

This Week's Citation Classic

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Kates M. Bacterial lipids. *Adv. Lipid Res.* 2:17-90, 1964.

[Division of Biosciences, National Research Council, Ottawa, Canada]

The article is a review of work done up to 1964 on the cellular lipids of bacterial species, the intracellular distribution of these lipids as well as their biosynthetic pathways. Attempts were made to correlate lipid composition with taxonomic classification of bacteria. [The SC® indicates that this paper has been cited over 255 times since 1964.]

Morris Kates

Department of Biochemistry
University of Ottawa
Ottawa, Ontario K1N 6N5
Canada

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"The idea for this article took several years to develop. Prior to 1958, I had worked mostly on phospholipids of plants and animals. I recall it was in the fall of 1958 that Norman Gibbons, then head of the microbiology section. National Research Council, Ottawa, came into my lab with a test-tube containing a red-coloured greasy blob of material. 'Do you know what this is?' he asked. 'No,' I said 'Well,' he said, 'this is a sample of extremely halophilic bacteria that require 4M NaCl for their growth and survival. They must have some very unusual membrane lipids to be able to function in almost saturated salt! Why don't you have a look at the lipids of these bacteria?'

"So I began to work on the lipids of these halophiles, together with Suren Sehgal, a post-doc with Gibbons, and by the end of the year we knew there was something strange about them since we could detect no fatty acids at all, esterified or free. In fact the lipids were derived from a dialkyl ether of glycerol rather than from a diacyl glycerol as is found for most organisms, in particular a moderate halophile *Micrococcus halodenitrificans*¹ that we were also studying

for comparison. We published these preliminary findings in 1962² and a year later³ we had established the structure of the glycerol ether as 2,3-diphytanyl-*sn*-glycerol and the structure of the major phospholipid as the diether analog of phosphatidylglycerophosphate.

"During this period I also became involved with other microbiologists at NRC on a survey of bacterial lipids –Donn Kushner on *Bacillus cereus*⁴ (and later with halophiles again), Stan Martin and Gordon Adams⁵ on *Serratia marcescens* and Per-Otto Hagen⁶ on psychrophilic *Serratia*-like species. I was struck by the great differences in lipid composition among the rather small number of bacterial species that we had examined, and this impression was confirmed on reading the literature of this subject which had already attracted the attention of many first-rate lipidologists in Europe and the US. It occurred to me that perhaps there might be a correlation between lipid composition and bacterial class or family which could be used as an aid in taxonomic classification. I thought it would be helpful for our work and that of other lipidologists to collect all the data available on bacterial lipid composition and cellular distribution and biosynthesis of these lipids.

"The resulting review article appeared about the time that biochemists and microbiologists became aware of the wide diversity of lipids in bacteria and began thinking about their role in membrane function. I think this article was cited frequently because it was the first comprehensive review of the subject and must have attracted the attention of researchers who appreciated the fact that many aspects of the subject were wide-open for investigation. It is indeed gratifying to know that this article has had some effect in stimulating research on bacterial lipids. A more recent review on the lipids of *Escherichia coli* has been published by C.R.H. Raetz⁷

1. Kates M, Sehgal S N & Gibbons N E. Lipid composition of *Micrococcus halodenitrificans* as influenced by salt concentration. *Can. J. Microbiol.* 7:427-35, 1961.
2. Sehgal S N, Kates M & Gibbons N E. Lipids of *Halobacterium cutirubrum* *Can. J. Biochem. Physiol.* 40:69-81, 1962.
3. Kates M, Sastry P S & Yengoyan L S. Isolation and characterization of a diether analog of phosphatidylglycerophosphate from *Halobacterium cutirubrum* *Biochim Biophys. Acta* 70:705-7, 1963.
4. Kates M, Kushner D J & James A T. The lipid composition of *Bacillus cereus* as influenced by the presence of alcohols in the culture medium. *Can. J. Biochem. Physiol.* 40:83-94, 1962.
5. Kates M, Adams GA & Martin S M. Lipids of *Serratia marcescens* *Can. J. Biochem.* 42:461-79, 1964.
6. Kates M & Hagen P O. Influence of temperature on fatty acid composition of psychrophilic and mesophilic *Serratia* species. *Can. J. Biochem.* 42:481-8, 1964.
7. Raetz C R H. Enzymology, genetics, and regulation of membrane phospholipid synthesis in *Escherichia coli* *Microbiol. Rev.* 42:614-59, 1978.