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Micrurgical Studies of Soaps, Glycerine, Dextrose and Ethylene Glycol on Amoeba Proteus.*

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Amoeba proteus was immersed in various soaps, glycerine, dextrose, and ethylene glycol, and these substances were also injected into the ameba by means of the micrurgical apparatus.[1] Some of these substances were studied as possible vehicles and others for their specific effects.

The soaps used were the following sodium compounds: eleidate, laurate, linoleate, linolenate, myristate, oleate, pelargonate, ricinoleate, ricinstearolate, trihydroxystearate. In both the immersion and injection experiments the action of the soaps is the same, a solution of the plasmalemma. As far as can be seen, the internal protoplasm is not affected. These soaps dissolve the plasmalemma at rates which vary with the concentration.

In immersion experiments the plasmalemma disappears within a minute in concentrations of 0.1 to 0.5 per cent; in 24 hours in concentrations of 0.003 to 0.01 per cent; in 2 to 4 days in concentrations of 0.0001 to 0.002 per cent. A comparison of these soaps shows their relative toxicity to be the following: through 1 day, myristate > eleidate > oleate > linolenate > linoleate > laurate > ricinoleate > ricinstearolate > pelargonate > trihydroxystearate; from 2 to 5 days, myristate > laurate > ricinstearolate > oleate > eleidate, pelargonate > linolenate > linoleate > ricinoleate > trihydroxystearate.

In injection experiments it was found that the ameba could repair its dissolved plasmalemma after small injections of solutions of the various soaps, ranging from 0.1 to 1 per cent in concentration. No solution occurred after introduction of small amounts of 0.05 to 0.5 per cent; of moderate injections of 0.01 to 1 per cent; of large quantities of 0.005 to 0.25 per cent. A water effect was obtained with 0.001 to 0.02 per cent.

The following results were obtained with respect to the toxicity of the injected soaps: from 0.25 to 1 per cent laurate, linoleate, ricinoleate > myristate > oleate > eleidate > linolenate > ricin-

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stearolate > pelargonate > trihydroxystearate; 0.25 per cent and more dilute solutions, eleidate > oleate > linolenate > ricinstearolate > myristate, laurate, linoleate > ricinoleate > trihydroxystearate, pelargonate.

In both immersion and injection experiments a comparison of the rates of toxicity with respect to concentration indicates that sodium ricinoleate is the most rapidly toxic in its solvent action on the plasmalemma. It is interesting to note this fact in view of the comparison made by Rideal[2] who shows that, depending on the concentration of the soap in the external phase, the mean area occupied by a molecule of sodium ricinoleate is higher than that of any other soap tested.

Glycerine, dextrose and ethylene glycol all affect the ameba in a similar manner. In immersion experiments lethal concentrations cause the ameba to shrink and become rounded. The action seems to be due essentially to an osmotic or dehydrating effect.

Amebae can live for 1 hour in M/2 glycerine, but are sluggish. They remain living and well in M/4 for a few hours, and in M/8 for at least 5 days. In dextrose the amebae can live for 1 hour in M/4, for 1 day in M/8, and through 5 days in M/12. In ethylene glycol, amebae die quickly in concentrations stronger than M/5. In more dilute solutions they live at least through 5 days.

The injection of glycerine, dextrose and ethylene glycol produces exactly the same action as that caused by the introduction of large amounts of water,[3] *viz.*, lifting of the plasmalemma and a rushing effect. In lethal doses this rushing action eventually results in a break in the plasmalemma. Whether this is due to the mechanical rupture of the violently active plasmalemma, or to a chemical effect of the injected compound or to the water, which is, in all probability, subsequently imbibed, could not be ascertained.

Amebae can recover from a small injection of 5M glycerine, a moderate amount of M/2 and a large quantity of M/4. They can recover from a small injection of M/1 dextrose, from a moderate amount of M/2 and from a large quantity of M/4. Ethylene glycol is the least toxic of these three compounds. It can be injected without toxic effects in small amounts in 17.7M (100 per cent), in moderate quantities in 8.8M (50 per cent), and in large doses in 4.4M (25 per cent).

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[1] Chambers, R., *Anat. Rec.*, 1922, xxiv, 1.

[2] Rideal, E. K., An Introduction to Surface Chemistry, University Press, Cambridge, Eng., 1926, p. 112.

[3] Chambers, R., and Reznikoff, P., *J. Gen. Physiol.*, 1926, viii, 369.