4464

Further Observations on the Relationship Between the Metabolism of Galactose and Glucose.*

RALPH C. CORLEY.

From the Department of Bio-chemistry of the School of Medicine, Tulane University, New Orleans.

It is a striking fact that lactose is found in but one place in nature, in the mammary secretion, milk. More information may well be obtained about it and its products of hydrolysis, particularly the galactose moiety. Several investigators have found that tolerance for galactose is less than for a mixture of glucose and galactose. The evidence presented has been the decreased urinary excretion and the less striking change in the blood sugar when glucose accompanied the galactose. One objection to such observations, and a limitation to their interpretation, lies in the absence of knowledge of what changes in galactose concentration of the blood and urine are taking place.

A method for the estimation of galactose in blood and urine has been developed,[1] and applied in an effort to learn more of the relationship between the metabolism of glucose and galactose. Glucose injected simultaneously with galactose has increased the rate of removal of the latter from the blood, but the effect could be explained at least in large measure by the greater urinary excretion resulting.[2] Glucose has been found to have a very marked effect on the amount of galactose appearing in the blood stream when the 2 sugars were fed.[3] However, glucose had an analogous influence on the appearance in the blood xylose, a pentose sugar, and one between which and glucose no metabolic relationship has been shown.[4]

A critical consideration of the data has not entirely ruled out the possibility that glucose has a more intimate connection with the metabolism of galactose, although the results as indicated above can be explained on other bases. Therefore it has seemed of interest to choose different experimental procedures, with the expectation that if the glucose and galactose were to enter the body by different channels, conjugated excretory effects and absorptive interrelationships would be obviated. Rabbits have been used. Experimental details have been described in earlier communications.

* Assisted by a grant from the David Trautman Schwartz Research Fund.

1 Corley, R. C., *J. Biol. Chem.*, 1927, lxxiv, 1.

2 Corley, R. C., *J. Biol. Chem.*, 1927, lxxiv, 19.

3 Corley, R. C., *J. Biol. Chem.*, 1928, lxxvi, 31.

4 Corley, R. C., *J. Biol. Chem.*, 1928, lxxvi, 23.

Intravenous injection of glucose simultaneously with galactose, in tartrate nephritis with urinary retention, did not increase the rapidity of removal of galactose from the blood.

Galactose has been fed, and at different intervals, glucose has been injected intravenously. The amount of galactose appearing in the blood has been greatly reduced as compared to control experiments and no increase in the excretion of galactose has been observed. This would seem to be fairly unobjectionable evidence of an actual metabolic influence of glucose on the disposal of galactose, since it is difficult to conceive that parenterally introduced glucose could affect the rate of absorption of another sugar from the gut, although this contingency is not to be disregarded in the absence of directly pertinent evidence.

Galactose has been injected intravenously at different stages of the absorption of glucose. No striking influence on the rate of removal of the former sugar from the blood has been observed. It is of interest to record, however, that the rate of disposal appeared appreciably faster when injection was made 2 hours after as compared to 1 and 3 hours after the feeding of glucose. A possible explanation may be that there is an evocation of insulin that exerts a maximum influence 2 hours after feeding glucose. Further investigations along these lines might yield valuable information in regard to the action of insulin in carbohydrate metabolism.

Subcutaneously injected insulin has been found to increase the ease of disposal of orally and intravenously administered galactose. Confirming an earlier report,[1] simultaneously injected insulin increased the rate of disposal of galactose from the blood.

This influence of insulin on the metabolism of galactose furnishes a basis for several interesting speculations. Any interrelationship between the metabolism of glucose and galactose might be ascribed to a mobilization of insulin, or the increased ease of disposal of galactose might be tied up with the simultaneous oxidation of glucose, in which insulin plays such an important rôle. After a subcutaneous injection of a mixture of glucose and insulin, circulating galactose disappeared more rapidly. Furthermore the simultaneous intravenous injection with galactose of glucose and insulin or of levulose and insulin increased the rate of disposal of galactose from the blood. These influences may of course be dependent on a conjugated oxidation with glucose, or may merely mean that with the quantities employed, there was an excess of insulin which exerted its action directly.

While this question has innumerable ramifications, and many of

the observations can be explained on the basis of other considerations, there still remains the impression that in some way the metabolism of galactose is intimately related to that of glucose. Further studies along these lines are in progress.

4465

Purification of Diphtheria and Other Bacterial Toxins by Adsorption.

PAUL GROSS.* (Introduced by E. E. Ecker.)

From the Department of Pathology, School of Medicine, Western Reserve University, Cleveland, Ohio.

Current methods of purification of diphtheria toxin include precipitation by acidification or by the addition of salts, and dialysis or ultrafiltration. Glenny and Walpole[1] by a combination of ultra filtration and acidification have succeeded in attaining a relatively high degree of purification. The method of adsorption, however, has not received sufficient attention. Various adsorbants such as calcium phosphate, aluminum chloride and zinc salts have been used with indifferent results, due either to poor adsorption or to destruction of the toxin. That adsorption can be almost complete has been demonstrated by Coplans,[2] who showed that finely divided asbestos removes 99.9% of diphtheria toxin from its broth.

Recently Fuchs[3] succeeded in adsorbing prothrombin to magnesium hydroxide. This fact suggested the use of magnesium hydroxide for the isolation of diphtheria toxin. It was found that when magnesium hydroxide (in colloidal suspension) was added to diphtheria broth, adsorption of the toxin occurred. The supernatant liquid retained less than 4% of its original toxicity. Following repeated washings with distilled water and subsequent treatment of the precipitate with CO_2 or ammonium phosphate the toxin was recovered. Dialysis removed traces of magnesium and ammonium salts. Injection of the adsorbed toxin into guinea pigs produced death with hemorrhagic adrenals and a gelatinous peritoneal exudate. Control animals receiving 10 times this amount of adsorbed toxin mixed with antitoxin survived. Titration of the adsorbed

* Crile Research Fellow in Pathology.

[1] Glenny, A. T., and Walpole, G. S., *Biochem. J.*, 1915, ix, 298.

[2] Coplans, M., *J. Path. and Bact.*, 1914, viii, 581.

[3] Fuchs, H., *Z. f. Immunitätsf.*, 1928, lviii, 14.