THE TAXONOMY AND NOMENCLATURE OF THE GENUS
AEROMONAS KLUYVER AND VAN NIEL 1936

Part II. Suggestions on the taxonomy and nomenclature
of the anaerogenic aeromonads

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SUMMARY. Three anaerogenic subspecies are
recognized in the genus Aeromonas:

Aeromonas punctata subsp. caviae (Scherago 1936)
Schubert 1964b,

Aeromonas hydrophila subsp. anaerogenes Schubert
1964b, and

Aeromonas salmonicida subsp. achromogenes (Smith
1963) comb. nov.

Descriptions of these three subspecies are
given. Each of the earlier descriptions of
anaerogenic species assumed to be related to
the genus Aeromonas is critically analysed.

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INTRODUCTION

Anaerogenic aeromonads are not listed in the genus Aeromonas prepared by S. F. Sniezko in Bergey's Manual (7th Ed.). Morphological and biochemical investigations of strains designated as Pseudomonas formicans Crawford (1954), P. caviae Scherago (1936, 1937). Aeromonas douglesi Leclerc (1951) and numerous recently isolated anaerogenic aeromonads led to the proposal of two taxa: Aeromonas hydrophila subsp. anaerogenes and A. punctata subsp. caviae (Schubert 1964a, 1964b). The morphological and biochemical properties of a third taxon of anaerogenic strains were described by Smith (1963) under the designation Necromonas achromogenes. These three taxa have many characteristics in common with the analogous aerogenic Aeromonas species. Therefore they should be regarded as anaerogenic subspecies of the aerogenic species Aeromonas punctata,

A. hydrophila and A. salmonicida, respectively. The anaerogenic A. punctata subsp. caviae differs from the anaerogenic subspecies A. hydrophila subsp. anaerogenes by its ability to produce acetoin from glucose and to dehydrogenate meso-2,3-butanediol to acetoin and diacetyl. A. salmonicida subsp. achromogenes can easily be distinguished from the other anaerogenic subspecies by its low minimum growth temperature.

In the table a description is given of the subspecies A. hydrophila subsp. anaerogenes, A. punctata subsp. caviae, and A. salmonicida subsp. achromogenes.

An analysis of the subspecies descriptions, essential for the determination of nomenclatural priority, will be found at the end of this paper.

DISCUSSION

The suggestions on the nomenclature and taxonomy of anaerogenic aeromonads are based on the following facts:

As far as is known the first effectively published description of an anaerogenic Aeromonas strain was that published by Scherago (1936, 1937); he named the species Pseudomonas caviae.

Scherago gave a precise description of P. caviae; from his description it is concluded that the strain undoubtedly is a Voges-Proskauer-negative anaerogenic Aeromonas strain. This statement is affirmed by investigations of Liu (1962). The strain showed a negative 2,3-butanediol dehydrogenase reaction (Schubert 1964b). For this reason P. caviae is considered to represent an anaerogenic subspecies of Aeromonas punctata; thus it was transferred to the genus Aeromonas under the name A. punctata subsp. caviae (Scherago 1936) Schubert 1964b.

Pseudomonas formicans Crawford (1954) was transferred to the genus Aeromonas as A. formicans by Eddy (1961); according to a later suggestion by Eddy (1962) and the author's investigations (Schubert 1964b), this species is identical with P. caviae. For this reason the specific epithet "formicans" is a later synonym of "caviae" and therefore illegitimate according to Principle 9, Rule 24b of the International Code of Nomenclature of Bacteria (1966). Prior to 1964 no validly published name had been given for the 2,3-butanediol dehydrogenase-positive and partly Voges-Proskauer-positive aeromonads; thus it was suggested to recognize them as an anaerogenic subspecies of A. hydrophila and

Characteristic or test	I		II	
	<i>Aeromonas hydrophila</i> subsp. <i>anaerogenae</i> (type strain: AFCC 15467)	<i>Aeromonas punctata</i> subsp. <i>caviae</i> (type strain: AFCC 15468)	<i>Aeromonas salmonicida</i> subsp. <i>salmonicida</i> (type strain: NCTC 1102)	III
Morphology	Rods, 0.6 - 1.0 by 1.0 - 4.4 μ single and in chains	Same as I except, 0.6-1.0 by 1.4-4.3 μ	Rods, length less than twice width, round ended, evenly stained coccobacilli. Occur in pairs, chains and clumps in nutrient broth.	
Motility	Motile with a single polar flagellum	Same as I	Nonmotile	
Gram reaction	Negative	Negative	Negative	
Agar colonies	Whitish, raised, moist, stippled	Same as I		
Agar slant	Thin, whitish, glossy spreading becoming yellowish and opaque	Same as I		
Yeastrel				
Agar				
Trypticase-	No water-soluble brown pigment	Same as I	Raised, round, entire, greyish yellow, translucent, friable colonies; no pigment	
Yeastrel Agar	Produced	Same as I	No pigment (negative); test for <i>Bacterium</i> <i>salmonicida</i> . See Griffin et al. (1953)	
Nutrient	Turbid, with heavy pellicle	Same as I	Clear to slight turbidity; flocculent growth with deposit and ring	
Broth				
Growth on	Yellowish brown, moist,	Same as I		
Potato	slightly raised			
Blood agar	Colonies 2 to 3 mm. in diameter, Same as I			
(horse and sheep)	round, entire, raised, smooth,			
colonies	moist, semi-translucent, greyish white. After 3-5 days at room temperature colonies are dirty brown-yellow			
Hemolysis	Host strains show marked hemoly- sis. Few strains no hemolysis	Only some strains show hemolysis	No hemolysis	
(Blood agar)				
Gelatin	Small, circular, grey, trans- lucent, stippled	Same as I		
Gelatin stab	Lucent, stippled	Same as I	No growth	
Casein	Diffuse liquefaction	Same as I	Same as I	
Loeffler's	Digested	Same as I	No digestion	
serum	Abundant growth, digestion	Same as I		
Litmus milk	slow; aberrant strains occur	Same as I	Proteolysis	
Starch	Acid; coagulated; peptonized	Same as I	Same as I	
Phosphatase	Hydrolyzed	Same as I	Negative	
Lipase	Positive	Same as I		
Egg yolk reaction	Positive	Same as I		
(lecithinase)	Produced	Same as I	Not produced	
Indol				

Characteristic or Test	I (Cont.)	II (Cont.)	III (Cont.)
Nitrates	Ammonia and nitrites produced	Same as I	Nitrites produced
Nitrogen sources	Ammonium sulfide, uric acid and asparagine	Same as I	
Urea	Not hydrolyzed	Same as I	Same as I
Sodium malonate	Not utilized	Same as I	Same as I
Growth on ammonium	Positive, aberrant strains occur	Positive	
Glucose			
Sodium citrate	Most strains utilize sodium citrate as sole carbon source	Same as I	Not utilized as sole source of carbon
Growth on H ₂ - Jer's KCN medium	Positive, aberrant strains occur	Same as I	
H ₂ S in Kligler's medium	Not produced	Same as I	Same as I
H ₂ S in peptone water	Produced	Same as I	
Methylene blue	Reduced	Same as I	
Catalase	Positive	Same as I	
Cytochrome oxid-	Positive	Same as I	
ase reaction			
Oxidase reaction	Positive	Same as I	Same as I
Arginine dehydro-	Positive	Same as I	
genase reaction			
Ornithine	Negative	Same as I	
decarboxylase			
Glutamic acid	Negative	Same as I	
decarboxylase			
Lysine decar-	Negative	Same as I	
boxylase reac-			
tion			
Phenylalanine desaminase	Different reactions, some strains weakly positive	Same as I	Negative
Starch	Acid but no gas	Same as I	Same as I
Dextrin	Acid but no gas	Same as I	Same as I
Glycogen	Acid but no gas	Same as I	Same as I
Maltose	Acid but no gas	Same as I	Same as I
Trehalose	Acid but no gas	Same as I	Same as I
Glucose	Acid but no gas	Same as I	Same as I
Glycerol	Acid but no gas	Different reactions*	Same as I
Galactose	Acid but no gas	Same as I	Same as I
Mannitol	Acid but no gas	Same as I	Same as I
Fluctose	Acid but no gas	Same as I	

Characteristic or Test	I (Cont.)	II (Cont.)	III (Cont.)
Sucrose	Acid but no gas	Same as I	Same as I
Arabinose	Acid but no gas	Same as I	Not attacked
Asculin	Different reactions*	Acid but no gas	
Raffinose	Different reactions*	Different reactions*	Not attacked
Lactose	Different reactions*	Different reactions*	Not attacked
Mannose	Different reactions*	Different reactions*	
Cellobiose	Different reactions*	Different reactions*	Not attacked
Salin	Different reactions*	Different reactions*	Not attacked
Sorbitol	Different reactions*	Not attacked	Not attacked
Inulin	Not attacked	Same as I	Not attacked
Melzitose	Not attacked	Same as I	
Rhamnose	Not attacked	Same as I	Not attacked
Xylose	Not attacked	Same as I	Not attacked
Inositol	Not attacked	Same as I	Not attacked
Dulcitol	Not attacked	Same as I	
Adonitol	Not attacked	Same as I	Not attacked
Amygdalin			
Methyl Red	Different reactions*	Same as I	Not attacked
Acetoin from Glucose	Produced in small amounts by most strains	Not produced	Not produced
Voges-Proskauer	Some strains positive	Negative reaction	Negative reaction
2,3 butanediol	Produced in small amounts by most strains	Not produced	Not produced
2,3 butanediol dehydrogenase	Positive reaction	Negative reaction	
Oxygen require- ment	Aerobic facultative	Same as I	Same as I
Optimum growth temperature	30° C	30° C	Growth at 5° C and 22° C
Growth at 37° C	Good growth	Same as I	No growth
Growth above 41° C	No growth		
Source	Oil emulsion	Septicemia causing death in guinea pigs	Fish of family Salmonidae
Habitat	Surface water	Same as I	Unknown

* The reaction may be different from strain to strain, but is reproducible in a given strain.

to name them A. hydrophila subsp. anaerogenes Schubert 1964b. The reasons for classifying the "dourges" strains with the species A. hydrophila have been discussed previously (Schubert 1967).

The name Necromonas achromogenes was given by Smith (1963). The description of the species corresponds in its essential morphological and biochemical characteristics to the species Aeromonas salmonicida and differs only in a few properties, e.g., the inability to produce pigment and the inability to produce gas from glucose. Therefore it is proposed to transfer Necromonas achromogenes Smith (1963) to the genus Aeromonas as a subspecies of Aeromonas salmonicida with the name Aeromonas salmonicida subsp. achromogenes (Smith) comb. nov.

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