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NOTE

Surface Interaction of Proteins

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Proteins contain a lot of hydrogen bonds. The rupture of these hydrogen bonds are responsible for the helix coil transition in protein leading to the conformational changes having a little variation of pH and ionic strength. But the situation is different both in solid state and in the atmosphere of various percentages of water vapour. Surface interaction of ammonia gas on casein and ovalbumin has been found to be facilitated by the adsorption of moisture on these proteins. The ± interaction and proton transfer on the surface of solid proteins seem to be easier with moist molecules. Some conformational changes also occur due to the exchange of hydrogen bond between ammonia and amide linkages in protein chain. The exchanging capacity decreased considerably in ammonia than in the vapour of alcohol.

Proteins are polyampholytes with the principal chain in the molecule made up of peptide linkages. A polyampholyte molecule would be charged positively in an acid solution and, negatively, if the solution is alkaline. At an intermediate point, the so called isoionic point, the number of positive charges becomes equal to that of negative charges. Proteins, in the solid state, have different behaviour. The helix-coil transition has no scope in this state. The total number of charged sites and the net charge is not the same. Far from the isoionic point, which is the same as the isoelectric point, in the absence of any foreign electrolyte, the protein solution is expected to behave as ordinary polyacids and polybases. Tanford and Kirkwood[1, 2] have shown the conformational changes of proteins on changing the medium.

The study of surface chemistry of proteins in the solid state is rather limited[3–5]. The simple technique of adsorption of molecules has been used in the present investigation mainly with a view to throw light on the surface interaction of proteins.

The samples of proteins, ovalbumin and casein were purchased from the biochemical division of Patel Chest Institute (Delhi University), Delhi. Ethyl alcohol was freshly distilled over sodium wire before use. Dried ammonia gas was obtained by laboratory method of preparation of the gas. 2 g of the protein

was taken in a petri dish each time. It was first kept for seven days in a desiccator containing water and then transferred to another desiccator filled with ammonia gas at atmospheric pressure. This desiccator was placed in an oven having temperature 25 ± 1°C. After keeping for seven days, the increase in weight of the protein sample was noted with an analytical balance weighing up to 0.1 mg.

The same procedure was repeated with the proteins kept in the desiccator containing saturated solution of ammonium chloride having 80% water vapour, conc. H_2SO_2 having zero water vapour and also with ethyl alcohol vapours. These steps were followed by keeping for seven days in ammonia gas and noting the increase in weight of the protein samples.

On the charged sites of the polymer chain of the protein, adsorption and interaction take place. The attachment will be different with different constituents and the environment. Table-1 shows the increase in weight of the sample with different atmosphere in the desiccator.

TABLE-1

Protein	Chemicals in the desiccator	Percentage increase in weight on keeping in ammonia gas
Ovalbumin	H_2SO_4	4.3
	Water	13.6
	NH_4Cl solution	7.4
	Ethyl alcohol	3.2
Casein	H_2SO_4	3.7
	Water	10.8
	NH_4Cl solution	5.6
	Ethyl alcohol	5.6

From the above it is clear that alcohol decreases markedly the capacity to absorb ammonia gas. In H_2SO_4 when the presence of water vapour is minimum the adsorption is also low. A solvent having hydrogen bond interacts on the surface of the protein and the increase in weight is less. The proton transfer and ± interaction seem to be easier in moist molecules. The viscometric studies on synthetic polypeptides have been reported to give similar behaviour. The molecules on the surface are physically adsorbed as the adsorption in the solid state is facilitated. It has been reported[6] that in the aqueous state the proteins are adsorbed due to lowering of surface tension in comparison to any non-aqueous liquid. This is in conformity with the potential energy consideration. Also the oxidation potential in the aquecus state is much higher than in any other state. Hydrogen bonds present in these proteins seem to rupture and with the denaturation, the interaction in ammonia gas is easily done. The amide group and the carboxyl group are two available sites where ammonia gas is adsorbed.

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