On the Nutritive Value of Pentosan. III.

The Glycogen Accumulation in the Body of Rats by the Xylan Feeding.

By

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In a previous communication of this investigation⁽²⁾ it was concluded that the total amount of glycogen accumulated in the body of rabbit, when xylan was administered, is nearly equal to that accumulated by the administration of the same amount of starch. In this paper a brief report is made on the effect of xylan feeding upon the glycogen content in the albino rat, which were selected as an example of omnivorous animals.

Experimental.

Young albino rats were divided into three groups, one of them was subjected to a fasting test, the other to a xylan feeding test, and the latter to a starch feeding test as a collateral. The detail of the experimental procedure was nearly equal as described in the second report of this investigation. The results obtained in regard to both the glycogen content and blood constituents, which were also studied in this connection, may be shown in Table I, II, III.

Table I. The fasting test.

Date. (1930~1932)	'30. Oct. 1	Oct. 28	Oct. 31	'31. Jan. 29	Jan. 30
Sex of albino rat.	male	male	female	female	female
Hours fasted.	25.5	24.0	24.0	24.5	24.0
Body weight, g.	208	180	105	133	149
Liver weight, g.	8.4	10.5	4.5	7.0	7.8
Liver glycogen, mg. in 100 mg.	11	37	32	60	41
Muscle weight (calculated), g.	97.8	84.6	49.4	62.5	70.0
Muscle glycogen, mg. in 100 g.	21	25	105	274	118
Total glycogen, in 100 g. body.	10.3	14.0	50.6	132.0	57.6
Do. average.	12.2		80.1		
Total blood sugar, mg. in 100 c.c.	—	—	• 106	96	98
Nonfermentable sugar. "	—	—	—	—	33
Nonprotein nitrogen. "	—	—	—	54	38
Haemoglobin, %	—	—	17.1	17.3	17.2

Table II. The xylan feeding test.

Date (1930~1932).	1930 9, 20 m.	1930 10, 1 f.	1931 3, 21 f.	1932 4, 18 f.	1930 10, 3 f.	1931 1, 29 f.	1931 1, 30 f.
Sex of albino rat.							
Hours fasted.	23.5	20.0	24.0	22.0	9.0	8.0	8.0
Hours, fed to killed.	2.0	3.5	2.0	2.0	16.0	18.0	16.0
Hours, fasting begun to killed.	25.5	23.5	26.0	24.0	25.0	26.0	24.0
Body weight, g.	152	115	180	145	94	134	145
Xylan eaten, g.	2.0	2.4	2.0	1.9	3.0	2.5	2.4
Liver weight, g.	6.2	5.0	7.1	7.0	3.7	7.0	7.2
Liver glycogen, mg. in 100 g.	15	46	57	61	64	128	115
Muscle weight (calculated), g.	71.4	54.1	84.6	68.2	44.2	63.0	68.2
Muscle glycogen, mg. in 100 g.	16	173	165	171	158	256	148
Total glycogen in 100 g. body.	8.1	83.3	79.8	83.4	76.8	127.0	75.2
Do. average.	8.1	82.2			93.0		
Do. increase compared with fast.	-4.1	2.1			12.9		
Do. increase per 1 g. xylan.	-3.1	1.4			5.8		
Total blood sugar mg. in 100 c.c.	—	100	98	90	86	104	95
Nonfermentable blood sugar. "	—	—	34	—	—	36	32
Nonprotein nitrogen. "	—	—	40	38	—	49	38
Haemoglobin. %	—	—	17.9	16.9	17.9	16.9	17.4
Xylan recovered from dig. tract.	—	—	1.83	1.50	—	—	1.45

Table III. The starch feeding test.

Date. (1930~1932)	'30. Sep. 20	'32. Mar. 29	Apr. 18.	'30. Oct. 31	'31. Jan. 31
Sex of albino rat.	male	female	female	female	female
Hours fasted.	24	24	22	9	8
Hours, fed to killed.	2	2	2.5	16	16
Hours, fasting begun to killed.	26	26	24.5	25	24
Body weight, g.	184	175	140	111	143
Starch eaten, g.	4	4	4	4	2
Liver weight, g.	7.8	7.2	7.2	4.7	7.1
Liver glycogen, mg. in 100 g.	1060	1394	1470	1284	214
Muscle weight (calculated), g.	86.5	82.3	65.8	52.2	67.2
Muscle glycogen, mg. in 100 g.	452	391	264	247	94
Total glycogen in 100 g. body.	257.4	241.3	199.3	170.5	54.8
Do. average.	257.4	220.3		112.7	
Do. increase compared with fast.	245.2	140.2		32.6	
Do. increase per 1 g. starch.	113.0	54.6		13.0	
Total blood sugar, mg. in 100 c.c.	—	109	112	115	103
Nonfermentable blood sugar. "	—	32	—	—	31

Nonprotein nitrogen, mg. in 100c.c.	—	40	39	45	39
Haemoglobin, %	17.4	17.1	16.8	17.2	16.9
Starch recovered from dig. tract.	—	2.07	1.95	—	0.3

The increase in the amount of glycogen by xylan feeding is found to be very small when compared with that in the case of starch feeding. The amount of absorbed xylan too is much smaller than that of absorbed starch. This, by the way, is a fact never noticed in the case of rabbits as was communicated in the first and second report⁽¹⁾⁽²⁾. Therefore, such a comparison should be based on the amount of substances absorbed. The digestibility of xylan two hours after the feeding was found to be 14.6%, and that of starch 49.8%. The digestibilities 16 hours after the feeding were not estimated then. Ordinary digestibility coefficients were, therefore, estimated afterwards, detail accounts of which will be reported in the next paper, but the results are briefly as follows: xylan 33.1%, starch 86.2%. These digestibility coefficients may be applied, for the comparison without any appreciable error, to the case of 16 hours after the feeding. Thus the increase in the amount of glycogen per gram of digested xylan or starch may be shown in Table IV, and figure.

Table IV The glycogen increase per gram of digested xylan.

	Xylan feeding.			Starch feeding.		
	one ♂	av. three ♀	av. three ♀	one ♂	av. two ♀	av. two ♀
Hours after the feeding.	2.0	2.5	16.6	2.0	2.3	16.0
Glycogen increase mg.	neg.	96	18	227	127	15

Fig. I. Glycogen increase per gram of eaten material.

Fig. II. Glycogen increase per gram of digested material.

Conclusion.

1. Glycogen could be accumulated in the body of albino rat by the

feeding of xylan. The accumulation, however, is very small in comparison with the application of starch. This may be attributed mainly to the difficulty in the digestion of xylan by rats. Accordingly, the increase in the amount of glycogen per gram of digested xylan is never so much small in comparison with that caused by the starch.

2. So far as the amounts of nonfermentable sugar, nonprotein nitrogen and haemoglobin are concerned, there was no appreciable difference noticed in the blood of rats, when examined at the end of either 2.5 or 16 hours after the feeding of xylan or starch or none of them. The total blood sugar, however, was found decreased somewhat in the case of xylan.

BIBLIOGRAPHY.

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 (2) Do. Do. Do. p. 33 (1931).

On the Nutritive Value of Pentosan. IV.

The Methods of Treatments and the Kinds of Animals as two of
 the Effecting Factors upon the Digestibility of Pentosan.

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The effect of various treatments, such as disintegration with alkaline solutions etc., upon the digestibility of pentosan was studied, using various gramineae straws which were recently applied to the investigation of straw-disintegration by the author⁽¹⁻⁵⁾. The results obtained are shown in Table I. The effects upon the digestibility of crude fiber and nitrogen free extract may be added here for a reference.

Table I.
 The effect of various treatments upon the digestibility of pentosan.

Materials and treatments.	Digestibility of pentosan by sheep av. %	Ratio of digestibility (untreated, as 100)		
		Pentosan	Crude fiber	N. free ext.
Rice straw, untreated.	52.6	100	100	100
Do, soaked 4 hours in 0.25% NaOH	53.7	102	101	87
Do, soaked 4 hours in 0.75% NaOH	82.9	158	141	153
Do, soaked 4 hours in 1.5% NaOH	82.1	156	139	156