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Intestinal Disaccharidase and Alkaline Phosphatase Activity in the Dog.* (30580)

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Studies on the intestinal disaccharidases of the rat, rabbit, pig and cow have been concerned principally with lactase activity and have demonstrated that the enzyme activity reaches its peak soon after birth and then diminishes in adult life(1-5). There is little information regarding the disaccharidases of the dog(6,7). The present study was undertaken to determine the lactase, sucrase, maltase and alkaline phosphatase activity in the small intestinal mucosa of the developing and adult dog.

Material and methods. Five litter mates (Monseybrook breed) were used for the studies on the young dogs. An animal was sacrificed by exsanguination at 5, 12, 20, 29 and 61 days after birth. The small intestine was rapidly removed from the abdominal cavity and sections were taken one inch distal to the gastroduodenal junction (proximal section), the exact middle (middle section) and one inch proximal to the ileocecal junction (distal section). The sections were opened, rinsed and frozen on dry ice. The intestine from 7 adult mongrel dogs (A1-A7) was removed while the animals were under nembutal anesthesia and similar segments were removed and handled in the same manner. In addition, sections were removed half way between the proximal and middle sections (proximal ¼th) and between the middle and distal sections (distal ¼th) in some of the adult dogs. The tissue was homogenized (25 mg/ml water) and centrifuged in the cold. Disaccharidase activity was assayed by the method of Dahlqvist(8). Aliquots of the supernate were diluted 1:2 for lactase, 1:5 for sucrase and 1:40 for maltase assays. The glucose oxidase reagent used was Glucostat X4 (Worthington Biochemical Corp., Freehold, N. J.). The pH optimum for each disaccharidase was determined by measuring enzyme activity in a wide range of pH's using a 0.05 M sodium acetate buffer from pH 3.6 to 4.5, a 0.056 M maleate buffer from pH 5.0 to 7.0 and a 0.025 M sodium veronal buffer from pH 7.5 to 8.0. The necessary pH adjustments were made using HCl or NaOH and a Beckman pH meter. All analyses were performed in duplicate and the means of these 2 figures were taken for presentation of the results. The disaccharidase activity was expressed in units (micromoles of disaccharide hydrolyzed)/min/g wet weight. Alkaline phosphatase activity was determined by the method of Klein *et al*(9) and expressed as K.R.B. units/30 min/g wet weight (Phosphatabs—Quantitative Alkaline Substrate Tablets, Warner-Chilcott, Morris Plains, N. J.).

Results. Optimum pH. The optimum pH was found to be pH 5.0 for lactase activity and pH 6.0 for sucrase and maltase activity. The 0.056 M maleate buffer and these pHs were used for all of the following experiments.

Changes according to age. Alkaline phosphatase was high in all 3 sections of small intestine from the youngest dogs and decreased to adult levels in the proximal section by 29 days, Table I. The activity of this enzyme in the middle and distal sections obtained from the 29- and 61-day-old pups was still higher than that noted in the same sections from the adult dogs. Lactase activity also was the highest in the intestine of the youngest dogs and decreased to the levels

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TABLE I. Intestinal Alkaline Phosphatase and Lactase Activity.

	Alkaline phosphatase, K.R.B. units/g wet wt					Lactase, units/g wet wt				
	Prox	Prox ¼	Mid	Dist ¼	Dist	Prox	Prox ¼	Mid	Dist ¼	Dist
Young dogs										
Day 5	184		680		500	2.5		8.7		3.5
" 12	517		368		221	4.7		8.1		2.1
" 20	292		90		309	3.6		5.9		3.3
" 29	16		80		117	.3		2.2		1.5
" 61	114		80		16	.6		1.3		.1
Adult dogs										
A-1	173	—	22	—	0	1.6	—	1.2	—	.1
A-2	15	—	1	—	1	.5	—	.2	—	.1
A-3	28	3	20	—	8	.5	.4	.4	—	.2
A-4	36	36	39	30	8	2.2	1.2	2.6	1.8	.2
A-5	28	27	32	28	—	1.9	2.4	2.3	1.3	—
A-6	18	27	31	3	8	.8	.3	1.0	.1	.2
A-7	29	34	27	11	11	.7	.7	.8	.7	.1
Mean	47	25	25	18	6	1.2	1.0	1.2	1.0	.2

TABLE II. Intestinal Sucrase and Maltase Activity.

	Sucrase, units/g wet wt					Maltase, units/g wet wt				
	Prox	Prox ¼	Mid	Dist ¼	Dist	Prox	Prox ¼	Mid	Dist ¼	Dist
Young dogs										
Day 5	1.5		1.4		.7	4.8		5.5		2.2
" 12	1.8		1.3		.5	7.2		4.8		1.2
" 20	.8		1.4		1.0	4.0		7.5		2.4
" 29	.3		.5		.7	2.1		5.1		1.9
" 61	1.3		2.0		.5	4.7		7.8		1.8
Adult dogs										
A-1	3.0	—	1.4	—	.2	12.3	—	4.6	—	.8
A-2	1.6	—	.9	—	.5	7.0	—	3.7	—	2.9
A-3	1.8	1.8	1.6	—	.8	8.7	7.6	10.0	—	6.3
A-4	4.0	3.8	5.2	2.7	.3	16.1	12.6	21.3	13.7	3.9
A-5	4.3	4.2	2.8	1.7	—	17.1	21.5	13.1	19.5	—
A-6	1.3	.8	2.5	0	.3	9.7	8.8	14.3	4.6	9.5
A-7	1.6	1.6	2.0	.8	.5	9.9	9.8	11.2	6.3	5.2
Mean	2.5	2.4	2.3	1.3	.4	11.5	12.1	11.2	11.0	4.8

found in the adult dog by 29-61 days of life, Table I. Sucrase activity in the proximal and middle sections of the young dog's intestine was less than the mean activity in comparable sections from the adult dogs. Sucrase activity in the distal section of intestinal mucosa from the young and adult dogs was similar, Table II. The mean maltase activity was greater in all 3 sections of the adult dog intestine than in the comparable portions from the young dogs, Table II.

Differences due to location. In the intestine of the dogs sacrificed at 5 to 61 days of life, lactase activity was the highest in the middle section, Table I. In the adult dog, all the disaccharidases and the alkaline phosphatase activity were lowest in the distal ¼ and distal sections, Table I and II.

Discussion. The present data confirm the previous report that lactase activity in the mucus membrane of the dog small intestine is greatest in the young animal and decreases with age(7). A similar relationship has been reported for the rat(2,5), rabbit(2,3), cow (4) and pig(1). In contrast, sucrase and maltase activity was demonstrated to be higher in the intestine of some adult dogs than in the young animals, as was the finding in the pig(1) and the rat(5).

Under the conditions of the present experiments, the activities of the alkaline phosphatase and all of the disaccharidases assayed

were the lowest in the distal ¼ and distal sections of the adult dogs' small intestine. We did not demonstrate a consistently higher lactase activity in the jejunum than the duodenum of the adult dog, as reported previously(6). The distribution of the different disaccharidases along the small intestine appears to depend on the species of the animal (10).

Summary. 1. Lactase and alkaline phosphatase activity in the small intestine of the dog sacrificed soon after birth was higher than that in adult animals. The activity of these 2 enzymes during the first few weeks after birth decreased and reached their lowest levels in the adult animals. Sucrase and maltase activity, on the other hand, were low in the young dogs and highest in the adult dogs. 2. The activity of all the enzymes measured, lactase, sucrase, maltase and alkaline phosphatase was highest in the proximal and middle sections of the adult dog small intestine and decreased strikingly toward the distal portions.

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The Fate of Dietary Wax Esters in the Rat.* (30581)

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Matsuo(1) has reviewed a number of reports describing the seborrheic and rapidly fatal effect of some wax esters. To gain some insight into this process, a C_{34}-ester, oleyl palmitate, was fed to rats as 15% of the diet.

The original intention of this study was to investigate the nature of the oil presumed to be secreted by the sebaceous glands. It soon became clear, however, that the effects of long-chain esters on the rats could be ascribed to a cause other than seborrhea, and further knowledge of the digestibility and absorption of wax esters was required.

Previous literature on the subject is scanty. Munk and Rosenstein in 1891(2) found that single small doses of spermaceti (cetyl palmitate) were well utilized. Carter and Malcolm(3) fed much larger doses of muttonbird oil (largely cetyl and oleyl oleates) to rats over periods of 8 days and found that they could absorb 3.3 g/kg/body wt/day. Cats given large amounts absorbed some but also excreted cetyl esters and cetyl alcohol in the feces. Savage(4) found that rats ingesting jojoba oil at 15% of the diet absorbed about 70% and excreted the remainder as wax esters and free alcohols. She also observed a purgative effect of this diet.

This paper describes some aspects of the metabolism of oleyl palmitate in the gut and the accumulation of wax ester and free alcohol in the liver.

Materials and methods. Oleyl palmitate.

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