

TABLE 12-2 Phenotypic Characteristics for the Differentiation of *Staphylococcus*, *Micrococcus* and Related Species, and *Micrococcus*

Characteristic	Reaction/Description for:		
	<i>Staphylococcus</i>	<i>Micrococcus</i> and Related Species ^a	<i>Micrococcus</i>
Organism size	0.6–1.6 μm	1–1.8 μm	1.3–2.5 μm
Colony profile	Raised, low convex	Convex	Low convex, domed
Growth rate	Slow to rapid	Very slow	Slow
Fermentation of glucose	+	–	–
Furazolidone susceptibility (100 μg furazolidone disk)	S	R	S
Bacitracin susceptibility (0.04 unit TaxoA disk)	R	S	R
Modified oxidase test	– ^b	+	+
Susceptibility to lysostaphin	S	R	S
Facultative growth under a coverslip on blood agar	1+ to 4+	–/1+	NA
Acid production aerobically from glycerol in the presence of 0.4 μg/mL erythromycin	+	–	NA

^a Includes the genera *Micrococcus*, *Kytococcus*, *Dermacoccus*, *Nesterenkonia*, and *Kocuria*.
^b All *Staphylococcus* species are modified oxidase-negative except for *S. vitulinus*, *S. sciuri*, and *S. lentus*.
 +, positive reaction; –, negative reaction; S, susceptible; R, resistant; NA, data not available.

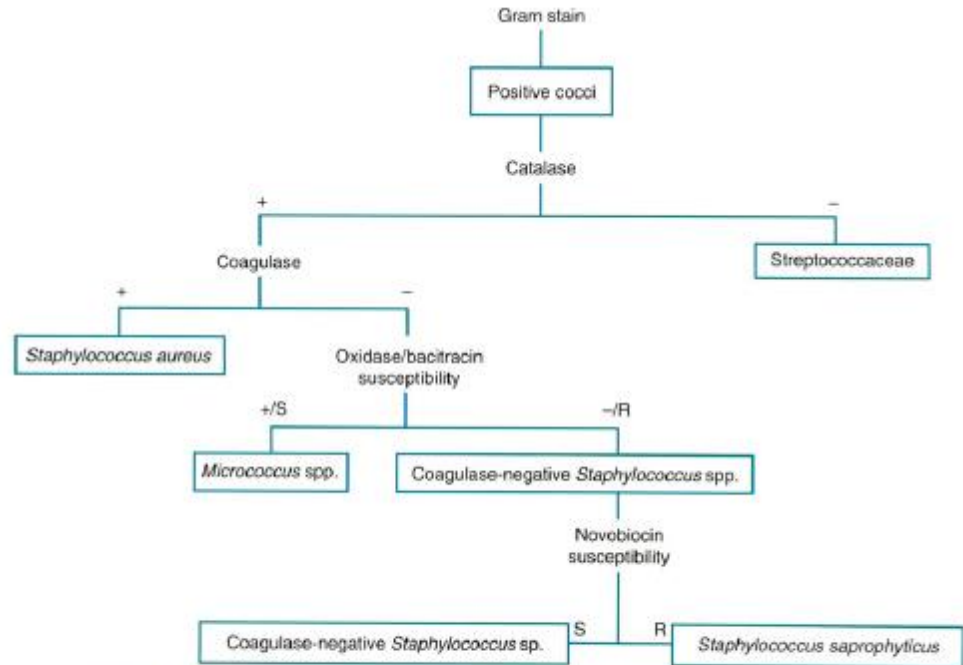


FIGURE 14-8 Schema for the identification of staphylococcal species. NOTE: Other *Staphylococcus* spp. that are coagulase positive besides *S. aureus* include *S. schleiferi* and *S. lugdunensis* (which can be slide-test positive), *S. intermedius*, and *S. hyicus* (tube positive and slide positive).

TABLE 12-5 Phenotypic Characteristics for Identification of Staphylococci Commonly Isolated From Human Clinical Specimens

Test	<i>S. aureus</i>	<i>S. epidermidis</i>	<i>S. saprophyticus</i>	<i>S. haemolyticus</i>	<i>S. wagneri</i>	<i>S. hominis</i> subsp. <i>hominis</i>	<i>S. hominis</i> subsp. <i>novobioceticus</i>	<i>S. lugdenensis</i>	<i>S. schleiferi</i> subsp. <i>schleiferi</i>
Clumping factor	+	-	-	-	-	-	-	+ ^d	+
Coagulase	+	-	-	-	-	-	-	-	-
Novobiocin	S	S	R	S	S	S	R	S	S
Polymyxin B	R	R	S	S	S	S	NA	S/R	S
PYR	-	-	-	+	-	-	-	+	+
ODC	-	V-	-	-	-	-	-	+	-
URE	V	+	+	-	+	+	+	V	-
ACET	+	+	+	+	+	V	V	+	+
PAL	+	+	-	-	-	-	-	-	+
Heat-stable nuclease	+	-	-	-	-	-	-	-	+
β-GAL	-	-	+	-	-	-	-	-	+ ^d
Acid produced aerobically from:									
GLU	+	+	+	+	+	+	+	+	+
MAL	+	+	+	+	+ ^d	+	+	+	-
SUC	+	+	+	+	+	+ ^d	+ ^d	+	-
MNTL	+	-	V	V	V ^e	-	-	-	-
MANN	+	+ ^d	-	-	-	-	-	+	+
TREH	+	-	+	+	+	V	-	+	V

+ , positive reaction; - , negative reaction; +^d , slow or delayed positive reaction; V , variable reaction; V- , variable reaction, most strains negative; S , susceptible; R , resistant; NA , data not available; PYR , Pyrrolidonyl arylamidase; ODC , Ornithine decarboxylase; URE , Urease; PAL , Alkaline phosphatase; ACET , Acetoin (VP); β-GAL , β-Galactosidase; GLU , Glucose; MAL , Maltose; SUC , Sucrose; MNTL , Mannitol; MANN , Mannose; TREH , Trehalose.

Table 7-3 Key Characteristics of Pseudomonads

	OXIDASE	MOTILITY	PROVERDIN	YELLOW	GLUCOSE	MALTOSE	LACTOSE	MANNITOL	ARGININE	LYSINE	NO ₃ -NO ₂	NO ₃ -N ₂	UREA	ONPG	DNASE	ACETAMIDE	ESCULIN	H ₂ S IN KIA	POLYMYXIN
Genus Pseudomonas																			
Fluorescent group																			
<i>P. aeruginosa</i>	+	+	++	-	+	V	-	V	+	-	+	V	V	-	-	+	-	-	S
<i>P. fluorescens</i>	+	+	++	-	+	V	-	V	+	-	-	-	V	-	-	-	-	-	S
<i>P. putida</i>	+	+	++	-	+	V	-	V	+	-	-	-	V	-	-	-	-	-	S
Stutzeri group																			
<i>P. stutzeri</i>	+	+	-	-	+	+	-	V	+	-	+	+	V	-	-	-	-	-	S
<i>P. mendocina</i>	+	+	-	-	+	-	-	-	+	-	+	+	V	-	-	-	-	-	S
CDC group Vb-3	+	+	-	-	+	+	-	+	+	-	+	+	V	-	-	-	-	-	S
Alcaligenes group																			
<i>P. alcaligenes</i>	+	+	-	-	+	-	-	-	-	-	V	-	V	-	-	-	NA	-	S
<i>P. pseudoalcaligenes</i>	+	+	-	-	+	-	-	-	V	-	+	-	-	-	-	-	-	-	S
<i>Pseudomonas</i> sp. group 1	+	+	-	-	+	-	-	-	V	-	+	-	-	-	-	-	NA	-	S
Yellow-pigmented group																			
<i>P. luteola</i>	-	+	-	+	+	+	-	+	V	-	-	-	V	+	-	-	+	-	S
<i>P. oryzae</i>	-	+	-	+	+	+	-	+	V	-	-	-	V	+	-	-	+	-	S
Genus Burkholderia																			
<i>B. pseudomallei</i>	+	+	-	-	+	+	+	+	+	-	+	+	V	-	-	-	V	-	R
<i>B. cepacia</i> complex	w	+	-	V	+	+	+	+	-	w	V	-	V	V	-	V	V	-	R
<i>B. gladioli</i>	+	+	-	-	+	-	-	+	-	-	V	-	+	+	-	-	-	-	R
Genus Ralsstonia																			
<i>R. pickettii</i> Va-1	+	+	-	-	+	+	+	-	-	-	V	V	+	-	-	-	-	-	R
<i>R. pickettii</i> Va-2	+	+	-	-	+	-	-	-	-	-	+	+	+	-	-	-	-	-	R
<i>R. mannitolilytica</i>	+	+	-	-	+	+	+	+	-	-	V	V	+	-	-	-	-	-	R
Genus Delftia																			
<i>D. acidovorans</i>	+	+	-	-	-	-	-	+	-	-	+	-	-	-	-	+	-	-	S
Genus Brevundimonas																			
<i>B. diminuta</i>	+	+	-	-	w	-	-	-	-	-	-	-	-	V	-	-	-	-	V
<i>B. vesicularis</i>	+	+	-	+	w	V	-	-	-	-	-	-	-	V	-	+	-	-	S
Genus Stenotrophomonas																			
<i>S. maltophilia</i>	+	+	-	-	+	++	+	-	-	+	V	-	-	+	+	-	+	-	S
Genus Shewanella																			
<i>S. algae</i>	+	+	-	-	+	-	-	-	-	-	+	-	-	-	+	-	-	+	S
<i>S. putrefaciens</i>	+	+	-	-	+	+	V	+	-	+	+	-	-	-	-	-	V	+	S
Genus Sphingomonas																			
<i>S. paucimobilis</i>	+	+	-	+	+	+	+	-	-	-	-	-	-	+	-	-	+	-	S

+ , 90% or more strains positive; -, 90% or more strains negative; V, 11-89% of strains positive; +, +, strong positive reaction; w, weak positive; S, susceptible; R, resistant; ONPG, orthonitrophenyl-β-D-galactopyranoside. Key reactions are shaded.

Data from reference²⁴⁹.

Table 7-24 Oxidase-Negative, Motile Nonfermenters

ORGANISM	LYSINE		OF MANNITOL	ESCULIN	POLYMYXIN	PIGMENT
	DECARBOXYLASE	OF MALTOS				
<i>Stenotrophomonas maltophilia</i>	+	+	-	+	S	Yellow Lavender
<i>Burkholderia cepacia</i> complex	+	+	+	V(67)	R	Yellow
<i>Burkholderia gladioli</i>	-	-	+	-	R	Yellow
<i>Bordetella trematum</i>	-	-	-	-	NA	Gray-white
<i>Sphingomonas paucimobilis</i>	-	+	-	+	V(89)	Deep yellow
<i>Pseudomonas luteola</i>	-	+	+	+	S	Dull yellow
<i>Pseudomonas oryzae</i> habitans	-	+	+	-	S	Dull Yellow

Data from reference²⁴⁹.

+, 90% or more strains positive; -, 90% or more strains negative; V, 11-89% of strains positive; ++, strong positive reaction; NA, results not available; R, resistant; S, susceptible. Numbers in parentheses are percentages of strains giving positive reactions.

Box 7-2 Medically Important Nonfermenters

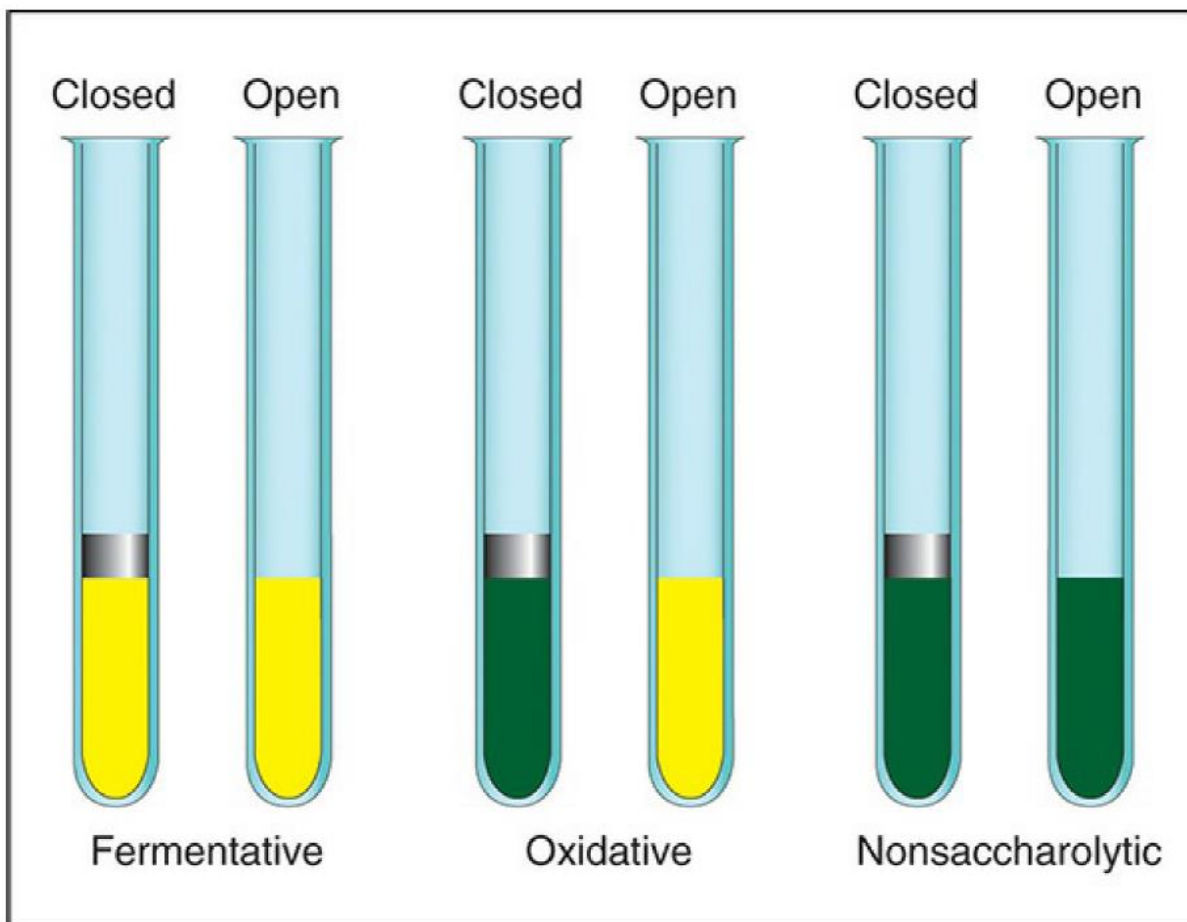
<p>Motile With Polar Flagella</p> <p>Family Pseudomonadaceae (rRNA group I) Genus <i>Pseudomonas</i></p> <p>Family Burkholderiaceae (rRNA group II) Genus <i>Burkholderia</i> Genus <i>Cupriavidus</i> Genus <i>Lautropia</i> Genus <i>Pandoraea</i> Genus <i>Ralstonia</i></p> <p>Family Comamonadaceae (rRNA group III) Genus <i>Comamonas</i> Genus <i>Acidovorax</i> Genus <i>Delftia</i></p> <p>Family Caulobacteraceae (rRNA Group IV) Genus <i>Brevundimonas</i></p> <p>Family Xanthomonadaceae (rRNA Group V) Genus <i>Stenotrophomonas</i></p> <p>Family Sphingomonadaceae Genus <i>Sphingomonas</i></p> <p>Family Oceanospirillaceae Genus <i>Balneatrix</i></p> <p>Family Alteromonadaceae Genus <i>Alishewanella</i> Genus <i>Shewanella</i></p> <p>Family Oxalobacteraceae Genus <i>Herbaspirillum</i> Genus <i>Massilia</i></p> <p>Family Methylobacteriaceae Genus <i>Methylobacterium</i> Genus <i>Roseomonas</i></p> <p>Organisms Whose Taxonomic Position Is Uncertain CDC Groups Ic, O-1, O-2, O-3, Vb-3</p>	<p>Genus <i>Kerstersia</i> Genus <i>Oligella</i> (<i>O. ureolytica</i>)</p> <p>Family Rhizobiaceae Genus <i>Rhizobium</i></p> <p>Family Brucellaceae Genus <i>Ochrobactrum</i></p> <p>Family Halomonadaceae Genus <i>Halomonas</i></p>
<p>Motile With Peritrichous Flagella</p> <p>Family Alcaligenaceae Genus <i>Achromobacter</i> Genus <i>Alcaligenes</i> Genus <i>Bordetella</i> (<i>B. avium</i>, <i>B. bronchiseptica</i>, <i>B. hinzii</i>, <i>B. trematum</i>)</p>	<p>Nonmotile, Oxidase-Positive</p> <p>Family Flavobacteriaceae Genus <i>Flavobacterium</i> Genus <i>Bergeyella</i> Genus <i>Chryseobacterium</i> Genus <i>Empedobacter</i> Genus <i>Myroides</i> Genus <i>Weeksella</i></p> <p>Family Sphingobacteriaceae Genus <i>Sphingobacterium</i> Genus <i>Pedobacter</i></p> <p>Family Moraxellaceae Genus <i>Moraxella</i> Genus <i>Psychrobacter</i></p> <p>Family Neisseriaceae Genus <i>Neisseria</i></p> <p>Family Alcaligenaceae Genus <i>Oligella</i> (<i>O. urethralis</i>)</p> <p>Family Rhodobacteraceae Genus <i>Paracoccus</i> (EO-2)</p> <p>Organisms Whose Taxonomic Position Is Uncertain CDC groups EO-3, EO-4, EF-4b CDC groups IIc, IIe, IIg, IIh, III, Gilardi rod group 1</p>
<p>Motile With Peritrichous Flagella</p> <p>Family Alcaligenaceae Genus <i>Achromobacter</i> Genus <i>Alcaligenes</i> Genus <i>Bordetella</i> (<i>B. avium</i>, <i>B. bronchiseptica</i>, <i>B. hinzii</i>, <i>B. trematum</i>)</p>	<p>Nonmotile, Oxidase-Negative</p> <p>Family Moraxellaceae Genus <i>Acinetobacter</i></p> <p>Family Alcaligenaceae Genus <i>Bordetella</i> (<i>B. pertussis</i>, <i>B. parapertussis</i>, <i>B. trematum</i>)</p> <p>Organisms Whose Taxonomic Position Is Uncertain CDC group NO-1 CDC group EO-5</p>

TABLE 7-11 Key Characteristics of *S. maltophilia* and *B. cepacia* complex^a

Test	<i>S. maltophilia</i>	<i>B. cepacia</i> Complex
Oxidase	-	+ (93)
Motility	+	+
Growth on MacConkey	+	+
OF glucose	A or Wk	A
OF maltose	A	A
OF lactose	V (86)	A
OF mannitol	-	A
NO ₃ reduction	V (42)	V (37)
NO ₃ to gas	-	-
Arginine	-	-
Lysine	+	V
Esculin hydrolysis	+	V (67)
ONPG	+ (93)	V (79)
DNase	+	-
Polymyxin B	S	R
Pigment	gray, slight yellow, lavender	gray, chartreuse, yellow

^a Data from reference 1172.

+, 90% or more strains positive; -, 90% or more strains negative; V, 11%–89% of strains positive; A, acid reaction; Wk, weak acid; S, susceptible; R, resistant; NA, not available. Numbers in parentheses are percentage of strains giving positive reaction.



■ **FIGURE 7-2** The oxidative-fermentative (OF) test. Fermentative organisms produce acid in both the closed and open tubes (*yellow*); oxidative organisms produce acid only in the open tube. Asaccharolytic organisms that do not use carbohydrates produce no change in either tube.

	MOTILE, STRONGLY SACCHAROLYTIC NONFERMENTERS										MOTILE, WEAK, OR NONSACCHAROLYTIC NONFERMENTERS										
	<i>Pseudomonas aeruginosa</i>	<i>Pseudomonas fluorescens/putida</i>	<i>Burkholderia cepacia</i>	<i>Achromobacter xylosoxidans</i>	<i>Stenotrophomonas maltophilia</i>	<i>Burkholderia pseudomallei</i>	<i>Pseudomonas stutzeri</i>	<i>Sphingomonas paucimobilis</i>	<i>Pseudomonas mendocina</i>	<i>Ralstonia pickettii</i>	<i>Deftia acidovorans</i>	<i>Pseudomonas pseudoalcaligenes</i>	<i>Alcaligenes faecalis</i>	<i>Achromobacter denitricans</i>	<i>Oligella ureolytica</i>	<i>Bordetella bronchiseptica</i>	<i>Pseudomonas alcaligenes</i>	<i>Brevundimonas diminuta</i>	<i>Brevundimonas vesicularis</i>	<i>Comamonas testosteroni</i>	<i>Shewanella putrefaciens</i>
Oxidase	+	+	+	+	-	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
Pyocyanin	+/-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Fluorescein	+	-/+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Glucose	+	+	+	+/-	+/-	+	+	+/-	+	+	-	-/+	-	-	-	-	-	-	+	-	-
Xylose	+	+	+/-	+	-	+	-/+	+/-	+	+	-	-	-	-	-	-	-	-	-	-	-
Mannitol	+/-	+/-	+/-	-	-	+	-/+	-	-	-	+/-	-	-	-	-	-	-	-	-	-	-
Lactose	-	-	+/-	-	-	+	+/-	+/-	-	-	-	-	-	-	-	-	-	-	-	-	-
Maltose	-	-	+/-	-	+	+	+/-	+/-	-	-	-	-/+	-	-	-	-	-	-	+	-	-
42° C	+	-	+/-	+	+/-	+	+	-	+	+/-	-	+	+/-	-/+	-	+	+/-	-/+	+/-	+/-	+/-
Esculin	-	-	-/+	-	+	+/-	-	+	-	-	-	-	-	-	-	-	-	-	+	-	-
Urea	+	-/+	+/-	-	+/-	-/+	-/+	-/+	+/-	+	-	-	-/+	-	+	+	-/+	+/-	-	-	+/-
DNase	-	-	-	-	+	-	-	+	-	-	-	-	-	-	-	-	-	+	+	-	+
ONPG	-	-	+/-	-	+	-	-	+/-	-	-	-	-	-	-	-	-	-	-	-	-	-
Indole	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Motility	+	+	+	+	+	+	+	-	+	+	+	+	+	+	+	+	+	+	+	+	+
Flagella	1	>1	>1	P	>1	>1	1	1	1	1	>1	1	P	P	P	P	1	1	1	>1	1
H ₂ S	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	+
N ₂ gas	+/-	-	-	-	-	+	+	-	+	-/+	-	-	+	+/-	+	-	-	-	-	-	-
Pigment	B,F,G	F	Y	-	Y	-	B,Y	Y	-	-	-	-	-	-	-	-	-	-	B,Y	-	B
Growth on MacConkey	+	+	+	+	+	+	+	-	+	+	+	+	+	+	+	+	+	+	-/+	+/-	+

FIGURE 21-2 Biochemical and morphologic characteristics of selected nonfermentative gram-negative bacilli. ONPG, o-Nitrophenyl-β-D-galactopyranoside; +, most strains positive; -, most strains negative; B, brown; F, fluorescein; G, green; Y, yellow. (Data from the Ohio State University Hospital, Columbus, Ohio.)

	NONMOTILE, PIGMENTED, INDOLE-POSITIVE NONFERMENTERS				NONMOTILE COCCOBACILLI	
					Oxidase negative	
	<i>Elizabethkingia meningosepticum</i>	<i>Myroides odoratus</i>	<i>Bergeyella zoohelcum</i>	<i>Weeksella virosa</i>	<i>Moraxella</i> sp.	<i>Acinetobacter lwoffii</i>
Oxidase	+	+	+	+	+	-
Pyocyanin	-	-	-	-	-	-
Fluorescein	-	-	-	-	-	-
Glucose	+/-	-	-	-	-	+
Xylose	-	-	-	-	-	+
Mannitol	-/+	-	-	-	-	-
Lactose	-	-	-	-	-	+
Maltose	-/+	-	-	-	-	+/-
42° C	+/-	-	-	-/+	-/+	+
Esculin	+	-	-	-	-	-
Urea	-/+	+	+	-/+	-	-/+
DNase	+	+	+	+	-	-/+
ONPG	+/-	-	-	-	-	-
Indole	+	-	-/+	+	-	-
Motility	-	-	-	-	-	-
Flagella	-	-	-	-	-	-
H ₂ S	-	-	-	-	-	-
N ₂ gas	-	-/+	-	-	-	-
Pigment	Y	Y	B	B	-	-
Growth on MAC	+	+	-	-	+/-	+

Flagella

1, Polar monotrichous



>1, Polar tuft (>1 flagellum)



P, Peritrichous



FIGURE 21-2, cont'd.

TABLE 19-11 Stool Culture Screening for Enteric Pathogens Utilizing TSI and LIA in Combination

LIA Reactions	TSI Reactions							
	K/A H ₂ S	K/AG H ₂ S	K/AG	K/A	A/A H ₂ S	A/AG	A/A	K/K
R/A		<i>P. vulgaris</i> <i>P. mirabilis</i>	<i>M. morganii</i> <i>Providencia</i>	<i>M. morganii</i> <i>Providencia</i>	<i>P. vulgaris</i> <i>P. mirabilis</i>	—	<i>Providencia</i>	—
K/K H ₂ S	<i>Salmonella</i> * <i>Edwardsiella</i>	<i>Salmonella</i> * <i>Edwardsiella</i> *	<i>Salmonella</i> *	<i>Salmonella</i> *	—	—	—	—
K/K	<i>Salmonella</i>	—	<i>Hafnia</i> <i>Klebsiella</i> <i>Serratia</i>	<i>Salmonella</i> * <i>Plesiomonas</i> [†] <i>Hafnia</i>	—	<i>Klebsiella</i> <i>Enterobacter</i> <i>E. coli</i>	<i>Serratia</i>	<i>Pseudomonas</i> [†]
K/A H ₂ S	—	<i>Salmonella</i> *	—	<i>Serratia</i>	—	—	—	—
K/A	—	<i>Citrobacter</i>	<i>Salmonella</i> * <i>Shigella</i> <i>Aeromonas</i> [†] <i>E. coli</i> <i>Enterobacter</i> <i>Citrobacter</i>	<i>Shigella</i> * <i>Yersinia</i> <i>Aeromonas</i> [†] <i>E. coli</i> <i>Enterobacter</i>	<i>Citrobacter</i>	<i>Aeromonas</i> ** <i>E. coli</i> <i>Citrobacter</i> <i>Enterobacter</i>	<i>Aeromonas</i> ** <i>Yersinia</i> <i>Citrobacter</i> <i>Enterobacter</i>	—

Data from the Microbiology Laboratory, The Ohio State University Hospitals and Maureta Ott, Columbus, Ohio.

LIA, lysine-iron agar; TSI, triple sugar iron; K, alkaline; A, acid; G, gas; R, deamination (red slant).

*Results of TSI and LIA reactions in this category indicate a potential pathogen; additional tests must be performed.

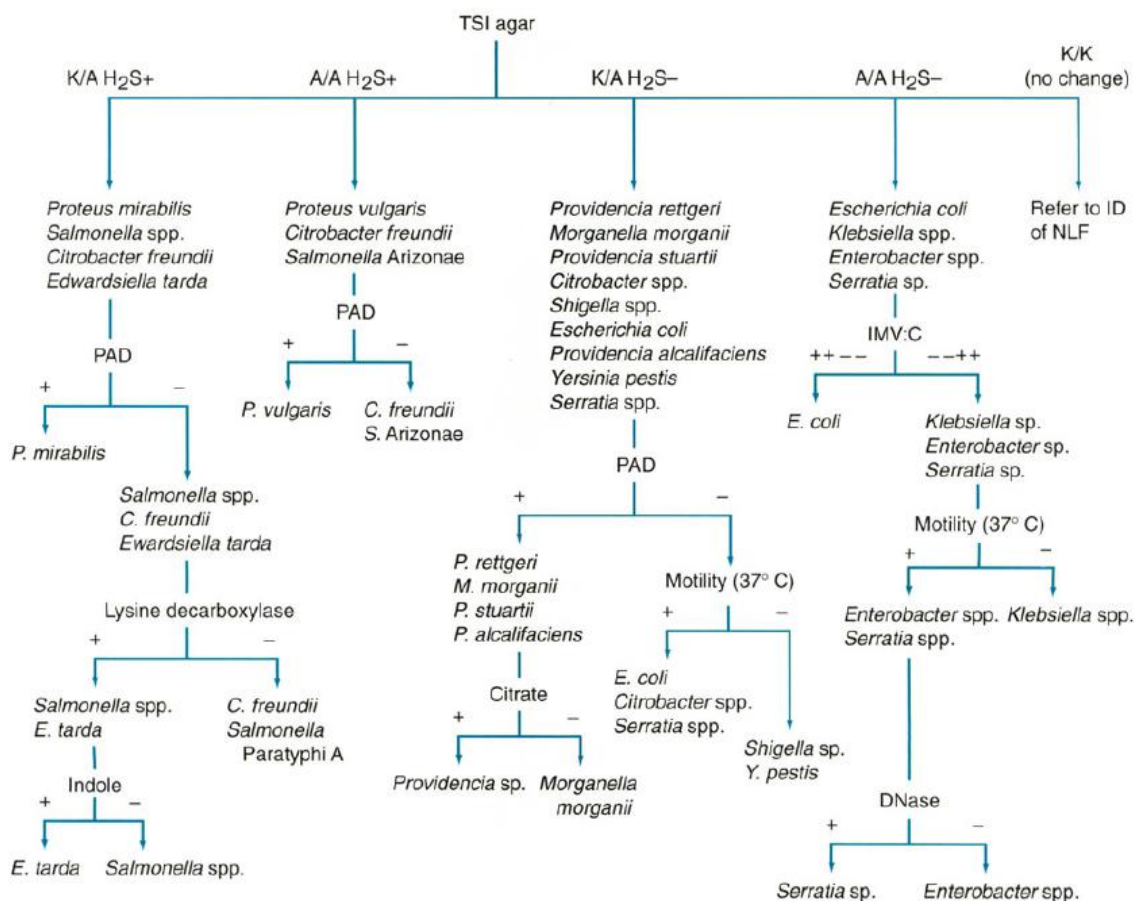


FIGURE 19-15 Flowchart for the presumptive identification of commonly encountered Enterobacteriaceae on triple sugar iron (TSI) agar. K, alkaline; A, acid; PAD, phenylalanine deaminase; IMV:C, indole, methyl red, Voges-Proskauer, citrate; NLF, nonlactose fermenter. (Data from Koneman E et al: *Color atlas in diagnostic microbiology*, ed 5, Philadelphia, 1997, Lippincott-Raven.)

	KIA	GAS	H ₂ S	MR	VP	IND	CIT	PAD	URE	MOT	LYS	ARG	ORN	ONPG
Tribe I: Escherichieae														
Genus: Escherichia														
<i>E. coli</i>	A/A	+	-	+	-	+	-	-	-	+	+	-/+	+/-	+
Genus: Shigella														
Groups A, B, C	Alk/A	-	-	+	-	-/+	-	-	-	-	-	-	-	-
<i>S. sonnei</i>	Alk/A	-	-	+	-	-	-	-	-	-	-	-	+	+
Tribe II: Edwardsielleae														
Genus: Edwardsiella														
<i>E. tarda</i>	Alk/A	+	+	+	-	+	-	-	-	+	+	-	+	-
Tribe III: Salmonelleae														
Genus: Salmonella														
	Alk/A	+	+	+	-	-	+	-	-	+	+	+/-	+	-
Tribe IV: Citrobactereae														
Genus: Citrobacter														
<i>C. freundii</i>	A/A; Alk/A	+	+	+	-	-	+	-	+/-	+	-	+/-	-/+	+
<i>C. koseri</i>	Alk/A	+	-	+	-	+	+	-	+/-	+	-	+/-	+	+
Tribe V: Klebsielleae														
Genus: Klebsiella														
<i>K. pneumoniae</i>	A/A	++	-	-	+	-	+	-	+	-	+	-	-	+
<i>K. oxytoca</i>	A/A	++	-	-	+	+	+	-	+	-	+	-	-	+
Genus: Enterobacter														
<i>E. aerogenes</i>	A/A	++	-	-	+	-	+	-	-	+	+	-	+	+
<i>E. cloacae</i>	A/A	++	-	-	+	-	+	-	+/-	+	-	+	+	+
Genus: Hafnia														
<i>H. alvei</i>	Alk/A	+	-	-/+	+	-	-	-	-	+	+	-	+	+
Genus: Pantoea														
<i>P. agglomerans</i>	A/A; Alk/ A	-/+	-	-/+	+/-	-/+	+/-	-/+	-/+	+	-	-	-	+

Genus: Serratia														
<i>S. marcescens</i>	Alk/A	+	-	-/+	+	-	+	-	-	+	+	-	+	+
Tribe VI: Proteeae														
Genus: Proteus														
<i>P. vulgaris</i>	Alk/A	+/-	+	+	-	+	-/+	+	++	+ ^a	-	-	-	-
<i>P. mirabilis</i>	Alk/A	+	+	+	+/-	-	+/-	+	++	+ ^a	-	-	+	-
Genus: Morganella														
<i>M. morganii</i>	Alk/A	+	-	+	-	+	-	+	++	+	-	-	+	-
Genus: Providencia														
<i>P. rettgeri</i>	Alk/A	-	-	+	-	+	+	+	++	+	-	-	-	-
<i>P. stuartii</i>	Alk/A	-	-	+	-	+	+	+	-/+	+/-	-	-	-	-
<i>P. alcalifaciens</i>	Alk/A	+/-	-	+	-	+	+	+	-	+	-	-	-	-
Tribe VII: Yersinieae														
Genus: Yersinia														
<i>Y. enterocolitica</i>	Alk/A	-	-	+	-	+/-	-	-	+/-	- ^b	-	-	+	+

^aSwarming motility demonstrated on noninhibitory media.
^bNonmotile at 36°C, motile at 22°C.

KIA, Kligler's iron agar; H₂S, hydrogen sulfide; MR, methyl red; VP, Voges-Proskauer; IND, indole; CIT, citrate; PAD, phenylalanine deaminase; URE, urease; MOT, motility; LYS, lysine; ARG, arginine; ORN, ornithine; ONPG, o-nitrophenyl-β-D-galactopyranoside; ++, strong positive reaction; +, 90% or more strains positive; -, 90% or more strains negative; +/-, 50% to 90% of strains positive; -/+, 50% to 90% of strains negative; shaded areas indicate key reactions; A/A, acid slant/acid butt; Alk/A, alkaline slant, acid butt.

TABLE 6-16 Differentiation of the Major Genera and Species Within the Tribe *Klebsielleae*

Biochemical Test	<i>Klebsiella</i>		<i>Enterobacter</i>		<i>Pantoea</i>	<i>Hafnia</i>	<i>Serratia</i>	
	<i>K. pneumoniae</i>	<i>K. oxytoca</i>	<i>E. aerogenes</i>	<i>E. cloacae</i>	<i>P. agglomerans</i>	<i>H. alvei</i>	<i>S. marcescens</i>	<i>S. liquefaciens</i>
Indole	-	+	-	-	V (20)	-	-	-
Motility	-	-	+	+	V (85)	V (85)	+	+
Lysine	+	+	+	-	-	+	+	+
Arginine	-	-	-	+	-	-	-	-
Ornithine	-	-	+	+	-	+	+	+
DNase (25°C)	-	-	-	-	-	-	+	V (85)
Gelatinase (22°C)	-	-	-	-	-	-	+	+
Fermentation of:								
Lactose	+	+	+	+	V (40)	-	-	-
Sucrose	+	+	+	+	V (75)	-	+	+
Sorbitol	+	+	+	+	V (30)	-	+	+
Adonitol	+	+	+	V (25)	-	-	V (40)	-
Arabinose	+	+	+	+	+	+	-	+

+, 90% or more strains positive; -, 90% or more strains negative; V, 11%–89% of strains positive.

TABLE 19-6 Diagnostic Features of *Enterobacter cloacae*, *Enterobacter aerogenes*, and *Klebsiella pneumoniae* subsp. *pneumoniae*

Test or Substrate	<i>E. cloacae</i>			<i>E. aerogenes</i>			<i>K. pneumoniae</i> subsp. <i>pneumoniae</i>		
	Sign	% +	(% +)	Sign	% +	(% +)	Sign	% +	(% +)
Urease	+w or -	65		-	2		+	95.4	(0.1)
Motility	+	95		+	97		-	0	
Lysine decarboxylase	-	0		+	98		+	98	(6.3)
Arginine dihydrolase	+	97	(2)	-	0		-	0	
Ornithine decarboxylase	+	96	(1.3)	+	98	(0.8)	-	0	
Gelatin (22° C)	(+)	0	(94.2)	(+) or -	0	(61.2)	-	0	(0.2)
Adonitol, gas	- or +	21.7	(1.3)	+	94.2		d	84.4	(0.3)
Inositol									
Acid	D	13	(8)	+	96.7		+	97.2	(0.9)
Gas	-	4.1	(1.5)	+	93.4		+	92.5	(1.5)
D-tartrate, Jordan's	- or +	30		+	95		+	95	
Sodium alginate (utilization)	-	0		-	0		+ or (+)	88.9	(8.9)

Modified from Ewing WH: *Edwards and Ewing's identification of Enterobacteriaceae*, ed 4, East Norwalk, Conn, 1986, Appleton & Lange.
 +, ≥90% Positive within 1 or 2 days; (+), positive reaction after 3 or 4 days; -, ≥90% no reaction in 30 days; + or -, most cultures positive, some strains negative; - or +, most strains negative, some cultures positive; d, different reactions; +, (+), -, +w, weakly positive reaction.