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This Week's Citation Classic

Dunker A K & Rueckert R R. Observations on molecular weight determinations on polyacrylamide gel. *J. Biol. Chem.* **244**:5074-80, 1969. [Biophysics Lab. and Dept. Biochemistry, Univ. Wisconsin, Madison, WI]

Electrophoresis in SDS-polyacrylamide gels provides a simple, inexpensive method for separating proteins, determining their relative proportions and estimating their molecular weights. This method has revolutionized the study of viruses, chromosomes, ribosomes, and membranes. [The *SCI*® indicates that this paper has been cited over 680 times since 1969.]

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"By 1965 my thesis advisor, Roland Rueckert,[1] and, independently, Jacob Maizel[2] had shown the picornavirus coat to contain several proteins. Rueckert and Maizel both used polyacrylamide gel electrophoresis in the presence of 8 M urea. My problem was to determine the relative proportion and the molecular weight of each coat protein.

"I attempted to improve the separation of the virus proteins in the gels containing 8 M urea by trying every pH at which polyacrylamide remains stable, without success. Inadvertently, I even tried pH values in which polyacrylamide is only metastable.

"Then came the remarkable paper by Shapiro, Vinuela, and Maizel[3] showing that, in gels containing sodium dodecyl sulfate (SDS), proteins migrate during electrophoresis according to their molecular weights. Thus, in one experiment we could dissolve and separate the picornavirus capsid proteins, determine their sizes and, by integrating the protein peaks, estimate their relative proportions. What would have been a monumental task (and probably several PhD theses) had suddenly become one relatively simple experiment. However, before SDS gels would be useful to us, the reliability and the limitations of the method needed to be established, especially for virus capsid proteins.

"We studied about 20 proteins including several virus capsid proteins and also chemically modified proteins to determine the effects of size, charge, and shape on the mobility of SDS-protein complexes. To our utter amazement, large changes in the charge and in the internal disulfide bonding registered as small, second order perturbations on the molecular weight estimates. Virus capsid proteins gave the correct molecular weight values. Extensions of this early work have been published.[4]

"Once we were able to set limits on the reliability of SDS gels, we used this method to study the picornavirus capsid proteins.[5] 'Observations on molecular weight determinations on polyacrylamide gel' was published belatedly as an afterthought. Despite our tardiness, our paper was received and published only about a month after the blockbuster by Weber and Osborn.[6] Occasionally I wonder what the outcome would have been of publishing our SDS-gel work before, rather than after, our studies on the picornavirus capsid."

1. **Rueckert R R.** Studies on the structural protein of ME virus. *Fed. Proc.* **23**:160, 1964.
2. **Maizel J V.** Evidence for multiple components in the structural protein of type 1 polio virus. *Biochem. Biophys. Res. Commun.* **13**:483-9, 1963.
3. **Shapiro A L, Vinuela E & Maizel J V.** Molecular weight estimation of polypeptide chains by electrophoresis in SDS-polyacrylamide gels. *Biochem. Biophys. Res. Commun.* **28**:815-20, 1967.
4. **Dunker A K & Kenyon A J.** Mobility of sodium dodecyl sulphate-protein complexes. *Biochemical J.* **153**:191-7, 1976.
5. **Rueckert R R, Dunker A K & Stoltzfus C M.** The structure of mouse-elberfeld virus: a model. *Proc. Nat. Acad. Sci. US* **62**:912-19, 1969.
6. **Weber K & Osborn M.** The reliability of molecular weight determinations by dodecyl sulfate-polyacrylamide gel electrophoresis. *J. Biol. Chem.* **244**:4406-12, 1969.