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# **NUTRITION REPORTS INTERNATIONAL**

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## NUTRITION REPORTS INTERNATIONAL

### MINERAL INTAKES OF UNIVERSITY STUDENTS : MAGNESIUM CONTENT.

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#### ABSTRACT

Magnesium content was analyzed in the three main meals served in an University cafeteria. The average magnesium content of the meals was 236 mg per day. The male and female students selected foods containing 247 and 224 mg of magnesium respectively. These observations indicate that meals at the cafeteria provided lower quantity of magnesium than the recommended dietary allowance of Canada and United States.

Most of the magnesium available to students was concentrated in two meals : lunch, 91 mg and dinner 103 mg. There was a large variation of the magnesium content depending on the main dish components.

#### INTRODUCTION

Magnesium is an essential element for life (1-3). Deficiency of magnesium can cause cardiovascular, renal, endocrinologic, digestive, neuromuscular and gynecological and obstetrical lesions (4,5). Hence it becomes important to know the magnesium content of mixed Canadian diet.

Magnesium content has been analyzed in a Montreal hospital diet (6), American diet (7), the total mixed diet of high school and college girls in the United States (8) and in France (9). However, no systematic investigation has yet been undertaken to analyze the magnesium content of various types of mixed Canadian diets. In the present report, data on the magnesium content of the meals served in the cafeteria of the University of Montreal are given. Furthermore, the effect of pattern of meal selection on the magnesium accessibility has also been investigated.

#### MATERIALS AND METHODS

The details for the method of sample collection, their treatment before ashing as well as the procedure for ashing of various samples are given in a previous publication (10). The ashed samples were diluted to a constant volume with lanthanum chloride and two concentrations of an internal standard for magnesium (11). These samples were then analyzed for magnesium content by atomic absorption spectrophotometry utilizing a hollow cathode for magnesium.

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## RESULTS AND DISCUSSION

### Magnesium (Table 1).

The three main meals at the cafeteria of the University of Montreal provided 236 mg of magnesium (Table 1). The male and female students had a daily average of 247 and 224 mg of magnesium, respectively. The lunch and dinner provided 91 and 103 mg of magnesium respectively, whereas breakfast had 42 mg of magnesium. Magnesium content per kg wet or dry weight or per 1000 Cal did not vary significantly between the breakfast, lunch and dinner. The only exception to this was the magnesium content per kg dry weight of dinner where it increased. Expressed as per g protein, magnesium content did not show any change between the breakfast and lunch but decreased in the dinner.

Our values on the total intake of magnesium per day are in agreement with those observed in a Montreal hospital diet utilized by the employee (6) and in a diet where 35% of the calories were obtained from the fat (7). However, the magnesium content observed in our study is higher than those of high school and college girls in United States (8), while values for magnesium content in the lunch of cafeteria are in close agreement with those of type A school lunches in the United States (12).

Meals selected by the male and female students provided lower amount of average magnesium content or magnesium content/1000 Cal as compared to recommended dietary allowances of Canada (13) and the United States (14).

The results presented in this study (Table 1) as well as those of others (6-9) clearly indicate that the occidental diet contained 200-270 mg of magnesium. On the other hand the balance studies have indicated that one should ingest 400-450 mg per day of magnesium to be in positive balance (6,15). Considering this fact, the three main meals served in the cafeteria of the University of Montreal were highly deficient in magnesium. This deficiency of magnesium in the cafeteria diet could become more severe if one considers the content of calcium and phosphorus in such diet (16). It was observed that the calcium content was normal and the phosphorus content was considerably higher in the cafeteria diet as compared to RDA of Canada and the United States. It is now well established that high phosphate content in the diet could form complexes with calcium which is a strong chelating agent for minerals, including magnesium. Furthermore, magnesium itself can also form magnesium phosphate. In both cases, magnesium will be excreted rather than being absorbed. These assumptions find considerable support from the data on the ratio of magnesium to calcium and to phosphorus (Table 1). These ratios are much lower in the cafeteria diet as compared to the recommended ratios in Canada and the United States. In this context, it will be advisable to increase the magnesium content of the three main meals by including the foods rich in magnesium i.e. cereals, spinach, maize, sugar beets, fruits and vegetables. This suggestion is supported by the magnesium content of various types of breakfast, lunch and dinner (Tables 2 and 3).

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TABLE 1  
Average magnesium content in the three main meals of the day selected by the male and female students

Meal	Number of samples	Total (mg)	mg/kg fresh weight	mg/kg dry weight	mg/g protein	mg/1000 Cal	Mg/Ca ratio	Mg/P ratio
<b>MALE STUDENTS</b>								
Breakfast	15	44 ± 20 <sup>1</sup>	104 ± 50	510 ± 241	3.4 ± 1.2	110 ± 53	0.22 ± 0.10	0.12 ± 0.06
Lunch	15	97 ± 48	119 ± 54	500 ± 261	3.2 ± 1.3	107 ± 48	0.29 ± 0.15	0.16 ± 0.08
Dinner	15	106 ± 57	120 ± 52	564 ± 258	2.5 ± 1.2	115 ± 53	0.28 ± 0.15	0.16 ± 0.09
Total	45	247 ± 125	114 ± 52	525 ± 253	3.0 ± 1.2	111 ± 51	0.27 ± 0.13	0.15 ± 0.08
<b>FEMALE STUDENTS</b>								
Breakfast	15	39 ± 18	96 ± 42	455 ± 228	3.9 ± 1.3	98 ± 47	0.27 ± 0.12	0.14 ± 0.07
Lunch	15	85 ± 42	121 ± 57	493 ± 243	3.3 ± 1.2	113 ± 59	0.29 ± 0.15	0.15 ± 0.08
Dinner	15	100 ± 53	125 ± 57	590 ± 263	2.5 ± 1.2	123 ± 57	0.24 ± 0.13	0.15 ± 0.07
Total	45	224 ± 113	114 ± 52	513 ± 245	3.2 ± 1.2	111 ± 54	0.26 ± 0.13	0.15 ± 0.08
<b>MALE &amp; FEMALE STUDENTS</b>								
Breakfast	30	42 ± 19	100 ± 46	482 ± 234	3.6 ± 1.2	104 ± 50	0.25 ± 0.11	0.13 ± 0.06
Lunch	30	91 ± 45	120 ± 55	496 ± 252	3.2 ± 1.3	110 ± 54	0.29 ± 0.15	0.15 ± 0.08
Dinner	30	103 ± 55	123 ± 54	577 ± 260	2.5 ± 1.2	119 ± 55	0.26 ± 0.14	0.15 ± 0.08
Total	90	236 ± 119	114 ± 52	519 ± 249	3.1 ± 1.2	111 ± 53	0.27 ± 0.13	0.15 ± 0.08
<b>RECOMMENDED</b>								
<b>DIETARY ALLOWANCE (19-35 years old)</b>								
Canada	Male	300	—	—	—	—	0.38	0.38
	Female	250	—	—	—	—	0.31	0.31
United States	Male	350	—	—	—	—	0.44	0.44
	Female	300	—	—	—	—	0.38	0.38

<sup>1</sup> Mean ± S.D. (Mg indicates magnesium while Ca and P represent calcium and phosphorus, respectively)

<sup>2</sup> Sum of mg/kg for breakfast, lunch and dinner ± 3.

TABLE 2  
Magnesium content in various types of breakfasts

Types of breakfasts	Number of samples	Total (mg)	mg/kg fresh weight	mg/kg dry weight	mg/g protein	mg/1000 Cal	Mg/Ca ratio	Mg/P ratio
Continental <sup>2</sup>	4	21.0 ± 3.2 <sup>1</sup>	66 ± 11	356 ± 41	3.9 ± 0.6	89 ± 10	0.17 ± 0.03	0.08 ± 0.02
Continental + one fried egg	12	35.5 ± 4.0	100 ± 17	473 ± 56	3.4 ± 0.6	101 ± 18	0.23 ± 0.09	0.14 ± 0.05
Continental + two fried eggs	6	44.8 ± 13.8	124 ± 16	498 ± 59	2.9 ± 0.4	98 ± 13	0.23 ± 0.08	0.15 ± 0.04
Continental + one piece of Ham + lettuce + cheese	2	49.8 ± 9.3	98 ± 16	518 ± 62	2.8 ± 0.3	103 ± 12	—	0.15 ± 0.03
Continental + one fried egg + Ham or bacon	2	52.1 ± 8.3	135 ± 14	478 ± 63	3.0 ± 0.5	86 ± 12	0.27 ± 0.03	0.17 ± 0.02
Continental + oatmeal + milk + brown sugar	2	59.7 ± 7.3	143 ± 22	746 ± 82	6.6 ± 0.8	163 ± 20	0.19 ± 0.02	0.09 ± 0.01
Continental + corn flakes + cheese + milk	2	86.5 ± 13.2	175 ± 21	793 ± 91	7.3 ± 0.9	137 ± 15	0.34 ± 0.09	0.17 ± 0.05

<sup>1</sup>Mean ± S.D.

<sup>2</sup>The continental breakfast consisted of either juice, two slices of toast and butter, coffee, cream for coffee, and sugar or juice, cornflakes, sugar and milk.

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TABLE 3  
Magnesium content in various types of lunch and dinners

Type of meal	Number of samples	Total (mg)	mg/kg fresh weight	mg/kg dry weight	mg/g protein	mg/1000 Cal	Mg/Ca ratio	Mg/P ratio
Cold cuts <sup>2</sup>	2	64.2 ± 6.4	76.8 ± 8.3	378 ± 42	2.53 ± 0.30	79.1 ± 8.2	0.23 ± 0.03	0.15 ± 0.02
Ham sandwich platter	2	69.2 ± 7.2	97.7 ± 10.1	490 ± 50	3.93 ± 0.43	110.0 ± 13.0	0.40 ± 0.05	0.20 ± 0.03
Ham croquette	2	73.6 ± 6.2	98.0 ± 9.2	562 ± 58	4.23 ± 0.51	118.0 ± 20.0	0.20 ± 0.02	0.10 ± 0.02
Veal cutlet	2	81.1 ± 4.1	141.2 ± 7.3	537 ± 39	2.95 ± 0.28	125.5 ± 11.3	0.25 ± 0.02	0.15 ± 0.02
Lasagne	6	94.9 ± 19.8	140.2 ± 27.2	650 ± 78	3.00 ± 0.38	117.0 ± 15.0	0.34 ± 0.06	0.16 ± 0.03
Red meat	19	99.3 ± 37.3	127.0 ± 48.1	579 ± 81	2.69 ± 0.31	98.2 ± 10.3	0.24 ± 0.09	0.15 ± 0.05
White meat	25	99.7 ± 39.2	127.2 ± 50.2	567 ± 83	2.62 ± 0.29	102.1 ± 11.8	0.26 ± 0.08	0.14 ± 0.04
Salad platter	2	115.5 ± 11.3	139.2 ± 51.0	1060 ± 192	3.18 ± 0.44	171.2 ± 21.8	—	0.33 ± 0.04
Blood sausages	4	130.8 ± 25.3	145.3 ± 62.8	657 ± 91	2.66 ± 0.33	161.1 ± 19.3	0.26 ± 0.04	0.20 ± 0.03
Fruit platter	2	132.9 ± 13.9	168.0 ± 73.4	777 ± 118	6.71 ± 0.78	215.4 ± 28.7	0.49 ± 0.05	0.29 ± 0.03

<sup>1</sup>Mean ± S.D.

<sup>2</sup>In the lunch and dinner, the main dish has been identified as a pattern of meal selection. On the average, the lunch and dinner also contained either a juice or soup, bread and butter, one portion of green vegetables, one portion of potatoes, one portion of green salad, a dessert, tea or coffee, cream or milk for coffee or tea and sugar. The composition of salad platter and fruit platter is the same as described in a previous publication (17).

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Contents, as influenced by choice of foods for meals :

### a) Breakfast (Table 2)

The magnesium content of continental breakfast (Table 2) was lowest (21.0 mg). Addition of one fried egg increased the magnesium content by 70% (35.5 mg) whereas addition of either two eggs or a piece of ham, lettuce and cheese or one fried egg, ham or bacon or oat meal and milk increased the magnesium content by two to three folds (44.8-59.7 mg). Continental breakfast with cornflakes, cheese and milk had highest magnesium content (86.5 mg). Similar type of variations were also noted when the results were expressed either as per kg fresh or dry weight, or per g protein or per 1000 Cal.

Continental breakfast with cornflakes, cheese and milk was the only breakfast where magnesium to calcium ratio reached the ratio of RDA for two minerals (Table 2). In other types of breakfasts this ratio was considerably lower. The ratio of magnesium to phosphorus (Table 2) was lower in all types of breakfasts as compared to the ratio of RDA for two minerals.

### b) Lunch and dinners (Table 3)

The magnesium content of various types of lunch and dinners is given in Table 3. Meals with cold cuts, ham sandwich platter and ham croquette had lowest amount of magnesium (64.2-73.6 mg) while the meals with veal cutlet, lasagna, white or red meat had intermediate values (81.1-99.7 mg). Meals with salad platter, blood sausages and fruit platter had the highest values (115.5-132.9 mg). Similar types of variations were also noted when the results were either expressed as per kg fresh or dry weight or per g protein or per 1000 Cal.

The ratio of magnesium to calcium was higher in meals with fruit platter and normal in meals with lasagna as compared to the ratio of Canadian RDA for two minerals (Table 3). In other types of meals this ratio was lower. The magnesium to phosphorus ratio was normal only in the salad platter and lower in all other meals as compared to the ratio of Canadian RDA for two minerals.

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## NUTRITION REPORTS INTERNATIONAL

### REFERENCES

1. Leroy, J. Nécessité du magnésium pour la croissance de la souris. C.R. Soc. Biol. Paris 94, 431, (1926).
2. Kruse, H.D., Orent, E.R. and McCollum, E.U. Studies of magnesium deficiency in animals. I. Symptomology resulting from magnesium deprivation. J. Biol. Chem. 96, 519, (1932).
3. Kruse, H.D., Orent, E.R. and McCollum, E.U. III Chemical changes in the blood following magnesium deprivation. *ibid.* 100, 603, (1933).
4. Durlach, J. Ed. Ier Symposium International sur le déficit magnésique en pathologie humaine. Vittel, Edition du Symposium, (1971).
5. Durlach, J., and Péchary, C. Mode d'exploration pratique du magnésium chez l'homme. Vie. Méd. 53, 4307, (1973).
6. Duruisseau, J.P., Lapointe, J. et Laurendeau, E. Teneur en magnésium de la diète servie à l'Hôpital Notre-Dame de la Merci. Can. J. Pub. Health, 67, 30, (1976).
7. Marshall, M.W., Iacono, J.M., Young, C.W., Waghington, V.A., Slover, H.T. and Leaply, P.M. Analyzed vs calculated values, composition of diets containing 25 and 35% calories from fat. J. Amer. Diet. A. 66, 470, (1975).
8. White, H.S. Inorganic elements in weighed diets of girls and young women. J. Amer. Diet. A. 55, 38, (1969).
9. Amiot D., Hioco, D. et Durlach, J. Fréquence du déficit magnésique chez le sujet normal et dans diverses ostéopathies. J. Méd. Besançon, 5, 371, (1969).
10. Srivastava, U.S., Nadeau, M.H. and Carbonneau, N. Mineral intakes of University students. I. Zinc content. J. Can. Diet. A. 38, 302, (1977).
11. Willard, H.H., Merritt, L.L. and Dean, J.A. Chapter II, Flame photometry In : Instrumental methods of analysis p. 309-356 (1965), 4th Edition. Publisher : D. Von Nostrand Company Inc. Princeton, N.J.
12. Murphy, E.W., Page, L. and Watt, B.K. Trace minerals in Type A school lunches. J. Amer. Diet. A. 58, 115, (1971).
13. Health and Welfare Canada : Canadian Nutritional Standards, Revised Edition, (1975).
14. Food and Nutrition Board : Recommended Dietary Allowances, Eighth Revised Edition, 1974. Washington, D.C. Natl Acad. Sci. (1974).

## NUTRITION REPORTS INTERNATIONAL

15. Seelig, M. 1er Symposium International sur le déficit magnésique en pathologie humaine. Page 11. (1971). Ed. Durlach, J. Publisher Vittel. Edition du Symposium.
16. Srivastava, U., Rakshit, A.K. and Khare, I. Mineral Content of University students : Calcium and Phosphorus content. Nutr. Rep. Inter. in press.
17. Srivastava, U., Nadeau, M.H. and Carbonneau, N. Mineral content of University students : Cadmium and Manganese content. Nutr. Rep. Inter. in press.

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