Magnesium absorption from mineral water

Article *in* European Journal of Clinical Nutrition · July 2003

DOI: 10.1038/sj.ejcn.1601750 · Source: PubMed

3 authors, including:

Magalie Sabatier
Nestlé S.A.
25 PUBLICATIONS **229** CITATIONS
SEE PROFILE

Maurice Arnaud
Independent Scientific Advisor
106 PUBLICATIONS **3,138** CITATIONS
SEE PROFILE

European Journal of Clinical Nutrition (2003) 57, 801–802
 0954-3007/03 $25.00
www.nature.com/ejcn

LETTER TO THE EDITOR

Magnesium absorption from mineral water

European Journal of Clinical Nutrition (2003) **57,** 801–802. doi:10.1038/sj.ejcn.1601750

We read with interest the paper of Verhas *et al* (2002), who studied magnesium (Mg) bioavailability from mineral water. The test was carried out on 300 ml of water containing 1.2 mmol of Mg. Using the radioisotope ^{28}Mg, administered orally and intravenously on two separate sessions, Mg absorption (MgA) was estimated to be $59.1 \pm 13.6\%$ (mean $\pm$ s.d.). We recently worked on the comparison of stable isotopic methods for MgA determination in men and have some comments to make regarding the method used by Verhas *et al*. Secondly, we would like to underline that MgA is mainly dose dependent, making comparisons between studies difficult.

The method applied by Verhas *et al* has been previously described by Danielson *et al* (1979). MgA was determined using the double labelling method, with a time between the two administrations ranging from 35 to 84 days. It was calculated as the quotient between forearm radioactivity values obtained 24 h after oral and intravenous ^{28}Mg administration, respectively. This calculation is the same as that used in a stable isotope field, which was initially adapted from the radioisotope technique (Turnlund, 1989; Sandström *et al,* 1993). In order to validate this approach, the method using stable isotopes were systematically compared with the single labelling method corrected for faecal endogenous excretion (Friel *et al*, 1992; Rauscher *et al*, 1997; Lowe *et al*, 2000). We compared these approaches in humans in order to validate the double labelling method for MgA determination. ^{26}Mg (70 mg) was administered orally and 15 min later 30 mg of ^{25}Mg were injected. Results using the double labelling from plasma at 6, 11, 16 and 24 h after the isotope administration were significantly higher than the faecal monitoring method corrected for faecal endogenous excretion, that is, 61 ± 10, 63 ± 11, 59 ± 10, $56 \pm 9\%$ *vs* $48 \pm 5\%$ (mean $\pm$ s.d., $n = 6$), respectively (Sabatier *et al*, accepted). Results agree with the reference method when determined from plasma after 72 h postisotope administration or in urine after 24 h postisotope administration when pooled by 24 h periods. The results for Mg are in agreement with those observed for other elements. Generally, the results from double labelling comply with single labelling when determined from serum or urine collections starting $\geqslant$24–48 h, depending on the nutrient, following isotope administrations (Lee *et al*, 1994; Lowe *et al*, 2000). This time is necessary since isotopes are metabolised at the same rate once equilibrium has been reached. Consequently, an early measurement as was carried out in the Verhas paper could lead to erroneous results. This method could be used to compare the MgA of two products, but needs to be validated against other methods, especially if it is used only to estimate MgA. Although the validation of this method could be of great interest for MgA determination, the short half-life (21.4 h) of ^{28}Mg could limit the development of the method, and stable isotopes have the advantage of being safer for subjects.

A wide range of MgA values have been reported (10–75%), which could be due to the analytical method, formulation, the nutritional origin of the preparation and the Mg load administered, as discussed in Verhas. From our point of view, considering the publications to which Verhas referred in healthy humans, the Mg load is the main explanation for such variability. It has been clearly demonstrated by three studies in adults, reviewed by Ekmekcioglu (2000), that MgA is load dependent. Thus, for the higher and lower Mg loads tested in those three studies, that is, 47, 41.7, 40.1 and 1.9, 0.3, 1.5 mmol, MgA was 23.7, 14, 11 and 75.8, 70, 65%, respectively (Graham *et al,* 1960; Roth & Werner, 1979; Fine *et al*, 1991). The upper range of MgA was obtained for the lower amount of Mg. However, the higher absolute amount of Mg absorbed was obtained with the higher amount tested. This demonstrates that the percentage of MgA has to be considered cautiously and raises the question: Is it correct to apply a rate of MgA determined with a tested amount of 1.2 mmol contained in 300 ml of water, to 1 l that contained 3.9 mmol of Mg?

Using the stable isotope single labelling method and a faecal monitoring, we found a lower value of MgA ($45.7 \pm 4.6\%$) from an Mg-rich mineral water (Sabatier *et al*, 2002). This test was carried out on 1 l of Mg-rich mineral water containing 4.5 mmol/l of Mg labelled with 30 mg of ^{25}Mg consumed twice by a bolus of 500 ml during 2 days. The apparent discrepancy between both results can be explained for 2–3% by the faecal endogenous excretion of the label. The possible overestimate of MgA using ^{28}Mg may account for a part, but the difference is mainly because of the amount tested, making comparisons difficult. The experiment of Verhas *et al* is probably closer to the usual way of

drinking. However, when we estimate the absolute amount absorbed in both cases by applying the rate of MgA obtained in our study to 300 ml of our tested water, which is underestimated considering that MgA is load dependent, the amount absorbed is similar. It is thus preferable to compare the absolute amount absorbed rather than the fraction absorbed.

In summary, the method used for MgA determination needs to be validated against a more conventional method, as early measurements after (stable or radioactive) isotope administration could yield erroneous results. Furthermore, MgA expressed as a percent or a fraction has to be considered cautiously. Nevertheless, it has been confirmed that Mg-rich mineral water is a reliable source of Mg.

References

Danielson BG, Johansson G, Jung B, Ljunghall S, Lundqvist H & Malmborg P (1979): Gastrointestinal magnesium absorption. Kinetic studies with ^{28}Mg and a simple method for determination of fractional absorption. *Mineral Electrolyte Metab.* **2**, 116–123.

Ekmekcioglu C (2000): Intestinal bioavailability of minerals and trace elements from milk and beverages in humans. *Nahrung* **44**, 390–397 (review).

Fine KD, Santa Ana CA, Porter JL & Fordtran JS (1991): Intestinal absorption of magnesium from food and supplements. *J. Clin. Invest.* **88**, 396–402.

Friel JK, Naake Jr VL, Miller LV, Fennessey PV & Hambidge KM (1992): The analysis of stable isotopes in urine to determine the fractional absorption of zinc. *Am. J. Clin. Nutr.* **55**, 473–477.

Graham LA, Ceasar JJ & Burgen AS (1960): Gastrointestinal absorption and excretion of ^{28}Mg in man. *Metab. Clin. Exp.* **9**, 646–659.

Lee WT, Leung SS, Fairweather-Tait SJ, Leung DM, Tsang HS, Eagles J, Fox T, Wang SH, Xu YC & Zeng WP (1994): True fractional calcium absorption in Chinese children measured with stable isotopes (^{42}Ca and ^{44}Ca). *Br. J. Nutr.* **72**, 883–897.

Lowe NM, Woodhouse LR, Matel JS & King JC (2000): Comparison of estimates of zinc absorption in humans by using 4 stable isotopic tracer methods and compartmental analysis. *Am. J. Clin. Nutr.* **71**, 523–529.

Rauscher A & Fairweather-Tait S (1997): Can a double isotope method be used to measure fractional zinc absorption from urinary samples? *Eur. J. Clin. Nutr.* **51**, 69–73.

Roth P & Werner E (1979): Intestinal absorption of magnesium in man. *Int. J. Appl. Radiat. Isot.* **30**, 523–526.

Sabatier M, Arnaud MJ, Kastenmayer P, Rytz A & Barclay DV (2002): Meal effect on magnesium bioavailability from mineral water in healthy women using stable isotopes. *Am. J. Clin. Nutr.* **75**, 65–71.

Sabatier M, Keyes WR, Pont F, Arnaud MJ & Turnlund JRH. Comparison of stable isotope methods for the determination of magnesium absorption in humans. *Am. J. Clin. Nutr.* in press.

Sandström B, Fairweather-Tait S, Hurrell R & Van Dokkum W (1993): Methods for studying mineral and trace element absorption in humans using stable isotopes. *Nutr. Res. Rev.* **6**, 71–95.

Turnlund JR (1989): The use of stable isotopes in mineral nutrition research. *J. Nutr.* **119**, 7–14 (review).

Verhas M, De La Gueronniere V, Grognet JM, Paternot J, Hermanne A, Van Den Winkel P, Gheldof R, Martin P, Fantino M & Rayssiguier Y (2002): Magnesium bioavailability from mineral water. A study in adult men. *Eur. J. Clin. Nutr.* **56**, 442–447.

M Sabatier[1], MJ Arnaud[1] and JR Turnlund[2]
[1]Nestle Water Institute BP 101 88 804 Vittel Cedex, France; and
[2]Western Human Nutrition Research Center USDA/ARS One Shields Avenue University of California Davis, CA 95616, USA