The ascigerous state of *Candida chodatii*

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VON ARX, J. A. and VAN DER WALT, J. P. 1976. The ascigerous state of *Candida chodatii*. Antonie van Leeuwenhoek **42**: 309–314.

In *Candida chodatii*, a mycelial yeast having denticulate conidiogenous cells, the asci are formed by conjugating budding cells (conidia) and usually contain 2 hat-shaped, small ascospores. It is classified in *Hyphopichia*, a new genus of the Ascoideaceae. A key to the genera of the Ascoideaceae is given.

Candida chodatii (Nechitch) Berkhout is a common mycelial yeast. With suitable enrichment techniques it is readily obtained from soil and often found on cereals and cereal products. The species has also been recovered from man and animals, mainly from the intestinal tract and the skin.

C. chodatii forms white expanding colonies characterized by the presence of rather broad, thick-walled, regularly septate hyphae. The blastoconidia (blastospores,budding cells) develop on distinct denticles and usually form acropetal, frequently branched chains. The conidial state has been described under several names and has been classified in the genera *Dematium*, *Monilia*, *Oospora*, *Candida*, *Trichosporon* and *Sporotrichum*.

Wickerham and Burton (1952) first observed conjugating yeast cells forming hat-shaped ascospores in matings of haploid strains of the species. They cited this perfect state as *Endomycopsis chodati* but omitted to provide a latin diagnosis. Kreger-van Rij (1964) accepted *E. chodati* in *Endomycopsis*. Boidin et al. (1964) working with mating types received from Wickerham, also observed the ascigerous state which they described and validly published as *Pichia burtonii* Boidin et al. Kreger-van Rij (1970) re-instated the species in *Endomycopsis* as *E. burtonii* (Boidin et al.) Kreger-van Rij.

The genera *Endomycopsis* Dekker and *Pichia* Hansen, as characterized by Kreger van Rij (1964, 1970), are rather unnatural and include species of divergent relationship. In addition to this, the generic name *Endomycopsis* Dekker has to be rejected because it is an obligate synonym of *Saccharomycopsis* Schiönning (1903) as was shown by van der Walt and Scott (1971) and von Arx (1972). Only three of the species accepted by Kreger-van Rij (1970) in *En-*

domycopsis were classified in *Saccharomycopsis*. Others were transferred to the genera *Endomyces* Reess, *Guilliermondella* Nadson et Krassilnikov, *Ambrosiozyma* v. d. Walt, *Hormoascus* v. Arx and *Arthroascus* v. Arx. *Endomycopsis burtonii*, however, was not dealt with by either van der Walt and Scott (1971), van der Walt (1972) or von Arx (1972). More recently de Hoog (1974) in his discussion of the genus *Sporothrix*, cited this species as *Pichia burtonii* Boidin et al.

That *E. burtonii* cannot be included in either *Pichia* or *Saccharomycopsis* is apparent. It is excluded from *Pichia* by its formation of expanding septate hyphae and conidia borne on denticles. Likewise it is debarred from *Saccharomycopsis* on the basis that in *Saccharomycopsis* the asci are not constituted by pairs of conjugated yeast cells but arise either terminally, laterally, or intercalarily on diploid hyphae. Moreover, the ascospores in *Saccharomycopsis* are much larger and often pigmented. The conidiogenous cells are not denticulate and the conidia, unlike those of *E. burtonii*, are obovate or clavate and have a broad truncate base.

Pichia burtonii consequently is transferred to a new genus for which the name *Hyphopichia* is proposed.

Hyphopichia von Arx et van der Walt, gen. nov.

Genus Ascoideacearum, heterothallicum. Hyphae septatae abundae, fere latae, praecipiter radiantes. Cellulae conidiogenae intercalares, laterales vel terminales, denticulatae. Conidia continua, parva, hyalina, saepe acropetaliter catenulata e denticulis oriunda. Cellulae zymatosae copulantes in ascos transformatae; asci parvi, forma irregulares, uni- ad quadrispori (plerumque bispori), evanescentes. Ascosporae parvae, semiglobosae, petasiformes, margine basilari circumdatae, hyalinae, saepe ascis dissolutis aggregatae.

Species typica *Hyphopichia burtonii* (Boidin et al.) v. Arx et v. d. Walt nov. comb. Basionym.: *Pichia burtonii* Boidin et al. in Bull. Soc. Mycol. Fr. 80: 437, 1964.

Ascoideaceae, heterothallic. Septate hyphae predominant, rather broad, expanding. Conidiogenous cells intercalary, lateral or terminal, denticulate. Conidia 1-celled, small, hyaline, often in acropetal chains, arising by budding from denticles. Asci formed from conjugating yeast cells, small, irregular in shape, 1–4 (usually 2) spored, evanescent. Ascospores small, hemispherical, hat-shaped, with a basal ledge, hyaline, often clustered after dissolution of the asci.

Type species: *Hyphopichia burtonii* (Boidin et al.) v. Arx et v. d. Walt

The expanding hyphae are 4–6 µm broad, regularly septate, often dichotomously branched, and form lateral, often erect, usually conidiogenous branches, 2–4 µm broad, sometimes fragmenting into separate cells. The conidia, formed on prominent denticles, 0.7–1.5 µm broad, 0.5–3 (rarely up to 10) µm long, are single or in acropetal chains, ovate or clavate, attenuated and truncate at base, 2–7 × 2.4 µm. The conidia usually form secondary conidia (budding yeast cells) which also develop on denticles. Conidia or budding cells

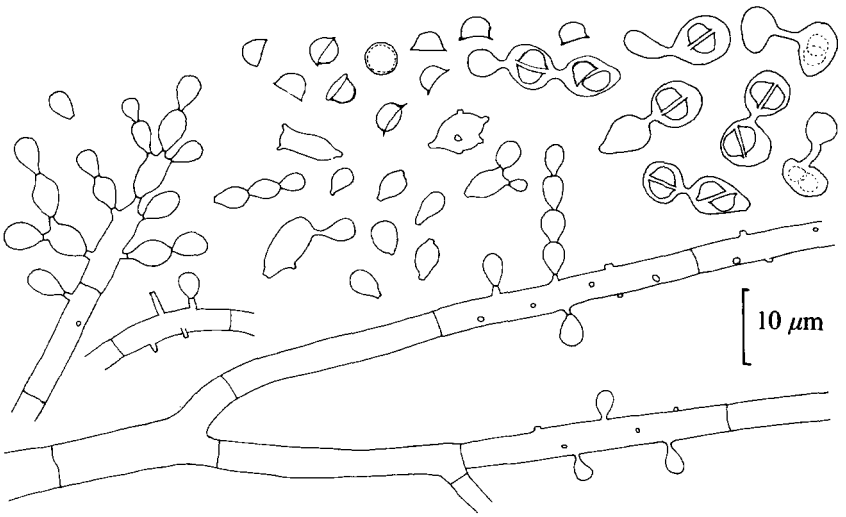

Fig. 1. *Hyphopichia burtonii*, hyphae, conidiogenous cells, conidia, asci and ascospores.

of mating types conjugate by anastomosis and become asci which are ellipsoidal, clavate, or irregular in shape, usually 4–6 × 3–5 μm in size and often form pairs. The asci usually contain 2, rarely 3–4 ascospores, which are hemispherical, hat-shaped, usually with a distinct basal ledge, measuring 2.5–3.5 × 2–3μm.

Several strains, some of which were freshly isolated from soil, foodstuffs and fodder cereals were studied and compared with CBS 2352 and CBS 2353, two mating types of which the former was designated as the "type culture" of the species. Matings of these two strains in petri dishes have been dried and are maintained in the Herbarium of the Centraalbureau voor Schimmelcultures in Baarn.

The genus *Hyphopichia* is assigned to the Ascoideaceae. The only genus in this family of mycelial yeasts known to form conidia on denticles is *Stephanoascus* Smith, v. d. Walt et Johannsen (1976) which comprises a single heterothallic species, *S. ciferii* Smith, v. d. Walt et Johannsen. This genus is characterized by conjugating hyphae and the asci formed singly in the subapical cell of a short outgrowth arising from an anastomosis. The Ascoideaceae contain Endomycetales (von Arx, 1974) forming septate hyphae and having oblate or hemispherical, usually ledged ascospores. The accepted genera can be distinguished by the following key:

1. Asci are swollen hyphal cells; budding cells or conidia absent; ascospores 2–4 μm in diameter *Arthroascus*
1. Above characters not combined 2
2. Asci catenulate, borne in apical brushes on stout, pigmented ascophores *Cephaloascus*

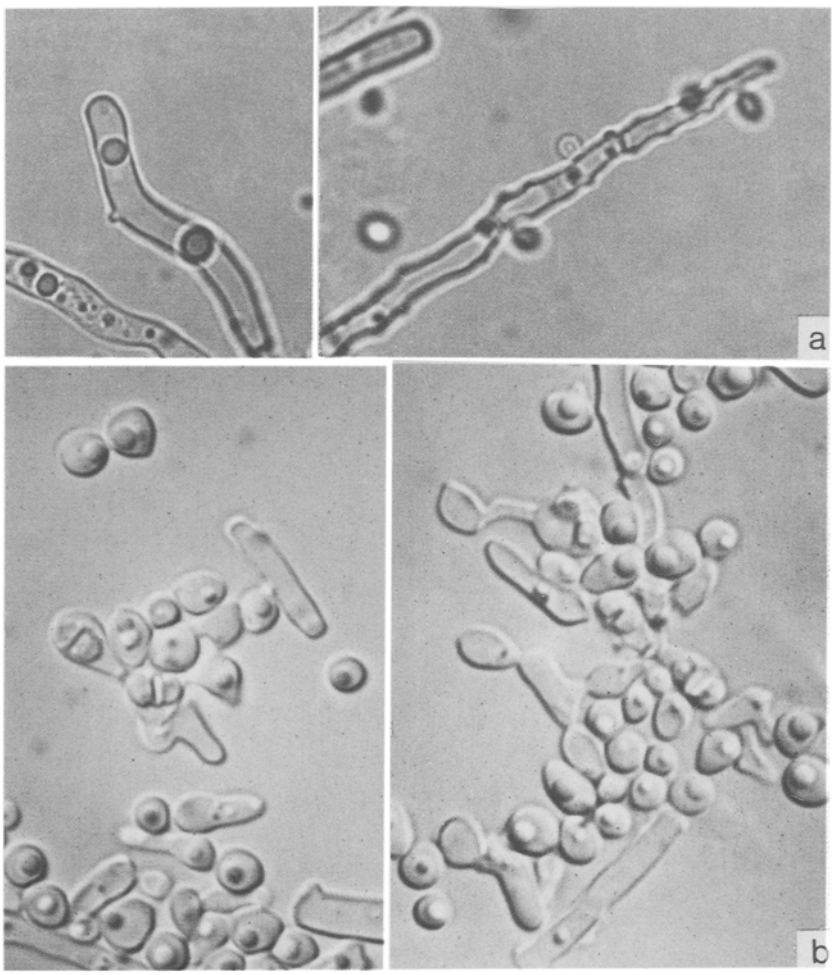

Fig. 2. *Hyphopichia burtonii*, a. denticulate conidiogenous cells and conidia; b. yeast cells, partly conjugating, forming asci and hat-shaped ascospores. 1500 ×.

2. Stout, pigmented ascophores absent 3
3. Asci many-spored *Ascoidea*
3. Asci 1- to 4-spored 4
4. Asci are conjugating yeast cells; ascospores small; conidia formed on denticles; heterothallic *Hyphopichia*
4. Asci formed on hyphae, single, botryose or catenulate 5
5. Asci thick-walled, crowned with an apical cell, single; conidia formed on denticles; heterothallic *Stephanoascus*

5. Asci not crowned with an apical cell, usually thin-walled, conidiogenous cells not denticulate 6
6. Hyphae with septa thickened around a central, plugged pore visible under the light microscope (ambrosia yeasts) 7
6. Septate hyphae without plugged septal pores 8
7. Nitrate assimilated; asci catenulate; ascospores small, 2–4 µm in diameter *Hormoascus*
7. Nitrate not assimilated; asci usually botryose; ascospores larger *Ambrosiozyma*
8. Ascospores larger than 5 µm, often pigmented; budding cells present (not ambrosia yeasts) *Saccharomycopsis*
8. Ascospores 2–4 µm in diameter 9
9. Budding cells absent; conidia with a truncate base present (form genus *Raffaelea*, classified in Hyphomycetes); nitrate not assimilated (ambrosia yeasts) *Botryoascus*
9. Budding cells present; septate hyphae not predominant, usually absent (Saccharomycetaceae) 10
10. Nitrate assimilated *Hansenula*
10. Nitrate not assimilated *Pichia*

In the genera *Hansenula* and *Pichia* some species are described which occasionally form septate hyphae. These two genera of the Saccharomycetaceae have therefore been included in the key.

Received 19 *February* 1976

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