

New and noteworthy fungi from Kuwait

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ABSTRACT

Seventeen species of fungi are reported for the first time from Kuwait: eleven Hyphomycetes and six Ascomycetes (Eurotiaceae, one species; Gymnoascaceae, two species; Chaetomiaceae, two species; and Microascaceae, one species). *Chrysosporium tropicum* Carmichael (Hyphomycetes), first recorded from Kuwait in 1971, was re-found from numerous localities by the author. *Cephalophora tropica* Thaxter, first recorded from Kuwait in 1982, was re-found growing in abundance on dung.

INTRODUCTION

Moustafa (1975, 1978, 1982, 1986) reported 268 fungal species from Kuwait, isolated from air and different soil habitats. The present paper reports 17 species, 14 of which are new to the fungal flora of Kuwait. Among these 17 species, 10 are keratinophilic.

Chrysosporium tropicum Carmichael (Hyphomycetes) was recorded from a salt marsh in Kuwait for the first time by Moustafa in 1971 (published 1975). The present author reports this species from the majority of soil samples collected from numerous desert localities in Kuwait.

MATERIALS AND METHODS

Samples from desert soils were collected for an ecological survey of keratinophilic fungi in Kuwait. The localities chosen represented three major communities which constitute the greater part of the vegetation cover of the desert. These are *Rhanterium epapposum* in the north and north west, *Hammada salicornica* in the north, and *Cyperus conglomeratus* in the west and the south of Kuwait. Additional samples were collected from the animal breeding unit at the Omariya Agricultural Experimental Station where cattle, sheep, goats and domestic birds are kept. The soils varied from loose or compacted light brown sandy loam to loamy sand. The pH value of all soils was around 8.00 and T.D.S. ranged from 2–2.5%. The concentration of organic carbon ranged between 0.06 and 0.25%.

The isolation of keratinophilic fungi was performed by the baiting of the soil samples with animal wool obtained from Scholl (U.K.) Limited. The wool was degreased by refluxing in diethyl ether for 24 hours and autoclaved for 10 min at

1.5 bar. The baited soils were moistened with sterile distilled water and incubated for three to four weeks at 25°C. Obvious fungal growth was re-isolated in pure culture and identified. Keratinophilic activity was tested by the visual degradation of wool or human hair in pure culture. Other non-keratinophilic species were occasionally isolated as they show obvious growth on debris present in the baited soil samples. Dung-loving fungi were isolated from sheep dung incubated in moist chambers in daylight for a period of two weeks.

The identification was carried out by the author in the Botany and Microbiology Department, Kuwait University and kindly checked by the staff of the Centraalbureau voor Schimmelcultures—Baarn, the Netherlands. The illustrations were made by the author using camera lucida, then traced by a draftsman.

Samples of all species are kept in the Kuwait University culture collection; a duplicate of *Pseudallescheria ellipsoidea* (v. Arx & Fassati) McGinnis, Padhye & Ajello is deposited with the CBS—Baarn collections (the Netherlands).

The following pages report a list of the 17 species accompanied by short descriptions, relationships, ecological notes, and illustrations whenever available.

ASCOMYCETES

FAMILY GYMNOASCACEAE

Gymnoascus reesii Baranetzky. Bot. Zeit. 30: 145–60 (1972). (Fig. 1, Plate 1).

The fungus was isolated from its ascocarps which colonize exposed edges of the defatted animal wool inserted in soil under laboratory conditions.

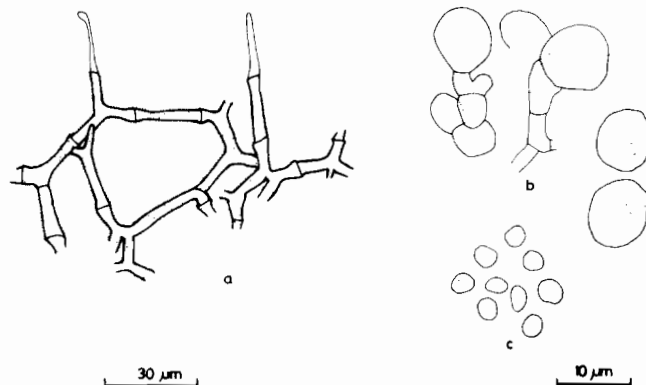


Fig. 1. *Gymnoascus reesii*: (a) peridial hyphae and appendages, (b) asci, (c) ascospores.

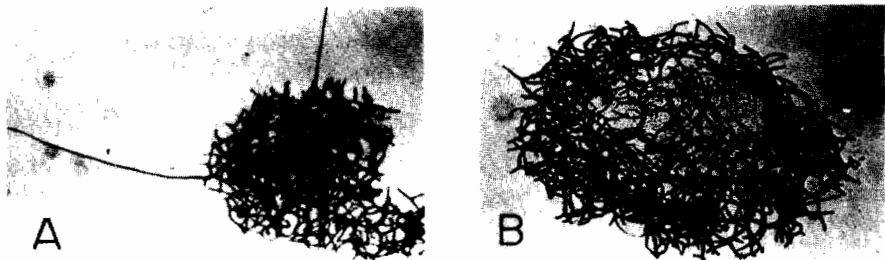


Plate 1. *Gymnoascus reesii*: (A) Minute ascocarp showing apically bent peridial spines and long straight appendages ($\times 58$), (B) fully developed ascocarp ($\times 82$).

Ascocarps produced from strains kept in our collections are globose, 300–450 μm , pale coloured, peridial appendages typically short, 30–40 μm , blunt, often bent near the apex. In old cultures, elongated appendages are often produced; these are sinuate or uncinata at the apex, rarely with lateral branch; ascospores globose to ellipsoid, 3–4 \times 2–2.5 μm (3–4.5 \times 3.5 μm in Apinis (1964)).

Auxarthron thaxteri (Kuehn) Orr & Kuehn. Mycologia 63(2): 200 (1971). (Fig. 2, Plate 2).

Myxotrichum thaxteri Kuehn. Mycologia 47: 878 (1955).

Auxarthron brunneum, sensu Orr & Kuehn. Can. J. Bot. 41: 1446 (1963).

Conidia of the anamorph colonize the whole surface of animal wool used for soil baiting. Strains kept in our collections produce brown or orange ascocarps in culture; diameter 500–600 μm , peridial wall often with elongated appendages; these are undulate with uncinata or circinate apices; ascospores spherical, slightly compressed in the centre, 2.5–3.0 μm ; conidia are *Chrysosporium*-like, 5.5–9 \times 3.5–5 μm , terminal or lateral on hyphae or on short lateral branches, or more often intercalary, hyaline, smooth-walled. This species is strongly keratinophilic and vigorously colonizes animal wool in culture; reported from several desert soils.

Gymnoascus and *Auxarthron* may be separated as follows: the ascospores are globose-ellipsoid in *Gymnoascus* and predominantly spherical in *Auxarthron*.

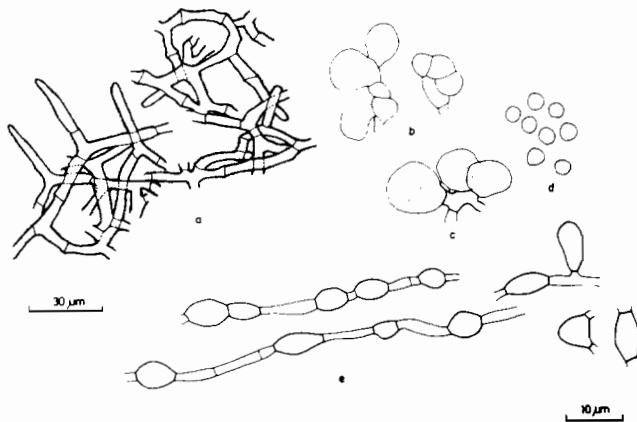


Fig. 2. *Auxarthron thaxteri*: (a) peridial hyphae, (b) ascogenous hyphae, (c) asci, (d) ascospores, (e) conidia of the anamorph.



Plate 2. *Auxarthron thaxteri*: (A) elongated appendages emerging from peridium ($\times 57$), (B) fully developed ascocarp ($\times 81$).

Moreover, the peridial hyphae of *Gymnoascus* and *Auxarthron* differ in thickness at the joints ($4\text{--}6\ \mu\text{m}$ in *Gymnoascus* and $6\text{--}10$ (12) μm in *Auxarthron*), as well as in the abundance of elongated appendages.

In his treatment of Gymnoascaceae, von Arx (1977) stated that the ascospores of *Auxarthron* are ornamented and often spiny. The strains of *Auxarthron thaxteri* in our cultures, however, possess no ornamentations apart from the depressed centre that gives the appearance of a thick wall of the spore.

FAMILY EUROTIACEAE

Eupenicillium crustaceum Ludwig, Lehrb. Nied. Krypt., p. 263 (1892). (Fig. 3).

This non-keratinophilic species was reported from one desert locality where remnants of *Rhanterium epapposum* occur. Ascocarps (cleistothecia) buff-coloured, sclerotoid, pseudoparenchymatous, abundantly produced in cultures, maturing within 4 weeks; asci borne in short chains, ellipsoidal, $8\text{--}9 \times 6\text{--}7\ \mu\text{m}$; ascospores broadly ellipsoidal, $2\cdot5\text{--}3 \times 3\cdot5\text{--}4\cdot0\ \mu\text{m}$, ornamented with two longitudinal flanges, wall echinulate. Associated anamorph is *Penicillium gladioli* McCulloch & Thom, sparsely produced and inconspicuous, greenish-grey to dull green.

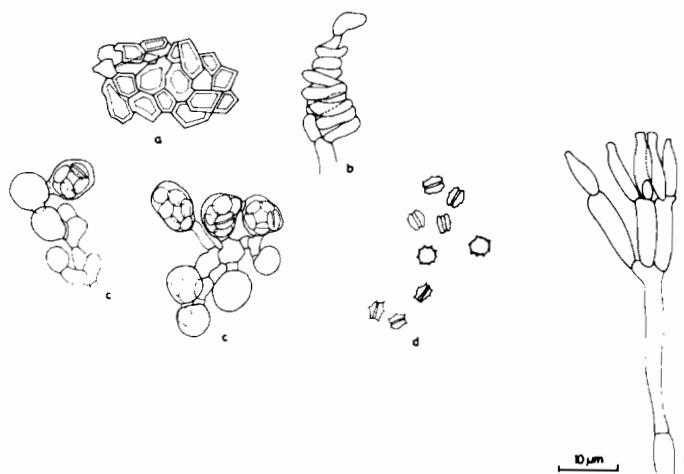


Fig. 3. *Eupenicillium crustaceum*: (a) peridial wall, (b) ascogenous hyphae, (c) short chains of asci, (d) ascospores, (e) conidiophore of the anamorph.

FAMILY MICROASCACEAE

Pseudallescheria ellipsoidea (v. Arx & Fassatiouva) McGinnis, Padhye & Ajello. Mycotaxon 14: 98 (1982). (Fig. 4, Plate 3).

Recovered from soil in its conidial state. The anamorph produces clavate or cylindrical conidia with truncate base, borne on hyphae or on short lateral branches, conidia $7\cdot5\text{--}11 \times 3\cdot5\text{--}6\cdot5\ \mu\text{m}$. In cultures, ascocarp formation is stimulated by the presence of partially decomposed, defatted, sterile human hair as the sole nitrogen source. Ascocarps are non-ostiolate perithecia less than $200\ \mu\text{m}$ in diameter; asci ellipsoidal to spherical, $20\text{--}25 \times 15\text{--}22\ \mu\text{m}$, very evanescent, ascospores broadly ellipsoidal, $6\cdot5\text{--}7\cdot5 \times 5\text{--}5\cdot5\ \mu\text{m}$, with two germ pores. The species is slightly

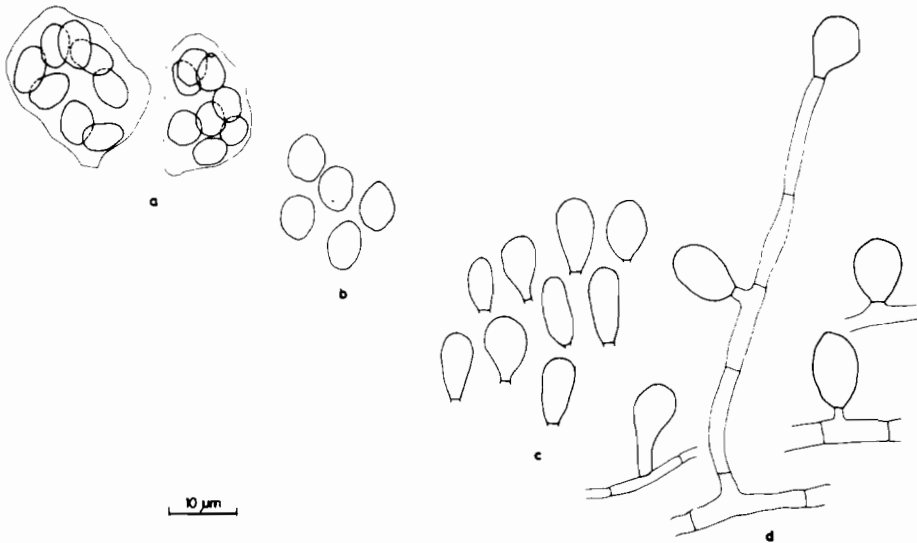


Fig. 4. *Pseudallescheria ellipsoidea*: (a) asci, (b) ascospores, (c) & (d) conidiophore and conidia.

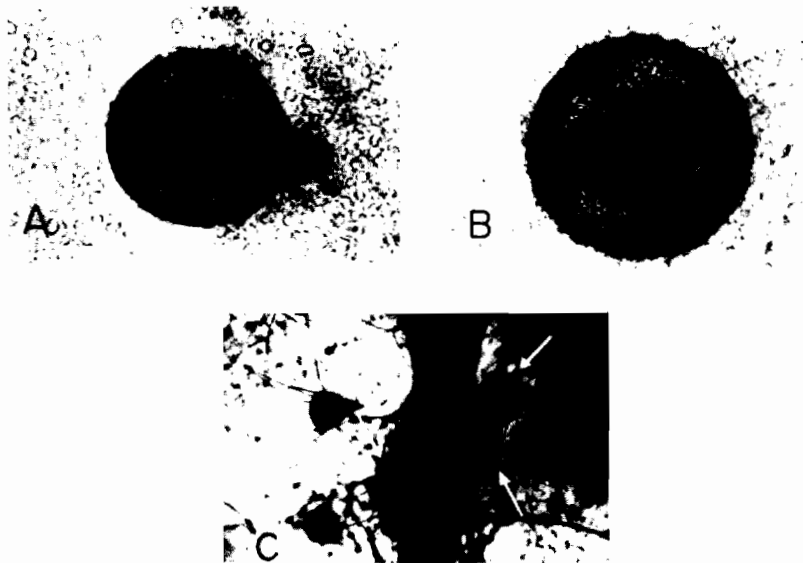


Plate 3. *Pseudallescheria ellipsoidea*: (A) ascocarp, side view showing semi-stirole ($\times 83$), (B) ascocarp, top view showing details of peridial wall ($\times 83$), (C) ascocarps emerging from hair colonized by the fungus ($\times 55$).

keratinophilic, colonizing animal wool or human hair in its anamorphic state, but ascocarps grow vigorously within the decomposed hair fibrils in culture with minimal sugar content and no other source of nitrogen apart from the hair. The fungus is reported from soils associated with cattle and goats in the farm of Omariya Agricultural Experimental Station. It is deposited at the CBS-Baarn (No. 505.83). *P. ellipsoidea* is the second species reported in Kuwait of the genus *Pseudallescheria* Negroni & Fischer. The first, *P. desertorum* (v. Arx & Moustafa) McGinnis, Padhye &

Ajello, was isolated by Moustafa from the coastal salt marshes and described by von Arx & Moustafa in von Arx (1973) as *Petriellidium desertorum*. *Pseudallescheria desertorum* possesses larger asci and ascospores ($20\text{--}30\ \mu\text{m}$ and $11\text{--}14 \times 7.5\text{--}10\ \mu\text{m}$, respectively) than those of *P. ellipsoidea*. The associated anamorph produces short cylindrical or clavate arthroconidia, $4\text{--}8 \times 3\text{--}4.5\ \mu\text{m}$, borne singly or in basipetal chains on hyphae or integrated cylindrical conidiogenous cell (von Arx 1973).

FAMILY CHAETOMIACEAE

Chaetomium mareoticum Besada & Yusef. Trans. Br. Mycol. Soc. **52**: 502 (1969). (Fig. 5, Plate 4).

Arx, Guarro & Figueras, the genus *Chaetomium*. Beihefte zur Nova Hedwigia **84**: 1–67 (1986).

Perithecia spherical, $130\text{--}135 \times 120\text{--}130\ \mu\text{m}$, greyish-brown; terminal hairs five times the diameter of the perithecium, undulate, loosely interwoven, verrucose and septate; asci club-shaped, $30\text{--}45 \times 11\text{--}15\ \mu\text{m}$; ascospores, broadly ovoid,

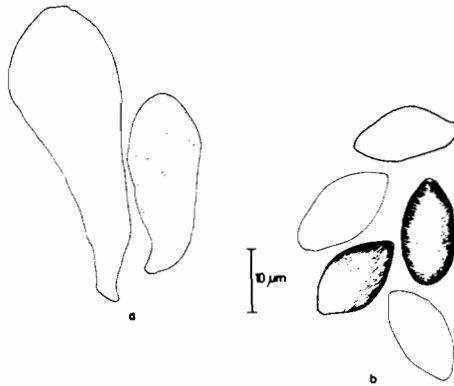


Fig. 5. *Chaetomium mareoticum*: (a) asci, (b) ascospores.



Plate 4. *Chaetomium mareoticum* ascocarps with long wavy appendages, and ascospores ($\times 81$).

15–17.5 × 7.5–9 μm, hyaline, becoming dark brown at maturity with two germ pores. This non-keratinophilic species was isolated once from desert soil in a community of *Cyperus conglomeratus*.

Chaetomium perlucidum Sergejeva. Botanicheskie Materialy. Botanical Institute, Moscow–Leningrad **11**: 108 (1956). (Fig. 6, Plate 5).

Perithecia brown, broadly ellipsoid, 145–170 × 100–130 μm; terminal hairs unbranched, septate, straight at the base, spiral above, coiled to form a conical structure; asci clavate, 37–45 × 10–14 μm, evanescent; ascospores spindle-shaped, 11.5–12.5 × 6–7.5 μm, brownish-yellow with two germ pores. This non-keratinophilic species was isolated from two desert localities in the north of Kuwait associated with either *Cyperus conglomeratus* or *Rhanterium epapposum*.

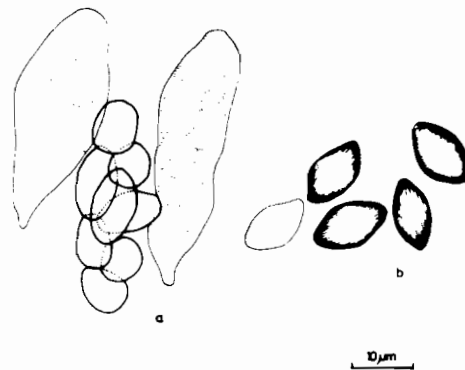


Fig. 6. *Chaetomium perlucidum*: (a) asci, (b) ascospores.

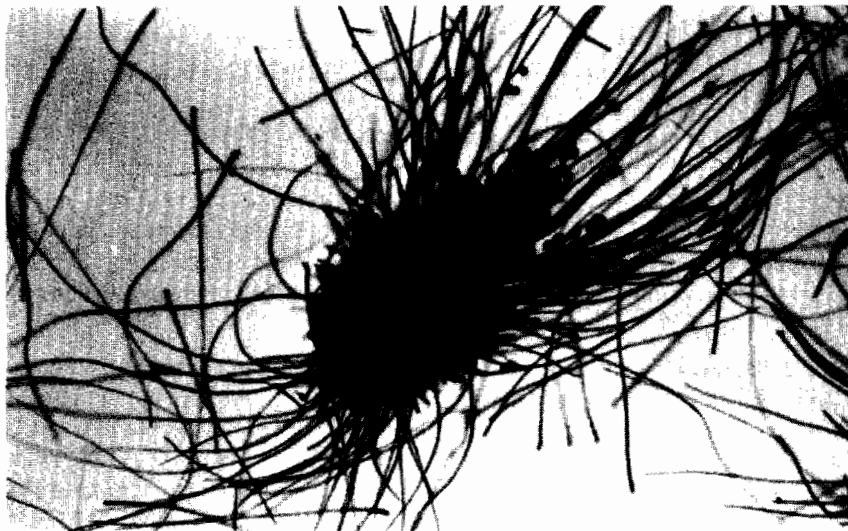


Plate 5. *Chaetomium perlucidum*: ascocarp with long straight appendages, and ascospores (× 81).

HYPHOMYCETES

The genus *Chrysosporium* is well represented in soils baited with animal wool. Five species new to the fungal flora of Kuwait are recorded, in addition to *Chrysosporium tropicum* Carmichael, which was previously reported by Moustafa (1975) from salt marshes in two coastal regions.

Chrysosporium indicum (Randhawa & Sandhu) Garg. *Sabouraudia* **4**: 262 (1966). (Fig. 7).

Trichophyton indicum Randhawa & Sandhu. *Mycopath. Mycol. Appl.* **20**: 227 (1963).

A keratinophilic species; colonies spreading but poorly sporulating; conidia solitary, terminal or lateral, $4\text{--}7.5 \times 1.5\text{--}3 \mu\text{m}$, ovoid to ellipsoid, often cymbiform, smooth to slightly echinulate. This fungus is less frequent than other *Chrysosporium* species, reported from desert soil only. Optimum temperature for growth in culture 25°C .



Fig. 7. *Chrysosporium indicum*: (a) conidiophore, (b) conidia.

Chrysosporium keratinophilum D. Frey ex Carmichael. *Can. J. Bot.* **40**: 1157 (1962). (Fig. 8).

Aleurisma keratinophilum D. Frey. *Mycologia* **51**: 641 (1959).

This keratinophilic fungus actively colonizes human hair and animal wool causing their rapid decomposition in soil as well as in culture. Solitary terminal and lateral conidia obovoid to clavate, $5\text{--}11 (22) \times 3\text{--}7 \mu\text{m}$; intercalary conidia cylindrical to barrel-shaped, $6\text{--}9 (25) \times 3\text{--}7 \mu\text{m}$. This species was recorded from diverse soils especially in farms where cattle and sheep are kept. Optimum temperature for growth $30\text{--}35^\circ\text{C}$.

Chrysosporium pannicola (Corda) van Oorschot & Stalpers. *Stud. Mycol.* **20**: 43 (1980). (Fig. 9).

Capillaria pannicola Corda. *Icon. Fung.* **1**: 10 (1837) = *Sporotrichum pannicola* (Corda) Rabenhorst. *Deutschl. Kryptogfi.* **1**: 78 (1844).

This keratinophilic species differs from *C. tropicum* (see below) by the terminal and lateral conidia which are solitary or subtended by another conidium, $5.5\text{--}9 \times 2.5\text{--}3 \mu\text{m}$ with fairly wide basal scar ($1\text{--}3 \mu\text{m}$), smooth-walled becoming echinulate, they are

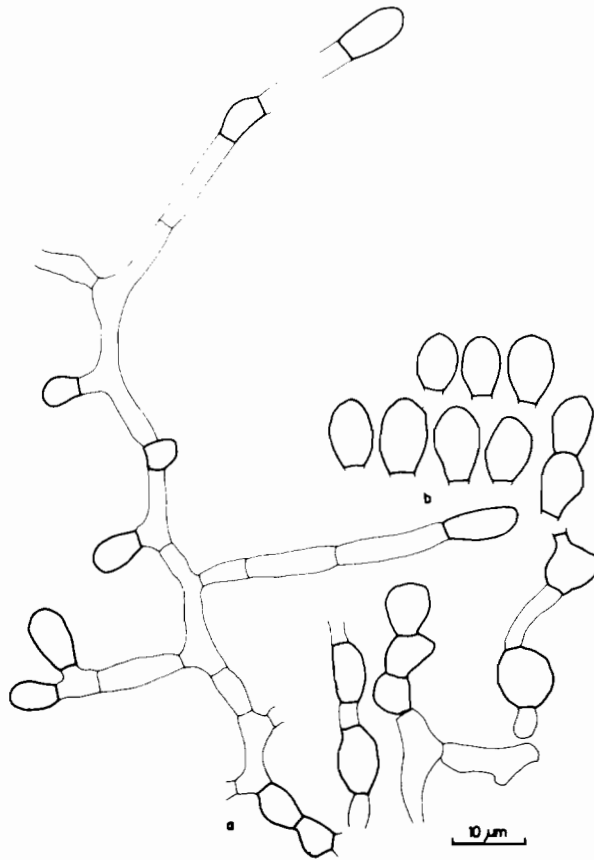


Fig. 8. *Chrysosporium keratinophilum*: (a) conidiophore, (b) conidia.

sessile or possess short almost conical protrusions; swollen conidiogenous cells are frequently produced, these are subglobose or irregular, smooth, thick-walled and hyaline. This species was recorded from several desert soils by baiting with animal wool. Optimum temperature for growth in culture is 20°C, maximum 30°C.

Chrysosporium queenslandicum Apinis & Rees. Trans. Br. Mycol. Soc. **67**: 524 (1976). (Fig. 10).

This keratinophilic species is closely related to *Chrysosporium tropicum* Carmichael (below), distinguished by the abundance of cylindrical to barrel-shaped intercalary conidia, 8–13.5 × 4–7 μm; terminal and lateral conidia 6–13 × 3.5–6 μm, sessile or on short protrusions. The fungus vigorously colonizes and decomposes human hair in culture. It was recorded from several desert soils. Optimum temperature for growth 30°C, maximum 35°C.

Chrysosporium tropicum Carmichael. Can. J. Bot. **40**: 1170 (1962). (Fig. 11).

This keratinophilic species was recovered from soil in its sporulating stage on animal wool as a powdery mass of white aleurioconidia; hyphae penetrate the woollen strand by cavity formation. Terminal and lateral conidia solitary, obovoid or clavate, 6–8.5 (10) × 3.5–5 μm, with a wide basal scar; walls smooth and slightly thick, conidia sessile or on short protrusions or on side branches; intercalary conidia infrequent,

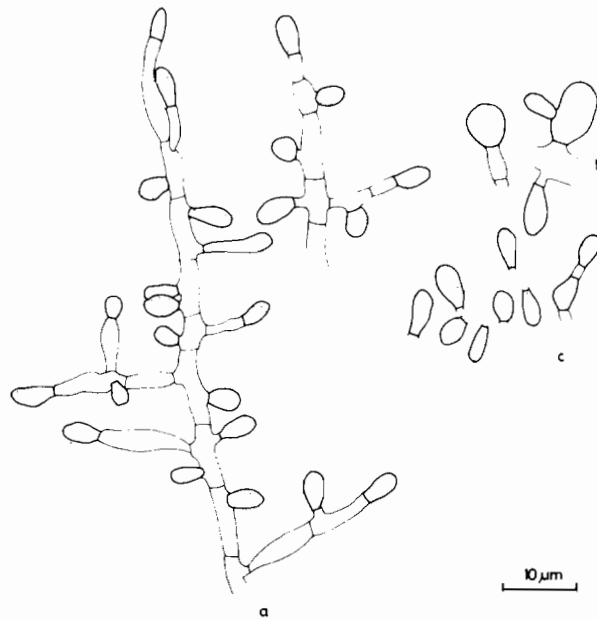


Fig. 9. *Chrysosporium pannicola*: (a) conidiophore, (b) swollen conidiogenous cell, (c) conidia.

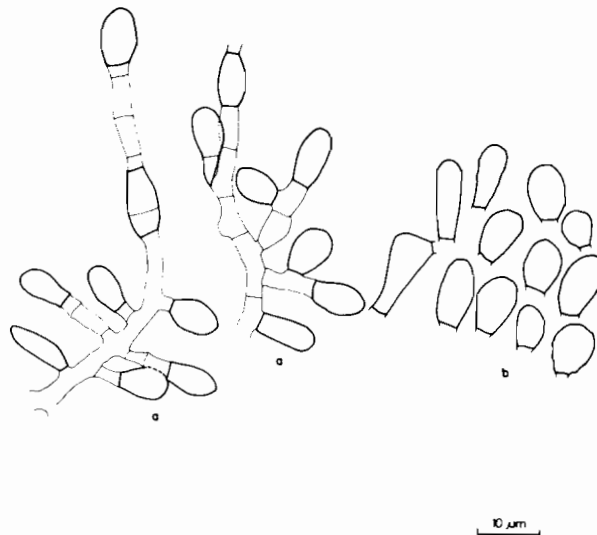


Fig. 10. *Chrysosporium queenslandicum*: (a) conidiophore, (b) conidia.

(3) $5.5-8 \times (2.5) 3-5 \mu\text{m}$, cylindrical or barrel-shaped, slightly wider than the supporting hyphae, and smooth-walled. If human hair is used as the sole nitrogen source for this keratinophilic fungus, it flourishes on it forming a vigorous growth which leads to rapid decomposition of the hair. The species was recorded from desert soils and farms frequented by cattle, goats and fowl. Optimum temperature for growth in culture $25-30^\circ\text{C}$, maximum 35°C .

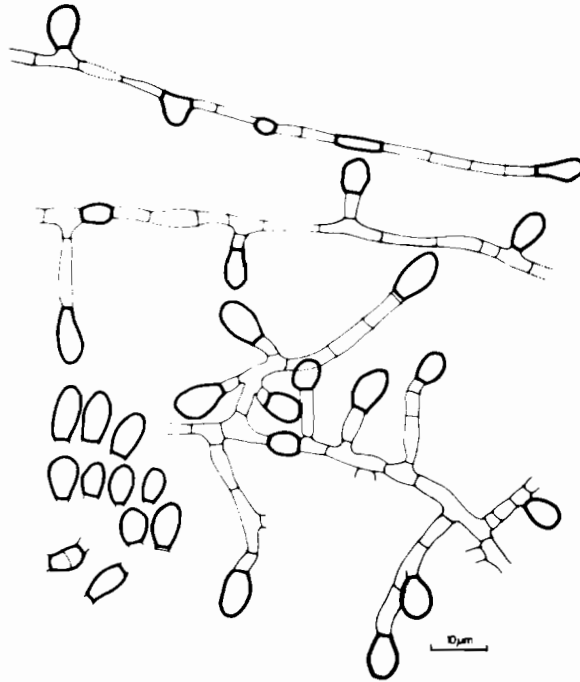


Fig. 11. *Chrysosporium tropicum*: conidia and conidiophores.

Chrysosporium anamorph of *Renispora flavissima* Siegler *et al.* Mycotaxon **10**: 133 (1979). (Fig. 12).

A keratinophilic species; colonies not spreading, pale yellow and felty. Unlike other *Chrysosporium* species, this fungus produces globose often pyriform terminal and lateral conidia, 5.5–17 (20) × 5–15 μm , unicellular, thick-walled, usually verrucose; intercalary conidia rare, barrel-shaped, up to 13 μm long, initially smooth and thin-walled becoming thick-walled and verruculose. The conidia of this species resemble the macroconidia of *Histoplasma capsulatum* Darling in the mode of ornamentation. Isolated once from a soil sample collected at the cattle farm in Omariya Agricultural Experimental Station. Optimum temperature for growth 15°C, maximum 30°C.

Aspergillus clavatus Desmazieres. Ann. Sci. Nat. Botan. **2**(2): 71 (1834).

Aspergillus clavatus is characterized by large, blue-green, clavate conidial heads, 300–400 × 150–200 μm ; isolated once from farm soil under cattle in Omariya Agricultural Experimental Station. This species was reported by Moustafa (1986) from manured garden soil. Moustafa's measurements of the conidial heads were slightly smaller than those of the present strain.

Cephalophora tropica Thaxter. Bot. Gaz. **35**: 513 (1903).

This fungus is characterized by its large septate conidia, synchronously developed on swollen ampuliform cells, 25–40 × 15–20 μm , thick-walled, light-coloured, pale orange in mass. Isolated from several soils rich in animal dung, more often on sheep dung incubated in daylight; grows intermixed with sporangiophores of *Mucor circiniloides* van Tieg. Moustafa (1986) reported this species once from manured

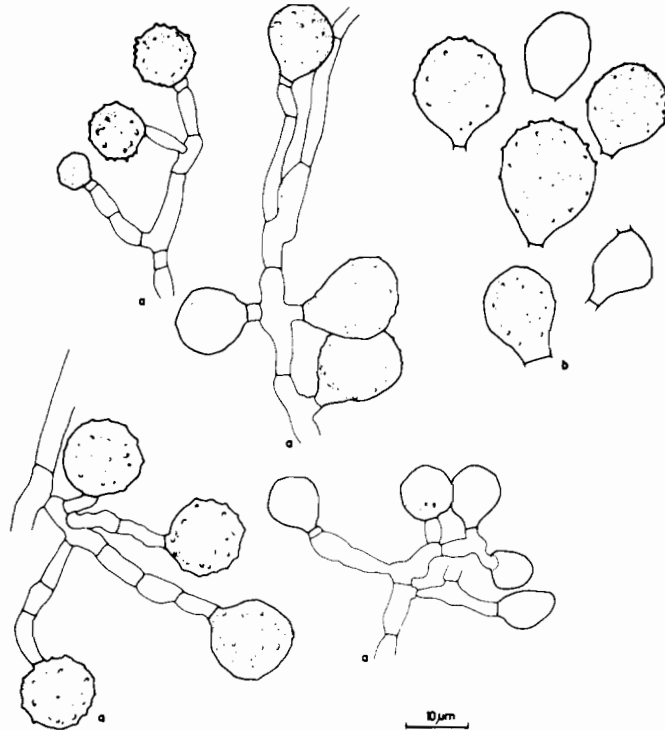


Fig. 12. *Chrysosporium* anamorph of *Renispora flavissima*: (a) conidiophora, (b) conidia.

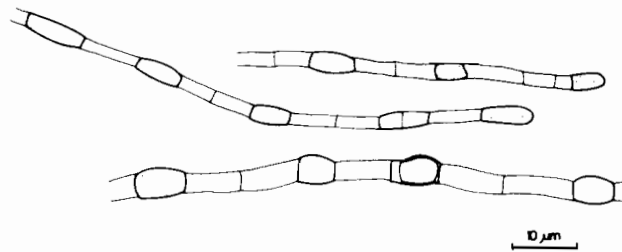


Fig. 13. *Malbranchea flocciformis*: terminal and intercalary arthroconidia.

garden soil, which indicates the coprophilous nature of the species. A second species: *Cephalophora irregularis* Thaxter was previously reported in air from Kuwait (Moustafa & Kamel 1976).

Fusariella bizzoeriana (Sacc.) Hughes. Mycological Papers CMI No. 28: 1-11 (1949).

This species is characterized by its hyaline, semi-macronematous conidiophores and olive-green fusiform, septate conidia, $25-32 \times 5.5-6.5 \mu\text{m}$. Reported once from desert soil. No culture was preserved.

Malbranchea flocciformis Sigler & Carmichael. Mycotaxon. 4: 452 (1976). (Fig. 13).

A slightly keratinophilic species with hyaline arthrospores. Fertile hyphae straight or occasionally curved with repeatedly branched short lateral branches to form a dense

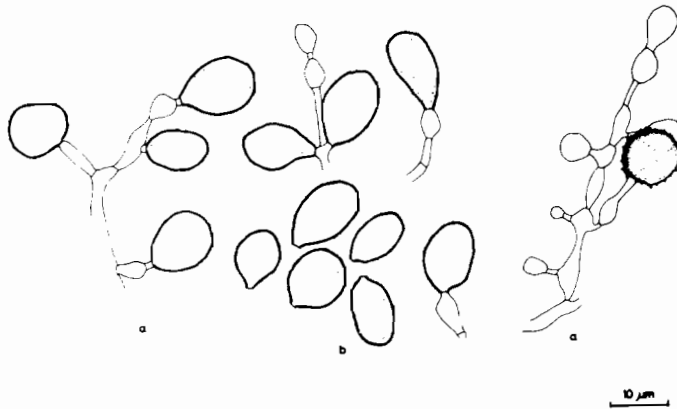


Fig. 14. *Myceliophthora vellerea*: (a) conidiophores, (b) conidia.

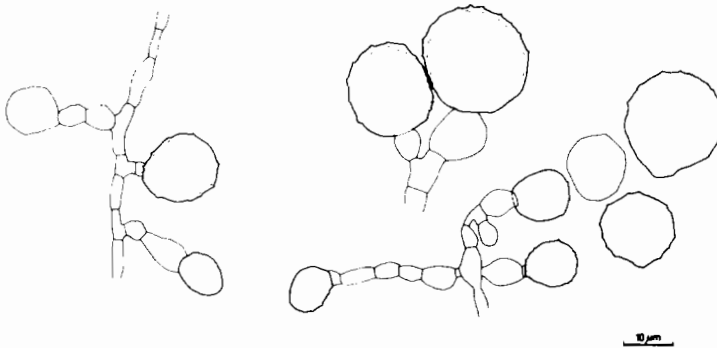


Fig. 15. *Sepedonium chrysospermum*: solitary terminal and lateral aleuriconidia.

tuft; arthroconidia cylindrical, $5.5\text{--}9 \times 2.5\text{--}3 \mu\text{m}$, unicellular, rarely two-celled ($2.5\text{--}5 \times (1.5)\text{--}2.5 \mu\text{m}$ in Sigler & Carmichael (1976)), hyaline or pale yellow, orange in mass, smooth-walled. Isolated from several desert soils dominated by *Cyperus conglomeratus*. Optimum temperature for growth 25°C , maximum 30°C .

Myceliophthora vellerea (Sacc. & Speg.) van Oorschot. Stud. Mycol. **20**: 47 (1980). (Fig. 14).

Sporotrichum vellereum Sacc. & Speg. Michelia **2**: 287 (1882).

This keratinophilic fungus is known in Kuwait from a single isolate recovered from desert soil. It produces predominantly white mycelium; hyphae thin-walled; aerial hyphae mostly fertile, bearing subglobose to pyriform or ellipsoidal blastic conidia, $10\text{--}15 \times 6.5\text{--}9 \mu\text{m}$ with narrow basal scar ($0.5\text{--}1.5 \mu\text{m}$); blastoconidia usually borne on short narrow protrusions, ampuliform swellings or side branches; conidia solitary or in chains of 2–3 conidia separated by narrow, short hyphal segments, subhyaline becoming verrucose at maturity. The fungus grows on animal wool in soil. Optimum temperature for growth 25°C , maximum 30°C .

Sepedonium chrysospermum (Bull.) Link ex Fr. Syst. Mycol. **3**: 428 (1832). (Fig. 15).

Colonies spreading, pale cream-coloured, powdery or felty; conidia solitary, globose to pyriform, $15\text{--}22 \times 14\text{--}21 \mu\text{m}$, usually borne on long (often swollen) stalks,

smooth, later becoming verruculose. Isolated once from the sheep farm in Omariya Agricultural Experimental Station.

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REFERENCES

- Apinis, A.E. 1964.** Revision of British Gymnoascaceae. Mycological Papers No. 96. Commonwealth Mycological Institute, Kew, Surrey, 56 pp.
- Arx, J.A. von. 1973.** The genera *Petriellidium* and *Pithoascus* (Microascaceae). *Persoonia* 7(3): 367–75.
- Arx, J.A. von. 1977.** Notices on Gymnoascaceae. *Persoonia* 9(3): 393–400.
- McGinnis, M.R., Padhye, A.A. & Ajello, L. 1982.** *Pseudallescheria* Negroni 1943 and its later synonym *Petriellidium* Malloch, 1970. *Mycotaxon* 14: 94–102.
- Moustafa, A.F. 1975.** A preliminary annotated list of fungi from Kuwait. *Journal of the University of Kuwait (Science)* 2: 67–87.
- Moustafa, A.F. 1978.** A supplementary annotated list of the fungi of Kuwait. *The Journal of the University of Kuwait (Science)* 5: 61–82.
- Moustafa, A.F. 1982.** New records for the fungal flora of Kuwait. *The Journal of the University of Kuwait (Science)* 9: 109–18.
- Moustafa, A.F. 1986.** Additional species as new records for the fungal flora of Kuwait. *The Journal of the University of Kuwait (Science)* 13: 207–17.
- Moustafa, A.F. & Kamel, S. 1976.** A study of fungal spore populations in the atmosphere of Kuwait. *Mycopathologia* 59: 29–35.
- Sigler, L. & Carmichael, J.W. 1976.** Taxonomy of *Malbranchea* and some other Hyphomycetes with arthroconidia. *Mycotaxon* 4: 349–88.

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فطريات جديدة وجديرة بالملاحظة من الكويت

عزه عبدالعزيز المسلم
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ص . ب ٥٩٦٩ ، الصفاة ١٣٠٦٠ ، الكويت

خلاصة

يتضمن هذا البحث دراسة لسبعة عشر نوعا من الفطريات تسجل للمرة الأولى من الكويت ، منها أحد عشر نوعا من الفطريات عارية الكونيدات ، وستة أنواع من الفطريات الزقية تنتمي إلى أربع فصائل . كما تم تسجيل إضافات جديدة تتعلق بتواجد فطر « كريسوسبوريوم تروبيكم » والذي عزل للمرة الأولى من الكويت في عام ١٩٧١ . وقد أظهرت الدراسة أن عشرة أنواع من هذه الفطريات تحلل المادة القرنية (الكيراتين) في التربة ، وهي مادة مصدرها الشعر والصوف الحيواني .

وقد أودعت نماذج من جميع الأنواع المذكورة في هذا البحث في مزارع نقية في قسم النبات والميكروبيولوجيا بجامعة الكويت .

