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Note

Adsorption of inorganic anions on Sephadex gels

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Numerous workers have studied the adsorption of organic substances on Sephadex gels (see, for example, Janson¹), and it is generally believed that the main mechanism of adsorption is a hydrophobic interaction. Recently, some workers have recorded the rather strong adsorption of some inorganic anions such as iodide^{2,3} and perchlorate⁴ and have advanced complicated explanations for this adsorption.

In paper chromatography, the adsorption of several inorganic anions has been observed in both neutral and acidic aqueous solutions. This adsorption is usually stronger on resins, where no ion exchange is possible, than on paper. There is usually a salting-out effect with increasing electrolyte concentration⁵ and usually desorption is produced by adding organic solvents to the developing solution⁶.

Sephadex gels are cellulose-like glucose polymers that are made "hydrophobic" by the introduction of cross-linking and, for Sephadex LH-20, by the addition of $-C_3H_6OH$ groups. We therefore felt that an adsorption similar to that observed on cellulose should be observed on Sephadex gels, and carried out the experiments reported in this paper.

EXPERIMENTAL

Sample solutions (0.1 M) were prepared by dissolving suitable amounts of reagents (Carlo Erba, Milan, Italy) in 0.01 M hydrochloric acid.

Sephadex G-25 and G-200 Superfine and Sephadex LH-20 (Pharmacia, Uppsala, Sweden) were swollen in the eluents for at least 24 h and spread on 20×20 cm glass slides, which were then put into a TLG chamber (Pharmacia apparatus) and conditioned at an angle of 17° for 24 h. Samples of 3 or 4 μ l were used. After development for 3 h, the samples were transferred from the wet layer onto a Whatman No. 1 filter-paper sheet and detected by the usual spot tests.

The void volume was assumed to be the position of Blue Dextran 2000, while $Co(NH_3)_6^{3+}$ was used as a reference substance for the movement of a small and non-interacting ion.

RESULTS AND DISCUSSION

Fig. 1 shows clearly that the ions examined behave in the same manner as on cellulose paper or a range of resins (where there is no ion exchange).

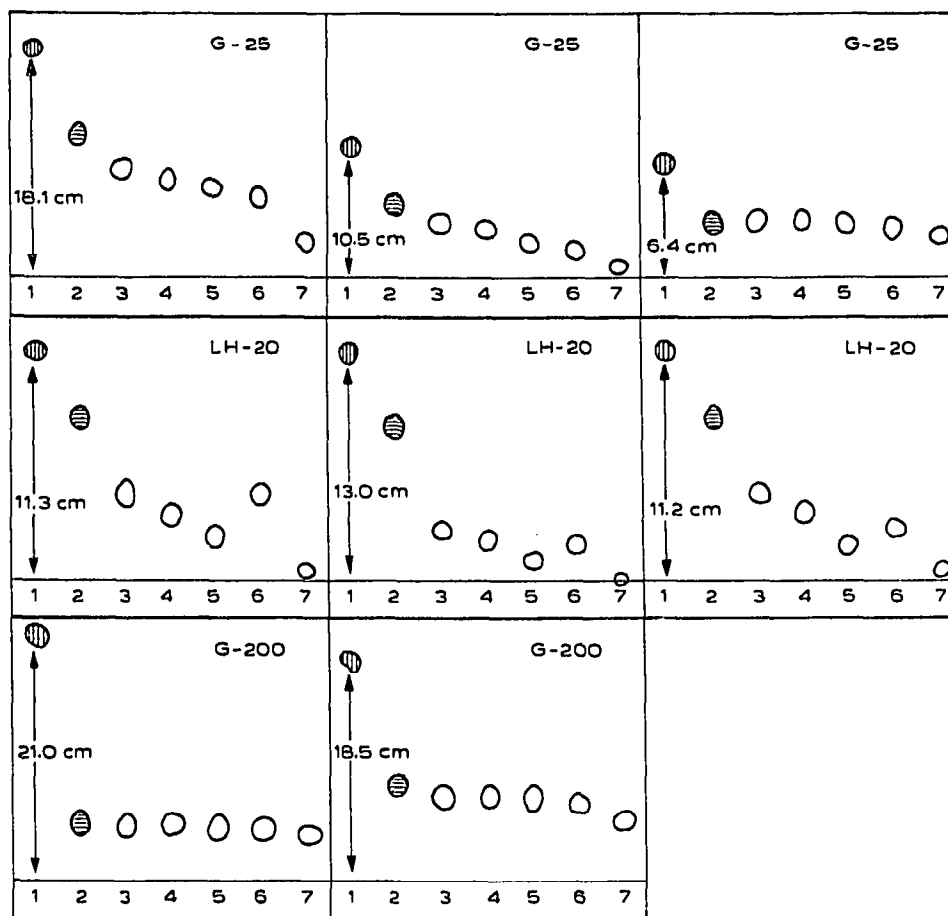


Fig. 1. Thin-layer gel filtration chromatograms: 1, Dextran Blue; 2, $\text{Co}(\text{NH}_3)_6^{3+}$; 3, iodide; 4, thiocyanate; 5, perrhenate; 6, bichromate; 7, chloroauric acid (HAuCl_4). Gels (top to bottom): Sephadex G-25; Sephadex LH-20; Sephadex G-200. Eluents (left to right): 0.01 *M* hydrochloric acid; 4 *M* lithium chloride solution; ethanol-0.01 *M* hydrochloric acid (1:1). The distance moved by Dextran Blue is indicated on each chromatogram.

All anions are not adsorbed or are very slightly adsorbed on Sephadex G-200, owing to the low degree of cross-linking of this gel and also to the higher solvent: support ratio than that encountered in paper chromatography. There is considerable adsorption on Sephadex G-25 and even more on Sephadex LH-20. There is a strong salting-out effect when lithium chloride is used as solvent instead of 0.01 *M* hydrochloric acid and there is a strong desorption effect on Sephadex G-25 when ethanol-0.01 *M* hydrochloric acid (1:1) is used instead of 0.01 *M* hydrochloric acid alone. On Sephadex LH-20, desorption is not noticeable with ethanol-0.01 *M* hydrochloric acid (1:1), probably owing to the high hydrophobicity of the gel.

The ions selected for this study are those which we found to be adsorbed strongly on cellulose from neutral or quasi-neutral solutions. Some chloro-complexes

such as those of gallium(III) and polonium(IV) would require a high hydrochloric acid concentration in the aqueous phase and were thus precluded from this study owing to the poor stability of Sephadex gels in acid medium.

There now seems to be the possibility of using Sephadex gels for inorganic separations using this hydrophobic adsorption, which may be of special interest in metal complex chemistry where neutral species such as the $\text{PtCl}_2(\text{NH}_3)_2$ type of complexes are involved. Work in this direction is being planned.

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