Adsorption of Proteins from Aqueous Solution on the Films of Stearate and Lipids[1]

By Taro TACHIBANA,[2] Kiyoshige FUKUDA and Kozo HAMAGUCHI[3]

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A metal slide covered with a barium stearate multilayer film, which was rendered hydrophilic by treating with thorium nitrate solution, is highly polar and can adsorb proteins from their solution. A slide prepared in this way is dipped into a protein solution. The following washing and drying bring an increase in thickness which can be measured optically. We have studied, by such a procedure,[4] the adsorption of proteins. Some interesting phenomena observed in the investigation are briefly described below. The detailed description may be given elsewhere.

1. Adsorption of egg albumin from its aqueous solution was studied on the surface of stearate film conditioned with thorium nitrate. The effect of concentration of the solution and the time alloted for adsorption have been measured.

Preliminary experiments have led to the results that the adsorption was completed within five minutes at room temperature and the maximum thickness was 50 Å. which was deposited from the aqueous solution of the concentration over 0.01 percent. The adsorption was irreversible.

As far as the stearate film was left dipping in solution, the thickness of adsorbed layer never exceeded 50 Å. However, after taking

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(2) Present address, Chemical Lab. Ochanomizu University for Women, Bunkyo-ku, Tokyo.

(3) Present address, The Institute of Scientific and Industrial Research, Osaka University, Sakai, Osaka.

(4) I. Langmuir and V. J. Schaefer, *J. Am. Chem. Soc.*, **59**, 1406, 1672 (1937).

out the film from solution with the following washing and drying, the second dipping permitted the further increase of the thickness of adsorbed layer though the rate was much slower than in the case of the first dipping, *i. e.*, the increment was about 10 Å. thick at one hour after the beginning of the second adsorption. Thus, the repetition of dipping and drying always enhanced the adsorption. This seems to indicate that drying caused a certain change in the structure of adsorbed layer. Adsorbed layer of protein was found to decrease in thickness by bringing contact with 8 molal solution of urea. For instance, by this treatment the adsorbed layer decreased from 44 to 22 Å. in thickness for 16 hours, where it attained at minimal thickness.

By the way, it may be noted that the adsorption of egg albumin on unconditioned surface produced 20 Å. thick for 24 hours at 0°.

2. Likewise, experiments were performed with horse serum proteins. As shown in Table 1, it resulted that serum albumin was adsorbed on hydrophilic surface alone, while serum globulin was equally adsorbed from saline solution on both hydrophilic and hydrophobic surfaces. Serum globulin was not fractionated, so that which of the fractions was responsible for the phenomena was not established. Table 1 shows that salt also suppresses the adsorption of serum albumin.

3. A peculiar phenomenon was observed in dipping a slide having stearate multilayer film into rabbit serum. The maximal thickness of adsorbed layer, 50 Å., was obtained on the conditioned surface of stearate film, whereas with unconditioned stearate film the decrease of thickness of stearate film occurred at the rate of 15 Å. per one hour. This may be a case of solubilization and suggest a method of measuring the solubilizing power of serum towards a fatty acid.

Table 1

Adsorption of Horse Serum Protein from Solution onto Barium Stearate Film Conditioned or not with Thorium Nitrate.

Protein solution	The thickness of adsorbed layer on	
	Conditioned surface, Å.	Unconditioned surface, Å.
Serum albumin in aq. solution, 0.5%	36	5
Serum albumin in physiologically saline solution, 0.5%	28	0
Serum globulin in physiologically saline solution. 1.5%	68	71

Each figure represents an average of several determinations. Error is within 3Å.

4. Furthermore, experiments were made of the adsorption of serum protein on a single monolayer of lipids[5] transferred onto conditioned stearate film at compression of 15 dynes. Such a slide was dipped into human serum for ten minutes at 10°. The adsorption produced the thickness of 50-60 Å. on cardiolipin monolayer, 25-35 Å. on lecithin monolayer. These results may indicate the adsorptive power of respective lipids to serum portein.

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Department of Chemistry, Faculty of Science, the University of Tokyo, Tokyo

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