



POLAROGRAPHIC INVESTIGATION OF KINETICS OF INVERSION OF SUCROSE

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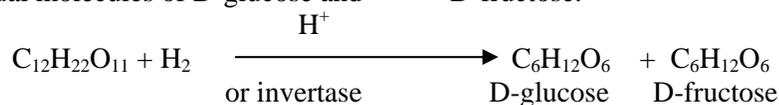
ABSTRACT

While carbohydrates exist almost entirely as cyclic hemiacetals in aqueous solutions, they are in rapid equilibrium with their open chain forms and behave in an analogous way as simple aldehydes and ketones. Sugars such as hexoses, give polarographic curve but the disaccharide such as sucrose do not. Sucrose may hydrolysis to fructose so that analytical use of reduction of fructose can be made in determination of sucrose. The study of increase in the wave height of fructose has been used to investigate the inversion of sucrose.

Keywords: Sucrose, polarography, inversion, disaccharide fructose, polarograms, DPP, DCP.

INTRODUCTION

The hydrolysis of sucrose by boiling with a mineral acid, or by the enzyme invertase, produce a mixture of equal molecules of D-glucose and D-fructose.

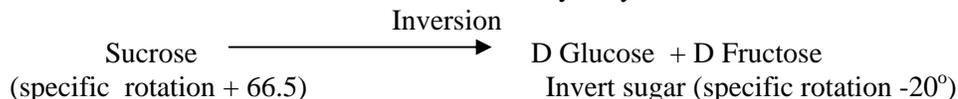


Sucrose solution is dextro rotatory but during hydrolysis it becomes laevorotatory.

The specific rotation of sucrose is + 66.5°. D-glucose has specific rotation +52° and D-fructose-92°. Therefore the net specific rotation of an equimolar mixture of D-glucose and D-fructose is-

$$\frac{+52 - 92}{2} = -20^\circ$$

In the process of hydrolysis, the specific rotation changes from +66.5° to -20°. The sign of the specific rotation changes from (+) to (-), or is said to 'Invert'. Hence the hydrolysis of sucrose to D-glucose and D-fructose is termed 'Inversion' and the hydrolysis mixture is called 'Invert - sugar'.



The enzyme that brings about inversion is named as invertase¹. The rate of inversion can be studied from the increase in concentration of fructose.

The rate of inversion of sugar, has been studied polarographically from the increase in the wave of fructose. Results have been discussed in the present paper.

EXPERIMENTAL

Determination of Fructose: 1 ml of 1M solution of fructose was transferred to a polarographic cell containing 10 ml of 1M CaCl₂. 5ml of 0.1% gelatin was added to the solution as a maximum suppressor.

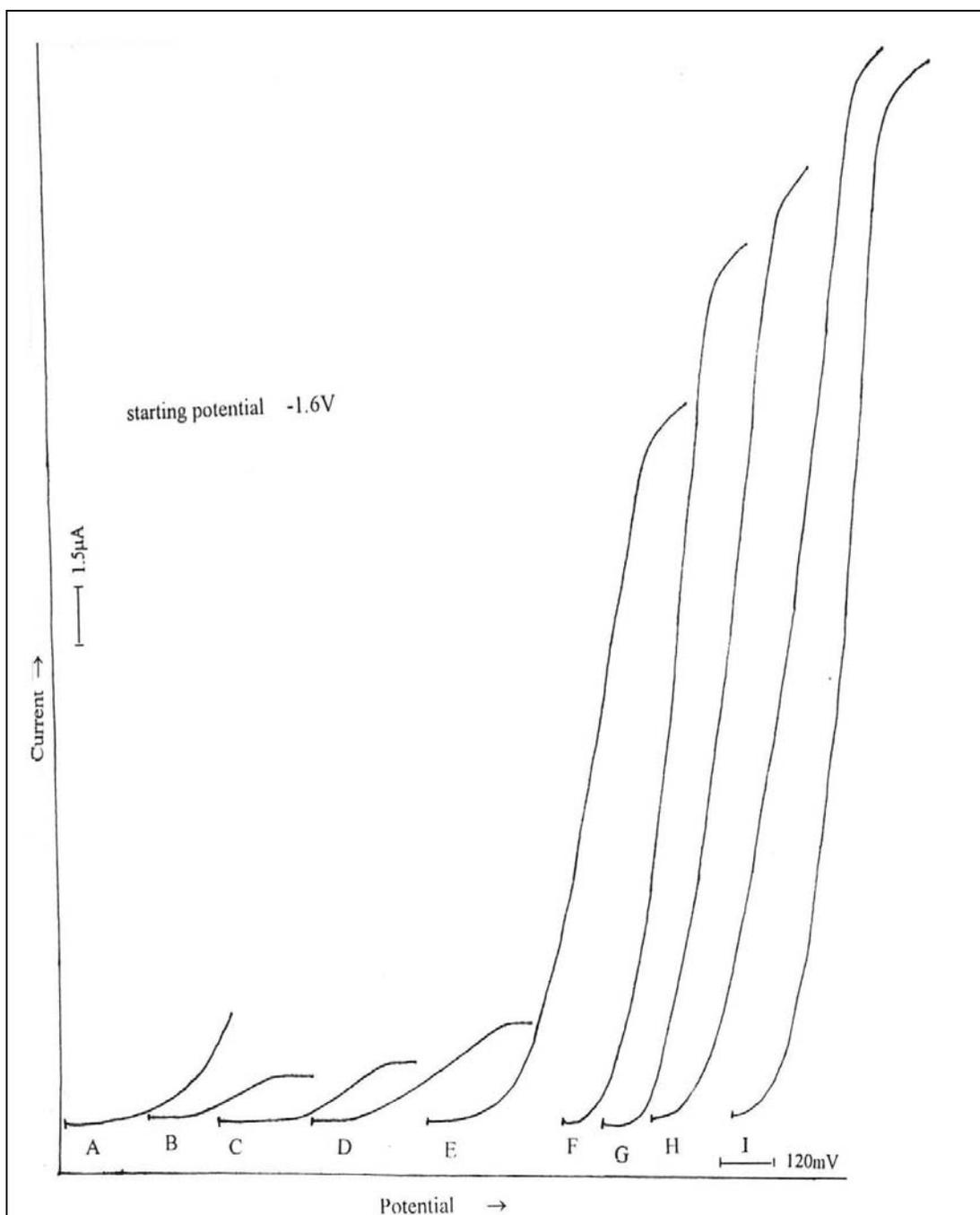
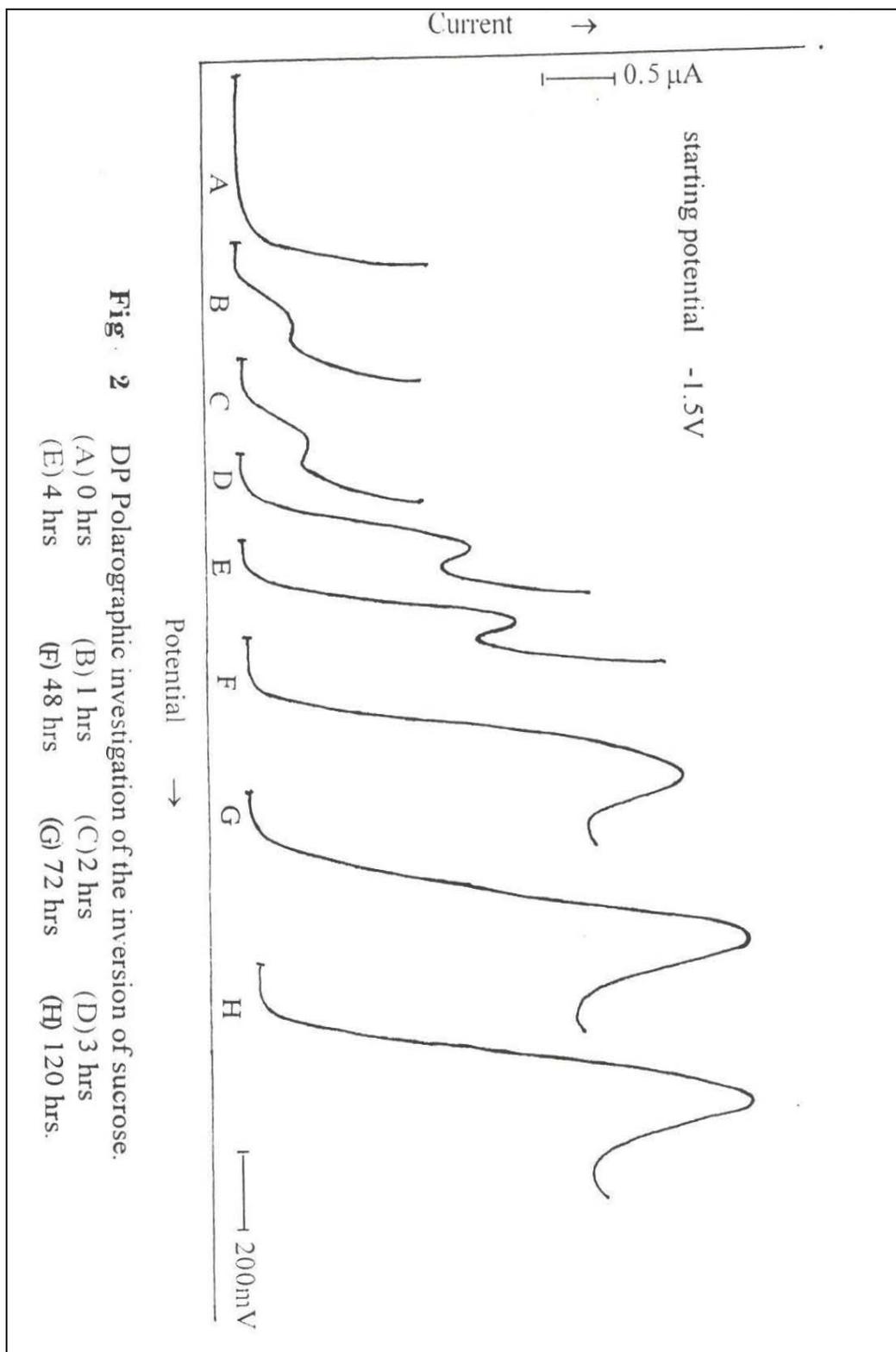


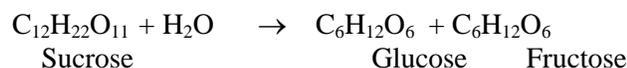
Fig 1 DC Polarographic investigation of the inversion of sucrose from the increase in the wave of fructose. From a 6% solution of sucrose in 0.1 N HCl, after a definite time (given in hours), 10 ml solution was taken, neutralised with 5 ml of 1 M LiCl and 5ml of 0.5 M NaOH, and diluted ten fold before polarographic analysis.

(A) 0 hrs (B) 2 hrs (C) 3 hrs (D) 4 hrs (E) 24 hrs
(F) 48 hrs (G) 72 hrs (H) 120 hrs (I) 144 hrs

1.



The fructose wave increases at -1.7V proportionally to its concentration. The reaction-



obeys the first order rate law as the amount of water present is in such an excess that its concentration may be considered to remain constant. The reaction is therefore a pseudounimolecular reaction. It has been studied by observing the increase in the polarographic wave of fructose at regular time intervals. The data has been depicted in Table-1 and 2. The constant value of k shows that the reaction is of first order. On the basis above data and ongoing discussion it could be concluded that the polarographic method is an accurate and reliable method for the study of kinetics of inversion of sucrose.

Table-1: Change in concentration of fructose with time

Time (Hrs.).	Concentration of fructose (mM)
1	0.031
2	0.059
3	0.084
24	0.470
48	0.609

Table-2: Rate constant for inversion of sucrose

t	a	a - x	k ₁
1	1.75	1.719	0.0177/hr
2	1.75	1.691	0.0166/hr
3	1.75	1.666	0.0161/hr
24	1.75	1.661	0.0130/hr
48	1.75	1.571	0.0096/hr

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