THE TAXONOMIC STATUS OF
SERRATIA MARCESCENS BIZIO

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SUMMARY: 1. In our work we have studied morphological, cultural and biochemical characteristics of 68 strains of *Serratia marcescens*. 2. We propose that the genus *Serratia* may have only one species. 3. We propose to acknowledge strain BS 303 (ATCC 13880) as the neotype culture of *Serratia marcescens* Bizio.

The oldest known species of the genus *Serratia* is *Serratia marcescens*. It was named as early as 1823 and since this time both its nomenclature and its taxonomy have undergone many changes. Recognition of this species as the type species of the genus *Serratia* was proposed by Buchanan (1918). It is so recognized in all seven editions of the Bergey's Manual.

The taxonomy of *Serratia marcescens* has been investigated by Breed *et al.* (1924, 1927), Topley and Wilson (1931) and Krassilnikov (1949). The two latter authors place this species in the genus *Chromobacterium* as *Chromobacterium prodigiosum*. But the name *Chromobacterium prodigiosum* is very little used. Much new information concerning the biochemical and antigenic structure of *Serratia marcescens* has been published by Davis, Ewing and Reavis (1957).

MATERIAL AND METHODS

We have studied 68 strains secured from several collections under the label *Serratia marcescens*. The list of strains is given in Table 1. The methods used were those described in our previous work (Martinec and Kocur, 1960). The staining of flagella was made by Zettnow's method (Kabelík 1925).

Table 1.

No. of strains	Source of strains
301, 302, 303, 304, 813	Own isolates
731, 545, 544	
147, 264	Institut of Plant Production, Prague
151	Institut of Epidemiology and Microbiology, Prague
766-798 (33 strains)	Prof. E. Steinhaus, Univ. of California, Berkeley
400, 412, 414, 420, 454	
455	Culture Coll. of Entomogenous Bacteria, Prague
849	C. B. van Niel, Stanford Univ. Pacific Grove, California
772	Dept. of Agriculture, Ottawa, Canada
361	Epid. and Hygiene Station, Brno
375	Department of Microbiol. Hradec Králové
376, 377	E. Eltinge, Mont Holl. Coll. Massachusettes, U.S.A.
522	Dept. of Microbiology, Charles Univ. Prague
535	Inst. of Biology, Czech. Acad. Sci. Prague
548	Inst. of Microbiology, Univ. of Tucuman
549, 580	Dept. of Bact. Indiana Univ. Bloomington
619	B. Hampl. Dept. of Biol. Sciences, Prague
620	Dept. of Bact. Univ. of Queensland, Australia
689	Inst. of Fermentation, Sao Paulo, Brazil
696, 697	Dept. of Microbiol., Tech. School, Bratislava
761	W. C. Haynes, NRRL, Peoria, Illinois

BACTERIOLOGICAL NOMENCLATURE
AND TAXONOMY

RESULTS

Morphology. The cells of all 68 strains of Serratia marcescens studied are small Gram-negative rods occurring individually or in groups. Their size varied from 0.8-1.0 x 1.5-2 μ . All the strains have motile cells.

Cultural characteristics. The colonies on nutrient agar are circular, 6-7 mm in diameter, with slight undulate margins, slightly convex, smooth. Red pigment was produced by most strains. In nutrient broth all the strains developed intense turbidity and formed slight sediment. Some strains formed red rings.

Cultural and physiological characteristics. The results of the study of biochemical characteristics of 68 strains of Serratia marcescens are given in Table 2.

DISCUSSION

Our study of 68 strains of Serratia marcescens brought many interesting notions. As it can be seen from the tabular summary No. 2, some strains showed different biochemical features. The most important variants here were: Strain 780 alone did not hydrolyze casein; strains 548 and 619 did not reduce nitrates; strains 303, 304, 772 and 787 showed positive hemolysis. It is interesting that the majority of these anomalies was observed in strains isolated from different species of insects (e.g. strains 780, 772, 787).

Relatively great variability of some strains was observed during the fermentation of carbohydrates. This problem was not met only by us but also by Davis et al. (1957). Also the differences in pigmentation are not surprising. On normal media and on media for pigmentation only 55 strains pigmented at normal cultivating temperatures. Out of these 55 strains only 15 pigmented at 37°C; 13 strains did not produce pigment at all.

The results obtained by us are essentially the same as those given in Bergey's Manual (1957), in Krassilnikov's Key (1949) and agree with the data stated by Davis et al. (1957).

We do not agree, however, with Krassilnikov's ascription of S. marcescens to the genus Chromobacterium solely on the basis of its ability to produce pigment. We believe that there are insufficient grounds for shifting this species to a very different genus. As we have ascertained, Serratia

Table 2. Results of biochemical tests with 68 strains of
Serratia marcescens

Test	Number positive	Number negative
Gelatin liquefaction	68	0
Casein hydrolysis	67	1
Nitrate reduction	66	2
Hydrogen sulfide I.	67	1
Hydrogen sulfide II.	0	68
Indole	0	68
Milk	68	0
Hemolysis	4	64
Glucose	68	0
Gas from glucose	43	25
Lactose	2	66
Sucrose	68	0
Maltose	63	5
Galactose	64	4
Fructose	67	1
Rhamnose	0	68
Mannose	66	2
Inulin	0	68
Xylose	6	62
Arabinose	0	68
Glycerol	66	2
Adonitol	64	4
Sorbitol	67	1
Mannitol	68	0
Dulcitol	0	68
Starch	0	68
Esculin	68	0
Koser's citrate	67	1
Simmon's citrate	66	2
Acetylmethylcarbinol	66	2
Methyl red	0	68
KCN	68	0
Phenylalanin	0	68
Catalase	68	0
Urease	0	68
Lipase	67	1
5% NaCl	68	0
7.5% NaCl	47	21
Pigment	55	13

Hydrogen sulfide I. = lead acetate papers

Hydrogen sulfide II. = modified Klinger's agar

marcescens differs from the representatives of the genus Chromobacterium not only morphologically, but especially biochemically and in the chemical structure of its pigment.

Since 1823 when the species was first described, authors have described and named other new species. These new species were classified unsatisfactorily. In 1957 Davis et al. (1957) concluded that the genus Serratia is monotypic, including only one species.

We have devoted much study to this problem and have substantiated the findings of Davis et al. (1957) (Martinec and Kocur, 1960).

Owing to the fact that there exists no culture of the original strain of Serratia marcescens, we propose the approval of our strain 303 as a neotype culture. The description of proposed neotype of Serratia marcescens:

Serratia marcescens Bizio (strain BS 303, ATCC 13880)

Small Gram negative rods, occurring individually or in groups. The size of cells was $0.8 \times 1.8\mu$. Motile by four lateral flagella.

Agar colonies (2 days): Circular with slight undulate margin, 4-6 mm in diameter, slight convex, smooth, produce red pigment.

Gelatin colonies (5 days): Circular, smooth sinking in 2-3 days in gelatin, white.

Agar slant (1 day): Smooth, white, taking on an orange-red to carmin red colour in 4-5 days.

Broth (1 day): Intense turbid and gray sediment.

Potato (2 days): Luxuriant growth, smooth, first white, later red colour.

Peptone water with carbohydrates: Acid but no gas formed from glucose, saccharose, maltose, galactose, mannitol, sorbitol, glycerol, mannose and adonitol. Not attacked by lactose, dulcitol, arabinose, rhamnose, xylose, inulin.

Milk (2 days): Alkaline, coagulation and peptonization.

Indole: -; H_2S : -; VP: +; MR: -; nitrate +; catalase +; urease -; lipase +; KCN +; phenylalanine -; Simmons' citrate +; Koser's citrate +; hydrolysis of gelatin +; casein +; hydrolysis of starch -; esculin +; hemolysis +.

Salt tolerance: Nutrient agar with 5% NaCl +; 7.5% NaCl +; 10% NaCl -.

Aerobic.

Optimum temperature 30°C, minimum 10°C, maximum 37°C.

Optimum pH 6.8, minimum 4.4, maximum 9.2.

Habitat: Isolated from pond water.

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