Comparison of the API 20E and Oxi/Ferm Systems in Identification of Nonfermentative and Oxidase-Positive Fermentative Bacteria

THOMAS R. OBERHOFER

Microbiology Section, Department of Pathology, Madigan Army Medical Center, Tacoma, Washington 98431

Received for publication 2 September 1978

The API 20E and Oxi/Ferm systems were tested in parallel to identify nonfermentative bacteria and oxidase-positive fermentative bacteria. Test strains consisted of consecutive clinical isolates, with stock cultures used to supplement those species infrequently recovered. The two microsystems, as well as tubes of triple sugar iron, motility, cetrimide, and oxidative glucose media, were inoculated by each worker for each organism. Identification of each isolate was by the protocol of the manufacturers, with supplemental tests and flagella stains performed when necessary. Concurrent identification was undertaken with a conventional system against which the results of the two systems were compared for accuracy. There was a 95.3% accuracy in identification by the Oxi/Ferm system and 88.9% by the API system. Almost one-fourth of all identification attempts with the API required computer assistance, and most of these were for oxidase-positive bacteria. Because of this, and because the API system showed greater accuracy in identification of the oxidase-negative bacteria, it seems best suited for identification of these organisms (*P. maltophilia*, *A. anitratus*, and *A. lwoffii*). The Oxi/Ferm system is technically less cumbersome than the API and is well suited for both groups of organisms.

The isolation and identification of nonfermentative bacteria (NFB) have come to be an essential task in the clinical microbiology laboratory, especially as workers come to recognize their presence and importance as potential pathogens. Even though various schema for identification of the NFB are available in the literature (2, 5, 7, 8), it is clear that there is a need for less complicated systems that will offer an alternative to the more conventional methods currently in use.

Few proven miniaturized systems are available commercially to facilitate the identification of NFB and the oxidase-positive fermentative bacteria (OPFB). One of these, the Oxi/Ferm (OxF) system (Roche Diagnostic Division, Hoffman-LaRoche, Inc., Nutley, N.J.), has been evaluated with fresh clinical isolates (3) as well as a large variety of stock cultures of known identity (6). Recently, the OxF and API (Analytab Products Inc., Plainview, N.Y.) systems were compared for usefulness in identifying both the fermentative and nonfermentative, oxidase-positive bacteria (1, 4).

This report presents the results of a comparative study of both the API and OxF systems to identify fresh clinical isolates of NFB and OPFB.

Each system was evaluated for performance and accuracy of identification when tests were performed concurrently under similar conditions. Also, the recently revised API profile register was compared to the manual formerly in use for ease of use, ability to decode, and accuracy of organism identification.

(This paper was presented in part at the 78th Annual Meeting of the American Society for Microbiology, Las Vegas, Nev., 14-19 May 1978.)

MATERIALS AND METHODS

Organisms tested. The 287 fresh clinical isolates tested in this study were recovered and identified over a 14-month period in the Microbiology Laboratory, Madigan Army Medical Center. Only those cultures judged to be of clinical importance were selected for testing. Eleven additional strains (three strains each of *Flavobacterium* IIB, CDC VE-2, and *Achromobacter xylosoxidans* and one each of CDC IIk-2 and *Flavobacterium* IIf) were stock organisms which were selected to supplement the infrequently recovered clinical isolates.

Commercial systems—general approach. By our procedures, non-lactose-fermenting organisms as seen on MacConkey agar or organisms growing on blood agar only were routinely screened with the oxidase test. All oxidase-positive organisms were tested directly with both the API and OxF systems. Oxidase-

negative NFB were tested in one of two ways. Experienced technologists, suspecting NFB based on the colonial morphology of the isolates on blood or MacConkey agar plates, inoculated both the API and OxF systems. Technicians of lesser expertise generally inoculated API strips only, with the OxF system inoculated later when an NFB was noted. Stock organisms were given to various workers as unknowns and processed as simulated clinical specimens as part of an internal quality control program. The following media were routinely inoculated in parallel to the two test systems: a triple sugar iron slant for fermentation reactions; an oxidation-fermentation glucose tube without oil overlay for glucose oxidation, accompanied by a tube of basal medium; a tube of semisolid medium for motility determinations; and a cetrimide slant for tolerance testing. Later, acetamide (5) was added to the battery of tests. All systems and media were incubated at 35°C. Additional tests necessary for proper identification were used as suggested in the respective code manuals.

API system. Well-isolated colonies were harvested and emulsified in saline and used to inoculate the wells of the API 20E test strip. After overnight incubation, positive results were recorded on the worksheet. If glucose was acidified, or if three tests excepting oxidase were positive, reagents were added and the tests were interpreted according to the manufacturer's directions. Tests not meeting these conditions were reincubated for an additional 24 h. Reactions again were recorded, and, regardless of the number of positive results at this time, the reagents were added to the strips and the results were coded. Isolates which could not be identified because of failure of the manuals to contain the specific codes were referred to the computer reference center for identification. The revised code manual, dated October 1977 and received in December 1977 (hereafter referred to as revised), was used to identify those organisms which had been coded previously with the manual in use at the time of testing (hereafter referred to as former). Isolates tested after receipt of the revised manual were identified by using both manuals.

OxF system. The details of inoculation and interpretation of test reactions have been presented elsewhere (6). Briefly, portions of colonies selected for testing were gathered on the inoculating needle, and the needle was drawn through the compartments of the tube in a single twisting motion and then used to inoculate a Trypticase soy agar plate. After overnight incubation, the plates and ancillary media were removed and examined. The OxF tube was examined at 48 h, with all test reactions recorded at this time. The indole test was performed according to the manufacturer's directions, and the test for nitrite production was performed as previously described (6). The resultant codes were searched in the code book and additional tests were performed as necessary.

Conventional system. The conventional tests used to identify the NFB and OPFB have been described (5). Each battery of conventional tests was set up during the same time period as the two microsystems. Identifications resulting from conventional tests were considered as correct in all instances.

RESULTS

A total of 298 organisms was tested during this study period. When the clinical isolates are listed in descending order of frequency of recovery from clinical materials (Tables 4 and 5), it is seen that of the 16 named and 9 unnamed species listed nonpigmented *Pseudomonas aeruginosa* and *A. anitratus* accounted for 27 and 23% of the strains tested, respectively. Just five species of NFB (*P. aeruginosa*, *A. anitratus*, *Pseudomonas maltophilia*, *Acinetobacter lwoffii*, and *Pseudomonas putida*) accounted for 76% of the organisms tested. Conversely, the nine strains of OPFB recovered during the study period constituted only 3% of the total organisms encountered.

The accuracy of the two systems for identification of NFB and OPFB is shown in Table 1. When compared to conventional tests the OxF system correctly identified 284 (95.3%) of the strains tested. Thirteen species (149 strains) were 100% correct in identification and accounted for 50% of the strains tested. A further 104 strains (35%) were at least 96% correct. Eight strains of *Flavobacterium* IIb and nine of *M. osloensis* were identified to the genus level and were considered to be correctly identified even though the OxF code manual did not accommodate these species or group designations. Three isolates of *P. acidovorans*, on the other hand, were not identified because the code manual did not differentiate this pseudomonad from others showing the identical code.

Of the 298 cultures tested with the API system (Table 1), 266 (89.3%) were correctly identified based on information contained in the former code manual. Six species (70 strains) were 100% correct in identification and accounted for 23% of the strains tested. An additional 149 strains (50%) were at least 90% correct. Overall results were similar when the revised code was used, although identification of *P. putida* increased in accuracy from 83 to 95% whereas that of *Pseudomonas fluorescens* decreased from 57 to 29%.

Additional tests were often necessary for proper identification with both systems, and the organisms relying on such tests are shown in Table 2. Almost half of identification attempts with OxF necessitated further testing, which far exceeded the requirements for API. It is seen that the fluorescent pseudomonads accounted for 103 of the 121 isolates needing these tests. Fifty-one *P. aeruginosa* isolates required cetrimide for differentiation (from *Achromobacter* sp.), 21 required tests for growth at 42°C, and two required both tests. The 20 isolates of *P. putida* required tests for growth at 42°C and

TABLE 1. Correct identification of organisms with the OxF and API systems

Organism	No. of strains tested	OxF		API			
		No. of strains identified	% Identified	Former ^a		Revised	
				No. of strains identified	% Identified	No. of strains identified	% Identified
<i>P. aeruginosa</i>	78	77	99	76	97	75	96
<i>P. putida</i>	23	20	87	19	83	22	96
<i>P. fluorescens</i>	7	7	100	4	57	2	29
<i>A. anitratus</i>	65	65	100	64	98	64	98
<i>A. lwoffi</i>	23	23	100	23	100	23	100
<i>P. maltophilia</i>	28	27	96	28	100	28	100
<i>P. cepacia</i>	10	10	100	9	90	9	90
<i>M. osloensis</i>	9	9	100	9	100	8	89
<i>Moraxella</i> sp.	7	3	43	6	86	6	86
<i>Flavobacterium</i> IIb	8	8	100	6	75	6	75
<i>Flavobacterium</i> IIc	3	3	100	2	67	2	67
CDC Ve	7	7	100	7	100	7	100
CDC IIIk	6	6	100	3	50	3	50
<i>P. acidovorans</i>	3	0	0	0	0	0	0
<i>Alcaligenes</i> sp.	3	3	100	2	67	2	67
<i>A. xylosoxidans</i>	5	5	100	2	40	2	40
CDC Va	3	2	67	0	0	0	0
<i>P. stutzeri</i>	1	1	100	1	100	1	100
<i>P. multocida</i>	7	6	86	3	43	3	43
<i>A. hydrophila</i>	2	2	100	2	100	2	100
Total	298	284	95.3	266	89.3	265	88.9

^a Former manual, December 1976; revised manual, October 1977.

TABLE 2. Supplemental information required for identification with the API and OxF systems

Organism	No. of strains tested	No. of strains identified by OxF	No. of strains identified by API			
			Additional tests		Computer assisted	
			Former	Revised	Former	Revised
<i>P. aeruginosa</i>	78	75	11	17	12	11
<i>P. putida</i>	23	20	20	22	11	1
<i>A. anitratus</i>	65	0	2	2	13	13
<i>Moraxella</i> sp.	16	12	0	0	1	7
<i>P. fluorescens</i>	7	6	2	4	0	0
<i>P. cepacia</i>	10	0	2	1	7	4
<i>P. maltophilia</i>	28	1	3	3	6	4
<i>A. lwoffi</i>	23	0	1	1	3	4
<i>Flavobacterium</i> IIb	8	1	1	0	3	1
CDC Ve	7	0	2	1	3	3
<i>A. xylosoxidans</i>	5	0	2	4	2	0
CDC IIIk	6	0	2	2	2	2
<i>P. acidovorans</i>	3	3	3	3	0	2
<i>Flavobacterium</i> IIc	3	0	0	0	2	0
<i>Alcaligenes</i> sp.	3	1	2	3	2	2
<i>P. multocida</i>	7	1	0	0	6	6
<i>A. hydrophila</i>	2	1	0	0	0	0
CDC Va	3	0	0	0	1	1
<i>P. stutzeri</i>	1	0	0	0	0	0
Total	298	121 (41) ^a	53 (18)	63 (21)	74 (25)	61 (20)

^a Numbers in parentheses indicate percents.

gelatin liquefaction, whereas strains of *P. fluorescens* needed these as well as several other tests. The identification of the moraxellae relied upon tests for anaerobic growth in addition to tests for penicillin susceptibility. Flagella stains were required for differentiation of *Pseudomonas* sp. and *Alcaligenes* sp. The test for motility was often necessary as a discriminating factor between *A. anitratus*, *A. lwoffii*, and *P. maltophilia*, but this was not charged against the OxF system because the test for motility, as used in this laboratory, constitutes an integral part of a basic battery of tests. The API system, although relying less on supplemental tests for identification, nevertheless presented unique difficulties. Tests for growth at 42°C were still required for *P. aeruginosa* (10 and 15 isolates when using the respective manuals). Moreover, the *P. putida* were coded as *P. fluorescens* "group," requiring lengthy searches through the tables of the former manual for appropriate tests to perform. The use of the revised manual as well as computer assistance resulted in the following tests necessary for identification of *P. putida*: gelatinase, four strains; lecithinase, three strains; growth at 42°C and gelatinase, five strains; growth at 42°C and utilization of acetamide, three strains; and growth at 42°C and lecithinase, seven strains. In addition to *P. acidovorans* and the *alcaligenes* species, *A. xylosoxidans* required the flagella stain for identification when using the former manual. When using the revised manual, moreover, cetrinide and acetamide also were needed.

Also shown in Table 2 are requirements for assistance of the computer reference center for identification attempts with the API system. It is seen that computer assistance was heavily relied upon since 25% (74 determinations) and 20% (61 determinations) of the test strains could not be identified with the information provided in the respective manuals. Of particular interest were the findings that 11 of the 19 isolates of *P. putida* and 7 of the 9 isolates of *P. cepacia* that were correctly identified required computer assistance. The revised manual permitted improved performance with *P. aeruginosa*, *P. putida*, and *P. cepacia* isolates, but reversed this trend with the moraxella isolates.

Table 3 shows the sources of discrepancies in identification. Ten of the misidentifications with OxF were at the species level, and four were at the genus level. Identification of *P. acidovorans* was incomplete because the manual failed to code at the species level for nonoxidative pseudomonads. Of the 33 cultures misidentified with the API system, 12 were misidentified as to genus, and 21 were misidentified as to species.

One isolate (*Flavobacterium* IIb) had an unacceptable code even with assistance of the computer reference center.

Table 4 shows the number of code profiles generated by API and OxF. Of the 298 cultures tested, there were 153 resultant codes with API in contrast to 63 with OxF. Of the more numerous organisms tested, *P. aeruginosa* had 36 profiles with API in contrast to 14 with OxF, *A. anitratus* had 20 (API) and 5 (OxF), and *P. maltophilia* had 17 (API) and 3 (OxF).

The OxF test systems were all examined after, and the results were recorded after, 48 h of incubation (Table 5). By contrast, 39% of the API tests were recorded at 24 h, with the remainder recorded at 48 h. Of the two most common organisms tested, results for 65% (42 *P. aeruginosa* and 51 *A. anitratus*) were recorded at 24 h. However, of the 10 least encountered species and groups (44 isolates), only two results were recorded at 24 h.

DISCUSSION

The reliability of the individual reactions has been described for the API (1, 4) and the OxF (6) systems, so that interest during this study was directed towards the accuracy and convenience of the two microsystems when used concurrently by workers of varying experience. The individual test reactions of the two systems are important for proper identification of each isolate, although aberrant reactions were considered in both code systems. The results of biochemical tests of OxF components have been described in detail (6), although correlations with conventional media in the present study were not as close. Because no codes required computer assistance for arbitration and because the degree of accuracy of identification was quite high, the disagreement in test reactions was not significant. The reasons that the 14 isolates could not be identified were varied. The misidentification of the three moraxella strains was not a result of poor performance but in the code itself. That is, the yellow-pigmented moraxella-like M4F and M-6 bacilli were misidentified as members of CDC IIk because the code did not account for these unusual organisms. Similarly, the misidentified *P. maltophilia* was an unusual oxidase-positive isolate and hence was not accommodated in the OxF profile register.

The test reactions in API were evaluated by Nord et al. (4) and Dowda (1) and found to compare favorably with the conventional tests. This report does not include a close scrutiny of the biochemical indexes because it is difficult to compare results of tests of different composition.

TABLE 3. Identification of discrepancies between the microsystems and conventional tests

Organism	Misidentifications by OxF	Misidentifications by API	
		Former	Revised
<i>P. putida</i>	3 <i>P. fluorescens</i>	3 <i>P. fluorescens</i> 1 <i>P. aeruginosa</i>	1 <i>P. fluorescens</i>
<i>P. fluorescens</i>		1 <i>P. putida</i> 1 <i>Pseudomonas</i> sp. 1 <i>P. aeruginosa</i>	2 <i>P. aeruginosa</i> 3 <i>P. putida</i>
<i>P. aeruginosa</i>	1 <i>P. putida</i>	2 <i>A. xylosoxidans</i>	2 <i>P. fluorescens</i> 1 <i>P. stutzeri</i>
<i>P. acidovorans</i>	3 <i>Pseudomonas</i> sp.	2 <i>Pseudomonas</i> sp. 1 <i>Alcaligenes</i> sp.	2 <i>Pseudomonas</i> sp. 1 <i>Alcaligenes</i> sp.
CDC Va	1 <i>P. vesicularis</i>	1 <i>P. stutzeri</i> 1 <i>P. cepacia</i> 1 <i>Pseudomonas</i> sp.	1 <i>P. stutzeri</i> 1 <i>P. cepacia</i> 1 <i>Pseudomonas</i> sp.
<i>P. multocida</i>	1 <i>P. ureae</i>	4 <i>Pasteurella</i> sp.	1 CDC IIj 3 <i>Pasteurella</i> sp.
<i>Moraxella</i> M-4f	3 CDC IIk, 1	1 CDC IIf	1 CDC IIf
<i>P. maltophilia</i>	1 <i>Pseudomonas</i> sp.		
<i>Moraxella</i> M-6	1 CDC IIk		
<i>Flavobacterium</i> IIb		1 CDC IIj 1 Unacceptable code 3 CDC IIk-1	1 CDC IIj 1 Unacceptable code 2 CDC IIk-1 1 <i>Pasteurella</i> sp.
CDC IIk,2			1 <i>Achromobacter</i> sp. 1 CDC IIj
CDC IVc		1 <i>Achromobacter</i> sp. 1 CDC IIj 3 <i>Alcaligenes</i> sp.	1 <i>Achromobacter</i> sp. 1 CDC IIj 3 <i>Alcaligenes</i> sp.
<i>A. xylosoxidans</i>		1 <i>P. stutzeri</i>	1 <i>P. stutzeri</i>
<i>P. cepacia</i>			1 <i>Pseudomonas</i> sp.
<i>M. osloensis</i>			1 <i>Flavobacterium</i> sp.
<i>A. anitratus</i>		1 <i>Flavobacterium</i> sp.	1 <i>Flavobacterium</i> sp.
Total	14	32	33

TABLE 4. Number of profiles resulting from use of the microsystems

Organism	No. of strains tested	No. of profiles from API	No. of profiles from OxF
<i>P. aeruginosa</i>	78	36	14
<i>A. anitratus</i>	65	20	5
<i>P. maltophilia</i>	28	17	3
<i>A. lwoffii</i>	23	11	2
<i>P. putida</i>	23	9	5
<i>Moraxella</i> sp.	16	5	1
<i>P. cepacia</i>	10	6	4
<i>Flavobacterium</i> IIb	8	8	4
<i>P. fluorescens</i>	7	7	5
CDC Ve	7	6	3
<i>P. multocida</i>	7	7	2
<i>A. xylosoxidans</i>	5	2	2
CDC IIk	6	4	3
<i>Flavobacterium</i> IIf	3	3	1
CDC Va	3	3	2
<i>Alcaligenes</i> sp.	3	3	2
<i>P. acidovorans</i>	3	3	2
<i>A. hydrophila</i>	2	2	2
<i>P. stutzeri</i>	1	1	1
Total	298	153	63

The substrates used in the API system are sufficiently different from conventional substrates to preclude a valid comparison. For example,

there was a 60% disagreement in urease reactions between API and conventional tests with *P. aeruginosa* and 28% disagreement with *A. anitratus*. There was a further 76% disagreement in glucose oxidation for *P. aeruginosa* between the two test systems. To declare that API reactions were erroneous would not only be unwarranted and improper, but insupportable as long as variable reactions were accounted for in the key or coding systems. Nevertheless, one test reaction was particularly troublesome in API and did account for misidentifications. The test for nitrogen gas was properly scored as positive when gas (bubbles) was evident in the glucose compartment or when, after adding zinc dust to a test negative for nitrites, a pink or red color failed to appear after 10 min. On many attempts, however, the zinc test failed to give the proper information, thereby resulting in either a misidentification, an unacceptable code, or no code at all. This was particularly true for two isolates each of *P. fluorescens* and *Flavobacterium* IIb as well as an assortment of other cultures.

The overall agreement in identification with conventional methods was 99 and 96% at the genus level, and 95 and 89% at the species level, respectively, for OxF and API. The results of

this study compared well with others (1, 4) with a similar variety of organisms. The organisms used in this evaluation were virtual consecutive isolates of NFB and OPFB recovered from clinical material and probably constitute the same distribution of organisms found in many laboratories. In contrast to a previous study employing selected and infrequently encountered organisms (6), five species of commonly found NFB accounted for 76% of all isolates encountered during the study period. The accuracy of identification at the species level of these common strains was 97.6% (Ox F) and 96.7% (API).

The coding system of Ox F was reduced to common and recurring codes for most organisms. This was an advantage of the system. Overall, only 63 profiles were necessary to identify the 25 species and groups of organisms. Fourteen of these profiles were attributed to *P. aeruginosa*, although 62 strains (79%) were identified with only four codes. A similar situation was not seen with API. The API system provided an extensive variety of profiles which became a decided disadvantage of the system during identification attempts. That a large number of well-selected tests will permit more accurate identification than will a small number is acknowledged. It was apparent, however, that the API profile register included some theoretical profiles because of the low probabilities of occurrence. The inordinately large number of profiles, many of which did not appear in the code manuals, resulted in unnecessary and often lengthy delays in identification because of the need for computer assistance. Indeed, a fourth of the test results could not be found when the former manual was searched and the situation was improved little with the latest edition of the manual. Even then, supplemental tests were required for proper identification, and difficulty still was experienced in choosing the appropriate tables in the appendix for selection of ancillary tests.

Approximately half of the organisms encountered during the evaluation period were fluorescent pseudomonads. Both systems, then, required supplemental tests for intragroup differentiation as well as differentiation between genera and species. The Ox F manual selects cetrimide and growth at 42°C as the supplemental tests of choice in most instances. Interestingly, it has been shown that utilization of acetamide perfectly parallels growth at 42°C among the fluorescent pseudomonads (5; unpublished data). For this reason and because selected non-oxidative organisms also alkalinize acetamide, use of acetamide is an acceptable substitute for tests of high temperature tolerance. Hence, an acetamide and cetrimide slant should be added

TABLE 5. Number of strains reported at 24 and 48 h of incubation

Organism	No. of strains tested	No. of strains by Ox F at:		No. of strains by API at:	
		24 h	48 h	24 h	48 h
<i>P. aeruginosa</i>	78	0	78	42	36
<i>A. anitratus</i>	65	0	65	51	14
<i>P. maltophilia</i>	28	0	28	7	21
<i>A. lwoffii</i>	23	0	23	0	23
<i>P. putida</i>	23	0	23	8	15
<i>Moraxella</i> sp.	16	0	16	0	16
<i>Flavobacteria</i>	11	0	11	0	11
<i>P. cepacia</i>	10	0	10	7	3
CDC Ve	7	0	7	1	6
<i>P. fluorescens</i>	7	0	7	1	6
<i>P. multocida</i>	7	0	7	0	7
<i>A. xylosoxidans</i>	5	0	5	0	5
CDC IIIk	6	0	6	0	6
CDC Va	3	0	3	0	3
<i>P. acidovorans</i>	3	0	3	0	3
<i>Alcaligenes</i> sp.	3	0	3	0	3
<i>A. hydrophila</i>	2	0	2	0	2
<i>P. stutzeri</i>	1	0	1	0	1
Total	298	0	298	117 (39) ^a	181 (61)

^a Numbers in parentheses indicate percents.

to the motility stab and triple sugar iron slant as a supplemental battery for routine inclusion to both of the API and Ox F systems.

Both of the microsystems offer the opportunity for a serious attempt at identification of NFB and the OPFB. The API system seems more suited for identification of the oxidase-negative NFB (99.2% correct) than the oxidase-positive NFB (82.3% correct). On the other hand, the Ox F system seems suited for both oxidase-positive (92.6%) as well as oxidase-negative (99.2%) groups even though it was essential for workers to recognize a possible oxidase-negative NFB to apply the Ox F system.

This study was undertaken to ascertain the suitability of the API 20E and Ox F systems for identifying clinical isolates of NFB and OPFB as found in the clinical microbiology laboratory. Test results were those obtained after workers were instructed in the proper use of the Ox F and API systems. Still, total reliance on basic codes must be avoided because judgment and experience is indispensable to good performance and proper identification of these bacteria. It also is imperative that these systems are not placed in the hands of inexperienced workers, but in those of experienced workers to simplify their tasks.

LITERATURE CITED

1. Dowda, H. 1977. Evaluation of two rapid methods for identification of commonly encountered nonfermenting or oxidase-positive, gram-negative rods. *J. Clin. Microbiol.* 6:605-609.
2. Gilardi, G. L. 1973. Nonfermentative gram-negative bac-

- teria encountered in clinical specimens. *Antonie van Leeuwenhoek J. Microbiol. Serol.* **39**:229-242.
3. **Isenberg, H. D., and J. Sampson-Scherer.** 1977. Clinical laboratory evaluation of a system approach to the recognition of nonfermentative or oxidase-producing gram-negative, rod-shaped bacteria. *J. Clin. Microbiol.* **5**:336-340.
 4. **Nord, C. E., B. Wretland, and A. Dahlback.** 1977. Evaluation of two test kits—API and OxiFerm tube—for identification of oxidative-fermentative gram-negative rods. *Med. Microbiol. Immunol.* **163**:93-97.
 5. **Oberhofer, T. R., J. W. Rowen, and G. F. Cunningham.** 1977. Characterization and identification of gram-negative, nonfermentative bacteria. *J. Clin. Microbiol.* **5**:208-220.
 6. **Oberhofer, T. R., J. W. Rowen, G. F. Cunningham, and J. W. Higbee.** 1977. Evaluation of the Oxi/Ferm tube system with selected gram-negative bacteria. *J. Clin. Microbiol.* **6**:559-566.
 7. **Pickett, M. J., and M. M. Pederson.** 1970. Characterization of saccharolytic nonfermentative bacteria associated with man. *Can. J. Microbiol.* **16**:351-362.
 8. **Weaver, R. E., H. W. Tatum, and D. C. Hollis.** 1972. The identification of unusual pathogenic gram-negative bacteria. Preliminary revision. Center for Disease Control, Atlanta, Ga.