Polarographic Studies: IV. A Note on the Determination of Ascorbic Acid

By J. E. PAGE and J. G. WALLER

A POLAROGRAPHIC method for the estimation of ascorbic acid in fruits and vegetables has been used by a number of investigators.[1,2,3,4,5,6] The technique employed differs from that generally used in that it entails oxidation at a dropping mercury anode rather than reduction at a dropping mercury cathode.

The method is fully described in a recent paper by Gillam.[6] We have tried to use a Cambridge polarograph for this estimation, but experienced considérable difficulty in measuring the anodic step height. However, we have since found that the method can be improved considerably by modifying the technique as recently described by Werthessen and Baker[7] in a paper on the polarographic estimation of ketosteroids.

These authors increased the potential scale of their polarograph by decreasing the range from one of 0 to $-3{\cdot}0$ v. to one of 0 to $-2{\cdot}0$ v. The recording system and automatically changing potentiometer were allowed to rotate at their normal speed. Werthessen and Baker found that under these conditions definition of the ketosteroid steps was much improved, and they were able to effect satisfactory separation of the steps for the 20-ketosteroids from those for the 17-ketosteroids.

The polarographic steps for the reduction of the ketosteroids occur at about $-1{\cdot}5$ v.; therefore in an examination of these substances the voltage range must extend to $-2{\cdot}0$ v. On the other hand, during the oxidation of ascorbic acid it is only necessary to consider potentials up to $+0{\cdot}3$ v.; in a buffer solution of *p*H 4·6 the vitamin is oxidized at $+0{\cdot}10$ v. (versus the saturated calomel electrode).[6]

We accordingly changed the potential range of our Cambridge polarograph so that the complete range was from 0 to $-1{\cdot}0$ v. instead of from 0 to $-3{\cdot}0$ v. This was achieved by connecting a 2 v. accumulator to the polarograph in place of the usual 6 v. battery and adjusting the applied potential to one-third of its normal value. Thus the reading of a voltmeter connected across the cell terminals of the polarograph was one-third of that indicated on the potentiometer scale of the polarograph. The horizontal voltage scales of polarograms obtained in this way have been magnified threefold. By reversing the connections to the polarograph cell, we were able to use the indicated range of 0 to $-0{\cdot}9$ v. (now equivalent to 0 to $+0{\cdot}3$ v.) for oxidations. The scale cannot be magnified more than threefold unless an external potentiometer is employed to reduce the voltage applied by the 2 v. accumulator. We found that a three-fold magnification gave satisfactory results for ascorbic acid.

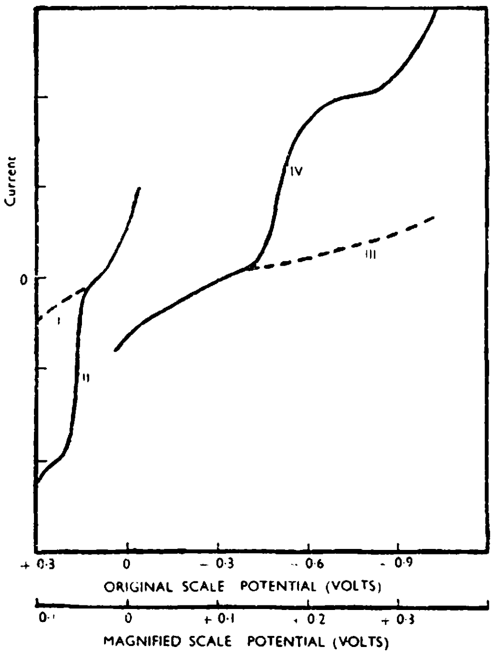

Fig. 1.

I. $0{\cdot}05\,M$ Phthalate buffer solution (original scale).
II. $0{\cdot}0002\,M$ Ascorbic Acid ,, ,,
III. $0{\cdot}05\,M$ Phthalate buffer solution (magnified scale).
IV. $0{\cdot}0002\,M$ Ascorbic Acid ,, ,,

Some typical curves for ascorbic acid in a $0{\cdot}05\,M$ potassium hydrogen phthalate buffer solution (*p*H 4·0) are shown in Fig. 1. The curves obtained by magnifying the scale have a much better definition and their step heights are the easier to measure.

It is thought that this modification of technique is likely to be of value for other polarographic analyses in which it is necessary to measure the height of steps that are very close together. The technique should also facilitate the accurate measurement of half-wave potentials.

References

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Glaxo Laboratories, Ltd.
Greenford, Middlesex

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