

calculated for 0-day-old chicks fed a comparable dose of the sugar.

These data suggest that the special mechanisms invoked to explain the selective absorption of sugars such as D-glucose are probably not fully functional until some time between 1 and 3 days after hatching.

Summary. A comparison of the alimentary absorption rates of 13 sugars in 14-day-old chicks indicated that D-galactose, D-glucose, D-xylose and D-fructose are selectively absorbed by this species. Furthermore, the ability to selectively absorb sugars seems to be fully developed in chicks just 3 days of age. In contrast to these older birds, embryos and 0-day-old chicks absorbed D-glucose and D-xylose at rates suggestive of a passive mode

of absorption. These data have been interpreted as meaning that the selective absorptive capacity of the chick gut is not maximally developed until 1 to 3 days after hatching.

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Development of Intestinal Selective Absorption of Glucose in Newly-Hatched Chicks.*† (26597)

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In an exploratory study of alimentary absorptive function in young chicks, the absorption velocity of glucose was found to increase by several fold between 0 and 3 days of age (1). The aim of the experiments described below was to characterize more fully this apparent change in absorptive capacity which occurs just after hatching. Accordingly, the absorption rates of glucose and sorbose, each alone and each in the presence of phlorhizin, were compared in chicks between 0 and 10 days of age. Sorbose, a passively absorbed sugar(2), was selected to obtain an estimate of the amount of hexose which leaves the intestine by simple diffusion. Any glucose absorbed in excess of this amount would presumably reflect the activity of selective absorption mechanisms. Phlorhizin was chosen because of its relatively specific ability to in-

hibit glucose absorption(3). It was of interest to see if its potency, in this respect, might vary with the changing functional capacity of the absorbing cells.

Materials and methods. Chicks, used without regard to sex, were obtained from a local hatchery and were of a Mount Hope-Babcock strain cross. Alimentary absorption rates were determined by the Cori method(4) essentially as adapted for the chick by Golden and Long(5). In these experiments the sugar absorbed was estimated by the difference between the quantity of sugar initially introduced into the crop and that recovered from the entire alimentary tract after a 30 minute absorption interval. In the recovery procedure a clamp was placed at the uppermost part of the duodenum so that the sugar retained above and below this point could be measured separately.

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Sugars were administered as 10% solutions in distilled water. When phlorhizin was used, it was added to the sugar solution in final

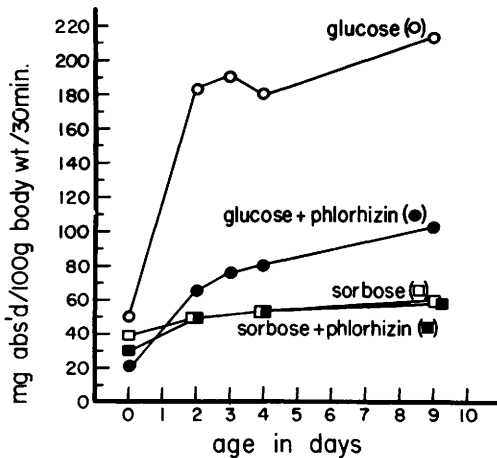


FIG. 1. Alimentary absorption rates of certain sugars in young chicks.

concentration of 0.002 M. The dose of sugar was adjusted as nearly as possible to 28 mg/10 g body weight. Absorption rates were expressed both as an absorption coefficient, *viz.*, mg sugar absorbed/100 g body weight/30 minutes, and as a percentage of total amount of sugar administered. Mean absorption rates for each experimental group were based on 10 or more individual determinations carried out on at least 3 separate lots of chicks. Sugar analyses were carried out according to the Somogyi-Nelson method(6).

Results. Experimental findings, summarized in Fig. 1 and Table I, indicate that:

1. Sorbose was absorbed by chicks in all age groups at a uniformly slow rate which was uninfluenced by the presence of phlorhizin. These results are in keeping with the view that this inert sugar is passively absorbed from the intestine(2).

2. Chicks 2 days of age and older absorbed glucose about 4 times as rapidly as 0-day-old chicks. Since the elevated absorption rates were not associated with a comparable increase in sugar delivered into the intestines proper (Table I), they presumably resulted from a greater absorptive capacity on the part of the intestinal epithelium.

3. Zero-day-old chicks absorbed glucose as slowly as sorbose. Calculations indicate that only about 1/5 of the glucose presented to the intestinal mucosa during the absorption interval was actually absorbed. It is there-

fore unlikely that its absorption was limited by a lack of substrate in contact with the absorbing surface. That glucose, as well as sorbose, is absorbed principally by a passive process at this early age would thus seem to be suggested.

4. However, administration of phlorhizin led to a 52-65% reduction in glucose absorption rate at all ages. As a consequence, in 0-day-old chicks, this served to depress the glucose absorption to a rate significantly below ($P = 0.05$) that of sorbose whether this latter sugar was fed alone or with phlorhizin. Hence it would appear that, while the absorption rates of glucose and sorbose are similar on the day of hatching, there may well be a difference between the two sugars in the precise mechanism of absorption.

Discussion. The absorption velocity of glucose from the chick intestine increased sharply after hatching, achieving a maximal level within just 48 hours. This increase served to raise the ratio of absorbed glucose to sorbose—a sugar presumed to be passively absorbed—from 1:1 to 4:1. It was further shown that the elevation of the glucose absorption rate was not consequent to a greater delivery of sugar into the intestines, but rather to the absorption of a greater proportion of that sugar in contact with the intestinal mucosa. These considerations suggest that a mechanism other than simple diffusion, capable of selectively enhancing the glucose absorption gradient, is rapidly developing just after hatching.

The phlorhizin-induced depression of glucose (but not sorbose) absorption here seen in the chick is similar to findings with other experimental animals(3). This effect occurred at all ages including 0-day-old chicks where sorbose and glucose absorption rates were quantitatively similar. Even at this early age, then, there is some basis for believing that the mode of absorption of these two sugars differs. Possibly the differentiative processes underlying the changing capacity to absorb glucose between 0 and 2 days of age are already under way at hatching. Lending credence to this view, the work of Moog(7) has shown that enzymes in the chick duode-

TABLE I. Results of Absorption Experiments.

Age in days	No. of chicks	Treatment*	Absorption coefficient (mg/100 g body wt./30 min.)	Avg % of sugar administered			
				Recov'd above intestines	Recov'd from intestines	Ab-sorbed	Delivered into intestines (b + c)
0	10	Glucose	49 ± 15§	21	62	17	79
	15	Glu + P†	22 ± 11	17	75	7	82
	12	Sorbose	38 ± 11	13	74	14	88
	12	Sorb + P	31 ± 9	16	73	11	84
2	10	Glucose	184 ± 34	13	23	64	87
	12	Glu + P	65 ± 21	10	67	24	91
	12	Sorbose	48 ± 7	16	67	17	84
	11	Sorb + P	48 ± 12	16	67	17	84
3	11	Glucose	192 ± 44	15	19	67	86
	10	Glu + P	76 ± 16	21	52	27	79
4	12	Glucose	181 ± 29	16	19	65	84
	22	Glu + P	80 ± 28	19	52	29	81
	11	Sorbose	53 ± 15	28	53	19	72
	11	Sorb + P	53 ± 15	17	64	19	83
8-10‡	31	Glucose	213 ± 40	17	8	75	83
	32	Glu + P	103 ± 30	12	52	36	88
	12	Sorbose	59 ± 13	26	53	22	75
	12	Sorb + P	58 ± 14	20	59	21	80

* Avg dose range of glucose or sorbose was 27-29 mg/10 g body wt.

† P = phlorhizin added to sugar solution for final concentration of 0.002 M.

‡ Data from chicks 8-10 days old were pooled since there were no significant differences from one age to the next.

§ Mean ± S.D.

num, thought to be concerned with absorption, are rapidly increasing at hatching but do not attain maximal activity until about 2 days thereafter.

Summary. 1. Absorption rates of glucose and sorbose, alone and with phlorhizin, were determined in chicks between 0 and 10 days of age. 2. Sorbose fulfilled the expectations of a passively absorbed sugar in that its absorption velocity was uniformly slow and uninfluenced by phlorhizin at all ages. 3. Glucose absorption velocity increased to a level 4 times as rapid as sorbose within 2 days of hatching and was inhibited by phlorhizin in all age groups. 4. These data, in support of

earlier findings(1), suggest that the mechanism(s) responsible for the selective absorption of glucose is not fully developed at hatching, but rapidly achieves an adult level of function within 2 days thereafter.

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