

# This Week's Citation Classic

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**Björndal H, Lindberg B & Svensson S.** Mass spectrometry of partially methylated alditol acetates. *Carbohyd. Res.* 5:433-40, 1967.  
[Inst. Organic Chem., Stockholm Univ., Stockholm, Sweden]

**The mass spectrometry of partially methylated alditol acetates was investigated and it was demonstrated that these substances are readily identified from their mass spectra. Analysis of mixtures of such derivatives by gas chromatography-mass spectrometry has become a standard method in structural studies of complex carbohydrates. [The SC® indicates that this paper has been cited over 205 times since 1967.]**

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"Methylation analysis, introduced by Haworth and coworkers in the thirties, is the most important method in structural studies of complex carbohydrates such as polysaccharides, glycoproteins, and glycolipids. It involves methylation of all free hydroxyl groups, followed by acid hydrolysis. During this hydrolysis the glycosidic linkages are cleaved but the methyl ether linkages are stable. The product is a mixture of partially methylated sugars, and the free hydroxyls in these mark the positions to which the sugars are linked in the starting material. A qualitative and quantitative analysis of this mixture therefore gives considerable structural information. Methylation analysis was, however, time-consuming as each partially methylated sugar in the generally complex mixture had to be isolated and characterized, and this also required fairly large amounts of material. Furthermore, the method was not very accurate, and minor components, which

might be structurally significant, were often overlooked.

"We were studying structures of biologically important polysaccharides from bacteria. It was, however, quite clear that new and better methods had to be developed if we were ever to cover even a small part of this vast field. Gas chromatography would be the best method for separation and quantitative analysis of the mixture of methylated sugars obtained on methylation analysis. However, these would first have to be transformed into stable, volatile materials. The alditol acetates were thought suitable, and we had found that they were readily separated by gas chromatography on some newly developed column materials.

"The components had, of course, also to be identified. With the aid of combined gas chromatography-mass spectrometry, for which instruments had recently become commercially available, it should have been possible to solve this problem. The only instrument at the university belonged to the department of analytical chemistry and it was already extensively used. My research students, Björndal and Svensson, however, did not mind working after hours, and the mass spectrometry was done at night, when we could use this instrument.

"The mass spectra of the partially methylated alditols were simple and it was easy to identify these substances. We had therefore reached our object, a fast and accurate method for methylation analysis, which required only small amounts of material. This method, in conjunction with a methylation technique developed by Hakomori, has been used in numerous structural studies of complex carbohydrates, and almost totally replaced other methods.<sup>1</sup> With the current interest in glycoproteins and glycolipids on the surfaces of cells, it is necessary to go from the milligram scale, which we use, to the nanogram scale, and there is consequently a need for further improvements "

1. **Hakomori S.** A rapid permethylation of glycolipid, and polysaccharide catalysed by methylsulfinyl carbanion. *J. Biochem.* 55:205-8, 1964.