Zeitschrift für
Ernährungswissenschaft Z Ernährungswiss 28:316–318 (1989)

Lack of effect of dietary minerals on liver cholesterol concentrations in rats

A. C. Beynen[1,2]), A. G. Lemmens[1]), A. M. Fielmich-Bouman[1]), A. C. Hoek[1,2]), and Y. W. H. M. Mars[1,2])

[1]) Department of Laboratory Animal Science, State University, Utrecht
[2]) Department of Human Nutrition, Agricultural University, Wageningen, The Netherlands

Summary: Female rats were fed cholesterol-free, purified diets with different concentrations of calcium (0.13–0.75 %, w/w), magnesium (0.02 or 0.04 %) or phosphorus (0.2–0.8 %) as the only dietary variable. After 28 days, no effects of the minerals were found on liver cholesterol concentrations and rates of fecal excretion of bile acids.

Zusammenfassung: Während 28 Tagen wurden an Ratten cholesterinfreie halbgereinigte Diäten, die verschiedene Konzentrationen von Calcium (0,13–0,75 g/100 g), Magnesium (0,02–0,04 g/100 g) oder Phosphor (0,2–0,8 g/100 g) enthielten, verabreicht. Die unterschiedlichen Mineralkonzentrationen hatten keinen Einfluß auf Serum- und Lebercholesterin oder die Ausscheidung von Gallensäuren im Kot.

Key words: dietary calcium; dietary magnesium; dietary phosphorus; serum cholesterol; liver cholesterol; fecal bile acids; rats

Schlüsselwörter: Calcium, Magnesium, Phosphor, Serumcholesterin, Lebercholesterin, Gallensäure im Kot, Ratten

Introduction

Increased intakes of calcium have been shown to counteract casein-induced hypercholesterolemia in rabbits (1). We wanted to know whether dietary calcium also affects cholesterol metabolism in rats. Generally, liver cholesterol concentrations in rats are more sensitive to diet than serum cholesterol concentrations. Thus we have measured liver cholesterol in the course of our studies on the effects of dietary calcium, magnesium, and phosphorus on nephrocalcinosis in female rats (2,3).

Materials and methods

Animals, housing, and diets have been described (2, 3). Four experiments with female rats, aged about 3 weeks, were carried out. After a pre-experimental period of about 10 days, the experimental diets and demineralized water were supplied ad libitum. Table 1 shows the mineral composition of the cholesterol-free purified

Table 1. Calculated concentrations (g/100 g) of minerals in the diets.

	Diet code						
	1	2	3	4	5	6	7
Calcium	0.25	0.25	0.50	0.50	0.13	0.75	0.50
Magnesium	0.02	0.02	0.02	0.02	0.02	0.02	0.02
Phosphorus	0.20	0.40	0.40	0.80	0.40	0.40	0.40
	8	9	10	11	12	13	14
Calcium	0.50	0.50	0.50	0.50	0.50	0.50	0.50
Magnesium	0.02	0.04	0.04	0.02	0.02	0.04	0.04
Phosphorus	0.80	0.40	0.80	0.20	0.60	0.20	0.60

Indicated minerals were the only dietary variables. Ingredient composition and results of chemical analysis can be found elsewhere (2, 3).

Table 2. Body weight, liver cholesterol, and fecal bile acid excretion.

	Diet code			
	1	2	3	4
Experiment 1				
Body weight[a]	187 ± 10	181 ± 15	174 ± 4	164 ± 7
Liver weight[a]	7.8 ± 0.7	7.7 ± 0.4	6.9 ± 0.6	6.8 ± 0.4
Liver cholesterol[b]	4.9 ± 0.3	5.0 ± 0.3	5.1 ± 0.5	5.2 ± 0.4
Fecal bile acids[c]	1.3 ± 0.6	1.3 ± 0.6	1.1 ± 0.5	2.2 ± 0.7
	5	2	3	6
Experiment 2				
Body weight[a]	161 ± 10	165 ± 11	162 ± 7	165 ± 7
Liver weight[a]	7.3 ± 0.7	7.2 ± 0.7	6.9 ± 0.9	6.6 ± 0.7
Liver cholesterol[b]	4.3 ± 0.3	5.0 ± 0.5	5.2 ± 1.3	5.0 ± 0.5
Fecal bile acids[c]	1.3 ± 0.5	0.8 ± 0.4	1.1 ± 0.4	1.1 ± 0.4
	7	8	9	10
Experiment 3				
Body weight[a]	167 ± 10	159 ± 12	174 ± 18	160 ± 8
Liver weight[a]	8.0 ± 0.8	8.1 ± 0.8	7.8 ± 1.1	7.6 ± 0.5
Liver cholesterol[b]	4.4 ± 0.2	4.3 ± 0.2	4.5 ± 0.6	4.2 ± 0.4
Fecal bile acids[c]	1.1 ± 0.2	1.4 ± 1.0	1.3 ± 0.5	1.5 ± 0.5
	11	12	13	14
Experiment 4				
Body weight[a]	157 ± 15	169 ± 8	165 ± 6	166 ± 11
Liver weight[a]	6.3 ± 1.4	7.2 ± 0.5	7.1 ± 0.6	6.7 ± 0.8
Liver cholesterol[b]	4.9 ± 1.1	4.8 ± 0.4	4.8 ± 0.8	5.0 ± 0.3
Fecal bile acids[c]	1.2 ± 0.2	1.8 ± 0.7	1.5 ± 0.5	1.6 ± 0.3

[a], g; [b], μmol/g; [c], μmol/d. Means ± SD for six rats per dietary group.

diets. Calculated concentrations of calcium, magnesium, and phosphorus agreed well with the analyzed concentrations (2,3). The experimental period lasted 28 days. From days 26 to 28 feces of each rat were collected. Liver cholesterol and fecal bile acids were determined as described (4).

Results and discussion

Table 2 documents that variations in the intake of calcium, magnesium, or phosphorus did not affect liver cholesterol concentrations and rates of bile acid excretion in female rats. Thus cholesterol metabolism in rats may be insensitive to the amount of calcium in the diet. Contrary, rabbits displayed a decrease of serum cholesterol after increased intakes of calcium (1). A possible explanation for such a species difference has been put forward (5).

References

1. Van der Meer R, De Vries H, West CE, De Waard H (1985) Casein-induced hypercholesterolaemia in rabbits is calcium-dependent. Atherosclerosis 56:139-146
2. Hoek AC, Lemmens AG, Mullink JWMA, Beynen AC (1988) Influence of dietary calcium: phosphorus ratio on mineral excretion and nephrocalcinosis in female rats. J Nutr 118:1210-1216
3. Mars YWHM, Lemmens AG, Beynen AC (1988) Dietary phosphorus and nephrocalcinosis in female rats. Nutr Rep Int 38:249-258
4. Beynen AC, Lemmens AG (1987) Dietary acetate and cholesterol metabolism in rats. Z Ernährungsw 26:79-83
5. Van der Meer R, Beynen AC (1987) Species-dependent responsiveness of serum cholesterol to dietary proteins. J Am Oil Chem Soc 64:1172-1177

Received June 20, 1989

Authors' address:

Prof. Dr. Anton C. Beynen, Department of Laboratory Animal Science, State University, P. O. Box 80.166, 3508 TD Utrecht, The Netherlands