

The effect of pH on the aerobic degradation of ascorbic acid solutions

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The stability of ascorbic acid in aqueous solution at 25° in the presence of excess oxygen has been studied in citric acid—phosphate buffer solutions in the pH range 2.2 to 7.0. The residual ascorbic acid was determined by potentiometric titration with ceric ammonium sulphate in the presence of iodide. At each pH, the logarithm of the concentration (C) of ascorbic acid is a rectilinear function of time, and the standard errors are about 2.5% of the regression coefficients. The degradation rate shows a maximum near pH 4 and a minimum near pH 5.6.

Finholt & others (1963) reported that the maximum rate of anaerobic degradation of ascorbic acid at 96° was at pH 4 and attributed this to a 1:1 complex of ascorbic acid molecules (A) and hydrogen ascorbate ions (A⁻) which would be present at a higher concentration near pH 4 than at any other pH. Kassem & others (1969) found that both on storage at 50° and during autoclaving, the maximum loss was at pH 4 and the minimum loss at pH 6.5, but they gave no explanation.

$$C = [A] + [A^-] + [A^{2-}] + 2[A \cdot A^-] = 5.66 \times 10^{-3} \text{ M}$$

$$K_1 = [H^+][A^-]/[A] = 9.16 \times 10^{-5} \text{ M} \quad K_2 = [H^+][A^{2-}]/[A^-] = 4.57 \times 10^{-12} \text{ M}$$

$$A + A^- \rightleftharpoons A \cdot A^- \quad K_8 = \frac{[A \cdot A^-]}{[A][A^-]}$$

The degradation rate has been found to depend mainly on the concentrations of the charged species A⁻, A²⁻ and A · A⁻, thus:

$$-dC/dt = kC = k_1[A^-] + k_2[A^{2-}] + k_3[A \cdot A^-]$$

The first-order rate constants k₁, k₂ and k₃ contain the concentration of oxygen, which is a constant at constant temperature. The anaerobic breakdown of ascorbic acid is very slow at 25° and it can be ignored in the presence of excess of oxygen (Yacomeni, 1968).

It has been found that the experimental pH-rate profile is matched quite closely with the following values for the stability constant of the complex and for the rate constants:

$$K_8 = 500 \text{ litre/mol}$$

$$k_1 = 5.7 \times 10^{-8} \text{ s}^{-1} \quad k_2 = 1.7 \text{ s}^{-1} \quad k_3 = 7.4 \times 10^{-5} \text{ s}^{-1}$$

If a preparation of ascorbic acid develops acidity on storage and if its initial pH is in the range 5 to 5.6, the rate of degradation will increase as the pH falls. An initial pH in the range 5.6 to 6 is recommended.

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The effect of the pore size of the inhaler support upon the concentration of volatile drug emerging in the air stream from a nasal inhaler

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An investigation of the physico-chemical factors influencing the release of a volatile drug from a nasal inhaler (Armstrong, Carless & Enever, 1970, 1971) indicated that the pore size of the inhaler support into which the drug is impregnated may affect the concentration of the drug in the emergent airstream.

The phenomenon has been studied by using sintered glass plugs (7 mm diameter by 25 mm long) ranging in maximum pore diameter from 60 to 240 μm, in place of the inhaler support. Methylamphetamine (0.1 ml) was impregnated into the plugs and, using an air flow rate of

0.95 litre min^{-1} , the concentration of drug emerging from an inhaler system was determined over the temperature range of 15 to 35°.

The results for two of the glass plugs are shown in Fig. 1 in the form of a graph of logarithm of drug concentration vs reciprocal of absolute temperature. It can be seen that, the smaller the maximum pore diameter, the lower the concentration of drug in the air stream.

Vapour pressure values have been derived from the concentrations of methylamphetamine at 25° for the various sintered glass plugs. Fig. 2 shows the plot of logarithm of derived vapour pressure against reciprocal of maximum pore radius is a shallow curve rather than the straight line that would be expected if the Kelvin equation were obeyed (Gregg, 1961).

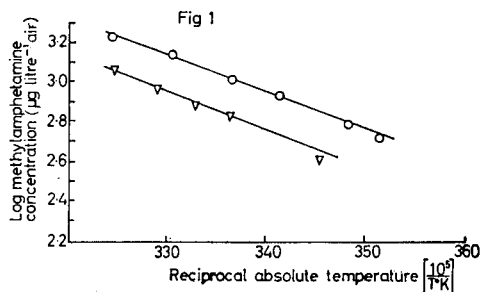


FIG. 1. Log concentration of methylamphetamine plotted against reciprocal absolute temperature. Maximum pore diameters ○ 206 μm , ▽ 109 μm .

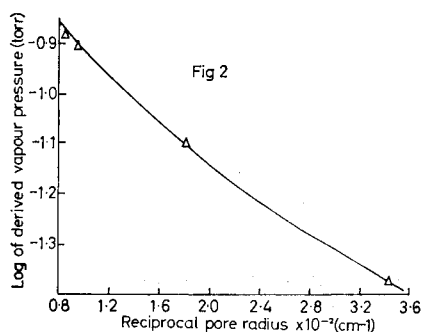


FIG. 2. Log derived vapour pressure of methylamphetamine at 25° plotted against reciprocal pore radius.

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