

REFERENCES

- Anschel, M. & Schoenheimer, R. (1936). *J. biol. Chem.* **114**, 539.
 Anschütz, R. (1897*a*). *Ber. dtsh. chem.* **30**, 2649.
 Anschütz, R. (1897*b*). *Ber. dtsh. chem. Ges.* **30**, 2652.
 Barnett, J., Henly, A. A. & Morris, C. J. O. R. (1946). *Biochem. J.* **40**, 445.
 Clarke, N. T., Gillespie, H. B. & Weisshaus, S. Z. (1933). *J. Amer. chem. Soc.* **55**, 4571.
 Curtius, T. (1904). *J. prakt. Chem.* (2), **70**, 89.
 Curtius, T. (1917). *J. prakt. Chem.* (2), **95**, 327.
 Houben, J. & Schreiber, G. (1920). *Ber. dtsh. chem. Ges.* **53**, 2346.
 Staudt, W. (1925). *Hoppe-Seyl. Z.* **146**, 286.
 Sudborough, J. J. & Roberts, D. J. (1905). *J. chem. Soc.* **87**, 1840.
 Wolfe, J. K., Hershberg, E. B. & Fieser, L. F. (1940). *J. biol. Chem.* **136**, 653.

The Effect of Phytic Acid on the Absorption of Calcium and Phosphorus

2. IN INFANTS

By E. HOFF-JØRGENSEN, OLUF ANDERSEN, H. BEGTRUP AND GUNNAR NIELSEN,
Universitetets Biokemiske Institut and Dronning Louises Børnehospital, Copenhagen

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It appears from previous experiments (Hoff-Jørgensen, 1946) that in very young puppies the decrease in calcium absorption caused by the presence of phytic acid in the diet is only moderate, while it is considerable in somewhat older puppies. In order to see whether children react in a similar manner experiments were done in which infants were given a diet containing varying amounts of phytic acid.

EXPERIMENTAL

Subjects

The investigation was carried out between September and November 1944 with four male infants who at the beginning of the experiment were 1, 4, 6 and 11 months old.

The infants were admitted to hospital for different reasons, and at the time of the experiment their organic diseases had been cured, and they were only detained at hospital for the sake of the experiment. In particular they presented no signs of dyspepsia or of rickets; their blood P, Ca and phosphatase were normal. Further particulars are given in Table 1.

Diet

The composition of the diets is given in Table 1. Cow's milk was used throughout. During the phytate periods a solution of sodium phytate (c. 25%, pH 6.8) was added to all the milk. Thereby a sparingly soluble calcium phytate was formed, which by analogy with that formed in pure aqueous solutions has the composition $C_6H_8O_4P_2Ca_3$ (Hoff-Jørgensen, 1944). The suspension of calcium phytate precipitated in milk is very stable.

Table 1. *Particulars of infants and of diet* and treatment*

Infant	Date of		Weight	Complaint on admission	Treatment	Diet during experiment
	Birth	Admission				
B.	19. ix. 44	22. ix. 44	4.0 kg. at 1.5 months	Admitted for vaccination with B.C.G.	No medical treat- ment. No addi- tional vitamins	Milk and water 1:1 with 2% sucrose
N.N.	25. v. 44	16. viii. 44	4.2 kg. at 4 months	<i>Dyspepsia antea</i>	Carrot soup. No additional vitamins	Semolina gruel; butter-milk gruel; fruit juice
E.P.	6. v. 44	16. ix. 44	6.4 kg. at 5 months	<i>Dyspepsia antea</i>	Carrot soup. 600 i.u. vitamin D ₂ and 100 mg. ascorbic acid daily	As above
H.C.S.	20. x. 43	23. viii. 44	9.1 kg. at 12 months	Imbecility	No medical treat- ment. No addi- tional vitamins	As above; rusks

* During the phytate periods a solution of sodium phytate (c. 25%, pH 6.8) was added to the milk; see also Table 2.

Table 2. *The effect of phytate on the retention of Ca and P in four infants*

Duration of exp. (days)	Total intake of			Total excretion of					Daily retention of			
	P (mg.)	Phytate-P (mg.)	Ca (mg.)	P in faeces (mg.)	P in urine (mg.)	Ca in faeces (mg.)	Ca in urine (mg.)	Phytate-P in faeces (mg.)	Ca		P	
									mg.	%	mg.	%
Subject B. Age 1-1.5 months												
3	1078	0	1206	334	212	563	22	0	207	51.5	177	49.3
3	2105	947	1236	814	321	1285	19	536	-6	—	323	46.1
3	2392	1194	1266	945	445	1395	17	758	-49	—	334	42.6
Subject N.N. Age 4-5 months												
4	2772	0	3062	592	1184	2164	22	0	219	28.6	249	35.9
3	2448	0	2533	894	872	1826	28	0	226	26.8	227	27.9
3	3067	942	2120	1112	1196	1892	12	612	72	10.2	253	24.8
3	5502	2680	2822	2282	1645	3541	0	1762	-240	—	525	28.6
Subject E.P. Age 6-7 months												
3	2380	0	2452	493	1246	1842	21	0	196	24.0	214	27.0
3	5099	1762	3632	1987	1794	3185	17	970	143	11.9	439	25.8
3	6166	3062	3314	3662	1256	3821	10	2142	-172	—	416	20.2
Subject H.C.S. Age 11-12 months												
3	1826	0	1628	280	882	772	63	0	264	48.7	221	36.4
3	2084	0	1989	438	1065	1425	33	0	177	26.7	194	27.9
2	2680	1208	1146	1115	1021	1632	5	642	-246	—	272	20.3

Collection and analysis of excreta

Faeces were collected in napkins in which were placed pieces of rubber cambric from which faeces could be removed almost quantitatively. Carmine was used as a faecal marker to separate periods. The urine was collected in glass urinals. The analyses of diet, faeces and urine were carried out as previously described (Hoff-Jørgensen, 1946).

Results

The results will be found in Table 2.

DISCUSSION

The results of these experiments on infants agree with those of McCance & Widdowson (1942) on adults in showing that the addition of sodium phytate to the diet decreases the calcium absorption very considerably. The effect of phytate on calcium absorption seems to be the more pronounced the older the infants; this accords with observations on puppies (Hoff-Jørgensen, 1946), but the effect is less conspicuous in the infants. The addition of phytate to the diet causes an increased absorption of phosphate. In some of the experiments the

amount of phosphorus absorbed was greater than the amount of non-phytate phosphorus in the diet. Some of the phosphate, which was split from the phytate in the intestine (about 35% of the intake) must therefore have been absorbed. Two infants (N.N. and E.P.) were given the same diet during the experiment, except that E.P. received daily a supplement of 600 i.u. of vitamin D₂ and of 100 mg. of ascorbic acid. The inhibitory effect of phytate on the calcium absorption was slightly less in E.P. than in N.N., but the difference was not significant enough to prove an effect of the vitamins.

SUMMARY

The addition of sodium phytate in amounts sufficient to combine with about 50, 75 and 100% of the total calcium of a diet containing cow's milk caused in infants a very considerable decrease in the calcium absorption and an increase in the phosphate absorption.

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REFERENCES

- Hoff-Jørgensen, E. (1944). *K. danske vidensk. Selsk. Skr. mat-nat. Medd.* 21, No. 7 (in English).
 Hoff-Jørgensen, E. (1946). *Biochem. J.* 40, 189.
 McCance, R. A. & Widdowson, E. M. (1942). *J. Physiol.* 101, 44.