SIMILARITIES BETWEEN THYMUS NUCLEIC ACID AND A POLYELECTROLYTE*

by

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The suggestion that Thymus Nucleic Acid (T.N.A.) behaves as a polyelectrolyte has lacked support since none of the synthetic polymers studied exhibited either the very marked changes in viscosity with rate of shear (β) or the relations between η/c versus c (c is the concentration, η the specific viscosity) found for T.NA.[1]. We have now found that the viscosity of dilute solutions of the sodium salt of polymethacrylic acid (P.M.A.) of high molecular weight ($2 \cdot 10^6$)—though not of mol. wt. $2 \cdot 10^5$—is strikingly similar to that of T.N.A.

From the figure it is seen that the relationship between η and β and the reduction of η on the addition of salt[2] and urea[3] is the same for P.M.A. as T.N.A. Moreover the η/c of P.M.A. at low rates of shear increases initially with concentration (compare curves *a* and *b*), and in this respect also resembles T.N.A.[1,4] and is in striking contrast to polybases for which η/c decreases sharply with concentration.

It is known from the studies of KUHN *et al.*[5] that the P.M.A. molecule is fully extended as a result of electrostatic forces when the degree of ionisation exceeds 50%, but that a reduction in the repulsion by decreasing the degree of ionisation or increasing the ionic strength leads to a coiling of the molecule. Furthermore we have shown that the non-Newtonian viscosity in the high-molecular-weight P.M.A. results from the formation of a network of long chains which are probably held together locally by hydrogen bonds, which are broken on the addition of urea. A similar structure has been proposed[6] for solutions of T.N.A. and the effect of urea on the η of T.N.A. is probably the same as for P.M.A.

By analogy, it is proposed that the T.N.A. molecule is flexible and that its shape is determined by electrostatic repulsion between the ionised phosphate groups, and if this is reduced (*e.g.* by adding salt) the molecule coils, thereby reducing the interaction between molecules and hence reducing the shear dependence of the viscosity. The length of the statistical element of T.N.A. (*i.e.* the average chain length whose orientation is independent of the neighbouring chain element) is probably comparatively long due to the rigidity imposed by the bulky side-chain, and therefore the coiled T.N.A. molecule will still be asymmetric and show streaming birefringence.

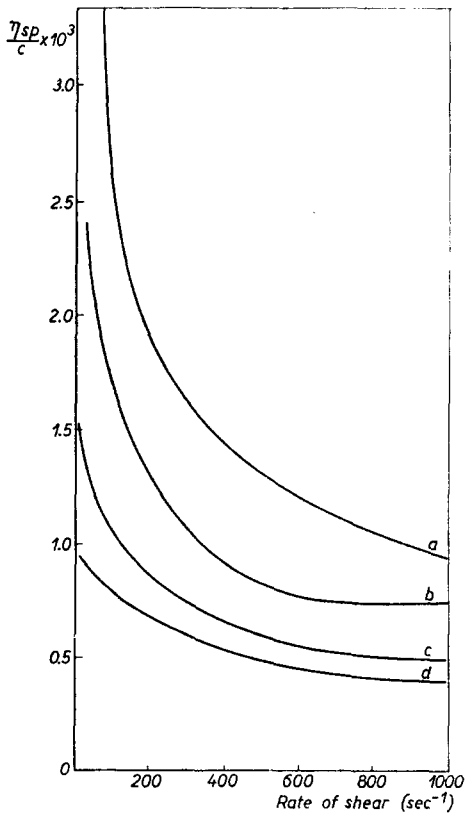

Fig. 1. Viscosity at different rates of shear of polymethacrylic acid (60% neutralised); (a) concentration 0.006 *N* P.M.A. (b) 0.00025 *N* P.M.A. (c) 0.006 *N* P.M.A. + 0.01 *M* KCl. (d) 0.006 *N* P.M.A. + 4 *M* urea

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A more detailed paper on this investigation will be submitted for publication in a later number of this journal*.

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THE ROLE OF RIBONUCLEIC ACIDS IN AMYLASE SECRETION BY PANCREAS SLICES

by

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CASPERSSON AND BRACHET and collaborators[1,2] observed that cells which synthesize digestive enzymes (*e.g.*, acinar cells of pancreas and chief cells of stomach) contain high concentrations of ribonucleic acids. They regarded these findings as evidence that ribonucleic acids are concerned in the synthesis of cytoplasmic proteins. GUBERNIEV AND IL'INA[3] were led to similar conclusions by their observation that the *in vivo* stimulation of enzyme secretion in digestive glands resulted in increases in the rate of incorporation of ^{32}P into the nucleoproteins (400% in parotid, 500% in liver and 1200% in pancreas).

An alternative explanation for the above observations is the assumption that ribonucleic acids are concerned with enzyme secretion (by which is meant the active extrusion of enzymes) rather than enzyme synthesis. Pancreas slices *in vitro* represent a system in which the synthesis and secretion of enzymes can be studied separately, since either can be stimulated without effect on the other (HOKIN[4]). The experiments reported below were designed to test whether there is a correlation between either of these processes and ribonucleic acid metabolism.

Amylase synthesis and secretion by pancreas slices were measured as described earlier[4]. 10–20 μC of ^{32}P was added as H_2PO_4 to each vessel. The specific activities of the ribonucleic acids were determined after their isolation (as a mixture of nucleotides) by the method of SCHMIDT AND THANNHAUSER[5] followed by paper chromatography (MARKHAM[6]).

An approximate doubling of the rate of amylase synthesis by the addition of an appropriate amino acid mixture did not result in any appreciable increase in the rate of uptake of ^{32}P into ribonucleic acids. This suggests that protein synthesis is not linked to ribonucleic acid metabolism. On the other hand, a 50–100% stimulation of amylase secretion by the addition of carbamylcholine was accompanied by a corresponding increase in the rate of uptake of ^{32}P into ribonucleic acids. The phosphorus of the ribonucleic acids in unstimulated slices reached equilibrium with inorganic phosphorus after about 80 minutes, when about 0.5% of the phosphorus in the ribonucleic acids had exchanged. On the other hand, in stimulated slices the phosphorus of the ribonucleic acids did not reach equilibrium with inorganic phosphorus until about 1–1.5% of the phosphorus had exchanged. Thus in stimulated slices more phosphate groups in the ribonucleic acids seem to be labile. Since neither respiration nor the turnover of acid-soluble organic phosphorus was increased when

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