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REPORT ON ADDITIONS TO THE PENICILLIUM SPECIES FROM WEST PAKISTAN KARACHI

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A study of *Penicillium* species from Karachi was taken up. Malt extract agar and Czapek-Dox agar media were utilised for screening these fungi. A total of 15 species, namely: *Penicillium chrysogenum* Thom., *penicillium* near *P. chrysogenum*, *penicillium* near *P. corylophilum* Dierckx, *P. cyclopium* Westling, *P. expansum* Link, *P. Janthinellum* Biourge, *P. lilacinum* Thom., *P. martensii* Biourge, *P. notatum* Westling, *P. oxalicum* Currie and Thom., *penicillium* near *P. patulum* Bainier, *P. purpurogenum* Stoll, *P. rubrum* Stoll, *P. steckii* Zaleski, and *P. variabile* Sopp, were recorded. Out of these, *penicillium* near *P. chrysogenum* Thom., *penicillium* near *P. corylophilum*, *P. cyclopium* Westling, *P. martensii* Biourge, *penicillium* near *P. patulum* Bainier and *P. steckii* Zaleski have been reported from Karachi for the first time. The species which have never been recorded as such from West Pakistan include *penicillium* near *P. chrysogenum*, *penicillium* near *P. corylophilum*, *P. cyclopium*, *P. martensii*, and *penicillium* near *P. patulum*. Brief descriptions based on our specimens for these five species have been provided.

It cannot be denied that the mycoflora of West Pakistan is very poorly known and, therefore, concentrated efforts and hard work is essentially required for improving the situation. About 1500 species of fungi have been reported till now from this area of over 3,00,000 sq. miles and the scope for hundreds of more species which have never been investigated seems encouraging. The species of the genus *Penicillium* Link, reported from West Pakistan. are also very limited in number and demand further investigations.

The mycologists who contributed in reporting *Penicillium* species from the area, now known as West Pakistan, include mainly Chaudhuri and Sachar,[1] Chaudhuri and Umar,[2] Hukam Chand,[3] Chaudhuri,[4] Sultan Ahmed,[5] Ahmed, Quraishi and Murtuza,[6] Rizvi,[7] Quraishi,[8] Husain, Hasany and Ahmed,[9] Ahmed[10], Nishat, Ahmedunnisa and Ahmed,[11] Ahmedunnisa, Nishat and Ahmed.[12]

The *Penicillium* species recorded from West Pakistan are: *P. atramentosum* Thom, *P. brevicaulis* var *glabra* Thom, *P. casei* Staub, *P. charlesii* Smith, *P. chloro-leucon* Biourge, *P. chrysogenum* Thom, *P. citrinum* Thom, *P. cyaneo-fulvum* Biourge, *P. digitatum* Saccardo, *P. ehrlichii* Klebahn, *P. expansum* Link, *P. fellutanum* Biourge, *P. funiculosum* Thom, *P. glaber* Westling, *P. glabrum* (Wehmer) Westling, *P. glaucum* Link, *P. janthinellum* Biourge, *P. lilacinum* Thom, *P. notatum* Westling, *P. oxalicum* Currie and Thom, *P. patulum* Bainier, *P. pinophillum* Hedgcock, *P. puberiulum* Bainier, *P. purpurogenum* Stoll, *P. spinulosum* Thom, *P. steckii* Zaleski, *P. sublateritium* Biourge, *P. tenellum* Cooke, *P. terrestre* Jense, *P. variabile* Sopp, *P. vinaceum* Gillman and Abbott, and *P. viride-varians* Chaudhri and Sachar.

After a thorough investigation it was disclosed that out of the above 33 species of *Penicillium*, only 26 were the accepted ones. The remaining were either synonyms or erroneous names. These cases have been discussed separately.

A total of 15 species, namely *P. chrysogenum* Thom; *penicillium* near *P. chrysogenum*, *penicillium* near *P. corylophilum* Dierckx, *P. cyclopium* Westling, *P. expansum* Link, *P. janthinellum* Biourge, *P. lilacinum* Thom, *P. martensii* Biourge, *P. notatum* Westling, *P. oxalicum* Currie and Thom, *penicillium* near, *P. patulum* Bainier, *P. purpurogenum* Stoll, *P. rubrum* Stoll, *P. steckii* Zaleski, and *P. variabile* Sopp, were recorded by us from Karachi. Out of these *penicillium* near *P. chrysogenum*, *penicillium* near *P. corylophilum*, *P. cyclopium*, *P. martensii*, *penicillium* near *P. patulum*, and *P. stekii* have been reported for the first time from Karachi. The species not reported from West Pakistan as such are: *penicillium* near *P. chrysogenum*, *penicillium* near *P. corylophilum*, *P. cyclopium*, *P. martensii* and *penicillium* near, *P. patulum*, *Penicillium* near *P. chrysogenum* and *penicillium* near *P. corylophilum* are considered here as variants of *P. chrysogenum* Thom and *P. corylophilum* Dierckx respectively. *Penicillium* near *P. patulum* seems to be a mutant of *P. patulum* Bainier. These discussions have been provided separately below the description of these three species.

Materials and Methods

Species included in the present paper were isolated from soil as well as air sources. The depth of the soil from which the samples were collected was maintained roughly at 5 in. one g of soil sample was thoroughly mixed with 10 ml of sterilised water. 0.1 ml of this solution was poured into 4 sterilized

petri plates and 1.0 ml in another set of four similar plates. 15 ml of malt extract agar was poured in 2 petri plates from each set and Czapek-Dox agar in the remaining 2. For uniform mixing, all these plates were gently rotated.

Spores from the air were trapped on the petri plate's surface by exposing them against the air current for about 5 minutes at the height of 10 feet from the ground level. Same media, as used for soil samples, were employed.

Incubation was carried out at a temperature of 28 to 30°C. These plates were examined under the dissecting microscope after 3 to 4 days and the *Penicillium*-like colonies picked up and transferred to Czapek's agar. Microscopic studies of the micro-structures were carried out on cultures up to 1-week old. For this purpose, the material was first washed in 75% ethyl alcohol on a slide and then mounted in Amman's solution (formula given on page 28 of the *Manual of the Penicillia* by Raper and Thom).[13]

Based on our studies, brief descriptions of *penicillium* near *P. chrysogenum*, *penicillium* near *P. corylophilum*. *P. cyclopium*, *P. martensii* and *penicillium* near *P. patulum*, which were not reported from West Pakistan, are provided.

Observations

1. *Penicillium* near *P. chrysogenum* Thom.—Rapid growth; central area of the colony non-sporulating, colonies radially furrowed, sporing heavily, velvety, marginal zone present, conidial areas finally bluish grey-green in shade; exudate light yellow in colour, reverse light yellow to vinaceous-brown, surrounding agar light brown; conidiophores smooth-walled, width 2.5–3.5μ; penicilli biverticillate and symmetrical showing one or two branches, metulae 2–5 in a verticil, measuring 10–13 × 1.5–2μ, sterigmata 5–7 in a cluster, measuring 7–9 × 2–2.5μ; conidia globose to subglobose, smooth, about 3μ in diameter (IMI No. 128168). Isolated from soil of P.C.S.I.R. Laboratories, Karachi.

Due to intergrading strains, it is not possible to draw a clear-cut line to delineate the species within the *Penicillium chrysogenum* series. The above strain agrees with *P. chrysogenum* in most of the characters but tends to *P. meleagrinum* in I, having light yellow to vinaceous-brown reverse and II, globose conidia, which are very rare for *P. chrysogenum*. On the basis of these two characters, the above strain is considered as a variant of *P. chrysogenum* Thom.

2. *Penicillium* near *P. corylophilum* Dierckx.—Growth rapid; conidia produced in about 4–5 days, colonies velvety with the appearance of conidial structures, not radially furrowed, blue green when young, finally becoming olive-brown; exudate lacking, reverse yellowish in the beginning, light brown to fuscous afterwards, coloration in the surrounding medium present; conidiophores unbranched, penicilli biverticillate and symmetrical with monoverticillate structures present, smooth-walled, measuring 2.5μ in width; metulae 2–3 in a verticil, mostly 11–15 × 2–3μ, sterigmata in clusters of 4–8, measuring 9–11 × 2–2.5μ conidia subglobosoe to elliptical, measuring 2.5–3 × 2–2.5μ, smooth-walled; perfect stage not seen (IMI No. 130741). Isolated from soil of Nazimabad.

This strain differs from *P. corylophilum* Dierckx in a few of the characters and therefore, treated as a variant. The characters in which it differs from *P. corylophilum* are: I, colonies not restricted; II, no furrowing of the colonies observed; III, exudate lacking; and IV, conidial formation starting 4th or 5th day and not in 8–10 days.

3. *Penicillium cyclopium* Westling.—Growth fairly rapid; colonies raised in the centre, more or less radially furrowed, zonation at the margin, light-green shade when young, finally bluish grey-green, exudate not produced, reverse yellowish to finally orange; conidiophore wall roughened, sometimes bulging at the tip before branching, width 3–4μ; penicilli assymetically branched, showing one or occasionally more branches; 3–4 metulae in a verticil, measuring 8–12 × 2.5–3μ; 4 to 8 sterigmata in a group, measuring 9–11 × 2.2 to 2.5μ; conidia wall delicately roughened, sub-globose to globose, 3–4μ in diameter, perfect stage not observed (IMI NO. 128171). Isolated from soil of P.C.S.I.R. Laboratories, Karachi.

4. *Penicillium martensii* Biourge.—Growth is fairly rapid, colonies usually raised in the centre with radial furrows, zonation at the margin present, surface granular to tufty due to heavy sporing, conidial areas bluish grey-green when young, finally becoming dull grey, exudate produced, reverse orange-brown to finally light maroon, surrounding agar similarly coloured; conidiophore slightly roughened, 3–3.5μ in width; penicilli showing one or two branches; metulae commonly 3–5 in a verticil, measuring 8–12.5 × 2.5–3μ; sterigmata usually in clusters of 4–8, measuring 6–8 × 2–2.5μ; apices narrowed; conidia elliptical to sub-globose, smooth-walled, 3.5–4 × 3–3.3μ; perfect stage not seen (IMI No. 125917). Isolated from soil of P.C.S.I.R. Laboratories, Karachi.

5. *Penicillium* near *P. patulum* Bainier.—Growth restricted; colonies raised in the centre, radially furrowed, surface granular, heavily sporing throughout, zonation at the margin, colonies court grey when young and finally becoming grey, reverse slightly orange-brown to dark-brown in age; conidiophores smooth-walled, mostly twice branched below the sterigmata. Width of the conidiophore 2.5–3μ; penicilli showing divaricate tendency, metulae short, 2–3 in groups, wall smooth; each measuring 6–8×3–3.3μ, sterigmata short, 8–10 in clusters, measuring 5–6×2–2.5μ; conidia elliptical, smooth, thin-walled, 2.5–3μ in diameter; perfect stage not seen—(IMI No. 130738). Isolated from air.

This strain agrees closely in most of the characters with *P. patulum* Bainier, but shows tendency to divaricate branching and thus tends to *P. nigricans* (Bain.) Thom. On this basis it is likely that it may be a mutant of *P. patulum* Bainier.

In the reports on fungi from West Pakistan, already referred to in the introduction portion, seven species were described under synonyms or erroneous names. These errors have been traced out and mentioned in the following against each of these species. The numbers quoted in these discussions referred to by Raper and Thom.[13]

1. *Penicillium chloro-leucon* Biourge.—This species has been found similar to *Penicillium corylophilum* Dierckx by different workers (p. 345). Since *P. corylophilum* is the earlier name, *P. chloro-leucon* is to be treated as the synonym of the former.

2. *Penicillium glabrum* (Wehmer) Westling.—This species seems to be the synonym of *Citromyces glaber* Wehmer (p. 176). It is stated that at one stage Wehmer himself was unable to differentiate between his two species. Further, it has been said that *P. glabrum* can not be differentiated from *C. glaber* as well as the name *P. glabrum* has been used loosely in biochemical literature. Under such a situation the name *P. glabrum* should be deleted from the list of the accepted species.

3. *Penicillium glaucum* Link fide Wehmer.—Wehmer's descriptions indicate that he had included *P. glaucum* forms which are regarded as *P. expansum* Link (p. 515). In the light of existing information, *P. glacucum* should be treated as a synonym of *P. expansum*.

4. *P. oxyalicum* Currie and Thom.—No such *Penicillium* species existed in the relevant literature and therefore, this should be treated as an outcome of typographical error for *P. oxalicum* Currie and Thom.

5. *P. scopulariopsis brevicaulis* var. *glabra* Thom.—The name in its present form does not exist in the literature. However, this could be *Penicillium brevicaule* var. *glabrum*, established by Thom to include strains with smooth-walled, colourless conidia (p. 699). This could also be *Scopulariopsis brevicaulis* var. *glabra* Thom (p. 700).

6. *P. tenellum* Cooke.—This species is not identifiable (p. 844). Perhaps the text and the literature concerning the type description are insufficient to provide a definite identity for this species.

7. *P. viride-varians* Chaudhuri and Sachar.—This was described as a new species from Punjab in 1934. From inadequate description given, this species possibly approximates in part to *P. nalgiovensis* Laxa (p. 847). In addition to insufficient information, the type description of this species was not accompanied by Latin diagnosis and therefore, it is supposed to be invalid according to Article 36 of International Code of Botanical Nomenclature (1961).

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