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Is Galacturonic Acid Absorbed by the Small and Large Intestine?

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Galacturonic acid is one of the decomposition products of pectin. Manville, Bradway and McMinis have reported results in the rabbit which indicated that, on feeding pectin, galacturonic acid is produced in and absorbed from the intestine and eliminated as a galacturonide in the urine.[1] Malyoth[2] first made such a suggestion, but later[3] stated, without supplying data and methods, that a high percentage of galacturonic acid, when given by mouth or parenterally to experimental animals, is recovered in the excreta without being conjugated. Our work was done to ascertain to what extent galacturonic acid is absorbed by the human and canine intestine and canine colon.

Methods. The galacturonic acid used was obtained from the Research Department of the California Fruit Growers Exchange. By the Link Method[4] the preparation yielded 21.8% CO_2, which is equivalent to 87.2% uronic anhydride. By the A. O. A. C. method[5] for the determination of furfural, one gram of the preparation yielded 0.300 g of phloroglucide.

Under nembutal anesthesia, a loop of ileum and colon was prepared by the usual method in 6 dogs. In addition, 3 unanesthetized dogs with permanent Thiery-Vella fistula of the ileum and one with a permanent entirely isolated colon fistula were used. Two healthy human subjects with an ileostomy and a snugly fitting ileostomy bag volunteered for the study. In all tests a 5% solution of galacturonic acid having a Δ of $-0.56°C$ and a pH of 2.5 was used; it was isotonic with erythrocytes. In the tests on the anesthetized dogs and on the dog with colon fistula, the absorption period was 2 hours, and 50 cc of the solution was introduced. In the case of the Thiery-Vella loops an absorption period of 1 hour was used, and 25, 40 and 50 cc of the solution was introduced. In all cases the loop was irrigated with Ringer's solution before the

1 Manville, I. A., Bradway, E. M., and McMinis, A. S., *Am. J. Dig. Dis. and Nutr.*, 1936, **3**, 570.

2 Malyoth, G., *Klin. Wchnschr.*, 1931, **10**, 1159, 1255.

3 Malyoth, G., *Klin. Wchnschr.*, 1934, **13**, 51.

4 Dickson, A. D., Otterson, H., and Link, K. P., *J. Am. Chem. Soc.*, 1930, **50**, 775.

5 *Method of Analysis*, Association of Official Agricultural Chemists, p. 344, 4th Ed., 1935.

galacturonic acid was introduced. At the end of the absorption period the loop was drained and irrigated with two 20 cc volumes of Ringer's solution. The washings were added to the fluid drained from the loop after its volume was measured, and the total volume analyzed in duplicate portions. The human subjects reported to the laboratory without breakfast and without taking water since the previous evening. As a control, they were given 200 cc of distilled water, and the discharge that passed into the ileostomy bag was collected at the end of 2 hours and analyzed for galacturonic acid, in duplicate portions. Then 200 cc of the galacturonic acid solution was ingested and the discharge collected and assayed at the end of 2 hours, when the flow from the fistula had practically ceased. Any uronic acid found in the control discharge was subtracted from the values obtained from the discharge obtained after the ingestion of the galacturonic acid.

All the assays included analysis by the 2 chemical methods indicated above.

Results. Recovery of galacturonic acid from the ileum and colon, in the 6 anesthetized animals, after a 2-hour absorption period, was practically the same. For the ileum it was 93% both by the phloroglucide and uronic acid methods, while for the colon it was 91% by the phloroglucide and 94% by the uronic acid method. In these experiments the volume of clear fluid drained at the end of the test period was practically the same as that which was introduced. Recovery from the 3 unanesthetized, Thiery-Vella dogs (9 experiments) was also very much the same for both the ileum and colon. In the case of the ileum it was 90% by the phloroglucide method and 94% by the uronic acid method. The volume of clear fluid drained from the ileum was greater than that introduced, in every instance, while in the 6 colon experiments, the volume of the fluid drained was smaller than that introduced.

From the human ileostomy subjects the average recovery of galacturonic acid was 91% by the phloroglucide method and 95% by the uronic acid method. The volume of fluid in the ileostomy bags was less than that taken in all of the control experiments, and more in all of the test experiments. The control volumes averaged 83 cc and the test volumes averaged 427 cc. The pH of the recovered fluid in all the foregoing tests was found to be approximately 7 when tested by the glass electrode.

The average recovery of the introduced galacturonic acid ranged from 87 to 93% by the phloroglucide method, and 92 to 95% by the uronic acid method of Link. Due to the inherent errors in the methods, and the possibility that some of the galacturonic acid may

have been destroyed by bacterial action, it is doubtful whether any of the galacturonic acid was absorbed.

Conclusions. Less than 10%, if any, of galacturonic acid, introduced as an isosmotic and isotonic solution, is absorbed from the canine small and large intestine and the human small intestine. Isosmotic galacturonic acid stimulates the secretion of fluid by the small intestine of unanesthetized human and canine subjects.

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Effect of Androgen Administration upon Pregnandiol Excretion in Cyclical Women.

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There is abundant evidence in the studies of Venning and Browne[1, 2] and others,[3, 4, 5] which indicates that the progesterone which is formed in the corpus luteum of cyclical women is excreted in the form of sodium pregnandiol glucuronidate (SPG). In previous communications, we have reported that testosterone propionate, administered in sufficient amounts to cyclical women, suppresses follicle growth, ovulation and corpus luteum formation,[6] inhibits production of estrogen and progesterone by the ovary[7, 8] and, as a consequence, prevents the development of the secretory pattern of the endometrium, ultimately leading to atrophy of the endometrium[7, 8, 9] and vaginal mucosa.[10, 11]

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2 Venning, E. H., and Browne, J. S. L., *Endocrinology*, 1937, **21**, 711.

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