ELSEVIER

FEMS Yeast Research 5 (2005) 1101–1113

FEMS Yeast Research

www.fems-microbiology.org

MiniReview

Malassezia Baillon, emerging clinical yeasts

Roma Batra [a,1], Teun Boekhout [b,*], Eveline Guého [c], F. Javier Cabañes [d], Thomas L. Dawson Jr. [e], Aditya K. Gupta [a,f]

[a] *Mediprobe Research, London, Ont., Canada*
[b] *Centraalbureau voor Schimmelcultures, Uppsalalaan 8, 85167 Utrecht, The Netherlands*
[c] *5 rue de la Huchette, F-61400 Mauves sur Huisne, France*
[d] *Departament de Sanitat i d' Anatomia Animals, Universitat Autònoma de Barcelona, Bellaterra, Barcelona E-08193, Spain*
[e] *Beauty Care Technology Division, Procter & Gamble Company, Cincinnati, USA*
[f] *Division of Dermatology, Department of Medicine, Sunnybrook and Women's College Health Science Center (Sunnybrook site) and the University of Toronto, Toronto, Ont., Canada*

Received 1 November 2004; received in revised form 11 May 2005; accepted 18 May 2005

First published online 12 July 2005

Abstract

The human and animal pathogenic yeast genus *Malassezia* has received considerable attention in recent years from dermatologists, other clinicians, veterinarians and mycologists. Some points highlighted in this review include recent advances in the technological developments related to detection, identification, and classification of *Malassezia* species. The clinical association of *Malassezia* species with a number of mammalian dermatological diseases including dandruff, seborrhoeic dermatitis, pityriasis versicolor, psoriasis, folliculitis and otitis is also discussed.

Keywords: *Malassezia*; Yeast; Identification; Animals; Disease

1. Introduction

Members of the genus *Malassezia* are opportunistic yeasts of increasing importance, due in large part to advances in detection and culture methodology which have both allowed their investigation and revealed their importance in human and animal disease [1,2]. The genus *Malassezia* belongs to the basidiomycetous yeasts and is classified in the *Malasseziales* (*Ustilaginomycetes*, *Basidiomycota*) [3–5]. The cells show a multilayered cell wall, enteroblastic budding (Fig. 1), urease activity, and a positive staining reaction with Diazonium Blue B (DBB) [3]. The genus was named in 1889 by Baillon [6] with the species *M. furfur*, to accommodate the filamentous fungus observed in scales of the human skin disease pityriasis versicolor (PV). *Pityrosporum* [7] has been proposed as an alternative generic name, but because *Malassezia* had been published earlier this name has nomenclatural priority. The genus remained limited to *M. furfur* and *M. pachydermatis* for a long time. *M. pachydermatis* is lipophilic but not lipid-dependent, and usually occurs on animals [8]. For many years all pathologies caused by *M. furfur sensu lato*, particularly disorders of the skin such as dandruff, seborrhoeic dermatitis (D/SD), pityriasis versicolor (PV), and folliculitis, were ascribed to a single species [9]. Only the recent recognition of a number of new species and the development of methods to differentiate them has

* Corresponding author. Tel.: +31 30 212 2671; fax: +31 30 251 2097.
E-mail address: boekhout@cbs.knaw.nl (T. Boekhout).
[1] Present address: W281N4904, Theodores Cove, Pewaukee, WI, USA.

1567-1356/$22.00
doi:10.1016/j.femsyr.2005.05.006

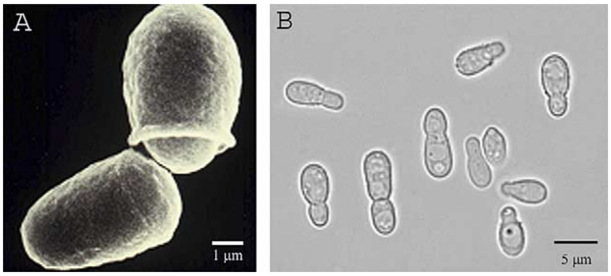

Fig. 1. Morphology of *Malassezia* cells. (A) Budding cells of *M. pachydermatis* viewed by scanning electron microscopy. (B) *M. furfur* under bright field microscopy.

changed this approach [2,10]. The 28S-rDNA sequences revealed seven distinct genetic entities [11], which are now widely accepted as species (*M. furfur*, *M. obtusa*, *M. globosa*, *M. slooffiae*, *M. sympodialis*, *M. pachydermatis*, and *M. restricta*) [10]. Since then, five new *Malassezia* species have been reported (*M. dermatis* [12], *M. equi* [13], *M. japonica* [14], *M. nana* [15], and *M. yamatoensis* [16]), but further biochemical and molecular characterization will be required for their acceptance as distinct species. Biochemical identification tests for *Malassezia* species include catalase and β-glucosidase activity, and evaluation of growth with cremophor EL and Tweens 20, 40, 60, 80, using the diffusion method in Sabouraud glucose agar (Table 1, Fig. 2) [1,4,10,17].

2. *Malassezia* species

M. furfur is morphologically heterogeneous with globose, oval or cylindrical yeast cells. This species can be identified by its ability to grow at 37 °C, strong catalase activity, absence or a very weak β-glucosidase activity, and equal growth in the presence of cremophor EL (=castor oil) and Tweens 20, 40, 60, 80 as sole lipid sources [4,17]. Strains of *M. furfur* showed two different karyotypes [18], but demonstrated high percentages of DNA/DNA reassociation and high ribosomal RNA similarity [10,11]. Some strains are able to produce filaments, either spontaneously or under particular culture conditions [19]. Strains of the species originate from various hosts, body sites and diseases. However, *M. furfur* was not observed in recent epidemiological surveys of healthy persons and patients with pityriasis versicolor (PV) and seborrhoeic dermatitis (SD) or with only PV [20,21]. This absence may, perhaps, be caused by the isolation protocols used, or may arise from competition between different skin-inhabiting species of *Malassezia*. Using the same isolation protocol, the species has been isolated from systemic and mucosal sites, such as urine, vagina and blood, or exposed sites such as nails (E. Guého, unpublished data). It has also been isolated from animals [22–24]. *M. furfur* is the only *Malassezia* species

Table 1
Salient characteristics of *Malassezia* species [1,2,10,12,14–17,24,26–28,30–33,36,38–42,55,57,62,63,65,72,80,82–84,92,95,96,99–101]

Species	Occurrence	Cell morphology	Lipid dependency	Tween 20	Tween 40	Tween 60	Tween 80	Cremophor EL	Catalase	β-Glucosidase	Growth at 37 °C
M. dermatis	AD	Ellipsoidal, globose	+	+	+	+	+	W, (+)	+	?	+
M. furfur	AD, AN, HS, OE, PV low, S, SD low	Globose, ellipsoidal, cylindrical	+	+, (−)	+, (−)	+, (−)	+, (−)	+, (−)	+, (−)	−, (w)	+
M. globosa	AN, AD, P, PV high, SD high, SD/D high	Globose	+	−	−[2]	−[2]	−	−	+	−	−, (w)
M. japonica	AD, HS	Globose, ellipsoidal	+	−	w	+	−	?	+	?	+
M. nana	AN, OE	Ellipsoidal	+	v	+	+	w	?	+	?	+
M. obtusa	AN, HS, OE, SD	Ellipsoidal, cylindrical	+	−	−	−	−	−	+	+	−, (w)
M. pachydermatis	AN, OE, S, SD/AN	Ellipsoidal	−, (w)	+[1]	+	+	+	+[1]	+, w	+, (−)	+
M. restricta	AD, HS scalp, P, SD, SD/D high	Globose, ellipsoidal	+	−	−[3]	−[3]	−	?	−	−	v
M. slooffiae	AN, HS, P, PV, SD	Ellipsoidal, cylindrical	+	+, w, (−)	+	+	−, (w)	−	+	−	+
M. sympodialis	AD, AN, HS, P, PV, SD	Ellipsoidal	+	−, w[2]	+	+	+	−, (w)	+	+	+
M. yamatoensis	AD, HS, SD	Ellipsoidal	+	+	+	+	+	?	+	?	+

AD, atopic dermatitis; AN, non-human animals; HS, healthy human skin; OE, otitis externa; P, psoriasis; PV, pityriasis versicolor; S, sepsis; SD, seborrhoeic dermatitis; SD/AN, seborrhoeic dermatitis in animals; SD/D, seborrhoeic dermatitis/dandruff; SD; w, weak; v, variable; ( ) indicate rare deviations from main pattern; [1], growth may be inhibited near the well where the substrate is placed; [2], growth may occur at some distance from the well where the substrate is placed; [3], opaque zone may occur.