

# AEROBIOLOGICAL MONITORING OF ALLERGENIC FLORA IN TIMISOARA

## MONITORING AEROBIOLOGIC ASUPRA FLOREI ALERGENICE ÎN TIMIȘOARA

IANOVICI NICOLETA

West University of Timișoara, Faculty of Chemistry-Biology-Geography

**Abstract.** *We report here the results of the monitoring of airborne pollen concentrations throughout 2000 to 2002 from Timișoara (România). A total of 21 allergenic pollen types were identified of which Ambrosia artemisiifolia pollen showed maximum concentration. Utilizing data on the aerobiological characteristics of allergophytes in urban ecosystem of Timisoara and taking into consideration some allergologic characteristics of their pollens, an allergen index (A.I.) is proposed. On the basis of this index, plants are grouped into strongly allergenic, moderately allergenic, slightly allergenic or of uncertain effect. The index can be used to conduct a rapid survey of a city's phytoallergenic potential. Further studies are needed to correlate climatic, phenological and aerobiological observations in our area.*

**Rezumat.** *Prezentăm în această lucrare rezultatele monitorizării concentrațiilor de polen aeropurtat din Timișoara, între anii 2000 și 2002. Am identificat un total de 21 de tipuri de polen alergen, între care cel provenind de la Ambrosia artemisiifolia a avut cele mai mari concentrații. Utilizând datele aerobiologice ale alergofitelor din ecosistemul urban al Timișoarei și unele caracteristici alergologice ale tipurilor polinice, propunem un index alergen. Pe baza acestuia, am grupat plantele în puternic alergenice, moderat alergenice, slab alergenice și fără efect cert. Studii viitoare vor necesita corelații cu observații climatice, fenologice și aerobiologice în arealul studiat.*

Aeroallergens are present as a natural part of the atmosphere, where they occur in the form of dust, aerosols, cellular material, particles as small as 0.01  $\mu\text{m}$ , and can be deposited on the mucous membranes of the eyes, nasal and oral cavity and airways. Aeroallergens include reproductive structures of many seed plants and fungi, as well as certain algae, bacteria and protozoa, which regularly undergo atmospheric transportation. In addition, biogenic debris, including mammalian danders and arthropod emanations, are also aeroallergens (Solomon & Mathews, 1988). Aeroallergens of plants can be derived from pollen of conifers and flowering plants, seeds, leaf and stem detritus and proteolytic enzymes. These allergens are a natural component of the atmosphere either through their biological activity or human activity (Ong et al., 1995).

Pollinosis is the most common allergic disorder. As is well known, the clinical manifestations of pollinosis are determined by a specific hypersensitivity to pollen, especially anemophilous pollens of certain plants, among genetically susceptible individuals (Pacini, 1990). A person can only develop pollinosis when he is exposed to pollen with allergenic properties. The severity of the symptoms depends in part on the

frequency of exposures and on the amount of pollen per exposure. Most exposures will be to pollen present in the air in relatively high concentrations (Driessen & Derksen, 1989). In practice this means that pollinosis is mostly caused by plants that depend on the wind for cross-fertilization: the wind-pollinating species. Due to the progressive increase in the human population of allergic manifestations brought on by pollen allergens, the need to study the phenomenon of pollinosis is becoming increasingly more urgent. In order to improve the quality of life of persons affected by these manifestations, it is useful to assess allergophyte presence and distribution directly in the city and to identify the urban areas particularly dangerous for the onset of pollinosis (Hruska, 2003).

The spectrum of air particles causing allergic rhinitis and asthma is rather well known. There are regional differences both in occurrence and allergenicity of pollen and spores. Due to human activities, we must await slight floral changes within a decade. Therefore, changes of the allergen content of the air should be observed, to react early enough with changes in diagnostic and therapy means whenever a new allergen should appear. If one or the other well known aeroallergen would show a significant trend to disappear, the obvious things will be easily done, but new allergens demand some time for organization of tests and therapeutical solutions (Jager, 1989). With up to 25% of the populations in industrialized countries suffering these diseases, the impact of allergy on society is significant. Of the diseases, allergic rhinitis (hay fever or pollinosis) has the highest incidence with 10–20% of the population suffering from this disorder; 5–10% exhibit asthmatic symptoms while 1–3% experience food allergies (Durham & Church, 2001). Whilst food allergy and eczema are often predominant in infancy, asthma and rhinitis often may not develop until late in childhood or early adulthood. Pollen allergy is also typically a seasonal disease often dependent upon the flowering season of the plant to which an individual is pollen-sensitive (Weerd et al., 2002). The knowledge of the presence, distribution, length and modality of flowering time of spontaneous and cultivated allergenic plants, compared with airborne pollen monitoring in a specific area is necessary for an etiologic diagnosis of pollinosis (Platt-Mills & Solomon, 1993). On a restrictive definition, plant species which are known to cause pollinosis in a substantial part of the population in a large area can be considered as allergenic (Lorenzoni et al., 1998). Plants considered dangerous in terms of the onset of allergies in the human population are those perennials with a phenantesic period lasting over a month or those that flower repeatedly during the same vegetative season. In addition, species considered strongly allergenic for man are those whose pollen provokes allergic reactions that are aggravated by food-related allergic reactions, particularly those from fruits or vegetables, through the phenomenon of cross reactivity (Eriksson 1993; Hruska, 2003).

## **MATERIALS AND METHODS**

In order to calculate the allergen index of a single species, the following parameters were taken into consideration: length of the phenantesic period (after Ciocârlan, 2000), presence of phenomena of cross reactivity and species abundance utilizing data on the aerobiological characteristics. These parameters were assigned numeric values in ascending order which express the potential of a plant species,

through its pollen, to cause allergic manifestations in man. Pollen count was carried out using a volumetric pollen trap (VPPS 2000 Lanzoni). Pollen was sampled during a 3-year (2000-2002) atmospheric pollen-monitoring programme in Timișoara, Romania. Measurements were performed mainly by the volumetric method in order to establish the spatial distribution of pollen in aeroplankton. Daily values expressed as pollen grains/m<sup>3</sup> of air per 24 h (Mandrioli et al., 1998). Airborne pollen concentration was expressed as a Pollen Index (PI = this index is expressed in percentage from annual sum pollen types during sampling period 2000-2002).

## RESULTS AND DISCUSSIONS

Monitoring of the pollen counts in the aeroplankton of cities is of relevant medical importance. The number of people allergic to plant aeroallergens has substantially increased in big cities and industrial areas (Nilsson & Persson, 1981). The allergen index value (A.I.) is the sum of the pre-chosen values for each of the partial characteristics outlined above. The parameters adopted were assigned values on an appropriate numeric scale. Table 2 presents calculation of the allergen index for the most common allergophytes in the western Romanian urban ecosystems, utilizing the scales of the proposed parameters from Table 1. Pollen grains of allergenic taxa occur in the atmosphere of Timișoara in large quantities from early February until late October. It is clear that the Romanian pollen seasons show 3 main parts: tree season (February–April), grass season (May–July), weed season (July–October). Classification of the plant species into groups of trees, grasses and weeds reveals exclusively tree airborne pollen to be found in March and April then in May and June the grass and weed pollen occurred, whereas an absolute predominance of weed pollen was recorded in July, August and September. The generally accepted conclusion is that the participation of arboreal pollen in the pollen fall reflects regional conditions, while the content of pollen of herbaceous plants reflects local ones (Ianovici, 2007). Comparing the allergenic indices obtained with the allergic manifestations of pollinosis patients, the numeric values were subdivided into the following four groups: A.I. up to 2 - uncertain effect; A.I. from 2,5 to 4,5 - species with slightly allergenic pollen; A.I. from 5 to 6 - species with moderately allergenic pollen; A.I. from 6,5 to 7 - species with strongly allergenic pollen.

These allergophytes are prevalently species of the *Poaceae* and *Asteraceae* families, which are becoming ever more abundant in the cities, especially because of the particular urban climate (Palmieri & Siani, 2000; Hruska, 2003). The allergenic flora in Timișoara can be roughly subdivided into two groups of plant species. One includes arboreal and shrub-like exotic species, growing and cultivated in private gardens and public parks. The second group includes perennial or annual spontaneous, mostly herbaceous species, growing anywhere in the urban environment provided where soil characteristics are favourable. Some agrarian species cultivated in peripheral areas are also present. All plants are spread in the urban environment according to their ecological characteristics and grow in the habitats most suited to them. They are mainly synanthropic weeds or ruderal species, whose propagation has been increasing according to the

continual expansion of waste areas. Other species grow in grassed areas, in traffic islands, along rivers and on channel banks, roadsides, and among hedges. The highly allergenic *Ambrosia artemisiifolia* is widely encountered. This leads to the necessity of individual testing with *Ambrosia* pollen and the complete study of this plant, in expansion in our country.

**Table 1.**

**Values of the parameters used in evaluating the allergenicity of plants**

Phenanthestic period	Cross reactivity	Abundance - Pollen index
less than one month = 0.5 more than one month = 2	none present = 0 present = 1	rare = 0.5 (0 – 0,99%) present = 1 (1 - 1,99%) rather common = 2 (2 - 4,99%) abundant = 3 (5-10%) very abundant = 4 (>10%)

**Table 2.**

**A.I. calculation for some plants frequently present in urban ecosystem**

Pollen type	Phenanthestic Period	Abundance (Pollen index)	Cross reactivity	Allergen index value
<b>strongly allergenic</b>				
<i>Ambrosia</i>	2	4 (19,99%)	1	7
<i>Poaceae</i>	2	4 (16,46%)	1	7
<b>moderately allergenic</b>				
<i>Urtica</i>	2	3 (8,97%)	1	6
<i>Artemisia</i>	2	3 (8,66%)	1	6
<i>Chenopodiaceae/Amaranthaceae</i>	2	2 (4,02%)	1	5
<i>Rumex</i>	2	2 (3,83%)	1	5
<i>Carpinus</i>	2	2 (3,48%)	1	5
<i>Betula</i>	2	2 (3,41%)	1	5
<i>Alnus</i>	2	2 (2,03%)	1	5
<b>slightly allergenic</b>				
<i>Populus</i>	2	2 (4,19%)	0,5	4,5
<i>Taxaceae/Cupressaceae</i>	2	2 (3,26%)	0,5	4,5
<i>Pinaceae</i>	2	2 (3,1%)	0,5	4,5
<i>Salix</i>	2	2 (2,76%)	0,5	4,5
<i>Acer</i>	2	2 (2,73%)	0,5	4,5
<i>Corylus</i>	2	1 (1,08%)	1	4
<i>Ulmus</i>	2	1 (1,04%)	0,5	3,5
<i>Quercus</i>	2	1 (1,17%)	0,5	3,5
<i>Fraxinus</i>	2	1 (1,26%)	0,5	3,5
<i>Tilia</i>	2	1 (1,84%)	0,5	3,5
<i>Morus</i>	0,5	2 (2,06%)	0,5	3
<i>Plantago</i>	2	1 (1,98%)	1	2,5
<b>uncertain effect</b>				
<i>Juglans</i>	0,5	1 (1,91%)	0,5	2
<i>Platanus</i>	0,5	0,5 (0,59%)	0,5	1,5

The flowering time demonstrates the presence of two different floral groups. Most cultivated phanerophytes are flowering at the beginning of spring, whereas the spontaneous plants delay their anthesis in late spring. The anthesis of spontaneous flora, however, can continue later and recur. In some cases there is no temporal overlap between flowering time and aerobiological data of the families. Pollens of *Corylaceae*, *Betulaceae*, *Chenopodiaceae/Amaranthaceae*, *Fagaceae* and *Polygonaceae* are detectable in the air for a period longer than the flowering time of the same species. In cultivated species, anthesis can be influenced by phytopathological treatment and by regular light (Lorenzoni et al., 1998). The numeric increase in pollinosis patients is especially accentuated in

large towns and cities, where studies of allergenic flora are fairly demanding. Selective floristic cartography has helped reduce money and monitoring time employed for study of urban allergophytes. Allergophyte distribution is assessed and urban areas particularly invaded by these species are identified, thus indicating residential zones unsuitable for pollinosis patients. Since the symptomatology of these illnesses varies considerably over the course of a year, it is very useful to indicate the periods of a given pollen's maximum production. Utilizing this data, one can define prevention and treatment measures for people who suffer from allergenic manifestations caused by urban pollens in order to ease the symptomatology of the illness (Hruska, 2003).

The geographic position of an urban ecosystem influences the presence and abundance of allergophytes. A species is usually more abundant in the central part of its areal and thus can be strongly allergenic in the center of its area of distribution and moderately dangerous on the edges of this area. A similar observation can be made about the species capable of occupying different habitats. In fact, a species develops most abundantly in its optimal habitat, and here, as well, the allergenic effects provoked by its pollen will also be most evident. The urban ecosystem hosts a rich reservoir of strongly allergogenic plants. The presence of the latter is continually increasing, as various species are brought into the city accidentally or deliberately by man. As already established, the period of time spent in contact with allergogenic taxa can influence the pathogenesis of pollinosis in people already sensitized to pollens (Ricci et al., 1993). Take, for example, the allergy suffered by urban children, caused by the pollen of *Aesculus hippocastanum*, an ornamental tree often used in urban parks (Popp et al., 1992). City park management can influence the allergic responses of inhabitants, as has been noted in Switzerland (Frei & Leuschner, 2000).

## CONCLUSIONS

Airpalynologic values recorded during the years 2000- 2002 show huge differences for our geographic area concerning the incidence of the pollen of some plants with airborne allergen pollen. We notice the abundance of the pollen coming from a species which is adventives in our country's flora: the *Ambrosia artemisiifolia*. Allergenic pollen taxa identified in Timișoara during monitoring throughout 2000–2002 was: *Acer*, *Alnus*, *Ambrosia*, *Artemisia*, *Betula*, *Carpinus*, *Corylus*, *Chenopodiaceae/Amaranthaceae*, *Fraxinus*, *Morus*, *Quercus*, *Pinaceae*, *Plantago*, *Poaceae*, *Populus*, *Rumex*, *Salix*, *Taxaceae/Cupressaceae*, *Tilia*, *Ulmus*, *Urtica*. More attention must be paid to these taxa, especially in managing of allergy problems in urban areas. The study of the concentrations of airborne pollen at the beginning of and during the season, the knowledge of peak concentrations and of the year to year variations, together with the phenological data regarding the frequency, distribution in the urban area and course of flowering of the allergenic plants, contribute to the understanding of allergic phenomena.

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