

## Citation Classics

**Morris D L.** Quantitative determination of carbohydrates with Dreywood's anthrone reagent. *Science* **107**:254-5, 1948.

**A solution of anthrone in 95% sulfuric acid produces a characteristic blue color when added to twice its volume of a water solution of carbohydrates. The depth of color can be used for quantitative determination of sugars and polysaccharides even when these are chemically combined. The effective range is from 20-500 micrograms. Prior hydrolysis to convert sugars to the free state is not needed; thus the reagent can be used for the quick determination of total carbohydrates in a mixture in terms of their glucose equivalent. Glycogen, starch, sucrose and other glucosides have been accurately measured. [The SC<sup>®</sup> indicates that this paper was cited 577 times in the period 1961-1976.]**

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"It would be a gross understatement to say I was astounded by your request for information on my 'classic' paper on the anthrone method. I have done no research work in biochemistry since the early fifties, and so was unaware that the method was even remembered, to say nothing of being used.

"This paper arose out of work on the glycogen which my wife and I had found to occur in large amounts in sweet corn.<sup>1</sup> I was trying to find out if the glycogen would give useful, prolonged elevation of blood sugar when injected intravenously. Blood sugar in rabbits, measured in conventional ways, did remain elevated for a number of hours, but there was still the question of the nature of this sugar, and also of how much of the injected

carbohydrate was excreted in the urine. At the time, all methods of carbohydrate determination required first the removal of extraneous materials such as proteins, followed by hydrolysis of polysaccharides, and finally measurement of the reducing power of the simple sugar. When Dreywood's paper appeared<sup>2</sup> it looked as though it might provide a method for the measurement of this total excreted carbohydrate.

"In a way other than that implied in the title of this series, this work was a classic, in that everything clicked as the work was being done. All guesses turned out to be good ones, and all discrepancies could be quickly accounted for. Thus, as I remember it, the greater part of the investigation was completed in a matter of two or three weeks, with only a few weeks more needed for tying up loose ends.

"In the course of the work, I found that the anthrone method permitted shortcuts that had hitherto been unacceptable, and so greatly simplified sugar determination in biological fluids. As I have said, proteincontaining solutions had to be freed of protein before conventional sugar methods could be applied. But with anthrone, lactose in milk could be accurately determined after simply diluting the whole milk. If whole blood were diluted, and then the anthrone method applied, the value for sugar that resulted was 30 to 60 mg % above that found after deproteinization. This higher value was presumably caused by carbohydrates attached to the precipitated protein. But the method could be used, and I believe has been used, for screening tests for hyperglycemia.

1. **Morris D L & Morris C T.** Glycogen in the seed of *Zea mays* (variety golden bantam). *J. Biol. Chem.* **130**:535-44, 1939.
2. **Dreywood R.** Qualitative test for carbohydrate material. *Ind. Eng. Chem. (Anal. ed.)* **18**:499, 1946.