Bioavailability of Magnesium Salts – A Review

Ragnar Rylander

Introduction
Magnesium (Mg) is the major intracellular divalent cation of the body and is involved in more than 300 enzymes throughout the body. Mg homeostasis is maintained through dietary intake. Disturbances appear in cases of insufficient intake or increased excretion. Studies show that dietary Mg supply is below recommended values, especially among elderly and young women. Therefore, Mg supplementation could be of value for certain groups in the population. The purpose of this review is to analyze the available information on the bioavailability of different Mg salts.

Method
Determination of the bioavailability of Mg salts is complicated. In contrast to pharmaceutical agents, Mg is always present in relatively high concentrations. Studies on bioavailability can be made by determining the plasma level of Mg although the range between normal homeostasis and a deficiency is very small. Information on Mg homeostasis can also be obtained by measuring the urinary excretion over a 24 hour period although no conclusion can be drawn regarding the total amount of Mg retained in the body. A total balance could be achieved by measuring the intake as well as the excretion via urine and faeces. Such studies are extremely cumbersome and have not been performed in investigations on bioavailability. Against this background, this review includes a total of eight studies on bioavailability of Mg salts.

Results
Bioavailability of Mg-oxide and Mg-citrate was compared in a study with 13 test persons (450 mg Mg/day). There were no effects on serum-Mg. The urinary excretion increased by 20% after Mg-oxide and 40% after Mg-citrate supplementation.

In a study on 16 healthy volunteers, commercial Mg-preparations as Mg-oxide, -chloride, -lactate and -aspartate (~ 510 mg/day) were compared. The mean urinary Mg excretion increased significantly after Mg-lactate, -aspartate and -chloride.

In an experimental study, 17 subjects received 608 mg Mg as Mg-citrate, -oxide or distilled water after adhering to a 3-days Mg standardized diet. In urine collected during 2-4 hours after the load, Mg increased by 0.035 mg/mg creatinine for Mg-citrate but only by 0.008 after Mg-oxide.

Mg-L-aspartate-HCl as tablets and granules was compared to Mg-oxide in a study on 3 groups of 8 healthy volunteers (60 and 90 mEq). The cumulative excretions of urinary Mg after the Mg-L-aspartate form at 90 mEq were 181 and 187 mg as compared to 137 after Mg-oxide. Similar difference was found after 60 mEq although the values were lower.

In a randomized, placebo controlled study, 46 healthy subjects received Mg-citrate, Mg-amino acid chelate or Mg-oxide (300 mg Mg/day). At 60 days, the urinary Mg excretion was higher after organic Mg salts than after Mg-oxide. The plasma Mg level at 60 days was higher after Mg-citrate supplementation than after the other forms.

Urinary Mg was measured in 18 women after receiving Mg-lactate/citrate, Mg-lactatehydroxide, Mg-hydroxide and Mg-chloride (365 and 501 mg Mg/day). The excretion in urine during the following 24 hours was higher after all supplements than after placebo. There was a non-significant tendency to a higher excretion after Mg-citrate.

One study with 51 persons investigated the influence of Mg-oxide and Mg-citrate (300 mg Mg resp.) on the intracellular, ionized concentration of Mg in human leukocytes. 9 and 24 hours after administration the concentration of ionized Mg was significantly higher in the Mg-citrate compared to the Mg-oxide group.

Conclusion
In spite of large methodological variations, the results are quite consistent. The water solubility of a Mg salt is of importance for the bioavailability. The studies demonstrate that organic salts of Mg have a higher solubility than inorganic salts. This indicates that Mg-citrate has a higher bioavailability than Mg-oxide. In conclusion available data suggest that Mg-citrate is the most appropriate preparation for therapeutic and supplementing purposes.