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Incidence of *Alternaria* Nees ex Fries in dwellings of Córdoba City (Spain)

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SUMMARY

We have studied the occurrence of *Alternaria*, a genus of allergenic interest in the indoor atmosphere of 14 homes in Córdoba throughout 1984.

The sampling was carried out by sedimentation on a broad-spectrum mycological culture medium (2% Agar-Malt extract) in Petri dishes. Samples were collected every fortnight in 14 homes (three dishes per home were exposed in the following rooms, namely the kitchen, the toilet and the bedroom, for 20 minutes) located in different areas of the city and as much as possible representing the various physical conditions found.

An overall of 727 *Alternaria* colonies belonging to six species (*A. consortiale*, *A. crassa*, *A. dendritica*, *A. japonica*, *A. tenuis* and *A. tenuissima*) were detected. Some of them were proven allergenic. They accounted for 5.2% of all fungal colonies found indoors.

A. tenuis was by far the most frequently found species, followed by *A. tenuissima* (second in number) and *A. consortiale* (the most cosmopolitan) as they were the only species found in all 14 homes. On the other hand, *A. crassa* was the least frequent of all species collected.

We have also determined the general variation of *Alternaria* and that of the different species found indoors throughout the year, finding a trend with the appearance of peaks towards spring and early summer, especially in June.

Key words: *Alternaria*. Mycology. Aeromycoflora. Allergenic mycoflora. Indoor aerobiology.

Palabras clave: *Alternaria*. Micología. Aeromicoflora. Micoflora alérgica. Aerobiología de interior.

INTRODUCTION

Alternaria Nees ex Fr. (Or. *Moniliales*) lives as a saprophyte or parasite on various vegetable substrates. It is usually found indoors on fabrics, clothes or foods such as juices and fruit, and hence its spores are found in the air. This genus is accounted as a human allergen, sporosis-inducer and an agent responsible for hay fever and other pathologies, as reported by numerous authors, namely Hopkins et al. (15), Bonilla-Soto et al. (3), Caplin and Haynes (6), Gregory (14), Pedersen et al. (21), Gravesen (12, 13), Petersen and Sandberg (22) and Muñoz and Martín (19), among others.

Many authors have studied the variation of the incidence of fungal spores in air, and that of *Alternaria* in particular, all over the world. Thus, Kramer et al. (17) studied volumetrically the variation of this genus for two years and reported three species (*A.*

tenuis, *A. consortiale* and *A. cucumerina*) as the most frequently found in Kansas. Calvo et al. (4) isolated gravimetrically in a culture medium six species occurring in the atmosphere of Barcelona (*A. alternata*, *A. chartarum*, *A. saponariae*, *A. oleracea*, *A. tenuissima* and *A. consortialis*) and reported their variation during two years of sampling. Sneller et al. (24) studied the annual variation of *Alternaria* in Arizona for a period of 20 years and found the smallest number of spores between late summer and early winter. In a recent study on the outdoor atmosphere of Córdoba (20), the authors identified six *Alternaria* species (*A. alternata*, *A. dianthi*, *A. radicina*, *A. raphani* and *A. tenuissima*) by using the two sampling methods most frequently employed for this purpose, of which the gravimetric method on a culture medium proved to be the more efficient for the sampling of spores of this genus from air.

The aim of this work was to determine the occurrence of the different *Alternaria* species present in various dwellings, and establish their variation throughout 1984 in the indoor atmosphere of homes in Córdoba.

MATERIAL AND METHODS

Samplings (representing indoor atmosphere varieties in Córdoba) were carried out bi-weekly throughout 1984 in fourteen different spots all over the city, except in August, this being the holiday month when the proprietors were away from their homes.

Samples were collected on Petri dishes (Ø 90 mm) containing sterile, broad-spectrum mycological culture media, which were exposed to the air for 20 minutes simultaneously in three different parts of the house (kitchen, bathroom and bedroom).

The culture medium used consisted of 2% Agar-Malt extract and oxytetracycline, the pH being adjusted to 5. Once exposed, the dishes were incubated at 27°C for seven days, the colonies being subsequently counted, isolated and identified by the usual method in each case.

The different species were identified according to Joly's monograph on the genus (16) and the works by Ellis (9, 10) and Simmons (23). Joly's criteria of nomenclature (16) was followed.

Although the quantitative study per unit volume of the sampled air was not possible, the gravimetric method permitted us to estimate the relative variation both qualitatively and quantitatively between indoor and outdoor occurrences. This method has been and is still used for quantification of fungal populations in air by various authors throughout the world: Dransfield (8), Gravesen (11), Collins-Williams et al. (7), Lumpkins et al. (18), Calvo et al. (4), Al-Doory et al. (1), Al-Tikriti et al. (2), etc.

RESULTS

An overall total of 725 *Alternaria* colonies corresponding to six species were counted. This figure represented 5.2% of the total number of fungal colonies isolated indoors throughout 1984. The number of colonies found for each species and their relative occurrences are listed in Table I which also shows the number of homes where each taxon was found, both in absolute and in relative terms.

In fig. 1 is illustrates the variation of the occurrence

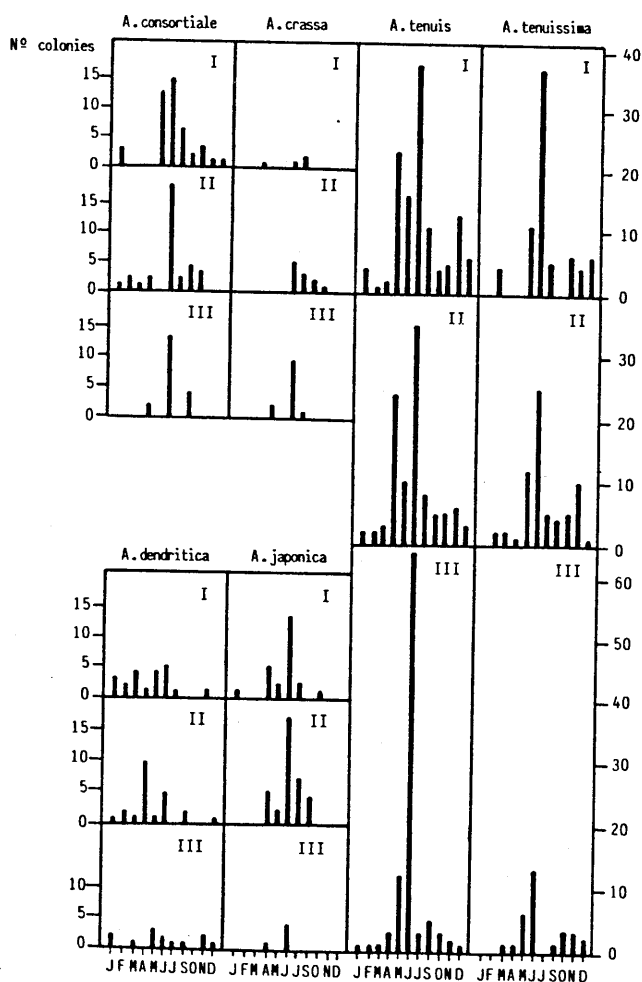


Fig. 1.—Number of colonies of the *Alternaria* species counted samples in each of the three types of room (I: kitchen; II: bathroom; III: bedroom) during 1984.

TABLE I
TOTAL NUMBER OF COLONIES COUNTED FROM EACH SPECIES, RELATIVE INCIDENCE AND NUMBER OF HOMES WHERE THEY WERE FOUND, IN ABSOLUTE AND RELATIVE TERMS

Taxa	Colonies	%	Homes	%
<i>A. consortiale</i>	95	13.1	14	100
<i>A. crassa</i>	25	3.5	9	64
<i>A. dendritica</i>	58	8.0	12	86
<i>A. japonica</i>	59	8.1	12	86
<i>A. tenuis</i>	323	44.6	14	100
<i>A. tenuissima</i>	164	22.6	14	100
<i>Alternaria</i> sp.	1	0.1	1	7

of each species samples in the three different rooms during the period investigated, while Fig. 2 represents the annual variation of the indoor occurrence of the genus as a whole throughout 1984. The graphs in Fig. 3 reflect the variation of the genus in each of the three rooms and the indoor incidence throughout 1984.

The species identified were *Alternaria consortiale* (Thüm.) Hughes, *A. crassa* (Sacc.) Rands, *A. dendritica* (S. Cam.) Joly, *A. japonica* Yoshii, *A. tenuis* Nees and *A. tenuissima* (Fr.) Wiltsh.

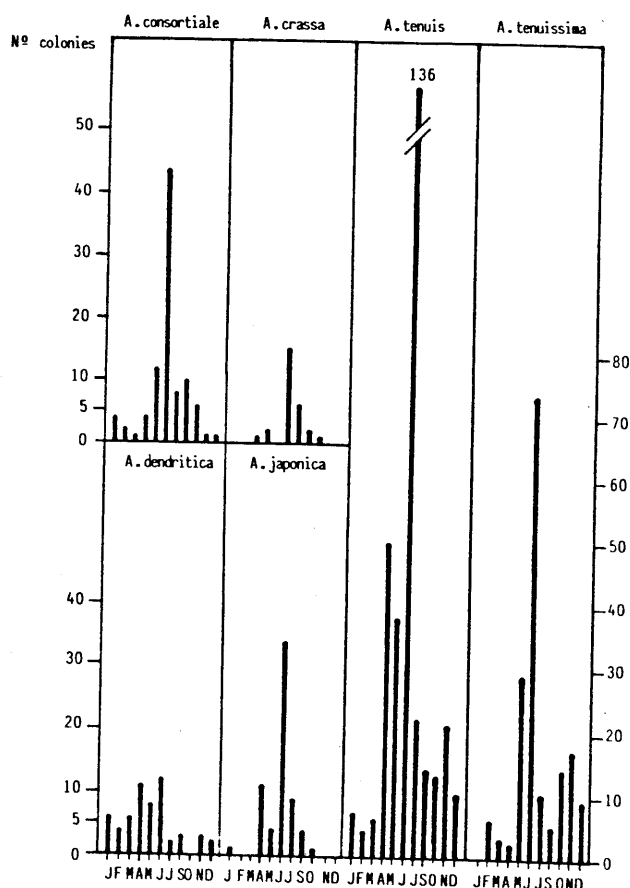


Fig. 2.—Overall number of colonies of *Alternaria* species samples found in 14 homes during 1984.

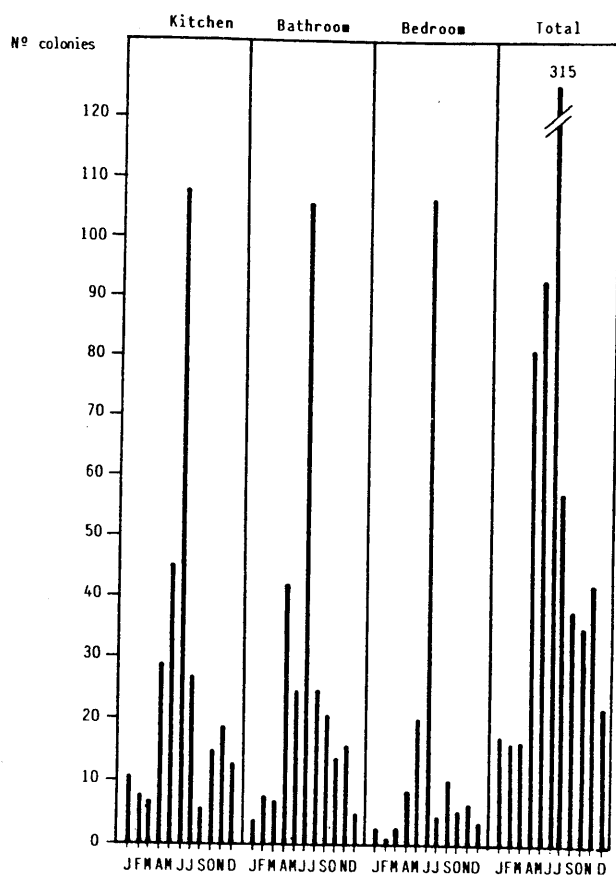


Fig. 3.—Overall number of *Alternaria* colonies counted in each of the three types of room and overall indoor colonies.

DISCUSSION

The *Alternaria* genus is a common component of indoor aeromycoflora. In fact, as can be seen from its annual variation (Fig. 3), it occurs throughout the year at high or low levels. It accounts for 5.2% of the overall number of fungi found indoor in Córdoba, i.e. well below the 16% found by Gravesen (11) in Danish homes.

A. tenuis was by far, the species most frequently found (44.6%). This has been reported to occur outdoors by Kramer et al. (17) in USA, and by Calvo et al. (4) and Nogales et al. (20) in Spain. *A. tenuissima* was second in abundance (22.6%). Both species and *A. consortiale* could be considered the most cosmopolitan as they were the only ones found in all fourteen sampling spots, even though the rest were also found in high proportions (Table I). *A. crassa* was the least abundant of all as it only accounted for 3.5% of the overall incidence of the genus.

The annual variation of the indoor occurrence of *Alternaria* in air in Córdoba is markedly seasonal (Fig. 3), reaching minimum in winter (December to March) and maximum from mid-spring to early summer (April to July). This seasonal variation is clearly consistent with that found by the authors (20)

outdoors in Córdoba in 1986, where the maximum and minimum concentrations were detected in May and during the winter, respectively. Solomon (25) also found low incidence of indoor *Alternaria* during the winter months. However, Gravesen (11) found the maximum incidence in mid-summer; the difference is probably influenced by the various climates and environmental conditions.

Only two species, namely *A. consortiale* and *A. tenuis* occurred throughout the year (Fig. 2). It is worth noting that despite its abundance, *A. tenuissima* was not detected in January (the coldest month in Córdoba), and neither was *A. dendritica*, in October.

In general, there were no significant differences in the variation of the occurrence of *Alternaria* in the three rooms investigated (Fig. 3), although quantitatively, bedrooms provided concentrations well below those found in the rest of the rooms. *A. consortiale*, *A. dendritica*, *A. japonica* and *A. tenuissima* were found in significantly lower concentrations in bedrooms (Fig. 1). This was also the case with *A. tenuis*, although the bedroom concentration was more similar to the bathroom and kitchen concentrations. *A. crassa* was the only species found at lowest concentrations in kitchens.

As can be seen from Fig. 2, all the species studied have a definite annual variation, except for *A. dendritica*, the concentration of which remained within narrower ranges. The number of colonies found for all species except this increased significantly in June.

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RESUMEN

Se estudia la incidencia de *Alternaria* en el aire de interior de catorce hogares de la ciudad de Córdoba, durante el año 1984.

Este género ha sido citado por numerosos autores (Hopkins et al., 1930; Bonilla-Soto et al., 1969; Caplin and Haynes, 1970; Gregory, 1973; Pedersen et al., 1976; Gravesen, 1979, 1981; Petersen and Sandberg, 1981; Muñoz et al., 1983) como alergénico humano, productor de esporosis, responsable de estados parecidos a la fiebre del heno y otras patologías.

Vive como saprófito o parásito sobre diversos sustratos vegetales. En el interior de los hogares es frecuente sobre fibras textiles, ropa o alimentos como frutas, zumos, etc., esto hace que sus esporas se encuentren con cierta frecuencia en el aire.

Para el muestreo se utilizó el método de sedimentación sobre un medio de cultivo micológico (agar extracto de malta al 2%) de amplio espectro, vertido sobre placas de Petri. Se ha muestreado quincenalmente en catorce viviendas, exponiéndose tres placas en diferentes habitaciones (cocina, aseo y dormitorio) durante veinte minutos, distribuidas por toda la ciudad y cubriendo en lo posible las diversas condiciones físicas.

El propósito de este trabajo es el conocimiento de las especies de *Alternaria* que puedan encontrarse en los hábitats de interior, la comparación de su incidencia en diferentes habitaciones y el establecimiento de la variación anual de estas especies en la atmósfera de interiores de la ciudad de Córdoba.

Este género es un componente habitual de la aeromicroflora de

interior, ya que aparece durante todo el año en unos u otros niveles.

Se han contabilizado 725 colonias de *Alternaria* pertenecientes a seis especies de este género (*A. consortiale*, *A. crassa*, *A. dendritica*, *A. japonica*, *A. tenuis* y *A. tenuissima*); algunas de ellas con probada capacidad alergizante. Estas cantidades representan el 5,2% del total de colonias de hongos aisladas en el interior.

A. tenuis ha sido la más abundante, destacando por su frecuencia del resto de las especies. Esta especie, junto con *A. tenuissima* (segunda en importancia) y *A. consortiale* son las más cosmopolitas, pues son las únicas que se encontraron en los 14 puntos de muestreo. *A. crassa* es la menos abundante de todas las especies recolectadas.

Se ha obtenido así mismo la fluctuación de *Alternaria* en general y en particular de las diferentes especies a lo largo de todo el año en el interior de hogares, pudiéndose observar una tendencia general a unos máximos de aparición en primavera y principios del verano, especialmente en el mes de junio.

En general no existen diferencias significativas en la variación entre las tres habitaciones investigadas, aunque cuantitativamente el dormitorio presenta valores claramente inferiores al resto de las habitaciones. En la comparación entre las habitaciones, *A. consortiale*, *A. dendritica*, *A. japonica* y *A. tenuissima* presentan valores sensiblemente inferiores en el dormitorio; *A. tenuis* presenta también valores más bajos en esta habitación, aunque más igualados con las otras dos; *A. crassa* es la única que presenta valores más bajos en la cocina.

Todas las especies estudiadas presentan una clara variación anual, a excepción de *A. dendritica*, que se mantiene dentro de unos límites más homogéneos. En estas mismas gráficas pueden observarse un significativo aumento de colonias durante el mes de junio de todas las especies, excepto el caso de *A. dendritica*.

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