

AIR-BORNE FUNGI IN THE AIR OF BARCELONA (SPAIN). III. THE GENUS *ASPERGILLUS* LINK

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Abstract

During a survey on the presence of species of the genus *Aspergillus* in the air of the city of Barcelona (Spain), the following species were identified: *Aspergillus flavus* Link, *A. niger* van Tieghem, *A. fumigatus* Fresenius, *A. clavatus* Desmazières, *A. terreus* Thom, *A. chevalieri* (Mang.) Thom et Church, *A. niveus* Bloch, emend. Thom et Church, *A. ochraceus* Wilhelm, *A. versicolor* (Vuillemin) Tiraboschi, and *A. amstelodami* (Mang.) Church et Thom.

established as follows: Early morning (8.30–9.30 A.M.), midday (1.30–2.30 P.M.), and evening (10.30–11.30 P.M.). The culture media utilized in the identification of species were those described by Raper and Fennell (15): Czapek-Dox agar medium supplemented with 20 or 30 % sucrose, malt extract agar and the medium M 40 Y, the latter one occasionally used for a few species.

Introduction

The genus *Aspergillus* is one of the basic components of the atmospheric mycoflora in most cities of the world. However, few are the authors of aerobiological surveys which indicate the different species of the genus isolated, and on the other hand, the seasonal presence the year around of the different species encountered is seldom considered.

The authors of this paper present a survey of the different species of *Aspergillus* isolated in the air of Barcelona at different intervals of the day and at different areas of the city during the two-year period comprised between the month of February 1976 to the month of January 1978.

Material and methods

Sampling methods have been described in a previous paper (3). Samples were recovered daily during a period of 24 months at four sampling areas of the city: the outskirt (A.Z.), the University (B.Z.), downtown (C.Z.), and at the coastal area (D.Z.). The sampling hours were

Table I. Number of spores per cubic meter of species of the genus *Aspergillus* isolated monthly.

MONTH	Morning		Midday			Evening	
	A.Z.	B.Z.	A.Z.	B.Z.	C.Z.	A.Z.	D.Z.
February	32.5	17.6	32.0	30.0	—	14.9	47.5
March	27.5	15.2	20.3	18.7	—	17.5	41.6
April	226.0	66.6	99.9	23.8	16.6	15.2	14.5
May	486.1	31.2	21.1	28.2	25.0	609.8	26.2
June	33.1	36.1	38.3	25.0	21.8	52.1	22.1
July	18.3	59.2	38.1	28.6	12.5	45.8	88.7
August	33.8	31.2	40.4	21.4	12.5	115.8	18.7
September	15.0	12.5	12.5	12.5	15.6	14.5	21.4
October	12.5	12.5	12.5	15.6	12.5	15.5	25.0
November	25.0	19.8	12.5	12.5	12.5	27.0	16.6
December	17.5	16.6	19.6	12.5	12.5	12.5	12.5
January	19.6	26.7	14.7	16.6	12.5	20.3	12.5
February	18.7	20.8	31.2	12.5	—	15.6	12.5
March	—	12.5	12.5	—	—	25.0	20.8
April	16.6	29.1	20.8	12.5	—	12.5	25.0
May	16.3	16.4	13.7	15.0	12.5	12.5	12.5
June	35.9	28.9	17.1	20.3	37.5	23.4	12.5
July	22.2	12.5	12.5	12.5	12.5	30.5	—
August	31.8	31.1	38.4	10.5	12.5	60.8	18.7
September	16.0	12.5	12.5	12.5	15.6	12.6	24.8
October	12.5	12.5	15.6	12.5	14.7	26.0	15.4
November	16.5	14.6	15.7	12.5	10.5	24.7	15.4
December	16.5	15.6	17.4	12.5	12.5	12.6	12.6
January	18.6	25.6	13.6	15.4	12.5	19.4	10.4

Note: A.Z. = Outskirt area; B.Z. = University area; C.Z. = Downtown area; D.Z. = Coastal area.

Results

Table 1 shows spore counts per cubic meter, per sampling at the different hours of the day.

During the survey the following species of *Aspergillus* were identified: *Aspergillus flavus* Link, *A. niger* van Tieghem, *A. fumigatus* Fresenius, *A. clavatus* Desmazières, *A. terreus* Thom, *A. chevalieri* (Mang.) Thom et Church, *A. niveus* Bloch, emended Thom et Raper, *A. ochraceus* Wilhelm, *A. nidulans* (Eidam) Wint., *A. ustus* (Bain.) Thom et Church, *A. versicolor* (Vuillemin) Tiraboschi, and *A. amstelodami* (Mang.) Church et Thom.

Discussion

Species of the genus *Aspergillus* were recovered along the whole year, not being subject then, in this instance, to seasonal variations. However, Kramer *et al.* (13) reported seasonal variations of this genus in the air of Manhattan, Kansas, with a high incidence in spring and a decrease in summer. From our own experience, we have to emphasize the high incidence of *Aspergillus* species during the winter months, principally at the early morning hours. The highest counts were found during the months of April and May at the outskirt area. However, mean values are generally maintained constant the year around.

Kramer *et al.* (13) identified in their survey a total of 23 different species of *Aspergillus*, among which *A. niger* van Tieghem was by far the commonest of all (32 % of the total colony counts), followed by *A. amstelodami* (Mang.) Church et Thom (23 %). In the air of Barcelona, *Aspergillus flavus* Link was the commonest species recovered from almost all samples, with a decrease during the month of July 1977. This species was followed in importance by *A. niger* van Tieghem.

Among the remainder species of *Aspergillus* isolated, *A. fumigatus* Fresenius, whose importance is well known in its implication with human health, was found to present a maximum of incidence during the period between April and December 1976, mostly at the outskirt area and at the University area. However, it was never recovered from the downtown area. A comparative study of the presence of *A. fumigatus* was carried out between the air in Barcelona and those in three Mediterranean cities in a previous work (4). Evans (7) found *A. fumigatus* in 50 % of the exposed Petri plates by incubating them at 45 °C. On the other hand, the same author considered this species as a constant component of the atmosphere the year

around. Hudson (11), in a recent study of thermophilous and thermotolerant fungi in the air of Cambridge, reported a spore concentration of 0.3–13 spores per cubic meter, accounting for the 69 % of the total of thermoresistant colonies, finding the highest values during the months of December and January. However, the presence of *A. fumigatus* showed lower values in the air of Israel (2) and Manhattan, Kansas (13).

Hudson (13) reported 14 species of *Aspergillus* isolated in the air of Cambridge, with an incidence of 1.1–1.4 % of the total colony counts. The species most frequently found by this author were *A. amstelodami* (Mang.) Thom et Church, *A. fumigatus* Fresenius, *A. repens* (Corda) Debary, and *A. versicolor* (Vuillemin) Tiraboschi. The highest values were recorded during the winter months and the lowest values were recorded from March to April, with another peak in July and August.

Feinberg's studies (9) by means of a gravimetric method, found a lack of seasonal periodicity in the incidence of *Aspergillus* species, the distribution along the year being uniform, and the percent of incidence accounting for the 4 % of the total colony counts. Pawsey (14), using the same method, found 54 colonies of *Aspergillus* during a whole year among 7,238 fungal isolates. Almost the 50 % of the *Aspergillus* species were recovered in January, February and June. The incidence of *Aspergillus* species in the air of Cardiff (12) was low. Only 34 isolates were encountered during a period of 12 months.

Studies on the presence of the genus *Aspergillus* in the air has been carried out in several cities of the world: Stockholm (17), San Antonio (Texas) (1), Albuquerque (New Mexico) (6), Miami (Florida) (18), Florianopolis (Brasil) (8), Phoenix (Arizona) (10), Turin (Italy) (19), Pavia (Italy), (5), Trujillo (Perú) (16), among others.

The genus *Aspergillus* occupied the fifth rank among the fungi encountered in our own study of the air in Barcelona, accounting for a 2.86 % of the total colony counts.

References

1. Al-Doory, Y. 1967. Further studies of the fungal flora of the air in San Antonio, Texas. *J. Allergy*. 40: 145–150.
2. Barkai-Golan, R., M. Frank, B. Kantor, R. Karadavid & D. Toshner. 1977. Atmospheric fungi in the desert town of Arad and in the coastal plain of Israel. *Ann. Allergy* 38: 270–274.
3. Calvo, M^a A., J. Guarro, & G. Suárez. 1976. Los hongos como agentes etiológicos de alergias y enfermedades pulmonares: su incidencia en Barcelona. *Anales de Medicina y Cirugía*. 61: 329–340.

4. Calvo, M^a A., J. Guarro, & E. Vicente. 1978. Presencia de *Aspergillus fumigatus* Fresenius en la atmósfera urbana. *Anales de Medicina y Cirugía* 69: 219–223.
5. Caretta, G.E. Piontielli, G. del Frate, A. Crippa, L. Savini & F. Todaro. 1975. Spore fungine dell' atmosfera urbana di Pavia: risultati ottenuti con il metodo di esposizione delle piastre. *Rivista di Patologia Vegetale*. 11: 5–23.
6. Dupont, E.M., R.C. Field, F.R. Leathers, & W.T. Northey. 1967. A survey of the airborne fungi in the Albuquerque, New Mexico, metropolitan area. *J. Allergy* 39: 238–244.
7. Evans, H.C. 1972. Thermophilous fungi isolated from the air. *Trans. Brit. Myc. Soc.* 59: 516.
8. Faraco, B.F., & B.A. Faraco. 1974. Poluição micológica da atmosfera. *Rev. Brasileira de Medicina* 31: 11.
9. Feinberg, S.M., & H.T. Little. 1935. Studies on the relation of microorganisms to allergy. III. A year's survey of daily mould spores content of the air. *J. Allergy*. 7: 149–155.
10. Goodman, D.H., W.T. Northey, C.R. Leathers, & T.H. Savage. 1966. A study of airborne fungi in the Phoenix, Arizona metropolitan area. *J. Allergy*. 38: 56–62.
11. Hudson, H.J. 1969. *Aspergilli* in the air-spores at Cambridge. *Trans. Brit. Myc. Soc.* 52: 153–159.
12. Hyde, H.A., & D.A. Williams. 1949. A census of mould spores in the atmosphere. *Nature*. 164: 668–669.
13. Kramer, C.L., S.M. Pady, & C.T. Rogerson. 1960. Kansas aeromycology. V. *Penicillium* and *Aspergillus*. *Mycologia*. 52: 545–551.
14. Pawsey, R.G. 1964. An investigation of the spore population of the air at Nottingham. *Trans. Brit. Myc. Soc.* 47: 357–363.
15. Raper, K.B., & D.I. Fennell. 1965. The genus *Aspergillus*. Williams & Wilkins Co., Baltimore. 696 pp.
16. Requejo, H.V., 1975. Micoflora atmosférica de la ciudad de Trujillo (Perú). III. Géneros aislados durante el año 1971. *Mycopatologia*. 36: 15–20.
17. Scandinavian Symposium on Aerobiology, Solna, April 17–18, 1972. *Grana*. 12: 121–128.
18. Sorenson, W.G., G.S. Bulmer, & L.H. Crip. 1974. Airborne fungi from five cities in the continental United States and Puerto Rico. *Ann. Allergy*. 33: 131–137.
19. Volterrani, L.. & U. Tosco. 1957. Allergia da spore fungine. *Minerva Medicina*. 48: 4283.