

VISCOSITY OF STARCH OF DIFFERENT VARIETIES OF RAGI (ELEUSINE CORACANA L., GAERTN) IN AQUEOUS SOLUTIONS AT DIFFERENT TEMPERATURES

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Twelve different varieties of starch were obtained from Ragi in usual way and were purified by the usual method [2]. Viscosity of these twelve different varieties of starch in aqueous solution at concentrations 0.1, 0.15, 0.20, 0.25, 0.30, 0.35 and 0.40 gm/ltr. At temperature, 30°, 35° and 40°C have been studied, and molecular weights were computed with a view to see their structure breaking effect on water. The detailed experimental procedure have been described earlier.

INTRODUCTION

Information of solute-solvent interaction of electrolytic solution in aqueous solution [1] are plenty, whereas the study of solute-solvent interaction in case of non-electrolyte is scanty. Hence the viscosities of twelve different varieties of starch obtained from twelve varieties of Ragi [2] in aqueous solutions concentration 0.1, 0.15, 0.2, 0.25, 0.3, 0.35 and 0.4 gm/ltr. at different temperature 30, 35 and 40°C have been studied [2] and from the knowledge of the B -values of reduced Jones-Dole equation [1] the structure breaking effect has been inferred. The detailed experimental procedure have been described earlier [1].

RESULTS AND DISCUSSION

The viscosity data of electrolytic solution are analysed as per Jones-Dole [1] equation :

$$\eta_r = 1 + A\sqrt{C} + BC \quad \dots(1)$$

and the plot of η_r vs. C is found to be linear and the B -values thus obtained from the slope are recorded in Table 1 for both the series.

DEPENDANCE OF B ON TEMPERATURE

According to Stokes and Mills [3], the viscosity of a dilute solution incorporates that of the solvent plus contribution of other sources. These are η^E , the positive increase due to size and shape of the solute, η^A , increase due to the alignment or orientation of the solvent molecules by the solute-solvent field and η^D , the decrease in viscosity arising due to the

distortion of the solvent structure by the solute. Therefore the B -Co-efficient has been discussed in terms of the viscosity effect at different temperatures. The positive B -values recorded in Table 1, indicates strong alignment of the solvent molecule with the solute, which undoubtedly promote the structure of the solvent molecule in its immediate vicinity. Thus, the net structure forming is found to be of the order :

$$S_1 > S_8 > S_9 > S_{10} > S_{11} > S_1 > S_2 > S_3 > S_4 > S_{12} > S_5 > S_6$$

and the structure breaking effect is of the reverse order.

$$S_6 > S_5 > S_{12} > S_4 > S_3 > S_2 > S_1 > S_{11} > S_{10} > S_9 > S_8 > S_7$$

Table 1. B/L. Mol⁻¹

	1st Series		
	30°C	35°C	40°C
S_1	0.1181	0.1190	0.1195
S_2	0.1044	0.1055	0.1065
S_3	0.0921	0.0933	0.0944
S_4	0.0717	0.0727	0.0739
S_5	0.0569	0.0583	0.0595
S_6	0.0348	0.0035	0.0359
S_7	0.481	0.500	0.512
S_8	0.463	0.475	0.487
S_9	0.311	0.320	0.332
S_{10}	0.301	0.309	0.317
S_{11}	0.182	0.193	0.199
S_{12}	0.064	0.071	0.079

DEPENDANCE OF B ON DIFFERENT TYPES OF STARCH

The increase in ' B ' co-efficient will be the change in the type of starch in the solvent may be attributed due to large size of the molecules and also through strong association through hydrogen bonding. For larger solvated ions would lead to large value of η^E and η^A , consequently $\eta^E + \eta^A > \eta^D$ and hence the B -coefficient become larger and larger with change in the type of starch in the solvent and structure breaking of the order is found to be of the order.

$$S_6 > S_5 > S_{12} > S_4 > S_3 > S_2 > S_1 > S_{11} > S_{10} > S_9 > S_8 > S_7$$

ACTIVATION PARAMETERS

Eyring *et al.*, [4] applied the theory of absolute rate to interpret viscosity of liquid by calculating the energy, free energy and entropy of activation. Nightingale and Benck [5] and Feakins *et al.*, [6] have shown that this theory of reaction rate can be successfully applied to solutions. Proceeding in the similar manner, ΔE (which does not differ much from ΔH), ΔG and ΔS for the solvents and solutes at 35°C have been calculated and are computed in Table 2.

It is observed that ΔG , ΔE and ΔS values are less than those of solvent, indicating a structure breaking effect.

Table 2. (Activation Parameter)

	1st Series		
	30°C	35°C	40°C
Solvent	4.57	10.05	14.33
S_1	3.11	7.45	10.22
S_2	3.25	7.85	10.89
S_3	3.77	8.45	10.41
S_4	3.47	8.81	10.94
S_5	3.95	9.11	12.34
S_6	4.11	9.45	13.44
	2nd Series		
S_7	3.44	10.05	14.33
S_8	3.72	8.55	11.75
S_9	3.87	8.77	11.99
S_{10}	4.02	8.99	12.24
S_{11}	4.18	9.25	12.89
S_{12}	4.22	9.55	13.33

The addition of different types of starch to water may give rise to two effects : if the starch having formula $(C_5H_{10}O_5)_n$ is accommodated in the solvent structure, it will strengthen the water structure because starch is a proton acceptor. If it cannot be accommodated because of its bulky size, then it may cause a breakdown in three-dimensional water structure, by loosing a -H atom from water. It is observed from the B -values and also from ΔE and ΔG values that the three dimensional water structure is broken down.

Name of the starch of different varieties of ragi (Eleusine coracana, L.Gaertn) are given in Table 3.

Table 3

S. No.	Name of variety
S_1	Co ₉
S_2	B ₇₇₉₃
S_3	T ₂₀
S_4	B ₄₋₁₀₋₅₆
S_5	I ₅
S_6	SL ₂₆
S_7	AKP ₇
S_8	A ₂₂₃
S_9	M ₁₈
S_{10}	PR ₂ O ₂
S_{11}	T ₂₅ ⁻¹
S_{12}	

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