جداول و الگوریتم های

شناسایی و افتراق باکتری ها

آزمایشگاه مرجع سلامت

وزارت بهداشت، درمان و آموزش پزشکی

سال ۱۳۹۷

محل مهر تضمین کیفیت	
تاریخ :	تاریخ :

Enterobacteriaceae

TABLE 19-12 Biochemical Reactions of the Named Species and Unnamed Groups of the Family Enterobacteriaceae

Organism	Indole production	Methyl red	Voges-Proskauer	Citrate (Simmons)	Hydrogen sulfide (TSI)	Urea hydrolysis	Phenylalanine deaminase	Lysine decarboxylase	Arginine dihydrolase	Ornithine decarboxylase	Motility	Gelatin hydrolysis (22° C)	Growth in KCN	Malonate utilization	D-Glucose, acid	D-Glucose, gas	Lactose fermentation	Sucrose fermentation	D-Mannitol fermentation	Dulcitol fermentation	Salicin fermentation	Adonitol fermentation
Budvicia aquatica	0	93	0	0	80	33	0	0	0	0	27	0	0	0	100	53	87	0	60	0	0	0
Buttiauxella agrestis	0	100	0	100	0	0	0	0	0	100	100	0	80	60	100	100	100	0	100	0	100	0
Buttiauxella brennerae	0	100	0	0	0	0	0	0	0	33	100	0	100	100	100	100	67	0	100	0	100	67
Buttiauxella ferragutiae	0	100	0	0	0	0	0	100	0	80	60	0	40	0	100	100	0	0	100	0	100	0
Buttiauxella gaviniae	0	100	0	20	0	0	0	0	20	0	80	0	60	100	100	40	60	0	100	0	100	100
Buttiauxella izardii	0	100	0	0	0	0	0	0	0	100	100	0	67	100	100	100	100	0	100	0	100	0
Buttiauxella noackiae	33	100	0	33	0	0	100	0	67	0	100	0	100	100	100	100	0	0	100	0	100	0
Buttiauxella warmboldiae	0	100	0	33	0	0	100	0	0	0	100	0	33	100	100	100	0	0	100	0	100	0
Cedecea davisae	0	100	50	95	0	0	0	0	50	95	95	0	86	91	100	70	19	100	100	0	99	0
Cedecea lapagei	0	40	80	99	0	0	0	0	80	0	80	0	100	99	100	100	60	0	100	0	100	0
Cedecea neteri	0	100	50	100	0	0	0	0	100	0	100	0	65	100	100	100	35	100	100	0	100	0
Cedecea species 3	0	100	50	100	0	0	0	0	100	0	100	0	100	0	100	100	0	50	100	0	100	0
Cedecea species 5	0	100	50	100	0	0	0	0	50	50	100	0	100	0	100	100	0	100	100	0	100	0
Citrobacter amalonaticus	100	100	0	95	5	85	0	0	85	95	95	0	99	1	100	97	35	9	100	1	30	0
Citrobacter braakii	33	100	0	87	60	47	0	0	67	93	87	0	100	0	100	93	80	7	100	33	0	0
Citrobacter farmeri	100	100	0	10	0	59	0	0	85	100	97	0	93	0	100	96	15	100	100	2	9	0
Citrobacter freundii	33	100	0	78	78	44	0	0	67	0	89	0	89	11	100	89	78	89	100	11	0	0
Citrobacter gillenii	0	100	0	33	67	0	0	0	33	0	67	0	100	100	100	100	67	33	100	0	0	0
Citrobacter koseri (C. diversus)	99	100	0	99	0	75	0	0	80	99	95	0	0	95	100	98	50	40	99	40	15	99
Citrobacter murliniae	100	100	0	100	67	67	0	0	67	0	100	0	100	0	100	100	67	33	100	100	33	0
Citrobacter rodentium	0	100	0	0	0	100	0	0	0	100	0	0	0	100	100	100	100	0	100	0	0	0
Citrobacter sedlakii	83	100	0	83	0	100	0	0	100	100	100	0	100	100	100	100	100	0	100	100	17	0
Citrobacter werkmanii	0	100	0	100	100	100	0	0	100	0	100	0	100	100	100	100	17	0	100	0	0	0
Citrobacter youngae	15	100	0	75	65	80	0	0	50	5	95	0	95	5	100	75	25	20	100	85	10	0
Cronobacter sakazakii	11	5	100	99	0	1	50	0	99	91	96	0	99	18	100	98	99	100	100	5	99	0
Enteric Group 137 (5 strains)	100	100	0	0	0	70	0	0	20	100	100	0	100	0	100	0	100	100	100	0	100	0
Edwardsiella hoshinae	50	100	0	0	0	0	0	100	0	95	100	0	0	100	100	35	0	100	100	0	50	0
Edwardsiella ictaluri	0	0	0	0	0	0	0	100	0	65	0	0	0	0	100	50	0	0	0	0	0	0
Edwardsiella tarda	99	100	0	1	100	0	0	100	0	100	98	0	0	0	100	100	0	0	0	0	0	0
Edwardsiella tarda biogroup 1	100	100	0	0	0	0	0	100	0	100	100	0	0	0	100	50	0	100	100	0	0	0
Enterobacter aerogenes	0	5	98	95	0	2	0	98	0	98	97	0	98	95	100	100	95	100	100	5	100	98
Enterobacter amnigenus biogroup 1	0	7	100	70	0	0	0	0	9	55	92	0	100	91	100	100	70	100	100	0	91	0
Enterobacter amnigenus biogroup 2	0	65	100	100	0	0	0	0	35	100	100	0	100	100	100	100	35	0	100	0	100	0
Enterobacter asburiae	0	100	2	100	0	60	0	0	21	95	0	0	97	3	100	95	75	100	100	0	100	0

From the Centers for Disease Control and Prevention, Atlanta, Ga.
TSI, Triple sugar iron; *KCN*, potassium cyanide; *ONPG*, o-nitrophenyl-β-D-galactopyranoside.
*Each number is the percentage of positive reactions after 2 days of incubation at 36° C unless noted otherwise. Most of these positive reactions occur within 24 hours. Reactions that become positive after 2 days are not considered.

myo-Inositol fermentation	D-Sorbitol fermentation	L-Arabinose fermentation	Raffinose fermentation	L-Rhamnose fermentation	Maltose fermentation	D-Xylose fermentation	Trehalose fermentation	Cellobiose fermentation	Alpha-methyl-D-glucoside fermentation	Erythritol fermentation	Esculin hydrolysis	Melibiose fermentation	D-Arabitol fermentation	Glycerol fermentation	Mucate fermentation	Tartrate, Jordan's	Acetate utilization	Lipase (corn oil)	DNase (25° C)	Nitrate nitrite	Oxidase, Kovacs	ONPG test	Yellow pigment	D-Mannose fermentation	Tyrosine utilization	D-Galactose	Citrate, Christensen's
0	0	80	0	100	0	93	0	0	0	0	0	0	27	0	20	27	0	0	0	100	0	93	0	0			
0	0	100	100	100	100	100	100	100	0	0	100	100	0	60	100	60	0	0	0	100	0	100	0	100			
0	0	100	100	33	100	100	100	100	0	0	100	100	67	67	67	0	0	0	0	100	0	100	0	100			
0	100	100	0	100	100	100	100	100	40	0	100	0	0	0	60	0	0	0	0	100	0	100	0	100			
0	0	100	0	100	60	100	100	100	0	0	100	0	80	0	80	40	0	0	0	100	0	100	0	100			
0	0	100	33	100	100	100	100	100	0	0	100	67	0	33	100	67	0	0	0	100	0	100	0	100			
0	0	100	0	100	100	100	100	100	33	0	100	0	0	0	100	100	0	0	0	100	0	100	0	100			
67	0	100	0	100	100	100	100	100	0	0	100	0	0	0	0	0	0	0	0	100	0	100	0	100			
0	0	0	10	0	100	100	100	100	5	0	45	0	100	0	0	0	0	91	0	100	0	90	0	100			
0	0	0	0	0	100	0	100	100	0	0	100	0	100	0	0	0	60	100	0	100	0	99	0	100			
0	100	0	0	0	100	100	100	100	0	0	100	0	100	0	0	0	0	100	0	100	0	100	0	100			
0	0	0	100	0	100	100	100	100	50	0	100	100	100	0	0	0	50	100	0	100	0	100	0	100			
0	100	0	100	0	100	100	100	100	0	0	100	100	100	0	0	0	50	50	0	100	0	100	0	100			
0	99	99	5	100	99	99	100	100	2	0	5	0	0	60	96	96	86	0	0	99	0	97	0	100			
0	100	100	7	100	100	100	100	73	33	0	0	80	0	87	100	93	53	0	0	100	0	80	0	100			
0	98	100	100	100	100	100	100	100	75	0	0	100	0	65	100	93	80	0	0	100	0	100	0	100			
0	100	100	44	100	100	89	100	44	11	0	0	100	0	100	100	100	44	0	0	100	0	89	0	100			
0	100	100	0	100	100	100	100	67	0	0	0	67	0	67	67	100	0	0	0	100	0	67	0	100			
0	99	99	0	99	100	100	100	99	40	0	1	0	98	99	95	90	75	0	0	100	0	99	0	100			
0	100	100	33	100	100	100	100	100	0	0	0	33	0	100	100	100	33	0	0	100	0	100	0	100			
0	100	100	0	100	100	100	100	100	0	0	0	0	0	0	100	100	0	0	0	100	0	100	0	100			
0	100	100	0	100	100	100	100	100	0	0	17	100	0	83	100	100	83	0	0	100	0	100	0	100			
0	100	100	0	100	100	100	100	0	0	0	0	0	0	100	100	100	100	0	0	100	0	100	0	100			
5	100	100	10	100	95	100	100	45	0	0	5	10	5	90	100	100	65	0	0	85	0	90	0	100			
75	0	100	99	100	100	100	100	100	96	0	100	100	0	15	1	1	96	0	0	99	0	100	98	100			
0	100	100	100	100	100	100	100	100	80	0	100	100	0	100	100	50	100	0	0	100	0	100	0	100	0	100	90
0	0	13	0	0	100	0	100	0	0	0	0	0	0	65	0	0	0	0	0	100	0	0	0	100			
0	0	0	0	0	100	0	0	0	0	0	0	0	0	0	0	0	0	0	0	100	0	0	0	100			
0	0	9	0	0	100	0	0	0	0	0	0	0	0	30	0	25	0	0	0	100	0	0	0	100			
0	0	100	0	0	100	0	0	0	0	0	0	0	0	0	0	0	0	0	0	100	0	0	0	100			
95	100	100	96	99	99	100	100	100	95	0	98	99	100	98	90	95	50	0	0	100	0	100	0	95			
0	9	100	100	100	100	100	100	100	55	0	91	100	0	0	35	9	0	0	0	100	0	91	0	100			
0	100	100	0	100	100	100	100	100	100	0	100	100	0	0	100	0	0	0	0	100	0	100	0	100			
0	100	100	70	5	100	97	100	100	95	0	95	0	0	11	21	30	87	0	0	100	0	100	0	100			

Continued

TABLE 19-12 Biochemical Reactions of the Named Species and Unnamed Groups of the Family Enterobacteriaceae—cont'd

Organism	Indole production	Methyl red	Voges-Proskauer	Citrate (Simmons)	Hydrogen sulfide (TSI)	Urea hydrolysis	Phenylalanine deaminase	Lysine decarboxylase	Arginine dihydrolase	Ornithine decarboxylase	Motility	Gelatin hydrolysis (22° C)	Growth in KCN	Malonate utilization	D-Glucose, acid	D-Glucose, gas	Lactose fermentation	Sucrose fermentation	D-Mannitol fermentation	Dulcitol fermentation	Salicin fermentation	Adonitol fermentation
Enterobacter cancerogenus (E. taylorae)	0	5	100	100	0	1	0	0	94	99	99	0	98	100	100	100	10	0	100	0	92	0
Enterobacter cloacae	0	5	100	100	0	65	0	0	97	96	95	0	98	75	100	100	93	97	100	15	75	25
Enterobacter dissolvens	0	0	100	100	0	100	0	0	100	100	0	0	100	100	100	100	0	100	100	0	100	0
Enterobacter gergoviae	0	5	100	99	0	93	0	90	0	100	90	0	0	96	100	98	55	98	99	0	99	0
Enterobacter hormaechei	0	57	100	96	0	87	4	0	78	91	52	0	100	100	100	83	9	100	100	87	44	0
Enterobacter intermedium	0	100	100	65	0	0	0	0	0	89	89	0	65	100	100	100	100	65	100	100	100	0
Enterobacter nimipressuralis	0	100	100	0	0	0	0	0	0	100	0	0	100	100	100	100	0	0	100	0	100	0
Enterobacter pyrinus	0	29	86	0	0	86	0	100	0	100	43	0	0	86	100	100	14	100	100	0	100	0
Escherichia albertii	0		0	0	0	0	0	100	0	100	0	0	0	0	100	100	0	0	100	0	0	0
Escherichia blattae	0	100	0	50	0	0	0	100	0	100	0	0	0	100	100	100	0	0	0	0	0	0
Escherichia coli	98	99	0	1	1	1	0	90	17	65	95	0	3	0	100	95	95	50	98	60	40	5
Escherichia coli, inactive	80	95	0	1	1	1	0	40	3	20	5	0	1	0	100	5	25	15	93	40	10	3
Escherichia fergusonii	98	100	0	17	0	0	0	95	5	100	93	0	0	35	100	95	0	0	98	60	65	98
Escherichia hermannii	99	100	0	1	0	0	0	6	0	100	99	0	94	0	100	97	45	45	100	19	40	0
Escherichia vulneris	0	100	0	0	0	0	0	85	30	0	100	0	15	85	100	97	15	8	100	0	30	0
Ewingella americana	0	84	95	95	0	0	0	0	0	0	60	0	5	0	100	0	70	0	100	0	80	0
Hafnia alvei	0	40	85	10	0	4	0	100	6	98	85	0	95	50	100	98	5	10	99	0	13	0
Hafnia alvei biogroup 1	0	85	70	0	0	0	0	100	0	45	0	0	0	45	100	0	0	0	55	0	55	0
Klebsiella oxytoca	99	20	95	95	0	90	1	99	0	0	0	0	97	98	100	97	100	100	99	55	100	99
Klebsiella ornithinolytica	100	96	70	100	0	100	0	100	0	100	0	0	100	100	100	100	100	100	100	10	100	100
Klebsiella planticola	20	100	98	100	0	98	0	100	0	0	0	0	100	100	100	100	100	100	100	15	100	100
Klebsiella pneumoniae subsp. *ozaenae*	0	98	0	30	0	10	0	40	6	3	0	0	88	3	100	50	30	20	100	2	97	97
Klebsiella pneumoniae subsp. *pneumoniae*	0	10	98	98	0	95	0	98	0	0	0	0	98	93	100	97	98	99	99	30	99	90
Klebsiella pneumoniae subsp. *rhinoscleromatis*	0	100	0	0	0	0	0	0	0	0	0	0	80	95	100	0	0	75	100	0	98	100
Klebsiella terrigena	0	60	100	40	0	0	0	100	0	20	0	0	100	100	100	80	100	100	100	20	100	100
Kluyvera ascorbata	92	100	0	96	0	0	0	97	0	100	98	0	92	96	100	93	98	98	100	25	100	0
Kluyvera cryocrescens	90	100	0	80	0	0	0	23	0	100	90	0	86	86	100	95	95	81	95	0	100	0
Kluyvera georgiana	100	100	0	100	0	0	0	100	0	100	100	0	83	50	100	17	83	100	100	33	100	0
Leclercia adecarboxylata	100	100	0	0	0	48	0	0	0	0	79	0	97	93	100	97	93	66	100	86	100	93
Leminorella grimontii	0	100	0	100	100	0	0	0	0	0	0	0	0	0	100	33	0	0	0	83	0	0
Leminorella richardii	0	0	0	0	100	0	0	0	0	0	0	0	0	0	100	0	0	0	0	0	0	0
Moellerella wisconsensis	0	100	0	80	0	0	0	0	0	0	0	0	70	0	100	0	100	100	60	0	0	100

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0	1	100	0	100	99	100	100	100	1	0	90	0	0	1	75	0	35	0	0	100	0	100	0	100			
15	95	100	97	92	100	99	100	99	85	0	30	90	15	40	75	30	75	0	0	99	0	99	0	100			
0	100	100	100	100	100	100	100	100	100	0	100	100	0	0	100	0	100	0	0	100	0	100	0	100			
0	0	99	97	99	100	99	100	99	2	0	97	97	97	100	2	97	93	0	0	99	0	97	0	100			
0	0	100	0	100	100	96	100	100	83	0	0	0	0	4	96	13	74	0	0	100	0	95	0	100			
0	100	100	100	100	100	100	100	100	100	0	100	100	0	100	100	100	0	0	0	100	0	100	0	100			
0	100	100	0	100	100	100	100	100	100	0	100	100	0	0	100	0	0	0	0	100	0	100	0	100			
100	0	100	0	100	100	0	100	100	0	0	100	0	0	0	0	0	0	0	0	100	0	100	0	100			
0	0	100	0	0	60	0	60	0	0	0	20	0	0	100	0		100	0	0	100	0	100	0	100			
0	0	100	0	100	100	100	75	0	0	0	0	0	0	100	50	50	0	0	0	100	0	0	0	100			
1	94	99	50	80	95	95	98	2	0	0	35	75	5	75	95	95	90	0	0	100	0	95	0	98			
1	75	85	15	65	80	70	90	2	0	0	5	40	5	65	30	85	40	0	0	98	0	45	0	97			
0	0	98	0	92	96	96	96	96	0	0	46	0	100	20	0	96	96	0	0	100	0	83	0	100			
0	0	100	40	97	100	100	100	97	0	0	40	0	8	3	97	35	78	0	0	100	0	98	98	100			
0	1	100	99	93	100	100	100	100	25	0	20	100	0	25	78	2	30	0	0	100	0	100	50	100			
0	0	0	0	23	16	13	99	10	0	0	50	0	99	24	0	35	10	0	0	97	0	85	0	99			
0	0	95	2	97	100	98	95	15	0	0	7	0	0	95	0	70	15	0	0	100	0	90	0	100			
0	0	0	0	0	0	0	70	0	0	0	0	0	0	0	0	30	0	0	0	100	0	30	0	100			
98	99	98	100	100	100	100	100	100	98	2	100	99	98	99	93	98	90	0	0	100	0	100	1	100			
95	100	100	100	100	100	100	100	100	100	0	100	100	100	100	96	100	95	0	0	100	0	100	0	100			
100	92	100	100	100	100	100	100	100	100	0	100	100	100	100	100	100	62	0	0	100	0	100	1	100			
55	65	98	90	55	95	95	98	92	70	0	80	97	95	65	25	50	2	0	0	80	0	80	0	100			
95	99	99	99	99	98	99	99	98	90	0	99	99	98	97	90	95	75	0	0	99	0	99	0	99			
95	100	100	90	96	100	100	100	100	0	0	30	100	100	50	0	50	0	0	0	100	0	0	0	100			
80	100	100	100	100	100	100	100	100	100	0	100	100	100	100	100	100	20	0	0	100	0	100	0	100			
0	40	100	98	100	100	99	100	100	98	0	99	99	0	40	90	35	50	0	0	100	0	100	0	100			
0	45	100	100	100	100	91	100	100	95	0	100	100	0	5	81	19	86	0	0	100	0	100	0	100			
0	0	100	100	83	100	100	100	100	100	0	100	100	0	33	83	50	83	0	0	100	0	100	0	100			
0	0	100	66	100	100	100	100	100	0	0	100	100	96	3	93	83	28	0	0	100	0	100	37	100			
0	0	100	0	0	0	83	0	0	0	0	0	0	0	17	100	100	0	0	0	100	0	0	0	0			
0	0	100	0	0	0	100	0	0	0	0	0	0	0	0	50	100	0	0	0	100	0	0	0	0			
0	0	0	100	0	30	0	0	0	0	0	0	100	75	10	0	30	10	0	0	90	0	90	0	100			

Continued

TABLE 19-12 Biochemical Reactions of the Named Species and Unnamed Groups of the Family Enterobacteriaceae—cont'd

Organism	Indole production	Methyl red	Voges-Proskauer	Citrate (Simmons)	Hydrogen sulfide (TSI)	Urea hydrolysis	Phenylalanine deaminase	Lysine decarboxylase	Arginine dihydrolase	Ornithine decarboxylase	Motility	Gelatin hydrolysis (22° C)	Growth in KCN	Malonate utilization	D-Glucose, acid	D-Glucose, gas	Lactose fermentation	Sucrose fermentation	D-Mannitol fermentation	Dulcitol fermentation	Salicin fermentation	Adonitol fermentation
Morganella morganii subsp. *morganii*	95	95	0	0	20	95	95	1	0	95	95	0	98	1	99	90	1	0	0	0	0	0
Morganella morganii subsp. *sibonii*	50	86	0	0	7	100	93	29	0	64	79	0	79	0	100	86	0	7	0	0	0	0
Morganella morganii biogroup 1	100	95	0	0	15	100	100	100	0	80	0	0	90	5	100	93	0	0	0	0	0	0
Obesumbacterium proteus biogroup 2	0	15	0	0	0	0	0	100	0	100	0	0	0	0	100	0	0	0	0	0	0	0
Pantoea agglomerans	20	50	70	50	0	20	20	0	0	0	85	2	35	65	100	20	40	75	100	15	65	7
Pantoea dispersa	0	82	64	100	0	0	9	0	0	0	100	0	82	9	100	0	0	1	100	0	0	0
Photorhabdus luminescens (all tests at 25° C)	50	0	0	50	0	25	0	0	0	0	100	50	0	0	75	0	0	0	0	0	0	0
Photorhabdus DNA hybridization group 5	0	0	0	20	0	60	0	0	0	0	100	80	20	0	100	0	0	0	0	0	0	0
Pragia fontium	0	100	0	89	89	0	22	0	0	0	100	0	0	0	100	0	0	0	0	0	78	0
Proteus mirabilis	2	97	50	65	98	98	98	0	0	99	95	90	98	2	100	96	2	15	0	0	0	0
Proteus myxofaciens	0	100	100	50	0	100	100	0	0	0	100	100	100	0	100	100	0	100	0	0	0	0
Proteus penneri	0	100	0	0	30	100	99	0	0	0	85	50	99	0	100	45	1	100	0	0	0	0
Proteus vulgaris	98	95	0	15	95	95	99	0	0	0	95	91	99	0	100	85	2	97	0	0	50	0
Providencia alcalifaciens	99	99	0	98	0	0	98	0	0	1	96	0	100	0	100	85	0	15	2	0	1	98
Providencia heimbachae	0	85	0	0	0	0	100	0	0	0	46	0	8	0	100	0	0	0	0	0	0	92
Providencia rettgeri	99	93	0	95	0	98	98	0	0	0	94	0	97	0	100	10	5	15	100	0	50	100
Providencia rustigianii	98	65	0	15	0	0	100	0	0	0	30	0	100	0	100	35	0	35	0	0	0	0
Providencia stuartii	98	100	0	93	0	30	95	0	0	0	85	0	100	0	100	0	2	50	10	0	2	5
Rahnella aquatilis	0	88	100	94	0	0	95	0	0	0	6	0	0	100	100	98	100	100	100	88	100	0
Salmonella bongori	0	100	0	94	100	0	0	100	94	100	100	0	100	0	100	94	0	0	100	94	0	0
Salmonella enterica subsp. *arizonae*	1	100	0	99	99	0	0	99	70	99	99	0	1	95	100	99	15	1	100	0	0	0
Salmonella enterica subsp. *diarizonae*	2	100	0	98	99	0	0	99	70	99	99	0	1	95	100	99	85	5	100	1	0	0
Salmonella enterica subsp. *enterica*	1	100	0	95	95	1	0	98	70	97	95	0	0	0	100	96	1	1	100	96	0	0
Salmonella enterica subsp. *houtenae*	0	100	0	98	100	2	0	100	70	100	98	0	95	0	100	100	0	0	98	0	60	5
Salmonella enterica subsp. *indica*	0	100	0	89	100	0	0	100	67	100	100	0	0	0	100	100	22	0	100	67	0	0
Salmonella enterica subsp. *salamae*	2	100	0	100	100	0	0	100	90	100	98	2	0	95	100	100	1	1	100	90	5	0
Salmonella serotype Choleraesuis	0	100	0	25	50	0	0	95	55	100	95	0	0	0	100	95	0	0	98	5	0	0
Salmonella serotype Gallinarum	0	100	0	0	100	0	0	90	10	1	0	0	0	0	100	0	0	0	100	90	0	0

From the Centers for Disease Control and Prevention, Atlanta, Ga.
TSI, Triple sugar iron; *KCN*, potassium cyanide; *ONPG*, o-nitrophenyl-β-D-galactopyranoside.
*Each number is the percentage of positive reactions after 2 days of incubation at 36° C unless noted otherwise. Most of these positive reactions occur within 24 hours. Reactions that become positive after 2 days are not considered.

myo-Inositol fermentation	D-Sorbitol fermentation	L-Arabinose fermentation	Raffinose fermentation	L-Rhamnose fermentation	Maltose fermentation	D-Xylose fermentation	Trehalose fermentation	Cellobiose fermentation	Alpha-methyl-D-glucoside fermentation	Erythritol fermentation	Esculin hydrolysis	Melibiose fermentation	D-Arabitol fermentation	Glycerol fermentation	Mucate fermentation	Tartrate, Jordan's	Acetate utilization	Lipase (corn oil)	DNase (25° C)	Nitrate nitrite	Oxidase, Kovacs	ONPG test	Yellow pigment	D-Mannose fermentation	Tyrosine utilization	D-Galactose	Citrate, Christensen's
0	0	0	0	0	0	0	0	0	0	0	0	0	0	5	0	95	0	0	0	90	0	10	0	98			
0	0	0	0	0	0	0	100	0	0	0	0	0	0	7	7	100	0	0	0	100	0	0	0	100			
0	0	0	0	0	0	0	0	0	0	0	0	0	0	100	0	100	0	0	0	90	0	20	0	100			
0	0	0	0	15	50	15	85	0	0	0	0	0	0	0	0	15	0	0	0	100	0	0	0	85			
15	30	95	30	85	89	93	97	55	7	0	60	50	50	30	40	25	30	0	0	85	0	90	75	98			
0	0	100	0	91	82	100	100	55	0	0	0	0	100	27	0	9	100	0	0	91	0	91	27	100			
0	0	0	0	0	25	0	0	0	0	0	0	0	0	0	0	50	0	0	0	0	0	0	50	100			
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	60	20	0	0	0	0	0	60	100			
0	0	0	0	0	0	0	0	0	0	0	78	0	0	0	0	0	0	0	0	100	0	0	0	0			
0	0	0	1	1	0	98	98	1	0	0	0	0	0	70	0	87	20	92	50	95	0	0	0	0			
0	0	0	0	0	100	0	100	0	100	0	0	0	0	100	0	100	0	100	50	100	0	0	0	0			
0	0	0	1	0	100	100	55	0	80	0	0	0	0	55	0	85	5	45	40	90	0	1	0	0			
0	0	0	1	5	97	95	30	0	60	1	50	0	0	60	0	80	25	80	80	98	0	1	0	0			
1	1	1	1	0	1	1	2	0	0	0	0	0	0	15	0	90	40	0	0	100	0	1	0	100			
46	0	0	0	100	54	8	0	0	0	0	0	0	92	0	0	69	0	0	0	100	0	0	0	100			
90	1	0	5	70	2	10	0	3	2	75	35	5	100	60	0	95	60	0	0	100	0	5	0	100			
0	0	0	0	0	0	0	0	0	0	0	0	0	0	5	0	50	25	0	0	100	0	0	0	100			
95	1	1	7	0	1	7	98	5	0	0	0	0	0	50	0	90	75	0	10	100	0	10	0	100			
0	94	100	94	94	94	94	100	100	0	0	100	100	0	13	30	6	6	0	0	100	0	100	0	100			
0	100	94	0	88	100	100	100	0	0	0	0	94	0	0	88	0	100	0	0	100	0	94	0	100			
0	99	99	1	99	98	100	99	1	1	0	1	95	1	10	90	5	90	0	2	100	0	100	0	100			
0	99	99	1	99	98	100	99	1	1	0	1	95	1	10	30	20	75	0	2	100	0	92	0	100			
35	95	99	2	95	97	97	99	5	2	0	5	95	0	5	90	90	90	0	2	100	0	2	0	100			
0	100	100	0	98	100	100	100	50	0	0	0	100	5	0	0	65	70	0	0	100	0	0	0	100			
0	0	100	0	100	100	100	100	0	0	0	0	89	0	33	89	100	89	0	0	100	0	44	0	100			
5	100	100	0	100	100	100	100	0	8	0	15	8	0	25	96	50	95	0	0	100	0	15	0	95			
0	90	0	1	100	95	98	0	0	0	1	0	45	1	0	0	85	1	0	0	98	0	0	0	95			
0	1	80	10	10	90	70	50	10	0	1	0	0	0	0	50	100	0	0	10	100	0	0	0	100			

Continued

TABLE 19-12 Biochemical Reactions of the Named Species and Unnamed Groups of the Family Enterobacteriaceae—cont'd

Organism	Indole production	Methyl red	Voges-Proskauer	Citrate (Simmons)	Hydrogen sulfide (TSI)	Urea hydrolysis	Phenylalanine deaminase	Lysine decarboxylase	Arginine dihydrolase	Ornithine decarboxylase	Motility	Gelatin hydrolysis (22° C)	Growth in KCN	Malonate utilization	D-Glucose, acid	D-Glucose, gas	Lactose fermentation	Sucrose fermentation	D-Mannitol fermentation	Dulcitol fermentation	Salicin fermentation	Adonitol fermentation
Salmonella serotype Paratyphi A	0	100	0	0	10	0	0	0	15	95	95	0	0	0	100	99	0	0	100	90	0	0
Salmonella serotype Pullorum	0	90	0	0	90	0	0	100	10	95	0	0	0	0	100	90	0	0	100	0	0	0
Salmonella serotype Typhi	0	100	0	0	97	0	0	98	3	0	97	0	0	0	100	0	1	0	100	0	0	0
Serratia entomophila	0	20	100	100	0	0	0	0	0	0	100	100	100	0	100	0	0	100	100	0	100	0
Serratia ficaria	0	75	75	100	0	0	0	0	0	0	100	100	55	0	100	0	15	100	100	0	100	0
Serratia fonticola	0	100	9	91	0	13	0	100	0	97	91	0	70	88	100	79	97	21	100	91	100	100
Serratia liquefaciens	1	93	93	90	0	3	0	95	0	95	95	90	90	2	100	75	10	98	100	0	97	5
Serratia marcescens	1	20	98	98	0	15	0	99	0	99	97	90	95	3	100	55	2	99	99	0	95	40
Serratia marcescens biogroup 1	0	100	60	30	0	0	0	55	4	65	17	30	70	0	100	0	4	100	96	0	92	30
Serratia odorifera biogroup 1	60	100	50	100	0	5	0	100	0	100	100	95	60	0	100	0	70	100	100	0	98	50
Serratia odorifera biogroup 2	50	60	100	97	0	0	0	94	0	0	100	94	19	0	100	13	97	0	97	0	45	55
Serratia plymuthica	0	94	80	75	0	0	0	0	0	0	50	60	30	0	100	40	80	100	100	0	94	0
Serratia rubidaea	0	20	100	95	0	2	0	55	0	0	85	90	25	94	100	30	100	99	100	0	99	99
Shigella boydii	25	100	0	0	0	0	0	0	18	2	0	0	0	0	100	0	1	0	97	5	0	0
Shigella dysenteriae	45	99	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	1	100	0	0	0
Shigella flexneri	50	100	0	0	0	0	0	0	5	0	0	0	100	0	100	3	1	1	95	1	0	0
Shigella sonnei	0	100	0	0	0	0	0	0	2	98	0	0	0	0	100	0	2	1	99	0	0	0
Tatumella ptyseos	0	0	5	2	0	0	90	0	0	0	0	0	0	0	100	0	0	98	0	0	55	0
Trabulsiella guamensis	40	100	0	88	100	0	0	100	50	100	100	0	100	0	100	100	0	0	100	0	13	0
Xenorhabdus nematophilus	40	0	0	0	0	0	0	0	0	0	100	80	0	0	80	0	0	0	0	0	0	0
Yersinia aldovae	0	80	0	0	0	60	0	0	0	40	0	0	0	0	100	0	0	20	80	0	0	0
Yersinia bercovieri	0	100	0	0	0	60	0	0	0	80	0	0	0	0	100	0	20	100	100	0	20	0
Yersinia enterocolitica	50	97	2	0	0	75	0	0	0	95	2	0	2	0	100	5	5	95	98	0	20	0
Yersinia frederiksenii	100	100	0	15	0	70	0	0	0	95	5	0	0	0	100	40	40	100	100	0	92	0
Yersinia intermedia	100	100	5	5	0	80	0	0	0	100	5	0	10	5	100	18	35	100	100	0	100	0
Yersinia kristensenii	30	92	0	0	0	77	0	0	0	92	5	0	0	0	100	23	8	0	100	0	15	0
Yersinia mollaretii	0	100	0	0	0	20	0	0	0	80	0	0	0	0	100	0	40	100	100	0	20	0
Yersinia pestis	0	80	0	0	0	5	0	0	0	0	0	0	0	0	100	0	0	0	97	0	70	0
Yersinia pseudotuberculosis	0	100	0	0	0	95	0	0	0	0	0	0	0	0	100	0	0	0	100	0	25	0
Yerrsinia rohdei	0	62	0	0	0	62	0	0	0	25	0	0	0	0	100	0	0	100	100	0	0	0
Yersinia ruckeri	0	97	10	0	0	0	0	50	5	100	0	30	15	0	100	5	0	0	100	0	0	0
Yokenella regensburgei (Koserella trabulsii)	0	100	0	92	0	0	0	100	8	100	100	0	92	0	100	100	0	0	100	0	8	0
Enteric Group 58	0	100	0	85	0	70	0	100	0	85	100	0	100	85	100	85	30	0	100	85	100	0
Enteric Group 59	10	100	0	100	0	0	30	0	60	0	100	0	80	90	100	100	80	0	100	0	100	0
Enteric Group 60	0	100	0	0	0	50	0	0	0	100	75	0	0	100	100	100	0	0	50	0	0	0
Enteric Group 68	0	100	50	0	0	0	0	0	0	0	0	0	100	0	100	0	0	100	100	0	50	0
Enteric Group 69	0	0	100	100	0	0	0	0	100	100	100	0	100	100	100	100	100	25	100	100	100	0

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TSI, Triple sugar iron; *KCN*, potassium cyanide; *ONPG*, o-nitrophenyl-β-D-galactopyranoside.

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myo-Inositol fermentation	D-Sorbitol fermentation	L-Arabinose fermentation	Raffinose fermentation	L-Rhamnose fermentation	Maltose fermentation	D-Xylose fermentation	Trehalose fermentation	Cellobiose fermentation	Alpha-methyl-D-glucoside fermentation	Erythritol fermentation	Esculin hydrolysis	Melibiose fermentation	D-Arabitol fermentation	Glycerol fermentation	Mucate fermentation	Tartrate, Jordan's	Acetate utilization	Lipase (corn oil)	DNase (25° C)	Nitrate nitrite	Oxidase, Kovacs	ONPG test	Yellow pigment	D-Mannose fermentation	Tyrosine utilization	D-Galactose	Citrate, Christensen's
0	95	100	0	100	95	0	100	5	0	0	0	95	0	10	0	0	0	0	0	100	0	0	0	100			
0	10	100	1	100	5	90	90	5	0	0	0	0	0	0	0	0	0	0	0	100	0	0	0	100			
0	99	2	0	0	97	82	100	0	0	0	0	100	0	20	0	100	0	0	0	100	0	0	0	100			
0	0	0	0	0	100	40	100	0	0	0	100	0	60	0	0	100	80	20	100	100	0	100	0	100			
55	100	100	70	35	100	100	100	100	8	0	100	40	100	0	0	17	40	77	100	92	8	100	0	100			
30	100	100	100	76	97	85	100	6	91	0	100	98	100	88	0	58	15	0	0	100	0	100	0	100			
60	95	98	85	15	98	100	100	5	5	0	97	75	0	95	0	75	40	85	85	100	0	93	0	100			
75	99	0	2	0	96	7	99	5	0	1	95	0	0	95	0	75	50	98	98	98	0	95	0	99			
30	92	0	0	0	70	0	100	4	0	0	96	0	0	92	0	50	4	75	82	83	0	75	0	100			
100	100	100	100	95	100	100	100	100	0	0	95	100	0	40	5	100	60	35	100	100	0	100	0	100			
100	100	100	7	94	100	100	100	100	0	7	40	96	0	50	0	100	65	65	100	100	0	100	0	100			
50	65	100	94	0	94	94	100	88	70	0	81	93	0	50	0	100	55	70	100	100	0	70	0	100			
20	1	100	99	1	99	99	100	94	1	0	94	99	85	20	0	70	80	99	99	100	0	100	0	100			
0	43	94	0	1	20	11	85	0	0	0	0	15	0	50	0	50	0	0	0	100	0	10	0	100			
0	30	45	0	30	15	4	90	0	0	0	0	0	0	10	0	75	0	0	0	99	0	30	0	100			
0	29	60	40	5	30	2	65	0	0	0	0	55	1	10	0	30	8	0	0	99	0	1	0	100			
0	2	95	3	75	90	2	100	5	0	0	0	25	0	15	10	90	0	0	0	100	0	90	0	100			
0	0	0	11	0	0	9	93	0	0	0	0	25	0	7	0	0	0	0	0	98	0	0	0	100			
0	100	100	0	100	100	100	100	100	0	0	40	0	0	0	100	50	88	0	0	100	0	100	0	100			
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	60	0	0	20	20	0	0	60	80			
0	60	60	0	0	0	40	80	0	0	0	0	0	0	0	0	100	0	0	0	100	0	0	0	100			
0	100	100	0	0	100	100	100	100	0	0	20	0	0	0	0	100	0	0	0	100	0	80	0	100			
30	99	98	5	1	75	70	98	75	0	0	25	1	40	90	0	85	15	55	5	98	0	95	0	100			
20	100	100	30	99	100	100	100	100	0	0	85	0	100	85	5	55	15	55	0	100	0	100	0	100			
15	100	100	45	100	100	100	100	96	77	0	100	80	45	60	6	88	18	12	0	94	0	90	0	100			
15	100	77	0	0	100	85	100	100	0	0	0	0	45	70	0	40	8	0	0	100	0	70	0	100			
0	100	100	0	0	60	60	100	100	0	0	0	0	0	20	0	100	0	0	0	100	0	20	0	100			
0	50	100	0	1	80	90	100	0	0	0	50	20	0	50	0	0	0	0	0	85	0	50	0	100			
0	0	50	15	70	95	100	100	0	0	0	95	70	0	50	0	50	0	0	0	95	0	70	0	100			
0	100	100	62	0	0	38	100	25	0	0	0	50	0	38	0	100	0	0	0	88	0	50	0	100			
0	50	5	5	0	95	0	95	5	0	0	0	0	0	30	0	30	0	30	0	75	0	50	0	100			
0	0	100	25	100	100	100	100	100	0	0	67	92	0	0	0	0	25	0	0	100	0	100	0	100			
0	100	100	0	100	100	100	100	100	55	0	0	0	0	30	0	60	45	0	0	100	0	100	0	100			
0	0	100	0	100	100	100	100	100	10	0	100	0	10	10	60	50	50	0	0	100	0	100	25	100			
0	0	25	0	75	0	0	100	0	0	0	0	0	0	75	0	75	0	0	0	100	0	100	0	100			
0	0	0	0	0	50	0	100	0	0	0	0	0	0	50	0	0	0	0	100	100	0	0	0	100			
0	100	100	100	100	100	100	100	100	100	0	100	100	0	0	100	0	25	0	0	100	0	100	0	100			

TABLE 6-10 Differentiation of Species Within the Genus *Shigella*

Biochemical Test	*S. dysenteriae*	*S. flexneri*	*S. boydii*	*S. sonnei*
Serogroup	A	B	C	D
ONPG	–	–	–	+
Ornithine decarboxylase	–	–	–	+
Fermentation of:				
Lactose	–	–	–	–
Mannitol	–	+	+	+
Raffinose	–	d	–	–
Sucrose	–	–	–	–
Xylose	–	–	d	–
Indole production	d	d	d	–

+, 90% or more strains positive; –, 90% or more strains negative; d, different strains positive/negative.

TABLE 6-15 Differentiation of Species Within the Genus *Citrobacter*[a]

	Citrobacter										
Biochemical Test	***koseri***	***werkmanii***	***sedlakii***	***rodentium***	***gillenii***	***amalon-aticus***	***farmeri***	***braakii***	***freundii***	***murliniae***	***youn-gae***
Adonitol	+	–	–	–	–	–	–	–	–	–	–
Malonate	+	+	+	+	+	–	–	–	–	–	–
Ornithine	+	–	+	+	–	+	+	+	–	–	–
Melibiose	–	–	+	–	V (67)	–	+	V (78)	+	V (33)	–
Sucrose	V (44)	–	–	–	V (33)	V (13)	+	–	+	V (33)	V (19)
Indole	+	–	+	–	–	+	+	V (33)	V (38)	+	V (14)
Dulcitol	V (38)	–	+	–	–	–	–	V (33)	V (13)	+	V (86)
H_2S	–	+	–	–	V (67)	V (13)	–	V (60)	V (75)	V (67)	V (67)

[a]Data obtained from reference 67.
+, 90% or more strains positive; −, 90% or more strains negative; V, 11%–89% of strains positive; numbers in parentheses are percentage of strains giving positive reaction.

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

Biochemical Test	*Klebsiella*		*Enterobacter*		*Pantoea*	*Hafnia*	*Serratia*	
	K. pneumoniae	*K. oxytoca*	*E. aerogenes*	*E. cloacae*	*P. agglomerans*	*H. alvei*	*S. marcescens*	*S. liquefaciens*
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 6-20 Differentiation of Clinically Important Species Within the Genus *Serratia*[a]

Biochemical Test	*S. marcescens*	*S. liquefaciens*	*S. rubidaea*	*S. plymuthica*	*S. ficaria*	*S. fonticola*	*S. odorifera* Biogroup 1	*S. odorifera* Biogroup 2
DNase (25°C)	+	V (85)	+	+	+	–	+	+
Lipase (corn oil)	+	V (85)	+	V (70)	V (77)	–	V (35)	V (65)
Gelatinase (22°C)	+	+	+	V (60)	+	–	+	+
Lysine (Moeller's)	+	+	V (55)	–	–	+	+	+
Ornithine (Moeller's)	+	+	–	–	–	+	+	–
Odor of potatoes	–	–	V	–	+	–	+	+
Red, pink, or orange pigment	V	–	V	V	–	–	–	–
Fermentation of:								
L-Arabinose	–	+	+	+	+	+	+	+
D-Arabitol	–	–	V (85)	–	+	+	–	–
D-Sorbitol	+	+	–	V (65)	+	+	+	+
Sucrose	+	+	+	+	+	V (21)	+	–
Raffinose	–	V (85)	+	+	V (70)	+	+	–
Malonate utilization	–	–	+	–	–	+	–	–

+, 90% or more strains positive; –, 90% or more strains negative; V, 11%–89% of strains positive.
Table includes only those *Serratia* species that have been isolated from human clinical specimens.
[a]Data obtained from reference 253 and Table 6-7.

TABLE 6-21 Differentiation of Species Within the Members of the Genus *Proteus*[a]

						Proteus vulgaris biogroup 3		
TEST	***P. mirabilis***	***P. myxofaciens***	***P. penneri***	***P. vulgaris***	***P. hauseri***	**DNA Group 4**	**DNA Group 5**	**DNA Group 6**
Ornithine	+	–	–	–	–	–	–	–
Indole	–	–	–	+	+	+	+	+
Esculin	–	–	–	+	–	–	–	V (9)
Salicin	–	–	–	+	–	–	–	V (9)
Lipase	+	+	V (35)	V (14)	–	+	+	V (90)
Tartrate	V (87)	+	V (89)	V (14)	–	+	+	+
Rhamnose	–	–	–	–	–	+	V (17)	–
DNase 25°C	V (50)	V (50)	V (12)	+	–	+	+	V (55)
Acetate	V (20)	–	V (12)	V (14)	–	–	V (12)	V (18)

[a]Data obtained from reference 478.
+, 90% or more strains positive; –, 90% or more strains negative; V, 11%–89% of strains positive; numbers in parentheses are the percentages of strains giving positive reactions.

TABLE 6-22 Differentiation of Species Within the Genus *Morganella*[a]

	***M. Morganii* subsp. *morganii* Biogroups**				***M. morganii* subsp. *sibonii* Biogroups**		
Biochemical Test	***A***	***B***	***C***	***D***	***E***	***F***	***G***
Lysine	–	+	–	+	+	d+	–
Ornithine	+	+	–	–	+	–	+
Trehalose	–	–	–	–	+	+	+
Tetracycline (% susceptible)	100[b]	100	14	100	0	0	21
Motility	+	–	d+	–	+	+	+

[a]Data obtained from reference 328.
[b]Strains with a zone of ≥28 mm around tetracycline were considered susceptible (minimal inhibitory concentration [MIC] correlate, ≤2 µg/mL), and those with a zone diameter ≤15 mm were considered tetracycline-resistant (MIC correlate, ≥32 µg/mL).
+, 90% or more strains positive; –, 90% or more strains negative; V, 11%–89% of strains positive; d+, delayed reaction, 50%–89% positive within 48 hour.

TABLE 6-23 Differentiation of Species Within the Genus *Providencia*[a]

Biochemical Test	*P. alcalifaciens*	*P. rustigianii*	*P. heinbachae*	*P. stuartii*	*P. rettgeri*
Urea hydrolysis	–	–	–	V (30)	+
Citrate utilization	+	–	–	+	+
Fermentation of:					
Inositol	–	–	V (46)	+	1
Adonitol	+	–	+	–	+
Arabitol	–	–	+	–	+
Trehalose	–	–	–	+	–
Galactose	–	+	+	+	+

+, 90% or more strains are positive; −, 90% or more strains are negative.
[a]Data obtained from reference 450 and other sources.

TABLE 6-24 Differentiation of Species Within the Genus *Yersinia*[a]

Biochemical Test	*Y. pestis*	*Y. pseudotuberculosis*	*Y. enterocolitica*	*Y. frederiksenii*	*Y. intermedia*	*Y. kristensenii*	*Y. aldovae*	*Y. bercovieri*	*Y. mollaretii*	*Y. rohdei*
Indole	–	–	V (50)	+	+	V (30)	–	–	–	–
Ornithine	–	–	+	+	+	+	V (40)	V (80)	V (80)	V (25)
Motility 25–28°C	–	+	+	+	+	+	+	+	+	NA
Fermentation of:										
Sucrose	–	–	+	+	+	–	V (20)	+	+	+
Rhamnose	–	V (70)	–	+	+	–	–	–	–	–
Cellobiose	–	–	V (75)	+	+	+	–	+	+	V (25)
Sorbitol	V(50)	–	+	+	+	+	V (60)	+	+	+
Melibiose	V(50)	V (70)	–	–	V (80)	–	–	–	–	V (50)

[a]Data obtained from references 43, 660, and other sources. All tests were done at 25°C–28°C.
+, 90% or more strains positive; −, 90% or more strains negative; V, 11%–89% of strains positive; NA, results not available.

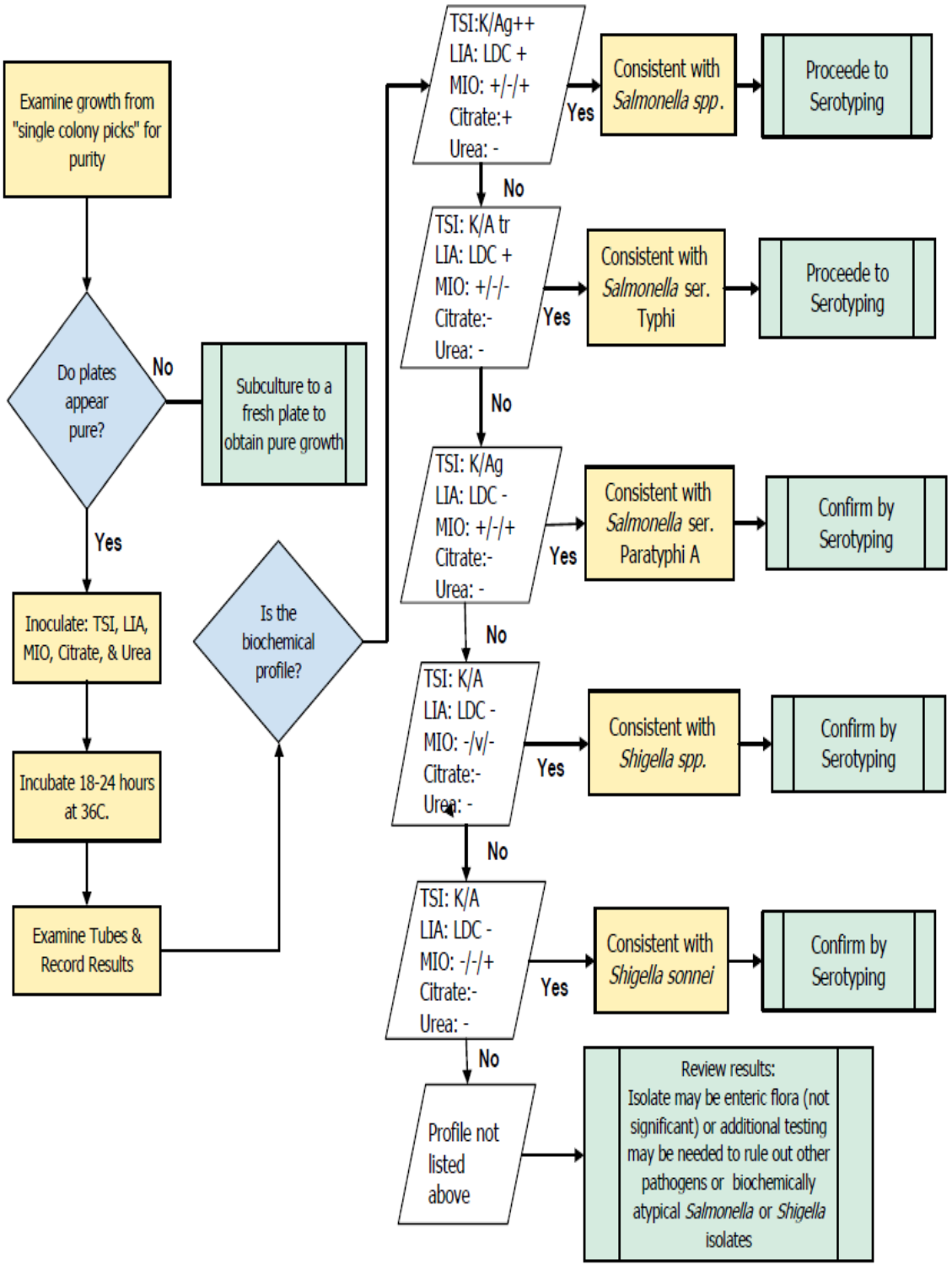

Examine growth from "single colony picks" for purity
Do plates appear pure?
No
Subculture to a fresh plate to obtain pure growth
Yes
Inoculate: TSI, LIA, MIO, Citrate, & Urea
Incubate 18-24 hours at 36C.
Examine Tubes & Record Results
Is the biochemical profile?
TSI:K/Ag++ LIA: LDC + MIO: +/-/+ Citrate:+ Urea: -
Yes
Consistent with *Salmonella spp.*
Proceede to Serotyping
No
TSI: K/A tr LIA: LDC + MIO: +/-/- Citrate:- Urea: -
Yes
Consistent with *Salmonella* ser. Typhi
Proceede to Serotyping
No
TSI: K/Ag LIA: LDC - MIO: +/-/+ Citrate:- Urea: -
Yes
Consistent with *Salmonella* ser. Paratyphi A
Confirm by Serotyping
No
TSI: K/A LIA: LDC - MIO: -/v/- Citrate:- Urea: -
Yes
Consistent with *Shigella spp.*
Confirm by Serotyping
No
TSI: K/A LIA: LDC - MIO: -/-/+ Citrate:- Urea: -
Yes
Consistent with *Shigella sonnei*
Confirm by Serotyping
No
Profile not listed above
Review results:
Isolate may be enteric flora (not significant) or additional testing may be needed to rule out other pathogens or biochemically atypical *Salmonella* or *Shigella* isolates

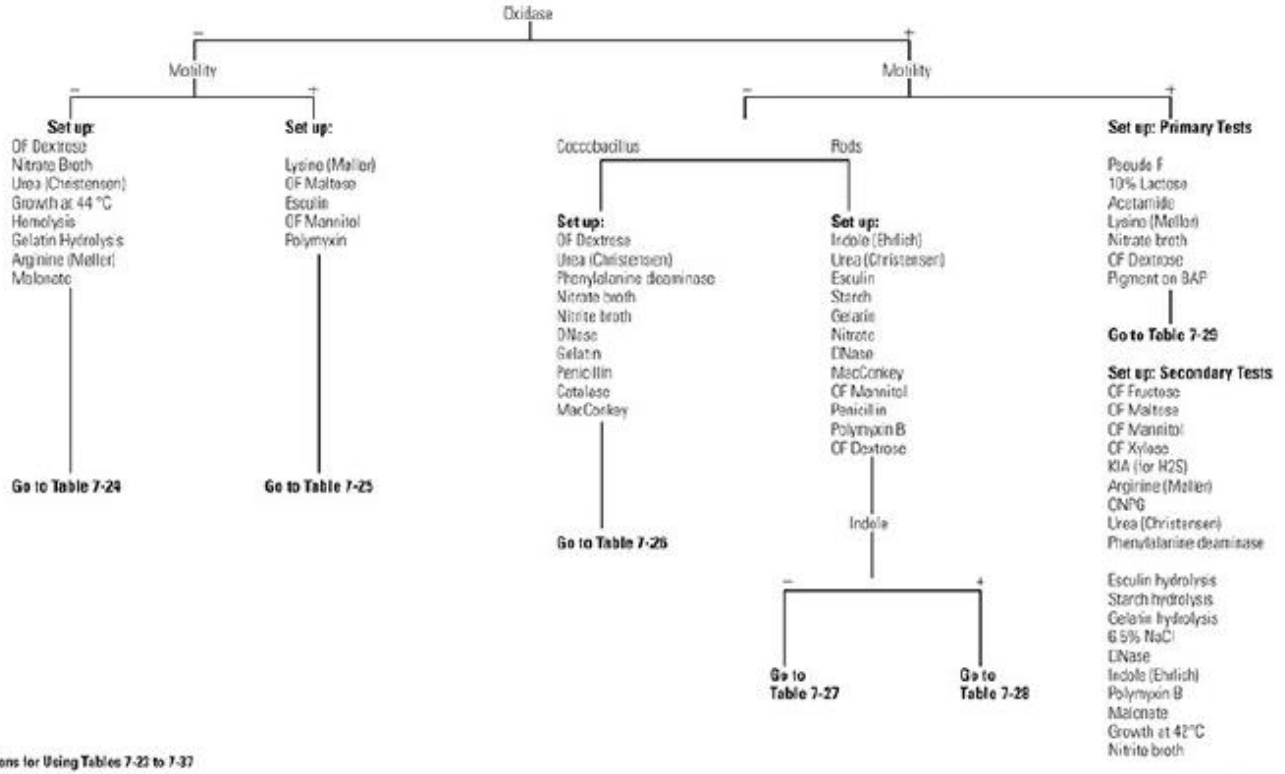
TABLE 19-11 Stool Culture Screening for Enteric Pathogens Utilizing TSI and LIA in Combination

	TSI Reactions							
LIA Reactions	**K/A H_2S**	**K/AG H_2S**	**K/AG**	**K/A**	**A/A H_2S**	**A/AG**	**A/A**	**K/K**
R/A		*P. vulgaris* *P. mirabilis*	*M. morganii* *Providencia*	*M. morganii* *Providencia*	*P. vulgaris* *P. mirabilis*	—	*Providencia*	—
K/K H_2S	*Salmonella** *Edwardsiella*	*Salmonella** *Edwardsiella**	*Salmonella**	*Salmonella**	—	—	—	—
K/K	*Salmonella*	—	*Hafnia* *Klebsiella* *Serratia*	*Salmonella** *Plesiomonas*† *Hafnia*	—	*Klebsiella* *Enterobacter* *E. coli*	*Serratia*	*Pseudomonas*†
K/A H_2S	—	*Salmonella**	—	*Serratia*	—	—	—	—
K/A	—	*Citrobacter*	*Salmonella** *Shigella* *Aeromonas*† *E. coli* *Enterobacter* *Citrobacter*	*Shigella** *Yersinia* *Aeromonas*† *E. coli* *Enterobacter*	*Citrobacter*	*Aeromonas**† *E. coli* *Citrobacter* *Enterobacter*	*Aeromonas**† *Yersinia* *Citrobacter* *Enterobacter*	—

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.
†Oxidase positive.

Nonfermentative Gram Negative Bacilli

TABLE 7-23 Practical Approach to the Identification of Nonfermenters



Instructions for Using Tables 7-23 to 7-37

This approach to the identification of nonfermenters is designed to minimize the number of biochemical tests needed for identification based on a preliminary assessment of the oxidase and motility reactions of organisms to be identified. Once this information is known, a specific battery of tests is performed to complete the identification of the organism. For those organisms that are both oxidase positive and motile, a two-step approach is used based on the reactions obtained in a primary test battery followed by additional supplemental tests that are specified in the designated Tables. Depending on the needs and resources available, the user of this guide may wish to set up all of the tests included in the primary and secondary batteries whenever a motile, oxidase-positive nonfermenter is encountered in order to obtain a definitive identification in the shortest time possible. As a general rule when working with NFBs, a heavy inoculum should be used and reactions should be held 48 hours before the final reading is taken.

Steps to Follow

1. Determine the motility and oxidase reactions and follow the flow diagram in Table 7-23.
2. Set up the specified biochemical tests and go to the Table indicated to complete the identification.
3. To utilize Tables 7-24 to 7-37, begin with the first biochemical test listed on the left hand side of the Table and locate the shaded box or boxes in the upper left hand corner.
4. If a single box is shaded, and if the reaction given matches the reaction obtained with your specimen, you are done. The organism identification is listed in the same row to the left of the box.
5. If multiple boxes are shaded and the reaction matches that of your specimen, use the reactions to the right of the shaded boxes to determine the correct identification.
6. If the reaction obtained with your specimen does not match that in the shaded box or boxes, proceed to the next column on the right and find the shaded box or boxes in this column. Repeat steps 4 and 5 until you reach a definitive identification.
7. Special consideration must be given to shaded boxes that contain a variable (V) reaction sign. In these rare cases, you must treat the variable reaction in the shaded box as both a match and a nonmatch.

TABLE 7-24 Oxidase-Negative, Nonmotile Nonfermenters[a]

Organism[b]	Genomospecies	Yellow Pigment	Urease	Nitrate Reduced	Brown Soluble Pigment	Growth at 37°C	Growth at 44°C	Hemolysis Sheep Blood	Gelatin Hydrolysis	OF Dextrose	Arginine	Malonate
CDC EO-5		+[c]	+	–	–	+	–	NA	–	+	–	NA
Bordetella parapertussis		–	+	–	–	+	NA	+	NA	–	NA	NA
CDC NO-1		–	–	+	–	+	NA	–	–	–	–	NA
Bordetella holmesii (NO-2)		–	–	–	+[d]	+	–	–	–	–	–	NA
Acinetobacter johnsonii	7	–	–	–	–	–	–	–	–	–	V (35)	V (13)
Acinetobacter baumannii	2	–	–	–	–	+	+[e]	–	–	+	+	+
Acinetobacter haemolyticus	4	–	–	–		+	–	+	+	V (52)	+	–
Acinetobacter sp.	6	–	–	–	–	+	–	+	+	V (66)	+	–
Acinetobacter bereziniae	10	–	–	–	–	+	–	–	–	+	–	–
Acinetobacter calcoaceticus	1	–	–	–	–	+	–	–	–	+	+	+
Acinetobacter pittii	3	–	–	–	–	+		–	–	+	+	V (87)
Acinetobacter radioresistens	12	–	–	–	–	+	–	–	–	V (33)	+	+
Acinetobacter junii	5	–	–	–	–	+	–	–	–	–	+	–
Acinetobacter lwoffii	8/9	–	–	–	–	+	–	–	–	–	–	–
Acinetobacter guillouiae	11	–	–	–	–	+	–	–	–	–	–	–

[a]Data from references 117, 249, 450, and 1171.
[b]All organisms included in this chart appear as gram-negative coccobacilli on Gram's stain.
[c]Also consider *Granulibacter bethesdensis* (see Table 7-18).
[d]Brown soluble pigment produced when grown at 35°C heart infusion tyrosine agar.
[e]Must also be OF dextrose positive.
+, 90% or more of strains are positive; –, 90% or more of strains are negative; V, 11%–89% strains positive; NA, results not available; numbers in parentheses are percentage of strains giving positive reaction. Instructions for interpreting table using shaded boxes are provided under heading "Steps to Follow" on p.392

TABLE 7-25 Oxidase-Negative, Motile Nonfermenters[a]

Organism	Lysine Decarboxylase	Esculin	OF Maltose	OF Mannitol	Polymyxin B	Pigment	Additional Characteristics
Stenotrophomonas maltophilia	+	+	+	–	S	Yellow Lavender	DNase positive
Burkholderia cepacia complex	+	V (67)	+	+	R	White or yellow	DNase negative Lipase positive
Sphingomonas paucimobilis	–	+	+	–	V (89)	Deep yellow	Vancomycin sensitive
Pseudomonas luteola	–	+	+	+	S	Dull yellow	
Pseudomonas oryzihabitans	–	–	+	+	S	Dull yellow	
Burkholderia multivorans	V (53)	–	+	+	R	Grayish white	Lipase Pos
Burkholderia gladioli	–	–	–	+	R	Yellow	Lipase Pos
Bordetella trematum	–	–	–	–	NA	Grayish white	Acetamide and malonate Pos
Kerstersia gyiorum	–	–	–	–	NA	White to light brown	Acetamide and malonate Neg
Pandoraea species	–	–	–	–	R	Grayish white	Lipase Neg

[a]Data from references 209, 217, 250, 367, 438, and 1105.
+, 90% or more strains positive; –, 90% or more strains negative; V, 11%–89% of strains positive; NA, results not available; numbers in parentheses are percentage of strains giving positive reaction; R, resistant; S, susceptible. Instructions for interpreting table using shaded boxes are provided under heading "Steps to Follow" on p.392

TABLE 7-26 Identification of Oxidase-Positive, Nonmotile Coccobacilli[a]

Organism	Characteristic Odor or Appearance	OF Dextrose	DNase	Urease	Phenylalanine Deaminase	Gelatin Hydrolysis	Nitrate Reduced	Growth on MacConkey	Nitrite Reduced	Catalase	Growth at 35°C
Psychrobacter immobilis (saccharolytic)	Odor of PEA agar (roses)	+	–	+	+	–	V (86)	V	NA	+	–
Paracoccus yeei (CDC EO-2)	O-shaped cells[b]	+	–	+	NA	–	+	V (82)	NA	V (82)	+
CDC EO-3	Yellow colonies (100)	+	–	+	NA	–	–	+	NA	+	+
CDC EO-4	Yellow colonies (83)	+	NA	+	NA	–	–	+	NA	+	+
CDC EF-4b		+	NA	–	NA	–	+	V (65)	V	+	+
M. canis		–	+	–	–	–	+	+	V	+	+
M. catarrhalis		–	+	–	V	–	+	–	+	+	+
Psychrobacter phenylpyruvicus[c]		–	–	+	+	–	V (89)	+	–	Weak	+
O. urethralis	Small coccoid cells	–	–	–	+	–	–	V (83)	+	+	+
M. lacunata		–	–	–	–	+	+	–	–	Weak	+
M. nonliquefaciens		–	–	–	–	–	+	V (17)	–	+	+
M. osloensis		–	–	–	–	–	V (26)	V (49)	–	Weak	+
M. atlantae	Spreading or pitting colonies	–	–	–	–	–	–	+	V (20)	Weak or –	+
M. lincolnii	Coccus-like to plump rods	–	–	–	NA	–	–	–	V	+	+

[a]Data obtained from references 251, 367, 493, 754, 1102, 1170, and 1172.
[b]Gram's stain smears show coccoid to short thick rods that are frequently vacuolated. Cells have unstained centers but are peripherally stained and appear as O's.
[c]*Brucella* species may be misidentified as *Psychrobacter phenylpyruvicus* in some commercial identification systems.
+, 90% or more strains positive; –, 90% or more strains negative; V, 11%–89% of strains positive; NA, results not available; numbers in parentheses are percentage of strains giving positive reaction. Instructions for interpreting table using shaded boxes are provided under heading "Steps to Follow" on p.392

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

Test	*S. maltophilia*	*B. cepacia* 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.

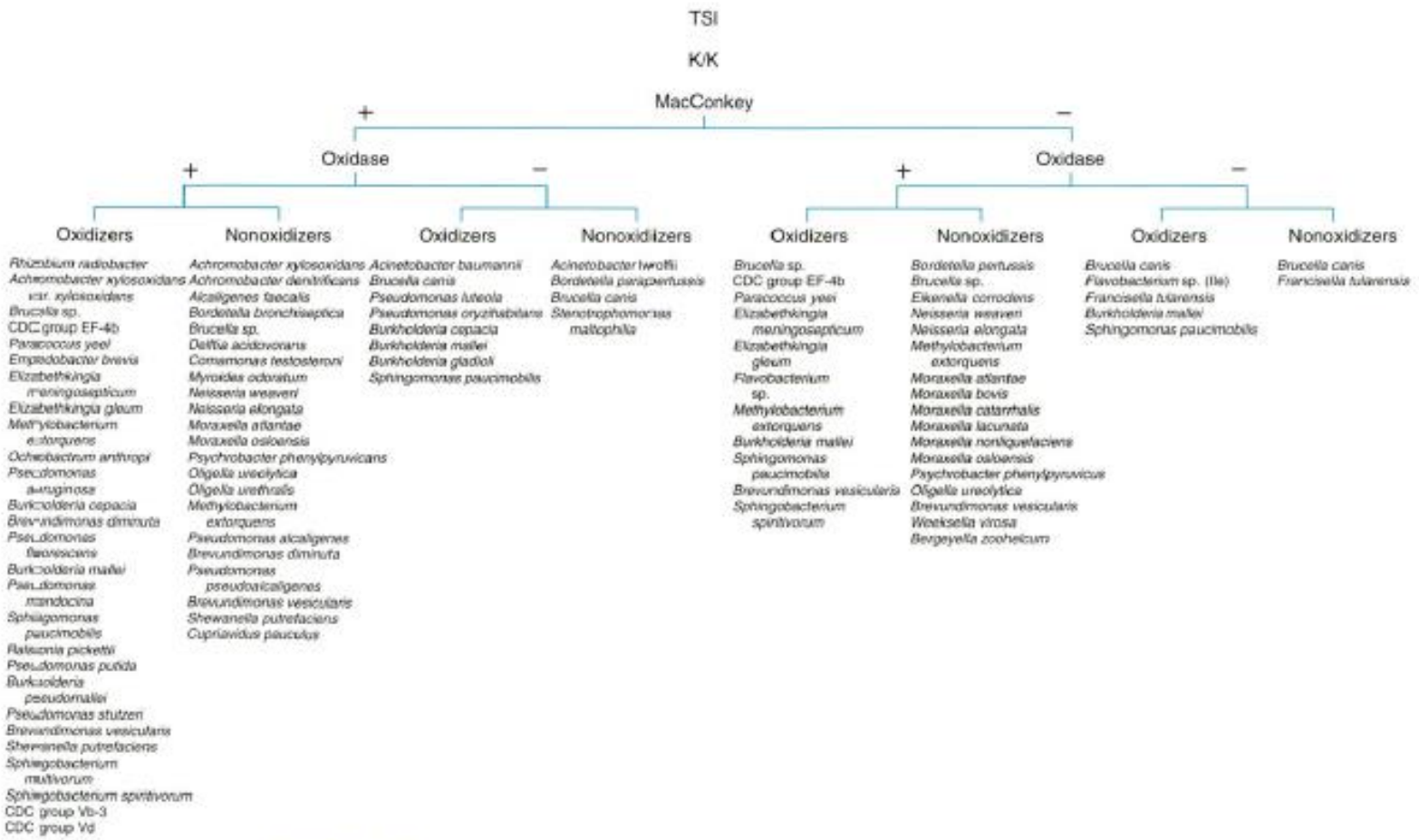


FIGURE 21-1 Grouping of nonfermenters based on eight possible results. *TSI*, Triple sugar iron; *K/K*, alkaline/alkaline. Some bacteria have variable results and belong to more than one group.

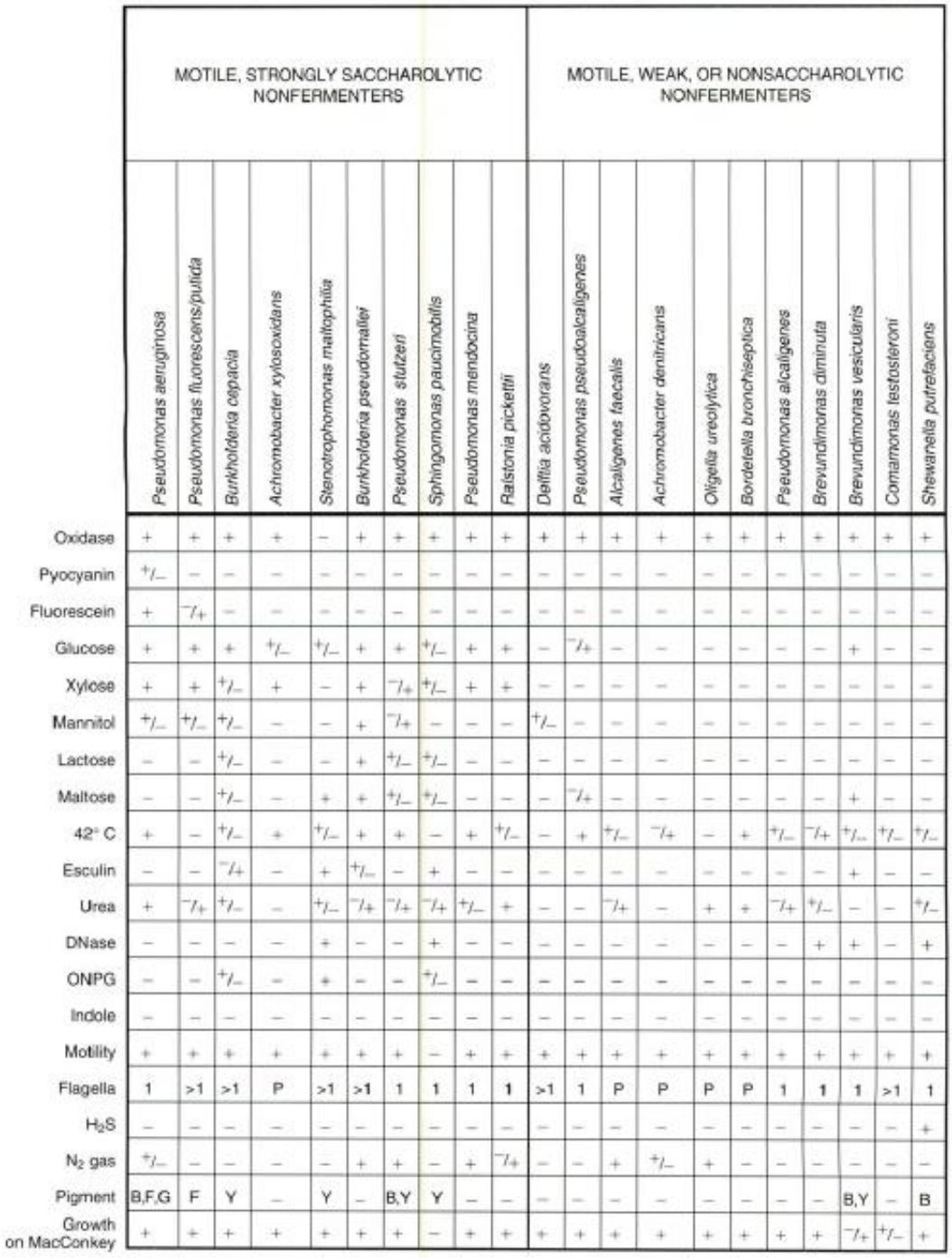


FIGURE 21-2 Biochemical and morphologic characteristics of selected nonfermentative gram-negative bacilli. *ONPG*, o-Nitrophenyl-β-D-galactopyranoside; +, most strains positive; –, most strains negative; *B*, brown; *F*, fluorescein; *G*, green; *Y*, yellow. (Data from the Ohio State University Hospital,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

	NONMOTILE, PIGMENTED, INDOLE-POSITIVE NONFERMENTERS				NONMOTILE COCCOBACILLI		
						Oxidase negative	
	Elizabethkingia meningosepticum	*Myroides odoratus*	*Bergeyella zoohelcum*	*Weeksella virosa*	*Moraxella* sp.	*Acinetobacter lwoffii*	*Acinetobacter baumannnii*
Oxidase	+	+	+	+	+	–	–
Pyocyanin	–	–	–	–	–	–	–
Fluorescein	–	–	–	–	–	–	–
Glucose	+/–	–	–	–	–	–	+
Xylose	–	–	–	–	–	–	+
Mannitol	–/+	–	–	–	–	–	–
Lactose	–	–	–	–	–	–	+
Maltose	–/+	–	–	–	–	+/–	–
42° C	+/–	–	–	–/+	–/+	–	+
Esculin	+	–	–	–	–	–	–
Urea	–/+	+	+	–/+	–	–/+	–/+
DNase	+	+	+	+	–	–	–/+
ONPG	+/–	–	–	–	–	–	–
Indole	+	–	–/+	+	–	–	–
Motility	–	–	–	–	–	–	–
Flagella	–	–	–	–	–	–	–
H_2S	–	–	–	–	–	–	–
N_2 gas	–	–/+	–	–	–	–	–
Pigment	Y	Y	B	B	–	–	–
Growth on MAC	+	+	–	–	+/–	+	+

Flagella

1, Polar monotrichous

>1, Polar tuft (>1 flagellum)

P, Peritrichous

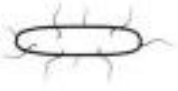


FIGURE 21-2, cont'd.

Gram Positive Cocci

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

Characteristic	Reaction/Description for: *Staphylococcus*	*Micrococcus* and Related Species[a]	*Macrococcus*
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.

TABLE 13-2 Phenotypic Characteristics for Presumptive Identification of Catalase-Negative, Gram-Positive Cocci

Genus	Gram Stain Morphology in Thioglycollate Broth	Hemolysis, SBA	Catalase	Growth, 10°C	Growth, 45°C	Motility	LAP	PYR	Growth, 6.5% NaCl Broth	Gas, MRS Broth	Vancomycin
Streptococcus	Chains	α, β, γ	–	–	V	–	+	–	V	–	S
Enterococcus	Pairs, chains	α, γ	–	+	+	V	+	+	+	–	S/R
Abiotrophia	Chains	α, γ	–	–	V	–	+	+	–	–	S
Granulicatella	Chains	α, γ	–	–	V	–	+	+	–	–	S
Aerococcus	Tetrads, clusters	α	–	–	–	–	V	V	+	–	S
Helcococcus	Tetrads, clusters	γ	–	–	–	–	–	+	+	–	S
Leuconostoc	Chains	α, γ	–	+	+	–	–	–	V	+	R
Weissella	Chains	α, γ	–	V	V	–	–	–	+	+	R
Pediococcus	Tetrads, clusters	α	–	–	+	–	+	–	V	–	R
Tetragenococcus	Tetrads, clusters	α	–	–	+	–	+	–	+	–	S
Gemella	Tetrads, clusters, chains	α, γ	–	–	–	–	V	+	–	–	S
Vagococcus	Chains	α, γ	–	+	–	+	+	+	+	–	S
Alloiococcus	Clusters, tetrads	α	+	–	–	–	+	+	+	–	S
Globicatella	Chains	α	–	–	–	–	–	+	+	–	S
Facklamia	Clusters, chains	α	–	–	–	–	+	+	+	–	S
Dolosigranulum	Clusters, tetrads	α	–	–	–	–	+	+	+	–	S
Ignavigranum	Clusters, chains	α	–	–	–	–	+	+	+	–	S
Dolosicoccus	Chains	α	–	–	–	–	–	+	–	–	S
Eremococcus	Chains	α	–	–	+	–	–	NA	+*	–	S
Catellicoccus	Pairs, short chains	γ	–	–	NA	–	+	–	NA	–	S
Lactococcus	Chains	α, γ	–	+	V	–	+	+	V	–	S

+, positive reaction; –, negative reaction; V, variable reaction; +*, weak-positive reaction; S, susceptible; R, resistant; NA, data not available; LAP, leucine aminopeptidase; PYR, pyrrolidonyl arylamidase; MRS broth, Mann-Sharpe-Rugosa broth.

Gram Positive Cocci
Staphylococci

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

Test	*S. aureus*	*S. epidermidis*	*S. saprophyticus*	*S. haemolyticus*	*S. warneri*	*S. hominis* subsp. *hominis*	*S. hominis* subsp. *novobiosepticus*	*S. lugdunensis*	*S. schleiferi* subsp. *schleiferi*
Clumping factor	+	–	–	–	–	–	–	+[s]	+
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	–	–	–	–
MANN	+	+[d]	–	–	–	–	–	+	+
TREH	+	–	+	+	+	V	–	+	V

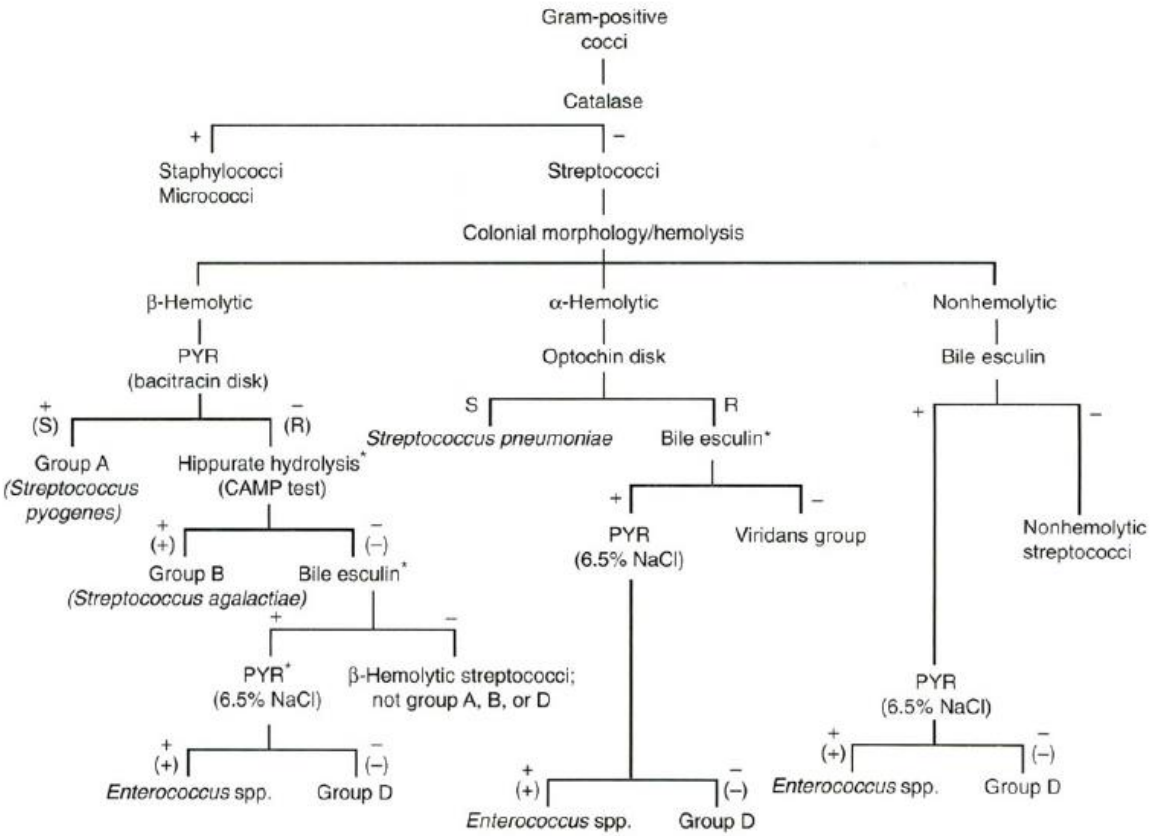
+, positive reaction; –, negative reaction; +[s], slow or delayed positive reaction; V, variable reaction; V–, variable reaction, most strains negative; S, susceptible; R, resistant; NA, data not available; PYR, Pyrrolidonyl arylamidase; ODC, Ornithine decarboxylase; URE, Urease; PAL, Alkaline phosphatase;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

Gram Positive Cocci
Streptococci & Enterococci

TABLE 13-3 Phenotypic Criteria for Presumptive Identification of Clinically Significant Streptococci and Enterococci

Organism	Hemolysis, SBA	LAP	Bacitracin	SXT	CAMP Test	HIPP	Growth, BE Agar	PYR	Growth, 6.5% NaCl Broth	Optochin	Bile Solubility
Group A *Streptococcus*	β	+	S	R	–	–	–	+	–	R	–
Group B *Streptococcus*	β, γ	+	R	R	+	+	–	–	V	R	–
Groups C, F, and G streptococci	β, γ	+	V	S	–	–	–	–	–	R	–
Group D *Enterococcus*	α, β, γ	+	R	R	–	V	+	+	+	R	–
Group D *Streptococcus*	α, γ	+	R	S	–	–	+	–	–	R	–
Viridans streptococci	α, γ	+	V	S	–	V	V	–	–	R	–
Pneumococcus	α	+	V	S	–	–	–	–	–	S	+

+, positive reaction; –, negative reaction; V, variable reaction; S, Susceptible; R, Resistant; LAP, leucine aminopeptidase; SXT, trimethoprim-sulfamethoxazole; HIPP, hippurate hydrolysis; BE agar, bile esculin agar; PYR, pyrrolidonyl arylamidase.



*Perform additional tests if isolate is from nonrespiratory source.

FIGURE 15-15 Schematic diagram for the presumptive identification of gram-positive cocci. S, Susceptible; R, resistant.

TABLE 15-5 Phenotype and Biochemical Characteristics of Enterococcal Species

Enterococcus Species	MOT	MAN	SOR	ARA	RAF	TEL	ARG	PYU	MGP
E. faecalis	–	+*	–	–	–	+	+*	+	–
E. faecium	–	+*	–	+	V	–	+	–	–
E. durans	–	–	–	–	–	–	+	–	–
E. avium	–	+	+	+	–	–	–	+	+
E. casseliflavus	+*	+	–	+	+	–*	+*	V	+
E. gallinarum	+*	+*	–	+	+	–	+*	–	+
E. raffinosus	–	+	+	+	+	–	–	+	+

Data from Teixeira LM et al: *Enterococcus*. In Murray PR et al, editors: *Manual of clinical microbiology*, ed 9, Washington, DC, 2007, ASM Press.
MOT, Motility; *MAN*, mannitol; *SOR*, sorbose; *ARA*, arabinose; *RAF*, raffinose; *TEL*, tellurite; *ARG*, arginine; *PYU*, pyruvate; *MGP*, methyl α-D-glucopyranoside; +, positive test; –, negative test; *v*, variable test.
*Occasional exceptions occur.

TABLE 13-10 Phenotypic Characteristics for Identification of *Enterococcus* and Related Species

Group/Species	Group D Antigen	Growth, BE Agar	Growth, 6.5% NaCl	Growth, 10°C	Growth 45°C	LAP	PYR	MOT	YELLOW PIGM	ADH	HIP	Acid Produced From: GLU	MNTL	SOR	ARAB	SBTL	RAFF	SUC	PYRV	MGP
Group I																				
E. avium	+	+	+	NA	+	+	+	−	−	−	V	+	+	+	+	+	−	+	+	V
E. gilvus	+	+	+	+	+	+	+	−	+	−	−	+	+	+	−	+	+	+	+	−
E. malodoratus	+	+	+	NA	−	+	+	−	−	−	V	+	+	+	−	+	+	+	+	V
E. pallens	+	+	+	+	+	+	−	−	+	−	+	+	+	+	+	+	+	+	+	−
E. pseudoavium	−	+	−	+	+	+	+	−	−	−	+	+	+	+	−	+	−	+	+	+
E. raffinosus	+	+	+	+	+	+	+	−	−	−	−	+	+	+	+	+	+	+	+	V
E. saccharolyticus	−	NA	+	NA	NA	+	−	−	−	−	−	+	+	+	−	+	+	+	−	+
E. hawaiiensis	−	−	+	+	−	+[w]	−	−	−	−	−	+	+	+	−	+	−	−	+	−
E. devriesei	NA	+	+	+	−	V	V	−	−	−	NA	+	+	V	V	V	+[w]	+	NA	−
Group II																				
E. faecalis	+	+	+	+	+	+	+	−	−	+	+	+	+	−	−	+	−	+	+	−
E. faecium	+	+	+	+	+	+	+	−	−	+	−	+	+	−	+	V	V	+	−	−
E. casseliflavus	+	+	+	NA	+	+	+	+	+	+	−	+	+	−	+	V	+	+	V	+
E. gallinarum	+	+	+	+	+	+	+	+	−	+	+	+	+	−	+	−	+	+	−	+
E. mundtii	+	+	+	+	+	+	+	−	+	+	−	+	+	−	+	V	+	+	−	−
E. haemoperoxidus	+	+	+	+	−	+	+	−	+[w]	+	+	+	+	−	−	−	−	−	+	−	+
E. silesiacus	NA	+	+[w]	+	−	+	+	−	−	+	−	+	−	−	−	−	−	−	NA	−
E. termitis	NA	+	+	+	+	+	−	−	−	−	−	+	−	−	−	−	−	−	NA	+
E. camelliae	NA	NA	−	+	+	NA	NA	−	−	−	NA	+	+	−	−	−	−	+	NA	−
E. thailandicus	NA	NA	+	+	+	NA	NA	−	−	+	NA	+	+	−	−	−	−	+	NA	−
Lactococcus spp.	−							−	−	+	V	+	+	−	−	−	−	V	−	−
Group III																				
E. dispar	−	+	+	+	−	+	+	−	−	+	V	+	−	−	−	−	+	+	+	+
E. durans	+	+	+	NA	+	+	+	−	−	+	V	+	−	−	−	−	−	−	−	−
E. hirae	+	+	+	+	+	+	+	−	−	+	−	+	−	−	−	−	+	+	−	−
E. ratti	+[w]	+	+	+	+	+	+	−	−	+	V	+	−	−	−	−	−	−	−	−
E. villorum	+	+	+	+	+	+	+	−	−	+	−	+	−	−	−	−	−	−	−	−
E. canintestini	−	+	+	−	+	V	Y	−	−	+	−	+	−	−	−	−	−	−	NA	+
Group IV																				
E. asini	+	+	−	V	V	+	+	−	−	−	+	+	−	−	−	−	−	−	−	V
E. cecorum	−	NA	−	−	+	+	−	−	−	−	−	+	−	−	−	+	+	+	+	−
E. sulfureus	−	+	+	+	−	+	+	−	+	−	−	+	−	−	−	−	+	+	−	+
E. phoeniculicola	NA	−	−	−	−	NA	NA	−	−	−	−	+	−	−	−	−	−	+	+	+
E. saccae	+	+	+	+	+	+	+	−	−	−	−	+	−	−	−	−	−	+	+	+
E. aquamarinus	NA	+	+	+	+	NA	+	−	−	−	−	+	−	−	+	−	+	+	NA	−
Group V																				
E. columbae	−	+	−	−	NA	+	−	−	−	−	−	+	+	−	+	+	+	+	+	−
E. canis	NA	+	+	NA	NA	+	+	−	−	−	−	+	+	−	+	−	−	V	+	+
E. moraviensis	+	+	+	+	−	+	Y	−	−	−	+	+	+	−	+	−	−	+	+	+
E. hermanniensis	−	+	V	+	−	+	+	−	−	−	−	+	+	−	−	−	−	−	NA	NA
E. italicus	+	+	+	+	+	+	+	−	−	−	−	+	−	−	−	−	−	+	+	+
Vagococcus spp.	−	NA	+	+	−	+	+	+	−	V−	−	+	+	−	−	+	−	+	−	+
New Species																				
E. rivorum	Y	+	−	+[w]	−	NA	NA	−	−	V	−	+	+	−	−	+	−	+	NA	+
E. ureilyticus (urease +)	+	+	+	+	−	+	+	−	+	−	+	+	−	+	−	−	−	+	NA	−
E. rotai (urease +)	+	+	+	+	−	+	+	−	+	−	+	+	−	−	−	−	−	+	NA	−
E. oroaviticus (urease +)	NA	+	−	NA	+	+	+	−	−	−	+	+	Y	NA	−	−	−	+	NA	+
E. quebecensis	NA	+	−	NA	−	+	+	−	−	−	+	+	+	NA	−	−	−	+	NA	+
E. plantarum (catalase +, urease +)	+	+	+	+	+	+	+	−	+	−	+	+	−	−	−	−	−	+	NA	−
E. lactis	NA	+	+	+	+	+	+	−	−	+	−	+	+	−	V	−	−	−	NA	−
E. lemanii	−	+	+	+	+	+	+	−	−	−	−	+	+	NA	+	−	+	+	NA	+
E. aumkensis	−	+	+	+[w]	+	+	+	−	−	−	−	+	−	NA	−	−	+	+	NA	NA
E. alcedinis	−	+	−	−	−	+	+	−	−	−	−	+	+	−	−	−	−	+	NA	−

+, positive reaction; −, negative reaction; V, variable reaction; +[w], weak positive; NA, data not available; BE agar, bile esculin agar; LAP, leucine aminopeptidase; PYR, pyrrolidonyl arylamidase; MOT, motility; PIGM, pigment; ADH, arginine dihydrolase; HIP, hippurate hydrolysis; GLU, glucose; MNTL, mannitol; SOR, sorbose; ARAB, arabinose; SBTL, sorbitol; RAFF, raffinose; SUC, sucrose; PYRV, pyruvate; MGP, methyl-α-D-glucopyranoside.

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