Streptococcus sobrinus nom. rev. and *Streptococcus ferus* nom. rev.: Habitat of These and Other Mutans Streptococci

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Streptococcus sobrinus and *Streptococcus ferus* were not included on the Approved List of Bacterial Names in 1980. Type strains of these species are now available, and I propose that they be recognized. The available evidence indicates that *S. ferus* is a commensal of wild rats and that *S. sobrinus* and the other mutans streptococci (except *S. ferus*) are human commensals.

The members of the mutans group of streptococci were described in 1977 (6). Although the five species in this group are remarkably similar in overall biochemical and ecological characteristics (12, 25), their nucleic acid base contents (3, 11) and base sequences (5, 7) are too disparate to regard these streptococci as a single species. Three species in this group appear on the Approved Lists of Bacterial Names (28). These are *Streptococcus mutans*, *Streptococcus rattus*, and *Streptococcus cricetus*. Two species, *Streptococcus sobrinus* and *Streptococcus ferus*, were not accepted as approved species, probably because type strains were not available from recognized type culture collections. As a result, *S. ferus* and *S. sobrinus* currently have no standing in taxonomy.

Type strains of *S. ferus* and *S. sobrinus* are now available from the American Type Culture Collection, and I propose that *S. ferus* and *S. sobrinus* be added to the Approved Lists as revived species according to Rule 28A of the *International Code of Nomenclature of Bacteria* (23).

***Streptococcus sobrinus* nom. rev. (i) Description.** *S. sobrinus* (basonym, *S. mutans* subsp. *sobrinus* Coykendall [5]; so.bri'nus., L. masc. n. *sobrinus* male cousin on mother's side, referring to the distant relationship between this species and *S. mutans*) cells are gram-positive cocci 0.5 μ m in diameter that occur in pairs and chains, which are often long. Mannitol and sorbitol are fermented; raffinose and melibiose are not. An adhesive glucan is produced from sucrose. Growth is enhanced in an atmosphere containing a reduced oxygen content. Ammonia is not produced from arginine. Colonies on agar containing sucrose are about 1 mm in diameter, rough, and heaped and often have droplets of liquid (containing glucan) at the top or the border. Hydrogen peroxide is produced. The deoxyribonucleic acid (DNA) base content is 44 to 46 mol% guanine plus cytosine (G+C).

(ii) Type strain. Strain SL1 (= ATCC 33478) is the type strain (5). This strain was isolated from a human mouth and was first mentioned by Fitzgerald and Jordan (14), but was not described by them. Strain SL1^T (T = type strain) produces acid from mannitol and sorbitol, but not from raffinose or melibiose; it does not split arginine (5). Perch et al. (25) reported that strain SL1^T is alpha-hemolytic on horse blood agar, produces H₂O₂, and does not grow at 45°C. Its base content is 45.1 mol% G+C as determined by thermal denaturation (3) and 44.9 mol% G+C as determined by density in CsCl (11).

(iii) Additional comments. Electron micrographs of *S. sobrinus* strains K1R (8), 6715 (24), and OMZ176 (18) show cocci with an outer dendritic layer or fuzz, which has not been observed in *S. mutans*, *S. rattus*, or *S. cricetus*. Most *S. sobrinus* strains react with Bratthall antiserum *d* (1). Some strains do not give a strong antiserum *d* reaction, and these strains have been put into a separate serotype, designated serotype *g* by Perch et al. (25). Strain SL1^T does not react with either group *d* or group *g* antibody. *S. sobrinus* strains SL1, K1R, and OMZ176 (5), as well as strains 14H, O1, and 1C (7), share extensive common DNA base sequences. Some strains do not ferment sorbitol (5, 25), and strain 14H ferments neither sorbitol nor mannitol (7). *S. sobrinus* cells appear to be incapable of synthesizing or catabolizing significant amounts of intracellular polysaccharide (15). The habitat of *S. sobrinus* is the surface of human teeth (2, 25).

***Streptococcus ferus* nom. rev. (i) Description.** *S. ferus* (fer'us. L. adj. *ferus* wild, referring to the wild rats from which the organism was isolated) cells are gram-positive cocci 0.5 μ m in diameter that occur in pairs and chains. Mannitol and sorbitol are fermented; raffinose is not. An adhesive glucan is produced from sucrose. This species is intolerant of 45°C or 6.5% NaCl. Ammonia is not produced from arginine. Colonies on

agar containing sucrose are about 1 mm in diameter, raised, and somewhat adherent, with no liquid on or around the colony. The final pH in 1% glucose broth is 4.2 to 4.5. The DNA base content is 43 to 45 mol% G+C (9).

(ii) **Type strain.** The type strain is strain 8S1 (9) (= ATCC 33477), which conforms to the description given above.

(iii) **Additional comments.** *S. ferus* was isolated in Florida from the mouths of wild rats that ate sugarcane (9) and from rats living in a landfill dump in Hartford, Conn. (7). Strains from the two locales were homologous as determined by DNA hybridization (7). Strains of *S. ferus* react with Bratthall antiserum *c*, although they are not related (as determined by DNA homology) to *S. mutans* (7). *S. ferus* strains do not grow on agar containing bacitracin (0.2 U/ml). The cells produce and catabolize intracellular polysaccharide (15). *S. ferus* has not been isolated from humans.

Despite their many similarities, the five mutans streptococcal species can be readily identified by biochemical or serological differences (1, 5, 6, 25) (Table 1). It is interesting that some authors, although expressing reservations about the taxonomic separation of *S. mutans*, nevertheless point out the biochemical, serological, and genetic heterogeneity of *S. mutans* and remark on the good correlation among serotypes, biotypes, and genotypes (16, 20, 25). That such clearly separable and genetically different organisms should all be called *S. mutans* seems unwarranted in light of modern taxonomic objectives (6).

Habitats of the mutans streptococci. There is also considerable confusion about the origins and natural habitats of the various mutans streptococcal species. Because *S. cricetus* and *S. rattus* are not common in humans, it has been

suggested that the natural habitats of these organisms are animals (19). Conversely, it has been suggested that *S. ferus*, which was found in wild rats, was transmitted to rats by humans (26).

Although *S. cricetus* was originally isolated from a laboratory hamster, it is very likely that laboratory animals carry human commensals, especially if they are fed sucrose diets. Since the oral flora of wild hamsters is unknown and since *S. cricetus* has been found in humans in various geographic areas (2, 22, 25), it seems reasonable to think of this species as a human commensal.

The case of *S. rattus* is similar. This organism was originally isolated from a laboratory rat, and it is likely that the organism was acquired from humans. Although this species is rare in humans, it has been found in scattered populations around the world (2, 17, 22). Moreover, wild rats examined in Florida and Connecticut did not harbor *S. rattus*. It was in these rats that *S. ferus* was discovered (9). Since *S. ferus* has not been reported in humans, it is unlikely that these rats acquired *S. ferus* from humans, as has been speculated (26).

The available evidence from zoo animals indicates that mutans streptococci are not common among animals (10). Although Dvarskas and Coykendall (J. Dent. Res. 54(Special Issue A):127, 1975) stated that "'*S. mutans*' was more widespread than expected," the statement referred to the fact that the wild rat strains (now *S. ferus*) of Florida were also found in Connecticut rats that scavenged a low-sucrose diet, and these authors would agree with Dent et al. (10) that except for *S. ferus* in rats, the mutans streptococci are not widely distributed in animals. Thus, it seems reasonable to regard *S. cricetus* and *S. rattus*, in addition to *S. mutans* and *S. sobrinus*, as human oral organisms.

TABLE 1. Differentiating characteristics of the members of the mutans group of streptococci^a

Species	G+C content of DNA (mol%) ^b	Serological reaction(s) ^c	Cell wall carbohydrates ^d	Biochemical characteristics useful in identification
<i>S. mutans</i>	36–38	<i>c, e, f</i>	Glucose, rhamnose	
<i>S. rattus</i>	41–43	<i>b</i>	Galactose, rhamnose	Produces ammonia from arginine; grows at 45°C
<i>S. cricetus</i>	42–44	<i>a</i>	Glucose, galactose, rhamnose	Susceptible to bacitracin ^e
<i>S. sobrinus</i>	44–46	<i>d, g</i>	Glucose, galactose, rhamnose	Does not ferment raffinose; produces H ₂ O ₂ ^f
<i>S. ferus</i>	43–45	<i>c</i>	Not known	Does not ferment raffinose; susceptible to bacitracin

^a All species ferment glucose, fructose, sucrose, trehalose, mannitol, and sorbitol and produce glucans from sucrose. See reference 6 for descriptions of *S. mutans*, *S. rattus*, and *S. cricetus*. For the results of extensive biochemical tests see references 12, 13, and 25.

^b Data from references 3 and 11.

^c Data from reference 1.

^d Data from reference 21.

^e Data from reference 27.

^f Data from reference 25.

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