Placement of the Name *Peptococcus anaerobius* (Hamm) Douglas on the List of *Nomina rejicienda*

Request for an Opinion

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Peptococcus anaerobius (Hamm) Douglas was first described under the name *Staphylococcus anaerobius* by A. Hamm in 1912. A study of Hamm's publication indicates that the original characterization of this organism was based primarily on published reports of anaerobic staphylococci isolated by other authors, even though Hamm did mention the isolation of an anaerobic coccus. The currently accepted descriptions of this organism were not taken from the original publication by Hamm but from the description of *Staphylococcus anaerobius* by A. R. Prévot in 1933. Modern data and insight strongly suggest that the original description of *Staphylococcus anaerobius* Hamm was based on a very small number of generally variable and nondifferentiating characteristics of strains which very probably represented several species of anaerobic cocci. Provision 3 of the International Code of Nomenclature of Bacteria states that "... names applied to a group made up of two or more discordant elements, especially if these elements were erroneously supposed to form part of the same individual (*nomina confusa*) . . ." are to be placed on the list of *nomina rejicienda*. Therefore, it is requested that the Judicial Commission of the International Committee on Systematic Bacteriology issue an Opinion establishing the name *Peptococcus anaerobius* (Hamm) Douglas as a *nomen confusum* according to Provision 3 of the International Code of Nomenclature of Bacteria and placing it on the list of rejected names.

HISTORICAL BACKGROUND

Staphylococcus anaerobius Hamm (5) was first described in 1912. Hamm's description of *Staphylococcus anaerobius* is quite brief, and a translation from the German follows:

12. *Staphylococcus anaerobius*: I should like to combine here the obligately anaerobic, gram-positive staphylococci which have been described up to now only separately.

First the species described by Wegelius as No. 35: small, round cocci of somewhat varying size, without capsule, Gram-positive. Yellowish, moderately raised colonies visible generally only after forty-eight hours, diffusing a weakly fetid odor. Encountered in the vagina in five cases, also in the uterus in two cases. Isolated once by me from foul smelling pus of a Douglas abscess in a pure culture. Bondy reports to me personally about the finding of an anaerobic, gram-positive staphylococcus from the pus of a fatal peritonitis puerperalis after abortion.

Schottmüller mentions 'the not rare occurrence' of an obligately anaerobic hemophilic staphylococcus.

Hamm's description thus was based almost entirely on Wegelius' more detailed description of coccus No. 35. Apparently Hamm did not examine any of the strains isolated by Wegelius, Bondy, or Schottmüller. In addition, he did not present any of the characteristics of the organism he isolated from a human rectouterine abscess.

In 1907, Jungano (8) described strains of anaerobic staphylococci isolated from appendicitis, cystitis, and gangrenous infiltration of the perineum, but he failed to name the organism. Prévot isolated from an infected tonsil an organism which he believed to be the same as Jungano's anaerobic staphylococcus. He adopted the name *Staphylococcus anaerobius* from Hamm but based his description on Jungano's publication and on characteristics of

the strain he had isolated from tonsils (10). Prévot also did not examine any of the strains isolated by Jungano, Hamm, Wegelius, Bondy, or Schottmüller.

A comparison of these early descriptions of anaerobic staphylococci is given in Table 1. The colonial characteristics and the descriptions of growth in broth are summarized below.

Colonial characteristics. *Staphylococcus anaerobius* Hamm (5): yellowish, moderately raised colonies, emitting a slight fetid odor (surface colonies); no description of agar deep colonies.

Wegelius' anaerobic coccus No. 35 (16): 1 mm, yellowish, round, elevated, smooth, with sinuate edge (surface colonies); 1 to 1.5 mm (8 to 10 days), trifoliate, but also lenticular, yellow, and often almost white (agar deep).

Jungano's anaerobic staphylococcus (8): large, round, biconvex with dark center and clear periphery (agar deep); no description of surface colonies.

Staphylococcus anaerobius (Jungano) Hamm as described by Prévot (10): lenticular (agar deep); no description of surface colonies.

Growth in broth. *Staphylococcus anaerobius* Hamm (5): not described.

Wegelius' anaerobic coccus No. 35 (16): slightly turbid with powder-like precipitate at the bottom and along the sides of the tube.

Jungano's anaerobic staphylococcus (8): growth was evident after 36 h; flakes which soon sedimented to the bottom of the tube formed in the broth, and after 5 days the broth became clear.

Staphylococcus anaerobius (Jungano) Hamm as described by Prévot (10): turbid at first, with formation of granules which are slowly deposited on the bottom of the tubes, leaving the broth clear.

DISCUSSION

In Hamm's (5) brief description of *Staphylococcus anaerobius*, he stated: "Hier möchte ich die bisher ganz vereinzelt beschriebenen obligat anaeroben, grampositiven Staphylokokken zusammenfassen." Because of this statement, and because of Hamm's failure to obtain and examine any of these strains or present the characteristics of the strain he isolated, we feel that Hamm could very well have been combining similar, but different, species of anaerobic cocci.

The following discussion indicates that these strains are different and suggests the species with which they are identical. The strains of Jungano must be considered in this discussion since Jungano's (10) characterization is the original basis of recent descriptions (3, 11; M.

Rogosa, in Bergéy's *Manual of Determinative Bacteriology*, 8th ed., in press) of *Peptococcus anaerobius*. Since none of the strains isolated by Hamm, Wegelius, Jungano, Schottmüller, or Bondy exists today, comparisons can only be made by using the published descriptions.

Schottmüller's coccus. Hamm cited as the reference for the blood-requiring anaerobic staphylococcus the article, "Ueber bakteriologische Untersuchungen und ihre Methoden bei Febris puerperalis," published by Schottmüller (12) in April 1911. This article described a method for isolating anaerobic bacteria from cases of puerperal fever. Schottmüller stated that the addition of blood to the media was necessary for the isolation of an anaerobic staphylococcus. He gave no further description of this organism. In 1912, prior to Hamm's description of *Staphylococcus anaerobius*, Schottmüller (13) published the description of this blood-requiring organism, named it *Staphylococcus aerogenes*, and cited the 1911 article in his description of colony types of *Staphylococcus aerogenes*. He stated: "Die Kultur auf Blutagarplastilinplatte (München Med. Wochenshr., 1911., No. 15) lässt nach länger als 24-stündiger Bebrütungszeit (37°) einen Rasen dunkelgrauer Kolonien von verschiedener Grösse erkennen." Thus, the name *Staphylococcus aerogenes* Schottmüller would have precedence over *Staphylococcus anaerobius* Hamm if the organisms are the same.

Wegelius' coccus No. 35. Wegelius' coccus No. 35 could be *Peptococcus variabilis* as described by Foubert and Douglas (4) in 1948. Foubert and Douglas (4) stated that "... in contrast to the uniform cell size of *M. anaerobius* [*Staphylococcus anaerobius* Hamm] the cell diameter of each individual strain in this group varies from 0.5 to 1.0 or 1.5 microns, and cells of all sizes may be present in a single culture." Wegelius (16) reported that the diameter of coccus No. 35 is 0.5 to 0.8 μ m; for Wegelius' coccus No. 35, Heurlin (6) reported a diameter of 0.3 to 1.0 μ m, with the smaller size predominating. Wegelius (16) stated that the cocci he described did show variation in cell sizes within a single culture.

Micrococcus variabilis (4) was found to liquefy gelatin. Wegelius (16), however, did not study the gelatin-liquefying abilities of his coccus. Nonliquefaction of gelatin was a characteristic reported by Jungano and Distaso (9) in 1910 and accepted by Prévot in 1933 in his description of *Staphylococcus anaerobius*. *Peptococcus variabilis* was distinguished from *Peptococcus anaerobius* by varying cell sizes in a single culture and by gelatin liquefaction (3,

TABLE 1. *Characteristics of anaerobic staphylococci as described by Hamm, Wegelius, Bondy, Schottmüller, Jungano, and Prévot*

Characteristic	Hamm (5)	Wegelius (16)	Bondy (1)	Schottmüller (12)	Jungano (8)	Prévot (10)
Cellular morphology	Round, small, varying size	Small, round, ^b varying sizes, 0.5-0.8 µm diameter pairs and tetrads	Staphylo- coccus- like	Staphylo- coccus- like	Cocci, singly, or in groups of 2 or 3	Cocci in masses; 0.5-0.6 µm diameter
Capsule	—	—	NR	NR	NR	—
Flagella	NR	NR	NR	NR	NR	—
Spores	NR	NR	NR	NR	NR	—
Gram reaction	+	+	NR	NR	+	+
Acid-fast	NR	—	NR	NR	NR	NR
Anaerobic	+	+	+	+	+	+
Killed by heating	NR	15 min at 55 C	NR	NR	NR	10 min at 80 C, 30 min at 60 C
pH range	NR	NR	NR	NR	NR	6-8
Temp of growth	NR	28-37	NR	NR	22-37	22-38
Growth requirement	Blood	NR	NR	Blood	NR	NR
Viability	NR	2-3 weeks	NR	NR	NR	2 mo
Gas production	NR	Variable	NR	NR	—	—
Indole production	NR	NR	NR	NR	NR	—
Carbohydrate	NR	Weak in fructose and peptone	NR	NR	^c	^d
fermentation	NR	None	NR	NR	NR	None
Action on milk	NR	NR	NR	NR	NR	—
Gelatin digestion	NR	NR	NR	NR	NR	—
Pathogenic	NR	—	NR	NR	For guinea pig and rabbit	For guinea pig and rabbit
Toxin	NR	NR	NR	NR	NR	—
Hemolysin	NR	NR	NR	NR	NR	—
Source	Pus from a rectouterine abscess	Vagina, uterus	Afebrile puerperal infection, peritoneal pus	NR	Appendicitis, cystitis, gangrenous infiltration of perineum	Tonsillitis

^a Symbols: +, positive result; —, negative result; NR, result not reported.^b Wegelius (16) reported that, after cultivation, the variation in size no longer appears.^c Jungano, in a later publication with Distaso (9), reported that his anaerobic staphylococcus was unable to ferment sucrose, glucose, dextrin, and lactose.^d Prévot (10) reported that his strains weakly fermented glucose and galactose. He mentioned that Jungano's strains did not ferment carbohydrates.^e Jungano (8) first reported weak gelatin liquefaction; later he and Distaso (9) reported negative gelatin liquefaction.

4), but the name *Peptococcus variabilis* is considered synonymous with *Peptococcus anaerobius* by Rogosa (M. Rogosa, in press).

Wegelius (16) found that his coccus No. 35 produced acid from peptone and fructose. Occasionally a weak gas formation from fructose occurred. We have shown, by chromatographic analysis of fermentation products of several strains of *Peptococcus variabilis* (including the type strain, ATCC 14955), that this species is capable of fermenting fructose when 0.1% Tween 80 is present in the medium. The pH of the medium may not always be lowered. Results are shown in Table 2. Acetic acid is also produced from peptone-yeast extract medium, although not in as great a quantity as from fructose. Because of the varying cell sizes and the fermentation of fructose, we believe Wegelius' coccus No. 35 to be identical with *Peptococcus variabilis* (Foubert and Douglas) Douglas.

Jungano's anaerobic staphylococcus. In 1907, Jungano (8), while studying urinary infections in the laboratory of M. Metchnikoff at the Pasteur Institute, isolated and described an anaerobic staphylococcus. In 1910, Jungano and Distaso (9), who collaborated on the book *Les Anaérobies* while both were at the Pasteur Institute, further described Jungano's anaerobic

staphylococcus. In this publication, they reported that Distaso had isolated Jungano's anaerobic staphylococcus from fecal material. In 1912 Distaso (2), who had studied the bacterial flora of fecal material in Metchnikoff's laboratory, published his description of *Staphylococcus asaccharolyticus*.

The only discrepancy that Distaso found between his organism and Jungano's was cell size. However, neither author listed the exact size of his organism. Distaso simply stated that *Staphylococcus asaccharolyticus* was twice as large as Jungano's anaerobic staphylococcus. In 1933, Prévot (10), who had no strains of *Staphylococcus asaccharolyticus*, reported the cell size to be 1.0 to 1.2 μm . This value is twice the measurement of 0.5 to 0.6 μm which Prévot observed for his strain of *Staphylococcus anaerobius* isolated from tonsils. Prévot assumed from Distaso's description that the cells of *Staphylococcus asaccharolyticus* were twice as large as the cells of Jungano's anaerobic staphylococcus.

Table 3 gives the cell sizes of individual strains of *Staphylococcus asaccharolyticus* and *Staphylococcus anaerobius* isolated and identified by Prévot after 1933. The cell size measurements of these two species fall into overlapping ranges: 0.5 to 1.2 μm for *Staphylo-*

TABLE 2. Chromatographic analysis of volatile acid products of *Peptococcus variabilis* (Foubert and Douglas) Douglas^a

VPI no.	Source	pH		Acetate ^b	
		Fructose	PY ^c	Fructose	PY ^c
5662	ATCC 14955 Foubert type	5.60	6.45	5.30	2.05
5663	ATCC 14956 Foubert	5.75	6.60	3.65	1.75
5187	Prévot 1884 A	6.02	6.20	3.35	1.40
5467	Prévot 1469 B	5.95	6.19	4.40	1.25
5753	Prévot 295	6.11	6.40	4.36	3.70
		6.15	6.40	4.40	2.75
5885 A	5221336, Medical College of Virginia, Richmond	6.15	6.35	3.45	1.55
		6.12	6.15	3.65	1.85
6460 B	672, Corning Hospital, Corning, N.Y.	6.20	6.35	3.00	1.90
		6.15	6.20	3.65	2.45
7031	2565, Florida State Board of Health	5.51	6.51	6.10	1.20
		5.70	6.50	3.55	1.75
7096	TRW Hazelton Lab, Vienna, Va.	6.22	6.32	3.30	2.30
		6.20	6.15	3.70	3.20
7101	TRW Hazelton Lab, Vienna, Va.	5.70	6.12	4.25	1.05
7347	N-977-70 A, Emory University, Atlanta, Ga.	6.01	6.10	3.90	2.80
		6.10	6.35	3.65	2.35

^a Cultural and chromatographic procedures are as described in the Anaerobe Laboratory Manual, L. V. Holdeman and W. E. C. Moore (ed.), 1972, V.P.I. Anaerobe Laboratory, Virginia Polytechnic Institute and State University, Blacksburg, Virginia.

^b In meq per 100 ml culture.

^c Peptone-yeast extract medium.

coccus asaccharolyticus and 0.3 to 0.8 μ m for *Staphylococcus anaerobius*. One must conclude that cell size is a somewhat variable characteristic.

In the original description of *Staphylococcus asaccharolyticus*, Distaso (2) reported that the species produced indole and emitted a bad odor. Jungano did not mention whether or not his staphylococcus produced an odor. Neither Jungano nor any of the other authors describing strains similar to anaerobic staphylococci reported indole reactions. Since Distaso and Jungano worked together, Distaso might have tested Jungano's strains before he wrote that *Staphylococcus asaccharolyticus* "... s'approche par sa biologie de celui isolé par Jungano."

Jungano's descriptions (8, 9) of an anaerobic staphylococcus, however, are nearly identical with Tissier and Martelly's (15) and with Prévot's original description of *Diplococcus magnus* [*Peptostreptococcus magnus* (Prévot) Smith; *Peptococcus magnus* (Prévot) Moore and Holdeman (14)] except for cell size. Tissier and Martelly (15) reported that *Diplococcus magnus anaerobius*, which they isolated from putrefying butcher's meat, was difficult to distinguish in the meat from other cocci. However, in broth it appeared as a large coccus. Tissier and Martelly (15) failed to give an exact measurement of their organism. The size in micrometers was a characteristic added by Prévot (10) in 1933. Prévot did not study any of the strains isolated by Tissier and Martelly.

Descriptions of deep agar colonies of Jungano's coccus (8) and those of *Diplococcus magnus anaerobius* (Tissier and Martelly) appear to be identical. Tissier and Martelly (15) reported that the colonies were 1 to 2 mm in diameter with a granular surface and that they appeared to be formed of concentric circles with successively clearer zones and a dark center. Prévot's (10) description of *Diplococcus magnus* colonies is identical with that by Tissier and Martelly. Jungano (8) reported that the colonies of his anaerobic staphylococcus in deep agar were large, round, and biconvex with dark centers and clear peripheries.

Other characteristics given by Tissier and Martelly (15) and Prévot (10) correspond with those published by Jungano (8), as seen in Table 4. Jungano's organism could have been either *Peptococcus magnus*, *Peptococcus asaccharolyticus*, or some similar anaerobic coccal species.

CONCLUSIONS

From the above discussion, it is evident that Hamm's description was based on two, if not

TABLE 3. Cell size of *Staphylococcus asaccharolyticus* and *Staphylococcus anaerobius* strains isolated by A. R. Prévot

Strain ^a	Original identification	Size (μ m) ^b
HD II	<i>S. asaccharolyticus</i>	0.6-0.7
266 D	<i>S. asaccharolyticus</i>	0.7-0.8
534 A	<i>S. asaccharolyticus</i>	0.8
600	<i>S. asaccharolyticus</i>	0.6-0.7
808 A	<i>S. asaccharolyticus</i>	0.8-1.0
998	<i>S. asaccharolyticus</i>	1.0-1.2
1813	<i>S. asaccharolyticus</i>	0.5
2229	<i>S. asaccharolyticus</i>	0.7-0.9
2480 A	<i>S. asaccharolyticus</i>	0.8-1.0
TR 7	<i>S. anaerobius</i>	0.5
390 B	<i>S. anaerobius</i>	0.5-0.6
681 B	<i>S. anaerobius</i>	0.5-0.7
1324	<i>S. anaerobius</i>	0.6
1469 B	<i>S. anaerobius</i>	0.5
1718	<i>S. anaerobius</i>	0.4
1793	<i>S. anaerobius</i>	0.4
2081	<i>S. anaerobius</i>	0.3
2253 B	<i>S. anaerobius</i>	0.4
2381	<i>S. anaerobius</i>	0.5
2342 B	<i>S. anaerobius</i>	0.5
2357 B	<i>S. anaerobius</i>	0.8
2529 B	<i>S. anaerobius</i>	0.8
2640	<i>S. anaerobius</i>	Small cocci
2719 B	<i>S. anaerobius</i>	0.6
2767	<i>S. anaerobius</i>	0.8
2906 B	<i>S. anaerobius</i>	0.5
2991 C	<i>S. anaerobius</i>	0.4-0.7
3433	<i>S. anaerobius</i>	0.6
3493 A	<i>S. anaerobius</i>	0.8
3778	<i>S. anaerobius</i>	0.8
3889 A	<i>S. anaerobius</i>	0.6
3896 A	<i>S. anaerobius</i>	0.6
3956	<i>S. anaerobius</i>	0.6
4049	<i>S. anaerobius</i>	0.6
4094 B	<i>S. anaerobius</i>	0.6
4196 A	<i>S. anaerobius</i>	0.6
4217	<i>S. anaerobius</i>	0.6

^a We are greatly indebted to A. R. Prévot for copies of his records. The strain number and identification are as given by Prévot.

^b As reported by A. R. Prévot.

three, different species. Schottmüller's blood-requiring staphylococcus is *Peptococcus aerogenes* (Schottmüller) Douglas. Coccus No. 35 of Wegelius is, in all probability, *Peptococcus variabilis* (Foubert and Douglas) Douglas. The organisms isolated by Bondy and Hamm could be any of several anaerobic cocci.

There is also some question as to the identity of the organism that Prévot described as *Staphylococcus anaerobius*. His description was based on Jungano's report of an anaerobic staphylococcus and also on the characteristics of an organism he isolated from tonsillitis. Jungano could have been describing either

TABLE 4. Characteristics of Jungano's (7, 8) *anaerobic staphylococcus*, *Diplococcus magnus anaerobius Tissier and Martelly*, and *Diplococcus magnus Prévot*^a

Characteristic	Jungano's anaerobic staphylococcus		<i>Diplococcus magnus anaerobius Tissier and Martelly</i> (15) ^d	<i>Diplococcus magnus Prévot</i> (10) ^e
	Jungano (8) ^b	Jungano and Distaso (9) ^c		
Cellular morphology	Staphylococcus-like	Small coccus	Large coccus; singly, in pairs, masses, or short chains	Large coccus, 1.5-1.8 μ m in diameter; singly, in pairs, masses, or short chains
Gram reaction	+	+	+	+
Broth growth	Turbid; flakes are deposited as sediment; broth becomes clear	Turbid, becomes clear after 5 days	Turbid; viscous sediment appears with clearing of broth	Turbid; viscous sediment appears with clearing of broth
Anaerobic	+	+	+	+
Killed by heating	NR	NR	NR	1 h at 60 C, 5 min at 100 C
pH range	NR	NR	NR	5.5-8.5
Optimum pH	NR	NR	NR	7.0
Temp of growth	22-37 C	NR	24-37 C	18-37 C
Viability	2 weeks	2 mo	NR	3 weeks
Gas production	-	NR	-	-
Carbohydrate fermentation	NR	-	-	-
Gelatin digestion	Very weak	-	-	-
Action on:				
Milk	NR	None	None	None
Fibrin	NR	NR	None	None
Egg white	NR	None	NR	NR
Proteoses	NR	NR	NR	Digested
Ammonia production	NR	NR	+	+
Indole production	NR	NR	-	-
Pathogenic for	Guinea pig and rabbit	Guinea pig and rabbit	NR	Not pathogenic
Toxin	NR	-	NR	-
Hemolysin	NR	NR	NR	-

^a Symbols: -, negative result; +, positive result; NR, result not reported.^b Isolated from appendicitis, cystitis, gangrenous infiltration of the perineum.^c Isolated from urinary tract, fecal material in addition to earlier reported sources.^d Isolated from putrefying butcher's meat.^e Isolated from acute appendicitis.

Peptococcus asaccharolyticus (Distaso) Douglas, *Peptostreptococcus magnus* (Prévot) Smith (*Peptococcus magnus* [Prévot] Moore and Holdeman), or some other anaerobic coccus.

One must keep in mind that species in the genus *Peptococcus* are very similar in cellular morphology and cultural characteristics, even though they may be quite distinct biochemically (3, 4, 11, M. Rogosa, in press). Early authors primarily used morphological and cultural characteristics in distinguishing one species from another. Because of the paucity of biochemical characteristics cited in these early descriptions of anaerobic cocci, both the purity of the strains and the validity of grouping several strains into a species can be questioned.

In the forthcoming eighth edition of *Bergey's Manual of Determinative Bacteriology*, M. Rogosa (in press) is proposing that *Peptococcus variabilis* (Foubert and Douglas) Douglas, *Peptococcus glycinophilus* (Cardon and Barker) Douglas, and *Peptostreptococcus magnus* (Prévot) Smith be considered synonyms of *Peptococcus anaerobius*. Until additional data can be obtained, we feel that these should remain as separate species or, alternatively, that *Peptococcus variabilis* and *Peptococcus glycinophilus* be considered as later synonyms of *Peptococcus magnus*.

We believe that the name *Peptococcus anaerobius* is a nomen confusum. Further, the specific epithet in this name is identical with that in the name for a different species of anaerobic cocci, *Peptostreptococcus anaerobius* (Natvig) Kluyver and van Niel. The confusion that results by retaining the same specific epithets in the names of two different species of anaerobic cocci which belong to two different genera whose names are very similar and have the same initial letter is directly contrary to Principle I of the International Code of Nomenclature—the avoidance of confusion. In this particular case, it is quite important that confusion be avoided, for both organisms have clinical significance. For these reasons, we request that the Judicial Commission of the International Committee on Systematic Bacteriology issue an Opinion placing the name *Peptococcus anaerobius* (Hamm) Douglas on the list of nomina rejicienda.

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REPRINT REQUESTS

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