INTERNATIONAL JOURNAL OF
SYSTEMATIC BACTERIOLOGY

Vol. 19, No. 2

April 1969

pp. 159-163

Copyright 1969, Iowa State University Press

DNA BASE COMPOSITION AND PHYSIOLOGICAL
CHARACTERISTICS OF THE GENUS AEROCOCCUS¹

James B. Evans and L. M. Schultes

Department of Microbiology,
North Carolina State University
Raleigh, North Carolina 27607

ABSTRACT. The physiological and morphological homogeneity of this group of bacteria is in conformity with a relatively narrow range of DNA base ratios and is in marked contrast to the diversity of nomenclature that has been applied to them. They are Gram-positive cocci with a strong tendency toward tetrad formation. They produce little or no anaerobic growth in shake cultures yet lack a porphyrin respiratory system and produce hydrogen peroxide which restricts their aerobic growth. Their DNA has a base ratio of 37-41% GC. They are variously known as Gaffkya homari, Pediococcus homari, or Aerococcus viridans. Their correct name must await action of the Judicial Commission regarding rejection of the generic name Gaffkya.

- - - - -

The name Aerococcus was proposed by Williams, Hirsch and Cowan (1953) for a group of Gram-positive, α -hemolytic cocci that occur rather frequently in air. These organisms were feebly catalase positive, produced small translucent or semi-opaque colonies, failed to reduce nitrates, but were tolerant of 40% bile, 0.001% potassium tellurite and 0.00025% crystal violet. Deibel and Niven (1960) reported characteristic tetrad formation when these organisms were grown in a suitable medium, recognized their identity with the lobster pathogen Gaffkya homari, and suggested that they belonged in the genus Pediococcus. Several other workers have conducted limited studies of these organisms.

¹ Paper Number 2623 of the Journal Series of the North Carolina State University Agricultural Experiment Station, Raleigh, North Carolina.

Some of the best and most comprehensive of these later studies have been conducted and summarized by Whittenbury (1965) who paid particular attention to oxygen relationships of these organisms. These studies pointed out that hydrogen peroxide is a product of their aerobic metabolism and tends to inhibit aerobic growth as well as causing the α -hemolysis on blood agar. No catalase or pseudocatalase was detected. Anaerobic growth was slow and slight in soft agar media. Colman (1967) has reported on the occurrence of these organisms in human infections, has demonstrated that they tolerate 8% NaCl, fail to ferment glucose anaerobically, and grow only aerobically in agar shake cultures. Other physiological differences from a representative collection of pediococci and enterococci were noted in this study. He also analyzed their cell walls and demonstrated the presence of glucose, galactose, and galactosamine (unlike pediococci) and the absence of polyols and rhamnose (unlike enterococci). Concurrently our laboratory (Kerbaugh and Evans 1968) also found these organisms in the hospital environment and in clinical specimens. Their preferentially aerobic nature was confirmed, yet they gave a negative benzidine test which we assume to indicate the absence of a porphyrin-linked respiratory system. We also have confirmed their peroxide production aerobically.

We have determined the DNA base ratio of a collection of Aerococcus cultures and morphologically similar organisms using the thermal denaturation method of Marmur and Doty (1962). Pertinent results of this investigation are summarized in Table 1. It can be seen that the strains of Aerococcus are very homogeneous with respect to DNA base ratio, having 37-41% GC except for one strain (C_2). Two extensive tabulations of DNA base compositions reported for various bacteria (Hill 1966; Rosypal and Rosypalova 1966) indicate base ratios of 66-74% GC for micrococci, 34-38% GC for enterococci, 31-36% GC for staphylococci and 38.2 and 44.5 % GC for the two strains of pediococci that had been tested. More recently Gordon (1967) has reported base ratios of 30.5% and 35.6% for two pediococci, values that are fairly close to the 35.1% found for one strain in our study. The base ratio data currently available do not enable us to draw any conclusions regarding the possible relationship between aerococci and pediococci or between aerococci and enterococci. However, the apparent divergence in energy metabolism and cell wall composition between aerococci and these other two groups suggests that the aerococci differ from them more than they do from each other.

Table 1. DNA base ratios of some aerococci and possibly related organisms

Culture	Source	Mole % G + C
<u>Aerococcus viridans</u> C ₂	O. G. Clausen ¹	32.0
<u>Staphylococcus epidermidis</u> 155	ATCC	34.9
<u>Pediococcus cerevisiae</u> 8081	ATCC	35.1
<u>Aerococcus</u> 302	A. C. Baird-Parker ²	37.6
<u>Aerococcus viridans</u> 11563	ATCC	38.5
<u>Aerococcus</u> 301	A. C. Baird-Parker	38.8
<u>Aerococcus catalasicus</u> C ₉	O. G. Clausen	38.9
<u>Aerococcus catalasicus</u> C ₆	O. G. Clausen	39.4
<u>Gaffkya tetragena</u> 10875	ATCC	39.9
<u>Aerococcus viridans</u> C ₇	O. G. Clausen	40.3
<u>Aerococcus</u> 303	A. C. Baird-Parker	40.9

¹University of Oslo, Blindern, Norway

²Unilever Research Laboratory, Bedford, England

The base ratio of 39.9% GC for Gaffkya tetragena is somewhat higher than the 33% reported for the same strain by Auletta and Kennedy (1966) who found the holotype of G. homari to have 34% GC and another strain labeled G. tetragena to have 64%. This latter strain may well be a Micrococcus as was the G. tetragena studied by Aaronson (1956).

It would appear that organisms correctly identified as Gaffkya are indistinguishable from those that have been called Aerococcus. Actually, few Gaffkya strains have been subjected to detailed and critical studies, and several authors have recommended that this genus name be rejected (Aaronson 1956; Deibel and Niven 1960; Kocur and Martinec 1965).

There does appear to be a well-defined and homogeneous species based on morphology, physiology and DNA base ratio and the only problem is one of nomenclature. Three major alternatives appear to exist: (1) retain the name Gaffkya homari, (2) reject the name Gaffkya and its species and

retain the name Aerococcus viridans, or (3) reject both Gaffkya and Aerococcus and call them Pediococcus homari. Of course, other combinations also are possible.

We believe that the formal recommendation of Kocur and Martinec (1965) to reject the genus name Gaffkya is well justified. We also believe that these organisms differ sufficiently from pediocicci (see Colman 1967) to warrant being in a separate genus. Thus, we recommend the name Aerococcus viridans for these organisms with the name Gaffkya homari as a probable synonym.

ACKNOWLEDGMENT

This investigation was supported by U.S. Public Health Service research grant AI-07693 from the National Institute of Allergy and Infectious Diseases. The DNA base ratio data were from the study conducted by Mr. Schultes as part of his M. S. dissertation.

REFERENCES

- Aaronson, S. 1956. A biochemical-taxonomic study of a marine micrococcus, Gaffkya homari, and a terrestrial counterpart. J. Gen. Microbiol. 15:478-484.
- Auletta, A. E. and E. R. Kennedy. 1966. Deoxyribonucleic acid base composition of some members of the Micrococcaceae. J. Bacteriol. 92:28-34.
- Colman, G. 1967. Aerococcus-like organisms isolated from human infections. J. Clin. Path. 20:294-297.
- Deibel, R. H. and C. F. Niven, Jr. 1960. Comparative study of Gaffkya homari, Aerococcus viridans, tetrad-forming cocci from meat curing brines, and the genus Pediococcus. J. Bacteriol. 79:175-180.
- Gordon, D. F., Jr. 1967. Reisolation of Staphylococcus salivarius from the human oral cavity. J. Bacteriol. 94:1281-1286.
- Hill, L. R. 1966. An index to deoxyribonucleic acid base compositions of bacterial species. J. Gen. Microbiol. 44:419-437.
- Kerbaugh, M. A. and J. B. Evans. 1968. Aerococcus viridans in the hospital environment. Appl. Microbiol. 16:519-523.
- Kocur, M. and T. Martinec. 1965. Proposal for the rejection of the bacterial name Gaffkya. Intl. Bull. Bact. Nomen. Taxon. 15:177-179.

- Marmur, J. and P. Doty. 1962. Determination of the base composition of deoxyribonucleic acid from its thermal denaturation temperature. J. Mol. Biol. 4:109-118.
- Rosypal, S. and A. Rosypalova. 1966. Genetic, phylogenetic and taxonomic relationships among bacteria as determined by their deoxyribonucleic acid base composition. Folia Prirod. fakulty UJEP, 7:1-90.
- Whittenbury, R. 1965. A study of some pediococci and their relationship to Aerococcus viridans and the enterococci. J. Gen. Microbiol. 40:97-106.
- Williams, R. E. O., A. Hirsch and S. T. Cowan. 1953. Aerococcus, a new bacterial genus. J. Gen. Microbiol. 8:475-480.