PJN
ISSN 1680-5194

PAKISTAN JOURNAL OF NUTRITION

ANSInet
308 Lasani Town, Sargodha Road, Faisalabad - Pakistan
Mob: +92 300 3008585, Fax: +92 41 8815544
E-mail: editorpjn@gmail.com

Pakistan Journal of Nutrition 9 (12): 1162-1165, 2010
ISSN 1680-5194
© Asian Network for Scientific Information, 2010

Study of the Bioavailability and Clinical Studies of Calcium-Magnesium Tablets

Abdul-Wahab R. Hamad and Hamad H. Al-Jamaien
Department of Medical Allied Sciences, Zarka University College, Al-Balqa Applied University, Jordan

Abstract: The bioavailability of the trace elements selenium, manganese, zinc, iron etc. has been investigated using human and experimental animals as the test observations. Twenty volunteers were used for this study. All volunteers have a deficient in calcium and magnesium. All patients were administered orally a tablet of combined calcium carbonate 292.5 mg and magnesium carbonate 232.3 mg produced by Commercial Company, Jordan. The mean concentration of blood calcium and magnesium after one week of tablet supplement was 100.8±8.3 and 15.7±1.0, respectively. The results showed that calcium-magnesium tablet is the most important elements to recover patient's deficiency. It is thus concluded that combined calcium-magnesium carbonate are the best form for those elements for people deficiency.

Key words: Calcium, magnesium, supplement, bioavailability

INTRODUCTION

A therapeutic or prophylactic approach to osteoporosis, or to suppression of decrease in bone mass, is calcium supplementation (Proposed Diagnostic Criteria for Osteoporosis, 1993). The underlying mechanism is generally thought to consist in the suppression of parathyroid hormone secretion (Recker, 1981). Recently, stress is laid particularly on the importance of a well-balanced supply of calcium and magnesium rather than simple calcium intake (Esashi, 1992).

In their epidemiological study on the relationship of cardiac disorders to calcium/magnesium intake ratio in 1940, Karppanen *et al.* (1978) pointed out that the number of patients with cardiac disorder was prone to increase with rising calcium/magnesium ratio. Additionally, cardiac disorders were found to be of the highest in incidence in Finland where the intake ratio exceeded 4:1.

It has also been demonstrated by Seelig (1982) in a balance test with a daily magnesium intake of 350 mg and a progressively increasing daily calcium intake of 200 to 1,400 mg that urinary magnesium excretion increased with increasing calcium intake, leading eventually to a negative balance with excessive magnesium excretion over its actual intake. The nutritional requirement for calcium is 600 mg a day and the recommended daily magnesium intake is 300 mg in Japan. It may thus be said that a calcium-magnesium intake ratio of 2:1 is advisable for Japanese (Itokawa, 1990).

Ryukyuan coral is a dietary material approved as a food additive that contains calcium and magnesium in an approximate ratio of 2:1, with their contents of 20 and 10%, respectively. Under the view that it is justified to add this foodstuff to the so-called nutritionally well-balanced foods which satisfy the mineral balance, some researchers were incorporated coral powder into inexpensive, light, tasty crackers. This foodstuff was incorporated into crackers to permit a well-balanced mineral intake of about half the daily requirements of calcium and magnesium (i.e., 300 mg calcium and 150 mg magnesium) by the daily ingestion of 4 crackers (per box) as a snack.

This study was undertaken to evaluate in humans whether mean intestinal absorption of coral-derived calcium incorporated into crackers might be comparable or even superior to mean intestinal absorption of calcium carbonate-derived calcium in crackers.

Magnesium is an essential trace element for humans and animals. The recommended daily allowance is mg of mg per day in diet of a human adult.

There are many different forms of trace elements in supplements for human consumption that are available in the market place. Inorganic salts such as sulphates and carbonates are the most commonly used forms as well as they are the cheapest formula. Also the organic salts such as citrates and gluconates are common. Another form which is thought to be more utilized by the body are the amino acid chelates. These are usually formed by hydrolysis of protein and reaction of the resulting amino acid with an inorganic salt to supposedly form a chelate of the metal with the ligand amino acids.

A third form, yeast, is produced by growing yeast in a nutrient medium containing the inorganic salt. In theory, the yeast absorbs the element by forming a natural chelate between the metal ion and the proteins and/or amino acids of the yeast.

With the advent of atomic absorption spectroscopy twenty years ago, there has been large body of literature on the concentration of trace elements in foods and physiological fluids. While laboratory analysis can

Corresponding Author: Abdul-Wahab R. Hamad, Department of Medical Allied Sciences, Zarka University College, Al-Balqa Applied University, Jordan

determine how much of a given material is present in a food, only a well designed bioassay can provide information about the bioavailability of that material. In nutrition, a bioassay is especially important in dealing with essential trace elements because many factors influence their utilization. Among these are digestibility of the carrier food, chemical and physical form of the element, the body's own need for that element and interaction with other nutrients and the role of chelating. Bioavailability was defined by Fritz (1976) as the ration between the qualities of a nutrient in a sample as determined by animal assay to the quantity determined by chemical analysis. There are several methods to determine bioavailability of trace elements. These include:

1) Balance studies with either man or laboratory animals
2) Radiotracer techniques, or
3) Serum metal response following test doses

Although radiotracer studies with mice or animals are the easiest to perform, the results may be criticized because the spiked radiotracer may not behave in the same way as the non-spiked element being tested. This is the case when the form of the element being tested is different to that of the spiked tracer. Animal studies offer the best method of determining bioavailability of a trace element. The Association of Official Analytical Chemists (1975) has adopted a method for measuring bioavailability of iron based on repletion of hemoglobin in anemic rats. In this official method a reference standard is used and other forms of the element compared to it.

MATERIALS AND METHODS

Blood protocol: Twenty (20) volunteers (15 males and 5 females) their ages 30 years, body weight 67 kg and height 169 cm, participated in this study (Table 1). None of the subjects had a history of bone disease, peptic ulcer, enterectomy, regional enteritis, malabsorption, nephrolithiasis, liver cirrhosis, or renal disorder. Subjects had not taken Ca or Mg or Vitamins, or any other drugs that could affect calcium or magnesium metabolism during the week preceding the start of the study. After a subsequent 3 days wash out period. All volunteers have calcium and magnesium element deficiency in their blood. All volunteers were taken for one week a single dose of Calcium carbonate 292.5 mg + Magnesium carbonate 232.3 mg tablet as 67 mg Mg and 117 mg Ca produced by Commercial Company was administered orally to all volunteers which have deficient in both calcium and magnesium level, the supplementation of Cal-Mag. tablet was taken for one week to reduce the deficiency of this element in their blood. Each subject appeared on the experimental day after an overnight fast. The tablets were taken orally with 200 ml of water in the form of Cal-Mag carbonate.

Table 1: Characteristics of the volunteers

Subject	Sex	Age\years	Height\cm	Weight\kg
1	M	23	170	68
2	M	24	165	65
3	M	26	173	63
4	M	29	166	70
5	M	20	174	80
6	M	35	172	78
7	M	32	171	74
8	M	27	167	75
9	M	33	169	73
10	M	29	173	84
11	M	30	168	72
12	M	40	174	69
13	M	24	160	58
14	M	23	164	57
15	F	24	166	60
16	F	26	168	55
17	F	29	170	59
18	F	30	161	60
19	F	32	165	58
20	F	34	165	60
Mean		28.5	168.5	66.90
±SD		4.94	4.11	8.59

Blood samples were collected from all volunteers before treatment and after treatment. Blood (3 ml) was taken by means of intravenous sample. Blood samples were collected in polyethylene test tubes one week before treatment, as well as the blood were collected after 7 days intervals of oral administration after treatment. The samples were centrifuged and the plasma layer was kept frozen until analysis. The experiment was repeated 1 week later with the same volunteers and given the tablets from the same batch of tablets. The blood was analyzed by atomic absorption spectroscopy (AAS 1260, Schimatzu, Japan). Statistics were done using a t-test.

RESULTS AND DISCUSSION

The results of the Cal-Mag. supplementation study are shown in Table 2 and 3. The results showed that the differences of calcium and magnesium in serum after treatment was highly significant than the level before the treatment by about 47% and 33% respectively. The volunteers were recovered some of their deficiency from 68.7-100.7 ppm for calcium throughout one week of supplementation treatment, while the level of magnesium increased from 11.7-15.6 ppm (Tables 2 and 3).

We probably need more Calcium and Magnesium than any other vitamin or mineral because they are the primary building blocks of bones, teeth and muscles. Many foods contain these valuable minerals, especially calcium, so many people supplement their diets with Calcium...yet Calcium remains high on the list of minerals in which people are deficient. It is not how much Calcium and Magnesium you obtain from the foods you eat and supplements you take, but rather how much your body absorbs and utilizes. Very simply, Calcium is difficult to absorb for most people. Life Plus

Table 2: Concentrations of Magnesium (ug\ml) in serum volunteers before and after treatment of calcium magnesium tablets

No. of volunteers	Before treatment ug\ml	After treatment ug\ml
1	10.12	14.50
2	11.34	14.67
3	10.45	14.00
4	11.04	15.45
5	12.75	15.85
6	10.56	14.60
7	11.67	16.35
8	10.79	15.25
9	13.00	16.00
10	12.50	15.80
11	13.00	16.75
12	13.25	17.25
13	12.65	15.80
14	11.85	15.00
15	10.60	14.50
16	10.30	14.60
17	12.48	16.15
18	11.74	15.88
19	11.56	16.24
20	13.25	18.15
Mean	11.745	15.6395
±SD	1.064	1.0393

Table 3: Concentrations of Calcium (ug\ml) in serum volunteers before and after treatment of calcium magnesium tablets

No. of volunteers	Before treatment ug\ml	After treatment ug\ml
1	75.80	105.85
2	65.98	95.35
3	70.45	98.25
4	69.15	97.65
5	65.65	93.68
6	77.14	110.75
7	82.70	120.12
8	85.13	117.45
9	60.60	92.34
10	67.45	98.15
11	64.50	94.60
12	71.56	100.00
13	73.25	106.35
14	55.70	90.55
15	59.80	92.80
16	58.00	93.75
17	63.00	99.10
18	74.15	108.35
19	64.76	102.50
20	68.35	97.80
Mean	68.656	100.7695
±SD	7.81951	8.30605

understands that the name of the game is absorption and utilization; therefore, Cal-Mag PLUS is more than just a straight Calcium supplement. It includes an abundant amount of Magnesium and other specific nutrients your body needs in order to absorb and utilize both Calcium and Magnesium to its fullest potential.

Your body needs adequate amounts of Magnesium in order to absorb calcium and it also needs adequate amounts of Calcium to utilize magnesium. Vitamin D-3 is also included because it is necessary for both the absorption and utilization of Calcium and Calcium is needed to utilize Vitamin D-3. Any calcium supplement that does not contain calcium, Magnesium and Vitamin D is simply not of much value in terms of absorption and utilization in the body (Itokawa, 1990; The Declaration of Helsinki, 1988).

Many Calcium supplements contain only inexpensive, inorganic forms of Calcium, such as oxides or carbonates. In general, most of these products are not worthwhile because most of the Calcium is not absorbed. This is why Life plus Cal-Mag PLUS contains numerous sources of Calcium and Magnesium including citrates, chelates, aspartates, gluconates, ascorbates, glycerophosphates and lactates (Deborah and Canyon, 2007; Hanzlik *et al*., 2005; Pak *et al*., 1987). Individuals who are allergic to dairy products (a major source of Calcium in the American diet) can easily become deficient in Calcium and may need Cal-Mag PLUS to make up for the loss of this source of Calcium. During pregnancy, mothers need a great deal of calcium and magnesium to ensure the proper development of the fetal bones, muscles and teeth and to ensure that the mother's own mineral stores are not depleted. For the same reason, lactating mothers should continue to supplement their diets with Cal-Mag PLUS. Growing children need extra calcium in their diets to ensure continuing development of muscles, bones and teeth. If they maintain proper levels of calcium, they will have less tendency toward cavities and broken bones. Elderly people find it increasingly difficult to absorb calcium and in general don't seem to get enough magnesium. They often develop osteoporosis, a condition where calcium erodes from the bones causing them to become weak and brittle. Early and continuing calcium supplementation can be helpful in prevention of osteoporosis (Janet *et al*., 2005; Birge *et al*., 1969).

Directions: Five tablets twice a day-supply 1,000 mg of Calcium and 500 mg of Magnesium, plus other synergistic nutrients for optimal utilization.

This unique product contains PolyCalPlex™ and PolyMagPlex™ proprietary blends of high quality Calcium and Magnesium sources. Cal-Mag PLUS also contains Betaine HCl and L-Glutamic Acid to enhance Calcium absorption, plus Alfalfa, Kelp and Dulse as sources of trace elements synergistic with Calcium and Magnesium. Cal-Mag PLUS is formulated in the exclusive PhytoZyme™ base of plant enzymes for bioavailability and over 30 synergistic fruit, vegetable and herbal concentrates for "extra" phytonutrient cofactors (Van Dokkum *et al*., 1996; Suzuki *et al*., 1997). It contains no artificial preservatives, sugar, starch, caffeine, salt, wheat, gluten, yeast, corn, milk, egg, shellfish, soya derivatives, artificial sweetening, flavoring or coloring agents.

REFERENCES

Birge, S.J., W.A. Peck, M. Berman and G.D. Whedon, 1969. Study of calcium absorption in man: A kinetic analysis and physiologic model. J. Clin. Invest., 48: 1705-1713.

Deborah Straub, A. and Canyon Ranch, 2007. Calcium supplementation in clinical practice: A review of forms, doses and indications. Nutr. Clin. Practice, 22: 286-296.

Esashi, T., 1992. Calcium and magnesium. Rinsho Eiyo. Clin. Nutr., 81: 288-294.

Hanzlik, R.P., S.C. Fowler and D.H. Fisher, 2005. Relative bioavailability of calcium from calcium formate, calcium citrate and calcium carbonate. J. Pharmacol. Exp. Ther., 313: 1217-1222. View Abstract.

Itokawa, Y., 1990. Magnesium as a nutrient. Igaku no Ayumi (1 Clin. Exp. Med.), 154: 213-216.

Janet Barger-Lux, M., K. Michael Davies and P. Robert Heaney, 2005. Calcium supplementation does not augment bone gain in young women consuming diets moderately low in calcium. J. Nutr., 135: 2362-2366.

Karppanen, H., R. Pennanen and L. Passinen, 1978. Minerals, coronary heart disease and sudden coronary death. Adv. Cardiol., 25: 9-24.

Pak, C.Y.C., J.A. Harvey and M.C. Hsu, 1987. Enhanced calcium bioavailability from a solubilized form of calcium citrate. J. Clin. Endocrinol. Metab., 65: 801-805.

Proposed Diagnostic Criteria for Osteoporosis, Jpn. Soc. Bone Metab., 1993.

Recker, R.R., 1981. Continuous treatment of osteoporosis: Current status. Orthop Clin. North Am., 12: 611-627.

Seelig, M.S., 1982. Magnesium requirements in human nutrition. 1 Med. Soc., 79: 849-850.

Suzuki, K., M. Uehara, R. Masuyilma and S. Gotou, 1997. Calcium utilization from natural coral calcium~A coral preparation with a calcium-magnesium content ratio of 2:I. Abstracts of Papers Presented at the 44th Jpn. Soc. Nutr. Betterment, pp: 145, Fukuoka, Vol. 45, No. 5, 1999.

The Declaration of Helsinki (adopted in 1964; as amended in 1989), 1988. Nutr. Sci. Vitamino, 51: 41-42.

Van Dokkum, W., V. De la Gueronniere, G. Schaafsma, C. Bouley, J. Luten and C. Latge, 1996. Bioavailability of calcium of fresh cheeses, enteral food and mineral water: A study with stable calcium isotopes in young adult women. Br. J. Nutr., 75: 893-903.