

## Resorcinol (Fructose) Reaction in Cerebrospinal Fluid.

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Roe's<sup>1</sup> method for determining fructose in blood, an application of the resorcinol method, has been applied to 39 specimens of spinal fluid from 34 human subjects. The average concentration found was 4.1 mg. per 100 cc., while determinations on blood and plasma gave values of from 1 to 2 mg. per 100 cc. The substance which gives the test is completely destroyed when 2 cc. of spinal fluid is incubated with 0.5 cc. of yeast for 10 minutes, or when sterile spinal fluid is inoculated with *B. coli communis* or *B. coli communior* and incubated for 24 hours. It, therefore, has the biological properties of fructose and glucose, but not of sucrose.

The orcinol compound formed from dilute spinal fluid has the same absorption spectrum as that from fructose. When strong glucose solutions were treated by the technique a somewhat different spectrum, with relatively less absorption in the green portion of the spectrum, was obtained. Undiluted spinal fluid, or corresponding mixtures of glucose and fructose, gave similar spectra.

Additional evidence that the color was not given by the glucose in spinal fluid was obtained by repeated simultaneous analyses of dilute glucose solutions and serial dilutions of spinal fluid, which showed that only a small part of the color developed could have come from the glucose present.

It seems improbable that phosphoric acid esters of sugars could explain the finding, for (1) there is not sufficient organic phosphorus in spinal fluid to account for more than a trace of the "fructose" found,<sup>2</sup> and (2) when the method of Cori and Cori<sup>3</sup> was applied to spinal fluid only a small fraction—approximately 2%—of the total color-producing substance was precipitated.

The amount of "fructose" in the spinal fluid closely paralleled the amount of glucose (total reducing substances) present. It could be increased by injecting glucose. It was absent from a specimen containing no sugar, but practically free from cells.

It seemed logical to investigate the production of "fructose" from

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<sup>1</sup> Roe, J. H., *J. Biol. Chem.*, 1934, **107**, 15.

<sup>2</sup> Youngburg, G. E., *J. Lab. Clin. Med.*, 1927, **12**, 845.

<sup>3</sup> Cori, G. T., and Cori, C. F., *J. Biol. Chem.*, 1931, **94**, 561.

dilute solutions of glucose (0.02 to 0.1%) by treatment with alkali. 0.15 M  $\text{Na}_2\text{CO}_3$  and stronger alkaline solutions gave a marked production of the sugar on incubation, but there was no change when weaker alkalies (0.15 M  $\text{Na}_2\text{HPO}_4$  or 0.15 M  $\text{NaHCO}_3$ ) were used, except when the solutions were boiled. Boiling neutral glucose solutions also caused a marked increase in the amount of fructose present.

If the color-yielding substance in spinal fluid is formed from glucose, there must, therefore, be some factor besides the alkalinity of the solution taking part in the change. Some increase in the apparent amount of the compound giving the color was observed in each of 3 experiments in which glucose and sterile spinal fluid were incubated together, but the increase was slight (about 1 mg. per 100 cc. of solution) and close to the limit of accuracy of the method. Incubation of sterile spinal fluid by itself did not cause any increase in its apparent fructose content.

It seems to the authors that a rearrangement of glucose similar to that which takes place in dilute alkaline solutions is a fairly probable explanation of the presence of fructose, or of a fructose-like compound in spinal fluid. Such a rearrangement might take place in the fluid itself, as was suggested by the incubation experiment just described, or it might take place during the passage of sugar through the meninges.