

ment. ICS for CO₂-Ar system can thus be computed at least in the range of present study using three simple equations (1)-(3) and four parameters given by (4).

Equation (2) is not new. For N₂-Ar system also Koura⁸ noted such behaviour. The variation of γ according to (3) has been noted here for the first time.

Table I shows that the PG law underestimates the cross-sections for $|\Delta j| = 2$. Further, the difference between σ_{PG} and σ_{IOSAM} for $|\Delta j| = 2$ increases with decrease in K_1 . This behaviour may be related with the magnitude of the torque required for changing the angular momentum of the molecule. Change in angular momentum roughly depends on the product of the torque and the collision time. As the collision time, approximately, varies as $T_i^{-1/2}$ the torque, τ , required to cause particular transition would be proportional to $|\Delta j| \times \sqrt{T_i}$. Therefore, τ would be low for low values of $|\Delta j|$ and T_i . Thus we note that the power-gap law underestimates the efficiency of those transitions which require low value of torque. It may be mentioned that the PG law overestimates⁹ the efficiency of those transitions which require high value of torque. It is therefore inferred that the empirical power-gap law works well in the 'medium range' of τ . The details are being investigated further.

The dependence of β , α , γ_0 and d on the parameters of the colliding system is also being investigated further. Such a study may lead to the better understanding of the mechanism of RET also.

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1. *Laser fusion program progress report*, edited by F. Skoberne, LA-6245-PR, Los Alamos Scientific Laboratory, July 1976.
2. Brunner, T. A., Smith, N., Karp, A. W. and Pritchard, D. E., *J. Chem. Phys.*, 1981, **74**, 3324.
3. For the review see: Parker G. A. and Pack, R. T., *J. Chem. Phys.*, 1978, **68**, 1585.
4. Agrawal, P. M. and Raff, L. M., *J. Chem. Phys.*, 1981, **74**, 3292.
5. Parker, G. A., Snow, R. L. and Pack, R. T., *J. Chem. Phys.*, 1976, **64**, 1668.
6. Pack, R. T., *J. Chem. Phys.*, 1974, **60**, 633.
7. Agrawal, P. M. and Raff, L. M., *J. Chem. Phys.*, 1981, **75**, 2163.
8. Koura, K., *J. Chem. Phys.*, 1982, **77**, 5141.
9. Dexheimer, S. L., Durand, M., Brunner, T. A. and Pritchard, D. E., *J. Chem. Phys.*, 1982, **76**, 4996.

POLAROGRAPHIC STUDIES ON ACTIVE CONSTITUENTS OF *SIDA CORDIFOLIA*

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POLAROGRAPHIC method has been used widely for the identification and estimation of active components of plants. Thus, the optimum conditions for the isolation of anthocyanins¹ from fruits of *Sambucus nigra* were established by this method. Similarly, juglone and hydrojuglone contents of different parts of walnut trees and fruits were estimated². Several tropolone derivatives similar to colchicine, were detected and isolated from the seeds of meadow saffron and characterized by polarographic methods³.

The present investigation of the plant, *Sida cordifolia* (Malvaceae), has been undertaken from this point of view. The plant is of considerable medicinal importance and is said to contain an alkaloid, ephedrine, known to have wide therapeutic values⁴⁻⁷.

Polarograms have been recorded (298K) with a Radiometer pen-recording polarograph, Polariter PO4g. A Kaloušek cell with a saturated calomel electrode as reference electrode has been used. The dme made from sargent capillary has the following characteristics: $m = 0.952 \text{ mgs}^{-1}$ and $t = 4.3 \text{ s}$ at 60 cm height of mercury reservoir in potassium chloride solution (0.5 mol dm^{-3}) at zero applied potential (sce). The pH-values of the solutions have been measured before and after recording each polarogram on an ELICO model LI-10 pH-meter with an accuracy of ± 0.1 pH unit.

All the chemicals used are of A. R. grade. The stems and roots of the plant *sida cordifolia* have been separately dried in air, powdered and 11.0g of each are kept immersed in 1% perchloric acid (200 ml) at room temperature and after allowing to stand for a week, the extracts are filtered before use. Preliminary tests show that these extracts are too concentrated for polarographic work and have been diluted 100 times in the test solution. The extract (1 ml) is first diluted to 10 ml; 1 ml of this solution is added to 5 ml of acetic acid-tetra-ethylammonium acetate (0.1 mol dm^{-3}) buffer; 1 ml of tetra-ethylammonium bromide (1.0 mol dm^{-3}) is added and the solution is made up to 10 ml with conductivity water. A 1.5 ml of 0.2% gelatin is also added before making up to volume wherever required to suppress maxima.

A stock solution of ephedrine hydrochloride (10.0 mol dm^{-3}) has been used for comparison.

Polarograms of sida stem extract (without gelatin) can be seen in figure 1a. For pH's 3.8 and 4.7 the polarograms exhibit sharp maxima, which can be suppressed by 0.03% of gelatin (figure 1a). The current vs. pH plot (figure 2a) shows an asymptotic decay, similar to that for a system in acid-base equilibrium in which only the acid is electroactive. The plot of half-wave potential against pH (figure 3a) is linear with the slope of 90 mV pH^{-1} . Such a behaviour is normally exhibited by catalytic hydrogen currents⁸. The nature of the polarographic waves has been verified by the slopes of $\log i$ vs $\log h$ plots over the whole wave at pH 5.3. The slopes are negative up to about the half-wave potential and only near the limiting plateau the slope reaches the diffusion controlled value. This result proves the catalytic nature of the earlier portions of the waves. The polarograms (figure 1b) of ephedrine hydrochloride (1 mol m^{-3} , without maximum suppressor) show striking resemblance with those of figure 1a. Current vs. pH plot (figure 2b), $E_{1/2}$ vs. pH relationship (figure 3b) and similar slope values support this conclusion. The mixed polarogram (1:1) of stem extract and ephedrine hydrochloride (1.0 mol m^{-3}) at pH 5.3 has a single wave with enhanced height which proves the complete identity of the active

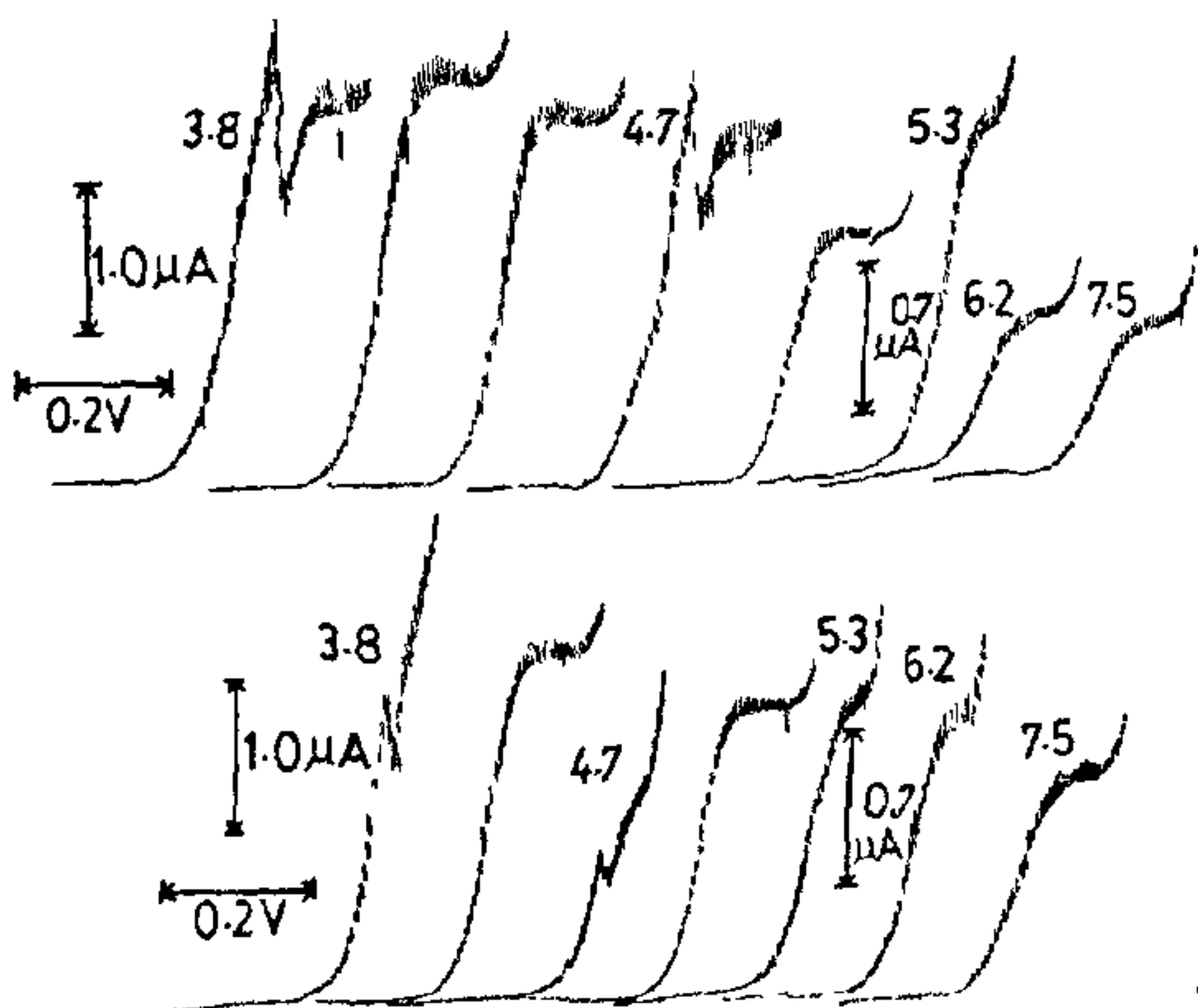


Figure 1. Polarograms of (a) Sida stem extract (.001 ml), (i), (iv), (vi), (vii), (viii): without maximum suppressor; (ii): with 0.02% gelatin; (iii) and (v): with 0.03% gelatin; (top, from left); (b) Ephedrine hydrochloride (1.0 mol m^{-3}); (i), (iii), (v), (vi), (vii): without maximum suppressor; (ii) and (iv): with 0.03% gelatin (bottom, from left); starting voltage: -0.8 V (versus sce).

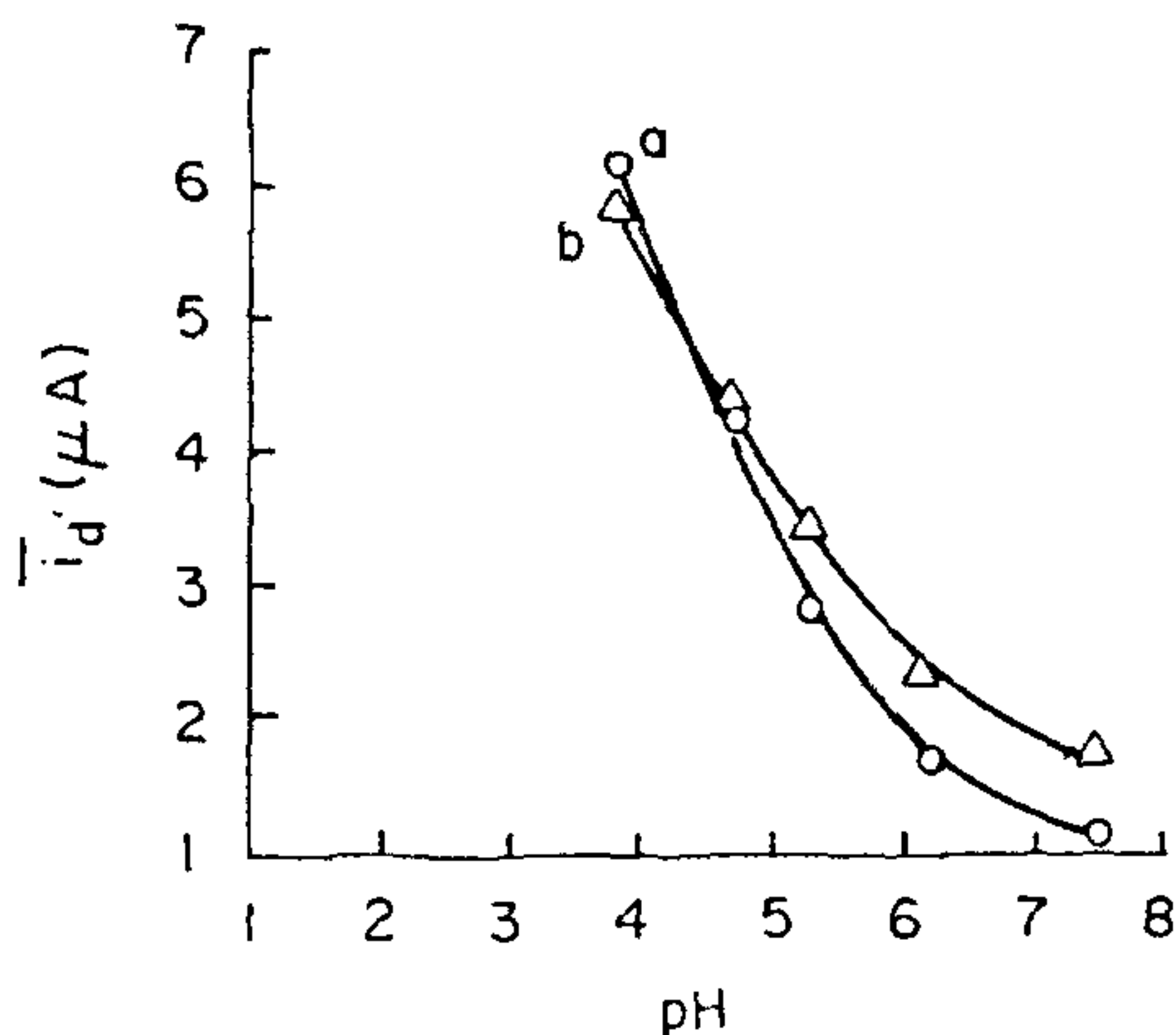


Figure 2. pH dependence of limiting current of waves of (a) Sida stem extract; (b) Ephedrine hydrochloride.

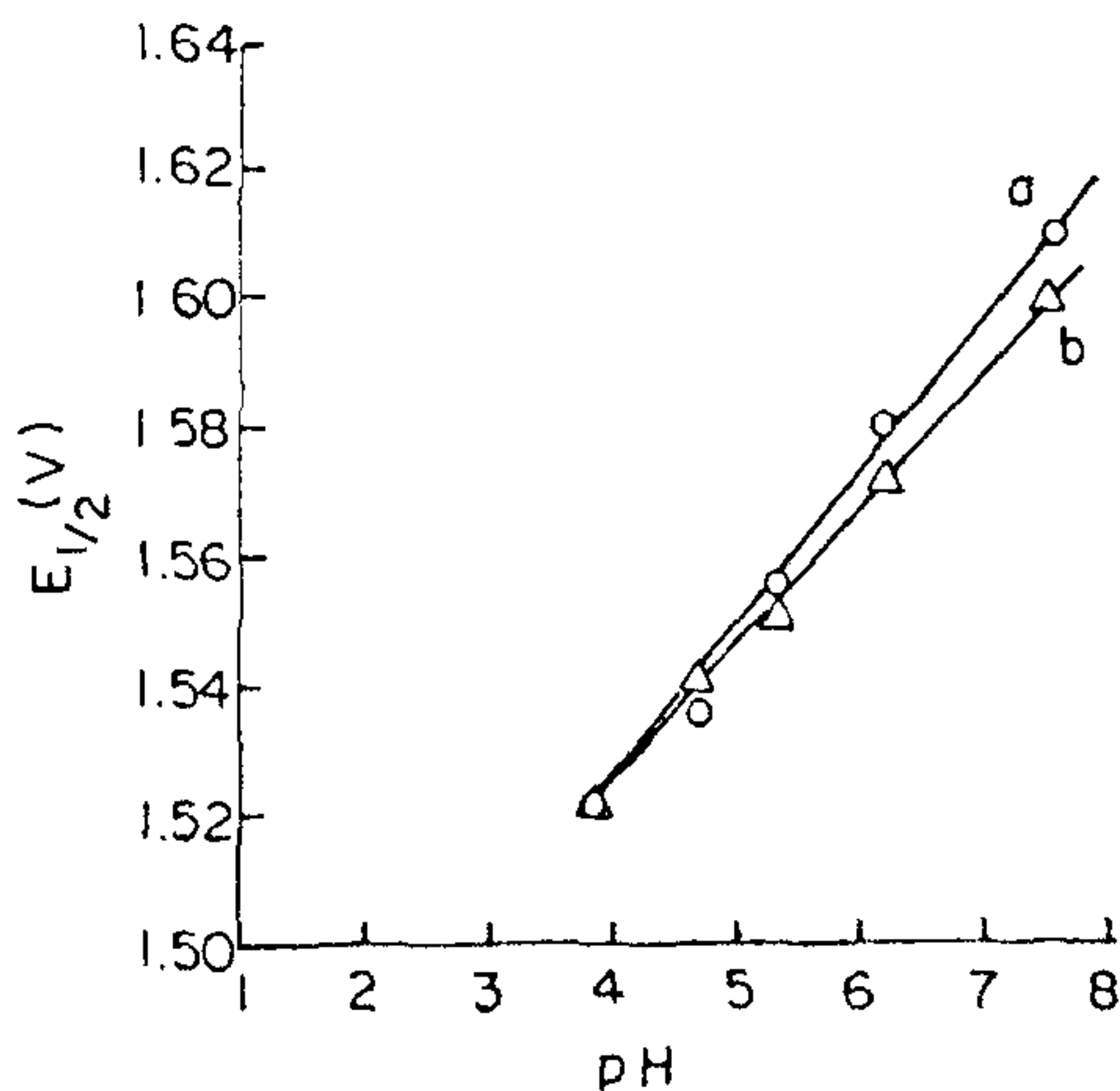


Figure 3. pH dependence of half-wave potential of waves of (a) Sida stem extract; (b) Ephedrine hydrochloride.

component of sida stem with ephedrine. The polarogram of sida root extract at pH 5.3 has half-wave potential very close to those for ephedrine and sida stem extract (-1.59 V , -1.595 V and -1.60 V for sida stem, root and ephedrine hydrochloride respectively). The $\log i$ vs. $\log h$ plots for the root extract are

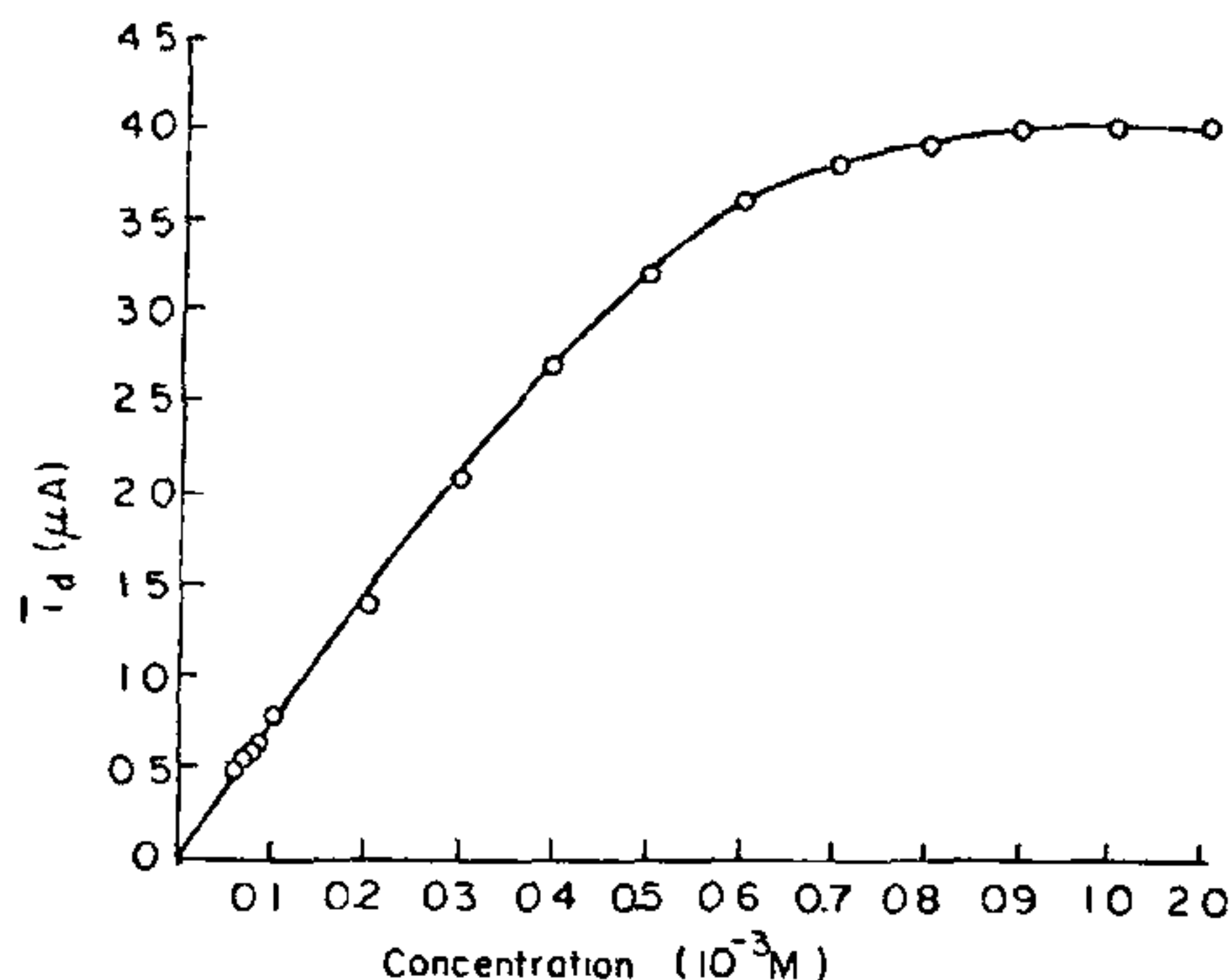


Figure 4. Concentration dependence of limiting current of waves of Ephedrine hydrochloride (pH 6.2).

very similar to those of stem extract and ephedrine; the slopes range from -0.20 , -0.20 and -0.23 at $-1.50 V$ to 0.34 , 0.32 and 0.34 at $-1.72 V$ for sida stem, root and ephedrine hydrochloride respectively.

To find the concentration of ephedrine in the sida stems and roots, polarograms for different concentration ($0.001-0.1 \text{ mol m}^{-3}$) of ephedrine hydrochloride (pH 6.2) have been recorded. The calibration curve (i_d vs concentration plot, figure 4) has the slope of $0.8 \mu A \text{ mmol}^{-1}$. The concentration of ephedrine in air-dried stems and roots are therefore, 1.86% and 1.64% respectively.

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- Zuman, P., *Coll. Czech. Chem. Comm.*, 1953, **18**, 36.
- Zuman, P., *Coll. Czech. Chem. Comm.*, 1954, **19**, 1140.
- Šantaýy, F. and Reichstein, T., *Helv. Chim. Acta.*, 1950, **33**, 1606.
- Chopra, R. N., *Indigenous Drugs of India*, U. N. Dhar and Sons Pvt. Ltd. Calcutta, 1958, p. 160.
- Nadkarni, A. K., *Indian Materia Medica*, Popular Book Depot, Bombay, 1954, p. 1137.
- Chopra, Nayar and Chopra, *Glossary of Indian medicinal plants*, CSIR, New Delhi 1956, p. 227.
- Ghosh, S. and Dutt, A., *J. Indian Chem. Soc.*, 1930, 825.

- Mairanovskii, S. G., *Catalytic and kinetic waves in polarography*, Plenum Press, New York, 1968, p. 252.

GROWTH EQUATION OF *SAPROLEGNIA*

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BACTERIAL cultures in an unlimited nutritive medium normally grow at a rate proportional to the number of bacteria at that time. In some cases, this ideal growth relationship is not obeyed. Although attempts^{1,2} have been made to establish the relationship between growth parameter and time, these equations do not represent the entire region of growth. Srivastava and Avasthi³, using the data of Wilson⁴ for the growth of *Salmonella pullorium*, suggested a new equation for the growth which represents the growth with time in the entire region. However, the validity of the equation³ has yet to be tested for fungal growth.

In this communication studies on the fungal growth of *Saprolegnia luxurians* (Bhargava & Srivastava) Seymour under three different light intensities are reported with a view (i) to studying the effect of light conditions on fungal growth and (ii) to work out the relationship between growth parameter and time.

The procedure followed for measurements of fungal growth was similar to the one adopted by Lee and Scott⁵. Single zoospores were used for inoculum and mycelial dry weights (in mg) were taken. SPS agar medium* defined earlier⁶ was used.

A 60 W Philips Argenta lamp emitting 400 ft-C intensity of light at a distance 60 cm was used for white light. A 30 W Philips germicidal lamp (1220 Å) was used for ultra violet. UV of the inoculated culture was irradiated at night under dark conditions for 2 min and

* Ingredients of SPS-Agar medium (g/L)

- Chelation agent: EDTA (0.5); 2. Buffer for pH 7.0: K_2HPO_4 (0.18), KH_2PO_4 (0.15); 3. Inorganic nutrients: $MgCl_2 \cdot 6H_2O$ (1.02), $CaCl_2 \cdot 6H_2O$ (0.02), $MnCl_2 \cdot 4H_2O$ (0.05), $ZnCl_2$ (0.05), $FeCl_3 \cdot 6H_2O$ (0.0014); 4. Organic nutrients: Methionine glucose (5.06), Sodium glutamate (mono) (2.02); 5. Ingredients of the above steps were dissolved in 972 ml of distilled water and then pH of the solution adjusted to 7 with KOH pellets, 6. Agar (20); 7. Autoclave the medium at 15 lbs. for 30 min.