

Comparison of the New API Candida System to the ID 32C System for Identification of Clinically Important Yeast Species

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API Candida was evaluated in comparison with the ID 32C system for the identification of 619 yeast isolates. The sensitivity of API Candida for the identification of the 15 species it claims to identify with and without additional tests was 97.4% (593 of 609) and 75.2% (458 of 609), respectively. The API Candida system is easy to use and rapid (result in 18 to 24 h).

The incidence of fungal infections has increased in recent years, especially in immunocompromised and severely debilitated patients (1, 23). Because of the more frequent use of antifungal agents, resistant pathogenic strains have emerged. The factors mentioned above, associated with the increasing diversity of the microorganisms involved (13), have made it imperative to precisely identify the microorganisms responsible for the infection, in order to ensure efficient management of patients. In response to this need, much effort has been devoted to develop rapid and accurate yeast identification methods and several commercial systems have been evaluated (3, 5–10, 14, 16, 20–22). These systems have some advantages and drawbacks concerning their capacity to rapidly and accurately identify yeast isolates. To improve yeast identification, different techniques have been developed in the last few years: latex tests (17, 18), PCR (11), and differential culture media (4, 12, 15, 19). However, for the moment these new procedures have been performed only for a few species and are not adapted to the identification of all medically important yeasts. A new system, API Candida (bioMérieux, Marcy-l'Etoile, France), has been developed for clinical microbiology laboratories to identify the most medically important yeasts and yeast-like organisms (15 species) in 18 to 24 h. The aim of this study was to evaluate the performance of the new product, compared with that of the ID 32C system (bioMérieux). The ID 32C system was chosen because it has been proven to be accurate and has the advantage of having a more extensive database (2, 10).

A total of 619 yeasts and yeast-like fungi were examined in the study (Table 1). Among these, 284 organisms were clinical isolates obtained from patients hospitalized at the Grenoble and Lyon university hospitals, and 335 came from the bioMérieux collection. Quality control organisms, supplied by the manufacturer, were tested to ensure adequate system performance. These included *Candida glabrata* ATCC 2001 (American Type Culture Collection, Rockville, Md.), *Candida guilli-*

ermundii ATCC 6260, *Candida kefyr* ATCC 4135, *Candida tropicalis* ATCC 7349, and *Cryptococcus neoformans* ATCC 32045. All quality control organisms were correctly identified by the new system. The experiments were carried out, according to the manufacturer's recommendations, using 18- to 48-h-old isolates obtained from primary cultures on gentamicin-chloramphenicol Sabouraud medium (bioMérieux).

The ID 32C system consists of a single-use disposable plastic strip with 32 wells to perform 29 assimilation tests (carbohydrates, organic acids, and amino acids), 1 assimilation test with a negative control, 1 susceptibility test (cycloheximide), and 1 colorimetric test (esculin) (10). It includes a database with 63 different species. The results were recorded by direct reading after 48 h of incubation at 30°C. Additional tests, such as macroscopic and microscopic morphology, were sometimes required for complete identification. The API Candida system consists of a strip of 10 API tubes allowing 12 colorimetric tests to be performed: 5 carbohydrate acidification tests (glucose, galactose, sucrose, trehalose, and raffinose) and 7 enzymatic tests (β -maltosidase, α -amylase, β -xylosidase, β -glucuronidase, urea hydrolysis, *N*-acetyl- β -glucosaminidase, and β -galactosidase). Inoculation of the tubes was performed by adding yeast suspension (inoculum [McFarland standard of 3] in saline) to the dehydrated substrates. After an 18- to 24-h incubation at 35°C, the reactions were read visually without addition of reagents. The results were transformed into a numerical profile which was compared with those given in the profile list in the package insert. Discrepancies in the results obtained with the API Candida and ID 32C systems were further analyzed by repeated testing with the two systems and by additional tests such as temperature tolerance at 37°C, pigmentation of isolated colonies, capsule detection by India ink, microscopic morphology on cornmeal agar, and an agglutination test (*Bichrolatex krusei*; Fumouze, Asnières, France) (17).

The sensitivity of the API Candida system for the identification of the 15 species it claims to identify with and without additional tests was 97.4% (593 of 609) and 75.2% (458 of 609), respectively. The API Candida system enabled the correct identification of 458 of the 619 isolates (74%) with no additional tests (Table 1). The species most likely to be correctly identified by this system, without extra tests, were *Can-*

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TABLE 1. Accuracy of identification of 619 fungal strains with the API Candida system

Species	Tested	No. of strains			
		Correctly identified with extra tests	Correctly identified	Not identified	Incorrectly identified
<i>Candida albicans</i>	96	93	3		
<i>Candida famata</i>	17	11	2	1	3
<i>Candida glabrata</i>	62	60	2		
<i>Candida guilliermondii</i>	25	25			
<i>Candida inconspicua</i>	21		21		
<i>Candida intermedia</i> ^a	1			1	
<i>Candida kefyr</i>	32	32			
<i>Candida krusei</i>	50		50		
<i>Candida lipolytica</i> ^a	2				2
<i>Candida lusitaniae</i>	34	31	3		
<i>Candida norvegensis</i>	11		11		
<i>Candida parapsilosis</i>	58	52	6		
<i>Candida pelliculosa</i> ^a	1			1	
<i>Candida rugosa</i> ^a	2			2	
<i>Candida sake</i> ^a	1				1
<i>Candida sphaerica</i> ^a	3				3
<i>Candida tropicalis</i>	60	52	5		3
<i>Cryptococcus neoformans</i>	32	27	4	1	
<i>Geotrichum</i> spp.	28	1	24		3
<i>Saccharomyces cerevisiae</i>	37	33	3		1
<i>Trichosporon</i> spp.	46	41	1	2	2

^a Uncommon species; not in the API Candida database.

Candida albicans (96.9%), *Candida glabrata* (96.8%), *Candida guilliermondii* (100%), *Candida kefyr* (100%), *Candida lusitaniae* (91.2%), *Candida parapsilosis* (89.7%), *Candida tropicalis* (86.7%), *Cryptococcus neoformans* (84.4%), *Saccharomyces cerevisiae* (89.2%), and *Trichosporon* spp. (89.1%). For 135 of the 619 isolates (21.8%), the profile number generated by the API Candida system yielded two or more species, one of which was correct. This occurred most often with *Candida inconspicua* (100%), *Candida krusei* (100%), *Candida norvegensis* (100%), and *Geotrichum* spp. (85.7%). In all such cases, the complete identification was obtained by additional tests, such as morphology. *Candida inconspicua*, *Candida krusei*, and *Candida norvegensis* had the same biochemical profile by the API Candida system: only one test (glucose acidification) was positive. With the ID 32C system, differentiation of these three species can be obtained with two tests only: *N*-acetylglucosamine and glucosamine assimilation. Identification of *Candida krusei* was confirmed by an agglutination test (Bichrolatex krusei; Fumouze). The identification of *Geotrichum* spp. was completed by microscopic observation (presence of arthrospores). The API Candida system incorrectly identified 18 of the 619 isolates (2.9%), including six strains belonging to three species not claimed in the database. Among these misidentifications (listed in Table 2), the two strains of *Candida lipolytica* had the profile of *Candida krusei*.

The API Candida system gave good results without extra tests in the identification of the majority of yeasts commonly isolated in clinical microbiology laboratories. However, two medically important kinds of yeast, *Candida krusei* and *Geotrichum* spp., required additional tests to complete identification because they had only one or two positive tests. Visual interpretation of ID 32C tests was sometimes difficult and required more experience than is usually available in a routine clinical microbiology laboratory. In conclusion, compared with the ID 32C system, the API Candida system was easier to use (only 10

TABLE 2. Incorrect identification results by the API Candida system

Species (no. of isolates tested)	Identification by the API Candida system (no. of isolates)
<i>Candida famata</i> (3).....	<i>Candida guilliermondii</i> (2), <i>Candida glabrata</i> (1)
<i>Candida lipolytica</i> ^a (2).....	<i>Candida krusei</i> (2)
<i>Candida sake</i> ^a (1).....	<i>Candida parapsilosis</i> (1)
<i>Candida sphaerica</i> ^a (3).....	<i>Candida kefyr</i> (3)
<i>Candida tropicalis</i> (3).....	<i>Candida famata</i> (3)
<i>Geotrichum</i> spp. (3).....	<i>Saccharomyces cerevisiae</i> (2), <i>Candida albicans</i> (1)
<i>Saccharomyces cerevisiae</i> (1).....	<i>Candida parapsilosis</i> (1)
<i>Trichosporon</i> spp. (2).....	<i>Candida tropicalis</i> (2)

^a Uncommon species; not in the API Candida database.

tubes to inoculate and visual reading of color reactions without addition of reagents), gave rapid results (obtained approximately 24 h earlier), and is cheaper. The API Candida system is particularly adapted to identify clinically important yeasts in a routine clinical microbiology laboratory.

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REFERENCES

- Anaïs, E. 1992. Opportunistic mycoses in the immuno compromised host: experience at a cancer center and review. *Clin. Infect. Dis.* 14:43-51.
- Bruun, B., H. Westh, and J. Stenderup. 1995. Evaluation of the ATB 32C system for identification of clinical yeast isolates. *J. Clin. Microbiol. Infect.* 1:134-138.
- Buesching, W. J., K. Kurek, and G. D. Roberts. 1979. Evaluation of the modified API 20C system for identification of clinically important yeasts. *J. Clin. Microbiol.* 9:565-569.
- De Champs, C., B. Lebeau, R. Grillot, and P. Ambroise-Thomas. 1995. Evaluation of Albicans ID plates. *J. Clin. Microbiol.* 33:2227-2228.
- Dooley, D. P., M. L. Beckius, and B. S. Jeffrey. 1994. Misidentification of clinical yeast isolates by using the updated Vitek Yeast Biochemical Card. *J. Clin. Microbiol.* 32:2889-2892.
- El-Zaatari, M., L. Pasarell, M. R. McGinnis, J. Buckner, G. A. Land, and I. F. Salkin. 1990. Evaluation of the updated Vitek yeast identification data base. *J. Clin. Microbiol.* 28:1938-1941.
- Fenn, J. P., H. Segal, B. Barland, D. Denton, J. Whisenant, H. Chun, K. Christofferson, L. Hamilton, and K. Carroll. 1994. Comparison of updated Vitek Yeast Biochemical Card and API 20C yeast identification systems. *J. Clin. Microbiol.* 32:1184-1187.
- Fricker-Hidalgo, H., B. Lebeau, P. Kervroedan, O. Faure, P. Ambroise-Thomas, and R. Grillot. 1995. Auxacolor[®], a new commercial system for yeast identification: evaluation of 182 strains comparatively with ID 32 C. *Ann. Biol. Clin.* 53:221-225.
- Fricker-Hidalgo, H., B. Lebeau, V. Lacassagne, P. Kervroedan, P. Ambroise-Thomas, and R. Grillot. 1993. Identification rapide de *Candida albicans*, *Candida tropicalis*, *Candida glabrata*, *Cryptococcus neoformans* par Fongiscreeen 4H[®]. Evaluation sur 191 souches de levures. *J. Mycol. Med.* 3:103-106.
- Gutierrez, J., E. Martin, C. Lozano, J. Coronilla, and C. Nogales. 1994. Evaluation of the ATB 32 C, automatic system and API 20 C using clinical yeast isolates. *Ann. Biol. Clin.* 50:443-446.
- Jordan, J. A. 1994. PCR identification of four medically important *Candida* species by using a single primer pair. *J. Clin. Microbiol.* 32:2962-2967.
- Lipperheide, V., L. Andracka, J. Ponton, and G. Quindos. 1993. Evaluation of the Albicans ID[®] plate method for the rapid identification of *Candida albicans*. *Mycoses* 34:417-420.
- Meunier, F., M. Aoun, and N. Bitar. 1992. Candidemia in immunocompromised patients. *Clin. Infect. Dis.* 14:S120-S125.
- Miller, J. M. 1991. Evaluating biochemical identification systems. *J. Clin. Microbiol.* 29:1559-1561.
- Odds, F. C., and R. Bernaerts. 1994. CHROMagar Candida, a new differential isolation medium for presumptive identification of clinically important *Candida* species. *J. Clin. Microbiol.* 32:1923-1929.
- Pfaller, M. A., T. Preston, M. Bale, F. P. Koozntz, and B. A. Body. 1988. Comparison of the Quantum II, API Yeast Ident, and AutoMicrobic systems for identification of clinical yeast isolates. *J. Clin. Microbiol.* 26:2054-2058.
- Robert, R., C. Bernard, and J. M. Senet. 1993. Rapid identification of *Candida krusei*, p. 18. In 1st Congress of the Confederation of Medical

- Mycology. Confederation of Medical Mycology, Paris.
18. **Robert, R., R. Sentandreu, C. Bernard, and J. M. Senet.** 1994. Evaluation du reactif Bichrolatex Albicans pour l'identification rapide de colonies de *Candida albicans*. *J. Mycol. Med.* **4**:226–229.
 19. **Rousselle, P., A.-M. Freydiere, P.-J. Couillerot, H. de Montclos, and Y. Gille.** 1994. Rapid identification of *Candida albicans* by using Albicans ID and Fluoroplate agar plates. *J. Clin. Microbiol.* **32**:3034–3036.
 20. **Schuffenecker, I., A. Freydière, H. de Montclos, and Y. Gille.** 1993. Evaluation of four commercial systems for identification of medically important yeasts. *Eur. J. Clin. Microbiol. Infect. Dis.* **12**:255–260.
 21. **Shankland, G. S., V. Hopwood, R. A. Forster, E. G. V. Evans, M. D. Richardson, and D. W. Warnock.** 1990. Multicenter evaluation of Microring YT, a new method of yeast identification. *J. Clin. Microbiol.* **28**:2808–2810.
 22. **Waller J., G. Contant, C. Crouzier, M. Debruyne, and H. Koenig.** 1995. Evaluation of a new yeast identification system: fungichrom®I based on chromogenic substrate hydrolysis and carbohydrate assimilation. *J. Mycol. Med.* **5**:92–97.
 23. **Wingard, J. R.** 1995. Importance of *Candida* species other than *C. albicans* as pathogens in oncology patients. *Clin. Infect. Dis.* **20**:115–125.