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Hydrogen Ion Equilibria of Interaction of Ribonucleic Acid and Albumin-Bovine

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On interaction of ribonucleic acid and albumine-bovine the hydrogen ion equilibrium is altered both in aqueous and in 0.25 M KCl solution. The ± interaction in the protein chain makes the alteration in pH more prominent in salt solution than in aqueous medium. In acid titration this feature is absent. Conformational changes are also accompanied with the availabilities of charged sites in the interacting species of the protein and nucleic acid. A structural variation is expected to modulate the translation of conserved RNA in the protein synthesis during the interaction.

INTRODUCTION

The synthesis of proteins in the embryos of plant seeds and animals has been studied in detail[1–3]. The imbibition of the seed converts a metabolically inactive dormant embryo into an active state of growth and development. It has been shown[4] that conserved ribonucleic acid (RNA) directs protein synthesis during the early phase of germination of seeds. Lee and Ingram[5] have observed changes in specific t RNAs from erythrocytes of chick embryos. The quantitative changes in the total t RNAs and one species of alanine t RNA as well as the variation in acceptor activities of t RNAs in chick embryo[6] at different development stages have been found to modulate the translation of certain messenger RNAs containing a different codon for alanine. At the interface of protein and nucleic acid the conformation changes might be taking place due to the presence of hydrogen ion equilibria of the medium[7, 8] and the salt solution. In the present study the variation of pH in aqueous and in KCl solution has been reported. The titration curves are indicating the pattern of structural changes on the interaction of RNA and albumin-bovine.

EXPERIMENTAL

The samples of ribonucleic acid and albumin-bovine were obtained from the biochemical unit of Patel Chest Institute, Delhi University, Delhi. All other chemicals were BDH, AnalaR. Firstly, the nucleic acids and proteins were taken in double distilled water and pH titrations were taken in double distilled water and pH titrations were performed with Systronics pH meter. Then 20 mg of the samples were taken in 0.25 M KCl solution and N/20 acid/alkali were added in

drops. The volume of a drop was 0.03 mL. After each addition sufficient stirring was done so that equilibrium might be established. The pH measurements were in the range of 0.01 and precautions to prevent carbon dioxide absorption from the atmosphere were taken.

RESULTS AND DISCUSSION

The titration curves are shown in Figs. 1–4. In Figs. 1 and 2 the alkali titrations and in Figs. 3 and 4 the acid titrations are shown.

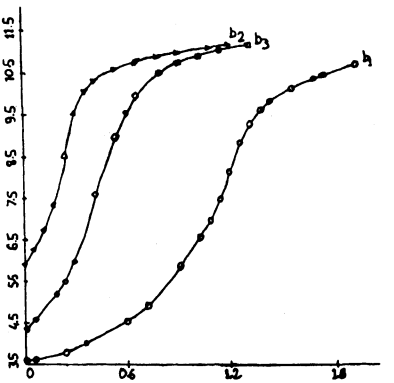

Fig. 1. Titration curves with KOH: b_1: pH curve of RNA in 0.25 M KCl; b_2: pH curve of RNA in albumin-bovine in 0.25 M KCl; b_3: pH curve of RNA in albumin-bovine in 0.25 M KCl.

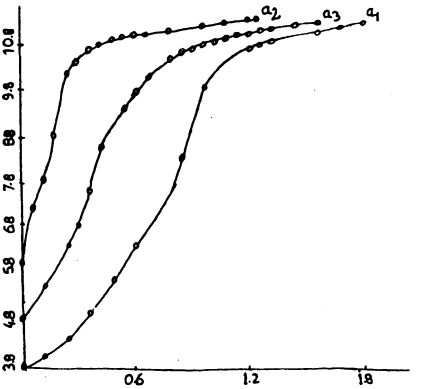

Fig. 2. Titration curves with KOH: a_1: pH titration curve of RNA in distilled water; a_2: pH titration curve of albumin-bovine water; a_3: pH titration curve of RNA + albumin-bovine water.

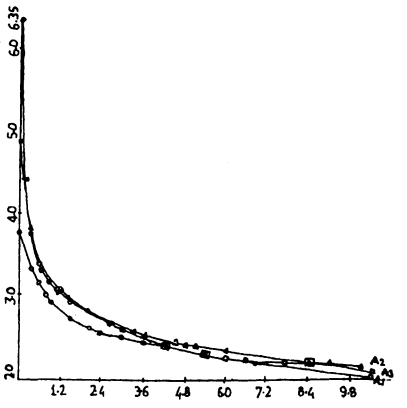

Fig. 3. Titration curves with HCl: A_1: pH curve of RNA in aqueous; A_2: pH curve of albumin in aqueous; A_3: pH curve of RNA + albumin-bovine in aqueous.

The quantitative change in pH with addition of acid/alkali is shown in Table-1 below:

TABLE-1
TITRATION IN AQUEOUS MEDIUM

Aqueous sample	Titration with N/20 HCl		Titration with N/20 KOH solution	
	Volume in mL	pH	Volume in mL	pH
RNA	1.2	3.12	0.2	4.20
	2.4	2.64	0.4	4.85
	4.8	2.40	1.2	10.20
Albumin-bovine	1.2	3.10	0.2	9.86
	2.4	2.60	0.4	10.85
	4.8	2.40	1.2	11.20
RNA + albumin-bovine	1.2	3.10	0.2	6.15
	2.4	2.65	0.4	9.40
	4.8	2.50	1.2	10.65

It is evident from the Table-1 that there is a marked variation of pH in N/20 KOH titration than in N/20 HCl titration. The interacted sample has pH in between pure protein and pure nucleic acid. This shows some of the groups are marked in the interaction process. Actually the acidic or alkali properties should have added together given the curve of titration of RNA albumin-bovine is not in the middle but at the top. But the changed situation suggests the conformational changes in the interaction process.

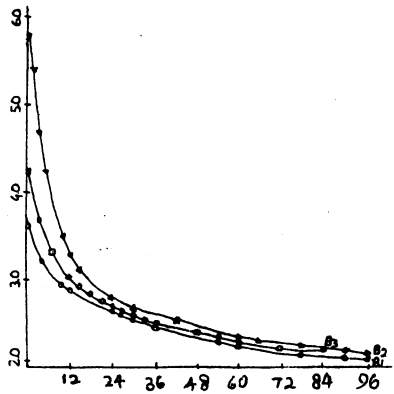

Fig. 4. Titration curves with HCl: B_1: pH curve of RNA in 0.25 M KCl; B_2: pH curve of albumin-bovine in 0.25 M KCl; B_3: pH curve of RNA + albumin-bovine in 0.25 M KCl.

Similarly the titration curves of samples in 0.25 M KCl solution show the intermediate stage of structural features. In Table-2 below the data are given:

TABLE-2
TITRATION VALUES IN 0.25 M KCl SOLUTION

Sample in 0.25 M KCl solution	Acid titration with N/20 HCl		Alkali titration with N/20 KOH	
	Volume in mL	pH	Volume in mL	pH
RNA	1.2	3.00	0.2	3.60
	2.4	2.65	0.4	3.85
	4.8	2.30	1.2	8.50
Albumin-bovine	1.2	3.25	0.2	8.80
	2.4	2.80	0.4	10.45
	4.8	2.65	1.2	10.90
RNA + albumin-bovine	1.2	3.10	0.2	6.35
	2.4	2.65	0.4	9.00
	4.8	2.45	1.2	10.80

In the large concentration of KCl solution the availability of ± charges has given a greater alteration in pH values compared to aqueous medium. There will be accumulation of large ions at different sites of protein and nucleic acid making the immobility of the polymer chain. Thus the titration curves are different from titration curves in distilled water. By this titration the conformational changes are also expected to take place. *In vivo* the situation may be more or less similar where protein synthesis takes place. It is the interacted species which is responsible for further addition of protein during the synthesis process. In plant, seeds or embryo, the conserved RNA first directs the protein synthesis and as

soon as a few molecules of protein are formed the structural variation makes it easier to form the further protein molecule.

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