identification of pollens has been done using pollen collection in the Aerobiology Laboratory of Botany Departments in different Universities in Turkey. The comparisons have been made with the figures published by different authors (Erdtman, 1966, 1969; Louveaux 1970; Moore *et al.*, 1991; Pehlivan, 1995; Sin *et al.*, 2007). The allergenic potential of important types has been presented according to Grant-Smith (1990).

## Results and Discussion

Pollen has an important place among aeroallergens in terms of their role in allergic diseases. Therefore determination of concentration of pollens of plant species in the air on daily, weekly, monthly or yearly of pollen in the atmosphere proves of great help in the preperation of pollen calendars their by paving the way for diagnosis and treatment of allergic diseases.

The first study on the pollen calendars in Turkey was conducted by Karamanoglu & Ozkaragoz (1968) in the capital city Ankara. It was followed by the pollen calendar and pollen atlas for the plants in Istanbul and its environs (Aytug *et al.*, 1971, 1974), who identified 131 pollen taxa in the atmosphere of Istanbul and Belgrad Forest. Later on Yurdukoru (1979) studied the atmospheric pollen in the city of Samsun, Gemici *et al*., (1989) in Izmir, Ince & Pehlivan (1990) in Antalya-Serik, and Inceoglu *et al*., (1994) in Ankara. Guvensen & Ozturk (2002) studied the atmospheric pollen in the atmosphere of Buca, Bicakci *et al*., (2002a) in Afyon, Bicakci *et al*., (2002b) in Rize, Guvensen & Ozturk (2003) in Izmir, Bicakci *et al*., (2004a) in Edirne, Bicakci *et al*., (2004b) in Usak, Kaya & Aras (2004) in Bartin, Kaplan (2004) in Zonguldak, Guvensen *et al*., (2005) in Canakkale, Celik *et al*., (2005) in Denizli, Celenk & Bicakci (2005), Guvensen (2006) in Karsiyaka, and Bicakci (2006) in Sakarya. Bursali *et al*., (2006) conducted studies on the pollen distribution in the atmosphere of Ankara, Adana and Diyarbakir. They compared the pollen concentrations with meteorological factors and investigated the effect of meteorological factors on pollen concentrations. Most important factor affecting the release of tree pollens in Ankara is precipitation and in Diyarbakir it is temperature. The relative humidity was highly effective on the concentration of pollen of herbaceous taxa in Adana. According to Erkara (2008) an increase in the temperature and wind promotes pollination. An increase in the relative humidity and high temperatures increase the number of pollen in the air. These studies were followed by the studies carried out in the touristic State of Mugla by Bilisik *et al*., (2008a,b) in Didim and Fethiye, Tosunoglu *et al*., (2009) in Koycegiz, Cetin *et al*., (2009) in Urfa, and Celenk *et al*., (2010) in Istanbul (Table 1). There are seven different geographical divisions in Turkey and similar pollen spectrums have been reported in the atmosphere of these divisions, but the concentration differs to alarge extent (Table 2). The reason for these differences is the distinct type and duration of the pollination season and different pollen sources. Both of these parameters vary from city to city, depending on the climate and vegetation.

The research on the pollen spectrum in the atmosphere of the Northern Cyprus has been carried out by Gucel *et al*., (2012). The results obtained are presented in Table 3. The incidence of allergy cases in Nicosia varies between 85-90 percent. A total of 7880 pollen grains belonging to 44 taxa were determined. Out of these, 25 belonged to the arboreal and 19 to the non-arboreal taxa. The representation of different taxa in the pollen calendar was Pinaceae (29.96%), Cupressaceae/Taxaceae (18.33%), *Olea europaea* (6.92%) and *Quercus* (4.92%), and for non-arboreal representatives these were Poaceae (8.46%), Chenopodiaceae/Amaranthaceae (2.61%), *Plantago* (1.69%) and *Parietaria* (1.51%). The distribution of pollen in the atmosphere of Nicosia followed the trend as March, April, May and June.

**Table 1. A comparison of the distribution of arboreal and non-arboreal pollens in different States of Turkey [G: gravimetric ($cm^2$); V: volumetric ($m^3$)].**

| City | Pollen season | Dominant taxa | Methods | References |
|---|---|---|---|---|
| Adana | March, June | Cupres./Taxa., Pinaceae, Graminea, *Betula,* Cheno./Amarant. | G | Bursali *et al*., (2006) |
| Afyon | May, April, June | *Pinus,* Poaceae, Cupressaceae | G | Bicakci *et al*., (2002) |
| Ankara | June, May, March, April | Pinaceae, Cupres./Taxa., *Platanus* | V | Inceoglu *et al*., (1994) |
| Bartin | May, April, June, July | *Populus,* Poaceae, Pinaceae | G | Kaya & Aras (2004) |
| Bitlis | June, May, April | Poaceae, Urticaceae, *Juglans* | G | Celenk & Bicakci (2005) |
| Bursa | April, May, June, March | *Pinus, Olea europaea, Platanus* | V | Bicakci *et al*., (1996) |
| Canakkale | April, March, May | Pinaceae, *Quercus,* Cupres./Taxa. | G | Guvensen *et al*., (2005) |
| Denizli | June, April, March, July | Pinaceae, Cupres./Taxa., *Quercus* | G | Celik *et al*., (2005) |
| Edirne | April, June | Gramineae, *Pinus, Quercus,* Cupres./Taxa, *Platanus* | G | Bicakci *et al*., (2004) |
| Istanbul (Asian part) | April, March, May | Cupres./Taxa., Urticaceae, *Pistacia* | V | Celenk *et al*., (2010) |
| Izmir | May, April, March | *Pinus, Quercus,* Poaceae | G | Guvensen & Ozturk (2003) |
| Rize | February, March, April | *Alnus,* Cupressaceae, *Castanea sativa* | G | Bicakci *et al*., (2002) |
| Sakarya | April, March, May | Poaceae, *Pinus, Quercus* | G | Bicakci (2006) |
| Usak | May | Pinus, Cupres./Taxa., Quercus, Gramineae, Platanus | G | Bicakci *et al*., (2004) |
| Zonguldak | March, April, May | Pinaceae, *Populus, Carpinus* | G | Kaplan (2004) |

**Table 2. Distribution of pollens of dominant taxa on the basis of geographical divisions in the atmosphere of Turkey.**

| Regıon | Domınant taxa |
|---|---|
| Marmara | Cupressaceae, *Fraxinus, Ulmus, Corylus, Platanus, Quercus,* Poaceae, *Olea, Castanea, Artemisia*, Chenopod./Amarant., *Xanthium, Ambrosia* |
| Aegean | Cupressaceae, *Fraxinus, Ulmus, Pinus,* Poaceae, *Morus,* Oleaceae, *Artemisia*, Chenopod./Amarant., Cedrus |
| Mediterranean | Cupressaceae, *Populus, Fraxinus, Platanus, Pinus,* Poaceae, Chenopod./Amarant., *Cedrus* |
| Inner Anatolia | Cupressaceae, *Betula, Populus, Pinus,* Poaceae, Chenopod./Amarant., Artemisia, |
| Black Sea | Corylus, Cupressaceae, Alnus, Platanus, Pinus, Poaceae, Asteraceae Chenopod./Amarant., Ambrosia, Artemisia |
| East Anatolia | *Fraxinus,* Cupressaceae, *Quercus, Salix, Juglans*, Urticaceae, Poaceae, Chenopod./Amarant. |
| South East Anatolia | Pinus, Cupressaceae, Poaceae |

**Table 3. Total percentage of taxa with highest density in the atmosphere in Nicosia (2007 and 2008) and their allergenic potentials.**

| Arboreal taxa | Total (%) | Allergenic potential |
|---|---|---|
| Pinaceae | 29.96 | * |
| Cupressaceae/Taxaceae | 18.33 | ** |
| *Olea europaea* | 6.92 | *** , ** |
| *Quercus* | 4.92 | ** |
| Total | 60.13 | |
| **Non-arboreal taxa** | | |
| Poaceae | 8.46 | *** , ** , * |
| Chenopod./Amarant. | 2.61 | ** , * |
| *Plantago* | 1.69 | *** , * |
| *Parietaria* | 1.51 | ** , * |
| Total | 14.27 | |
| General Total | 74.4 | |
| Others | 23.68 | |
| Unidentified | 1.92 | |
| Total | 100.00 | |

* Lowest, ** Medium, *** Highest (Grant-Smith, 1990)

The potential allergenic effects of atmospheric pollens on human health have been divided into different categories by Grant-Smith (1990). In accordance with this classification, the pollens in the atmosphere of Turkey can be evaluted as follows;

**Taxa with highest allergenic effects:** *Ambrosia, Artemisia, Olea europaea* and Poaceae

**Taxa with medium allergenic effects:** *Alnus glutinosa, Betula, Carpinus, Castanea sativa, Casuarina equisetifolia,* Chenopodiaceae/Amaranthaceae, *Corylus avellana,* Cupressaceae/Taxaceae, *Fraxinus, Ulmus, Juglans regia, Olea europaea, Pistacia, Plantago, Platanus orientalis, Quercus,* Urticaceae and *Xanthium strumarium*.

**Taxa with lowest allergenic effects:** *Acer*, *Aesculus hippocastanum, Ailanthus altissima, Carex, Carpinus, Carpinus, Castanea sativa, Castanea sativa, Centaurea, Eucalyptus camaldulensis, Fagus orientalis, Ligustrum vulgare, Morus,* Ostrya, Papaveraceae, Pinaceae, *Pistacia,* Poaceae, *Ranunculus, Salix, Taraxacum, Tilia* and Umbelliferae.

These observations reveal that pollens of *Olea europaea* show highest and medium effects, whereas the pollens of *Carpinus, Castanea sativa,* Chenopodiaceae/Amaranthaceae, *Pistacia* and Urticaceae can be included in the medium and lowest effects group. The pollens of Poaceae memebers include pollens with potential allergenic impacts of the highest , medium and lowest degree.

Allergic disease "polinosis" originates from the free amino acids, proteins, glycoproteins, lipoproteins, or polysaccharides, present in exine and intine layers of pollen (Levetin & Buck, 1980). Allergy in general is referred as the clinical response to allergens following the development of allergen sensitivity in atopic individuals. Allergens in atopic individuals produce specific immunoglobulin E (IgE)

antibodies. Asthma, rhinoconjunctivitis, gastrointestinal disorders and skin manifestations are the symptoms of allergic diseases (Sapan, 2011). Pollen allergens are water-soluble substances showing protein or glucoprotein structure and molecular weight ranging from 5-80 kDa.

The pollen allergy incidence shows variation all over the world, depending on the countries and different climates. In Europe and North America, the rates of allergic diseases in humans have been reported to lie around 5-7 percent (Burney, 1993; Weiss, 1993; Bousquet, 2001). In some countries this ratio has been reported as follows; Finland 14%, France 6-18.5%, The Netherlands 6.6%, Italy% 13, Japan 12.9-32.7%, Norway 10-20%, Spain 10%, Switzerland 4.4-14.2%, Sweden 13%, UK 11-24%, USA 10-42%, Germany 9.5-22.7%, Denmark 3.2%, Croatia 15-20%, and New Zealand 15-20% (Bousquet, 2001). In Turkey the incidence of allergic diseases is between 15-18%.

## Conclusions

The asthma and allergic diseases are spreading very fast all over the world. The percentages have increased highly during the last decades. Allergic diseases influence the quality and social aspects of life adversely, which in turn produce an adverse effect on the work productivity. This also has socio-economical impacts. The most important factor in pollen allergy, is the composition of the pollen in the air. The pollens from different plants show different allergic degrees in humans, particularly those with "atopic constitution". Pollen allergy symptoms show a good correlation with atmospheric pollen counts. Therefore, an identification of the pollens from different plant taxa causing allergic reactions proves of great help in this connection. The production of pollen calendars has particularly become very important in the daily life of humans around settlements, because the prevalence and etiology varies with different habitats. Presently many countries make announcements on the beginning of allergic pollen release, the highest density reached and the end of the period in meteorological bulletins, particularly thorugh internet, radio, television and newspapers. In Turkey these studies are contributing in the creation of pollen distribution maps.

In countries where tourism is an important source of income, atmospheric pollen studies; particularly in spring and summer when the population in tourist areas increases; will provide important information for pollen allergy sensitive persons. The pollen calendars will allow travellers to plan their trips more efficiently and on healthy basis. A qualitative and quantitative analysis of the atmospheric pollen, provides useful information to the doctors as well who can diagnose and treat the diseases due to pollen and provide efficient prescriptions for the drug use of patients.

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