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On the Fate of Ingested Pectin.

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Although pectin is being used for the treatment of certain types of diarrhea, and for other purposes in man, relatively little is known regarding its fate in the alimentary tract. We have been able to find only one report in which the fate of pectin ingested with a mixed diet was studied. Schneider[1] prepared from apple marc a pectin which according to his analysis yielded 35.9% pentosan and 45.8% galactosan. He fed the pectin with a mixed diet very low in cellulose to several human subjects, and found the "coefficient of digestibility" for the pentosans to be 88.7%, and for the galactosans, 76.8%. He also found that intestinal bacteria decompose the hemicelluloses of apple marc. We have studied the fate of pectin fed to dogs with a mixed diet containing no cellulose, and to the same dogs while fasting.

Methods: The pectin used in this study was a very pure citrous pectin obtained from the Research Department, California Fruit Growers' Exchange. By the Link[2] method 18.2% CO_2 equivalent to 72.8% uronic anhydride was liberated. By the A. O. A. C. method[3] for the determination of furfural, 1 g yielded 0.275 g of phlorogluside equivalent to 0.14528 g of furfural. (Uronic acids as well as pentoses yield furfural, hence this factor is not characteristic of all pectins, but must be determined for the particular pectin sample employed.) The methoxyl content was 9.5% and the jelly grade was 180. By the calcium pectate method,[4] 1 g yielded 110% pectic acid as calcium pectate, on the basis of ash and moisture-free pectin. The foregoing are the average results of a number of analyses made by us. When 5 g of pectin was added to 100 g of feces, 98% could be recovered by the uronic acid method, 94% by the furfural method, and 97.6% by the pectic acid method.

Four dogs weighing from 25 to 35 lb were placed, for the first absorption period, on a mixed diet low in crude fiber (as a control), consisting daily of 200 cc of milk, 200 g of hamburger, and 100 g

1 Schneider, E. C., *Am. J. Physiol.*, 1912, **30**, 258.

2 Dickson, A. D., Otterson, H., and Link, K. P., *J. Am. Chem. Soc.*, 1930, **52**, 775.

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

4 Joseph, G. H., personal communication.

TABLE I.
Pectin Recovered from Feces During 7-day Absorption Period as Estimated by 3 Chemical Methods.

Dog No.	Exp. No.	Feces wt (dry) for experimental period, g	Recovery of pectin by furfural method		Recovery of pectin by uronic acid method		Recovery of pectin by calcium pectate method	
			g	%	g	%	g	%
		20 g of pectin per day given with a mixed diet.						
I	1		16.24*	11.55				
	2	151	13.30	9.50	14.00	10.00		
	3	113	11.36	8.12	17.40	12.42	5.13	3.66
II	1							
	2	145	12.68	9.06	20.23	14.45		
	3	101	12.05	8.62	15.12	10.80	10.00	7.14
III	1		11.71	8.37				
	2	79	10.00	7.14	4.33	3.09		
	3	47†	6.89	6.35	1.51	1.08	0.00	0.00
IV	1							
	2	168	12.14	8.68	20.80	14.84		
	3	95	12.59	9.00	12.22	8.74	2.19	1.56
Avg		112.4	11.89	8.64	13.20	9.43	4.33	3.09
		20 g of pectin per day given during fasting.						
I	1	197	127.50	91.23	123.80	88.48	120.80	86.30
II	1	188	105.00	75.02	105.30	75.20	95.00	67.80
III	1	48†	34.80	24.82	37.40	26.70	32.50	23.06
IV	1	22†	3.15	2.25	4.27	3.05	1.80	1.29
Avg		144	67.86	48.33	67.69	48.36	62.52	44.61

*Calculation: 140 g of pectin was fed, and is represented by 20.3 g of furfural. However, 2.345 g of furfural returned, or 11.55%, or 16.24 g of pectin.

†Gave only one specimen during experimental period.

of liver. During the second period, 20 g of pectin was added daily. For a third period, the dogs were given pectin alone; 20 g dissolved in 500 cc of water was given by stomach-tube. The absorption periods were 7 days in length. Specimens of feces produced by the dogs during each period were collected, dried and pooled, and pectin or its degradation products determined quantitatively as furfural, uronic, and pectic acids.

When the dogs were fed the basal diet alone, no pectic acid was found in the feces, but a total of from 0.37 to 0.42 g of furfural and from 0.72 to 0.90 g of uronic acid was obtained from the different dogs during the 7 day test period. The quantity of furfural and uronic acid obtained during the control period was subtracted from the total obtained during the pectin-feeding period.

Results: Table I shows the quantity of pectin recovered in the feces as determined by the 3 chemical methods. When pectin was added to the mixed diet, furfural estimation indicated a recovery of 8.64%, uronic acid estimation 9.43%, and pectic acid estimation 3.09% (averages of the 4 dogs.) When pectin was given during fasting, furfural estimation gave a return of 48.33%, uronic acid estimation 48.36%, pectic acid estimation 44.61% (averages of the 4 dogs).

Analysis of the data proved to be very interesting. When one adds pectin to a mixed diet practically 90% disappears, and of the amount recovered in the feces only about a third may be obtained as pectic acid. When given during fasting, about 50% disappeared. In this case, dogs I and II defecated frequently, and the recovery of pectin ranged from about 70 to 90%; whereas in dogs III and IV, which defecated only once during 7 days, the amount of pectin recovered ranged from about 2 to 25%. Essentially the same results have been communicated to us by Drs. L. A. Crandall and H. K. Murer. In addition, the results indicate that the decomposition is carried further when pectin is added to a mixed diet than when given alone, for only about a third of the amount which may be recovered in the feces in the former case may be obtained as pectic acid, while in the latter practically all the pectin recovered may be obtained as pectic acid. Decomposition may be also furthered if the pectin fed is retained for longer periods.

Summary. In the dog when 20 g of pectin was fed per day, with a mixed diet over a 7 day period, an average of 90% of the pectin was decomposed; when fed during fasting an average of only 50% was decomposed. These observations, however, may not be applicable to man.