The Effects of Level of Protein Intake on Magnesium Metabolism in Young Adult Women

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INTRODUCTION

It has been reported that Mg has diversified functions and its utilization rate may vary depending on the various dietary factors[1-3]. Among them, the study results on body retention capacity up to the present have shown the dependence upon protein intake and its type has presented variously contradicted views[4,15].

Thus, it was known that there was a great differences in the metabolism of Mg depending on the amount and the quality of the ingested protein.

This report is a preliminary study that has observed with the consideration of menu contents of ordinary homes of middle class in Korea, the intake, the excretion, and the metabolism of Mg after differing them in the levels of the ingested protein, focusing on protein among the factors influencing Mg metabolism.

MATERIALS AND METHODS

Experimental Design

The amount of energy and Mg intake (see Table 3) for the experimental subject were disclosed to be at almost similar levels to each other. A series of comparison and observation have been made on the amount of Mg excreted to urine and feces after ingesting differing in the amount of protein. During entire experimental period of 23 days, after having had the adaptive period of the first 3 days, with diet containing protein levels of 0.45 g, 0.75 g, 0.60 g, and 0.90 g/kg/head/day each for 5 days. The 24 hours urine was collected every day throughout the experimental period whereas the fecal sample was collected during the last 2 days of each diet period, and they were analysed for the Mg contents.

Experimental subject

Six of female university students aged 19–21 were selected for the study subjects whose healthy condition were identified by a physical, hematological, and chest X-ray chek-up. Noteworthy was that all subjects were not in menstrual bleeding period during the study.

Table 1. Characteristics of study subject

No.	Name	Age	Sex	Height (cm)	Weight (kg)
1	Kim, MJ	19	F	151	44
2	Han, RS	19	F	154	47
3	Choi, YR	20	F	158	47
4	Song, MH	21	F	158	51
5	Shon, MO	21	F	156	51
6	Yang, MS	21	F	159	54

Diet

The meals for the experimental subjects were provided with 4 kinds of the ordinary Korean diet depending on the levels of protein. The energy allowance was set on about 40 kcal/kg/day. However, due to the difficulty of arranging menu, Mg content was accurately measured for each basic diet and they were used for Mg intake.

During the experimental period, all appliances necessary for tablewares of cooking preparation were chosen to those of glass or plastic products by utilizing every possible means, and prior to using them, they used to be rinsed out by ion eliminated water more than thrice at all time immediately before using them after soaking through EDTA (4 g/ℓ) over 12 hours. The ion eliminated water also was always used during the diet arrangement and as the drinking water for the experimental subjects.

Sample collection

1) Urine

The 24 hours urine were collected every day throughout the experimental period.

2) Feces

The fecal collection were made for the last 2 days during the period of each 5 days dietary term, and used for Mg measurment after homogenization.

3) Diet

The whole day diet ingested during the experimental period was homogenized and analyzed for Mg content.

Mg analysis

The measurement of Mg was carried out by the Atomic Absorption Flame Spectophotometry after samples were treated with wet-ashing method.

Data analysis

Experimental results have been statistically treated and calculated at each experimental stage for mean value and standard error. A significant test for the difference of each stage employed ANOVA test (F-test) and paired *t-test.*

Correlation for the Mg intake, excretion, balance, and digestibility for each experimental diet (different levels of protein intake) was used by Pearons's moment product correlation coefficients and

regression analysis, and was preserved by utilizing Package SAS for statistical treatment.

RESULTS AND DISCUSSION

Mg in diet

Due to the difficulty of arranging menu for Mg, the amount of Mg intake was not able to be accurately adjusted. As the result of analysing actual diet ingredients, the amount of Mg in the diet with given protein levels were 182.4 mg–0.45 g, 197.7 mg–0.60 g, 177.4 mg–0.75 g, and 179.7 mg–0.90 g respectively, and the amount of Mg in diet was not much affected by the level of protein in the diet, and mean daily Mg intake was 184.3 mg (3.85 mg/kg).

Metabolism of Mg

Daily urinary Mg excretion did not show a significant differences by ingesting different levels of protein in meal. This was in accord with Margen and Calloway's report[13] that was no change in Mg excretion in urine when ingested very large amount of protein meal, and Shier's[16] report that there was no correlation between the Mg excretion in urine and the amount of protein ingested.

However, fecal excretion of the Mg for the two periods ingested with protein 0.45 g/kg and 0.90 g/kg was reveald as 125.9±10.1 mg and 80.6±6.1 mg which showed a great difference, less Mg excretion in feces when ingested more protein than the less protein intake. This was in accord with the reports of McCane *et al.*[7] and Hunt and Schofield[8] that the fecal Mg excretion was decreased by increasing the amount of protein intake. And it was inclined to be consistent with the report of Schwartz *et al.*[14] that in study applied to adolescent boys, the retnetion capacity of Mg was enhanced when ingested the high protein diet, in the meantime there was no change of urinary Mg excretion but fecal Mg excretion was reduced.

During the experimental period, the mean Mg balance exhibited no significant differences corresponding to the amount of protein intake, and the mean Mg balance showed positive balance during the entire period of the experiment.

Table 2. Condition of Mg measurement by atomic absorption spectrometry

Element	Wave length (A^0)	Lamp current (A^0)	Burrner height (mm)	Slit (A^0)	C_2H_2 flow (1/mm)	Air flow (1/mm)
Mg	2,852	5	5	3.8	2.6	10

Table 3. Mean intake of energy, protein, and Mg

Period	Energy (kcal/kg)	Protein (g/kg)	Mg (mg/kg)
I	40	0.45 ± 0.01	3.8 ± 0.1
II	40	0.75 ± 0.04	4.1 ± 0.1
III	40	0.60 ± 0.02	3.7 ± 0.1
IV	40	0.90 ± 0.04	3.8 ± 0.1

The mean digestibility of Mg in the meal showed no significant change depending on the amount of protein intake. At the present time, an accurate assessment of Mg digestibility is not able to be made due to the fact the literatures related to the subject is extremely rare. It is regarded as being at almost similar levels when compared with the report that the Mg in common diet in general showed more or less than 30–40%.

From the results observed, the correlation among the amout of Mg intake, the amount of urinary Mg, the amount of fecal Mg, the balance of Mg,. and the digestibility of Mg were shown in Table 6. This was contradictory to the reports of Shier[16] and Janet *et al.*[20] asserting that the amount of urinary Mg is related with the amount of Mg intake.

Table 4. Mean Mg metabolism data for 6 subjects during the experimental period

Level of protein intake (g/kg)	Mg (mg/day)				Mg digestibility (%)
	Intake	Urinary output	Fecal output	Balance	
0.45	182.4	54.8 ±5.50	125.9 ±10.14	16.6 ±8.09	31.0 ±5.6
0.60	197.7	65.3 ±4.16	101.3 ±13.10	31.8 ±12.98	48.8 ±7.0
0.75	177.4	62.9 ±8.25	112.0 ±6.39	2.5 ±6.20	36.9 ±3.6
0.95	179.7	62.4 ±4.58	80.6 ±6.11	36.6 ±8.18	55.2 ±3.8
F-value 3.90			P-value N. S.*		

*N. S.: Statiscally not significant at $\alpha = 0.05$ Levels

Table 5. Mean ratio of Mg excretion to Mg intake

Levels of protein intake (g/kg)	Mg in urine / Mg intake	Mg in feces / Mg intake
0.45	30.05 ± 3.01	69.02 ± 5.56
0.60	33.03 ± 2.11	51.26 ± 7.03
0.75	35.46 ± 4.65	63.15 ± 3.60
0.90	34.78 ± 2.55	44.88 ± 3.40
F-value	0.56	4.60
P-value	N. S.*	N. S.*

*N.S.: Statistically not significant at $\alpha = 0.05$ levels

Table 6. Correlation among intake, urinary and fecal out put, balance, and digestibility of Mg

	Mg intake	Mg in urine	Mg in feces	Mg balance	Mg digestibility
Mg intake					
Mg in urine	0.11298				
Mg in feces	-0.02788	-0.32916			
Mg balance	0.25540	-0.24135	-0.5792**		
Mg digestibility	0.18098	0.32393	-0.98724***	0.59699***	

**: $P < 0.01$, ***: $P < 0.001$

The correlation between the amount of fecal Mg and the amount of Mg ingested was regarded as being necessary to be discussed in this kind of report, since the relevant literatures were rarely available.

CONCLUSION

As outline in the above, taking it into consideration that the menu ingested in general by middle class homes in Korea, the amount of protein intake was adjusted with relatively low level, in the metabolism of Mg, the excretory amount of Mg was not given any effect by either the amount of protein ingested or the amount of Mg ingested, and the excretory amount of Mg did show an inclination to be bound to more decrease as the amount of protein intake was increased.

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