



# **Importance of Plant Sources of Magnesium for Human Health**

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# Magnesium Functions

- **Needed for enzymatic reactions involved in DNA, RNA, protein and adenylate cyclase synthesis; cellular energy production and storage; glycolysis; and cellular electrolyte balance**
- **Controlling factor in nerve transmission, skeletal and smooth muscle contraction, cardiac excitability, vasomotor tone, blood pressure, and bone turnover**

# Magnesium Dietary Reference Intakes (DRIs)

- United States and Canada Estimated Average Requirements (**EARs**) for adults
  - Men – 330-350 mg/day**
  - Women – 255-265 mg/day**
- United States and Canada Recommended Dietary Allowances (**RDA**s) for adults
  - Men – 410 -420 mg/day**
  - Women – 310-320 mg/day**

# Magnesium Deficiency Occurrence

- **Moderate to marginal (subclinical) or chronic latent magnesium deficiency (50- <100% of requirement) commonly occurs**
- **In the United States, a 2005/2006 survey indicated that 60% of all adults did not meet the EAR for magnesium**

# Magnesium Deficiency Occurrence

- In 2010, United States Department of Agriculture and Department of Human and Health Services indicated that **magnesium is not a major nutrient of concern for health and well-being beyond those that take drugs or have disorders that inhibit its absorption or induce its excretion.**

# **Reason for Magnesium Deficiency Dichotomy**

- **Magnesium deficiency not consistently found in pathological conditions with which it is associated such as cardiovascular disease**
- **Use of this reason fails to take into account that magnesium deficiency may be a risk or disposing factor for pathological conditions through exacerbating or inducing chronic inflammatory stress, which may be alleviated or prevented by other factors that have anti-inflammatory action**

# Reason for Magnesium Deficiency Dichotomy

- **EARs and RDAs based on highly variable balance data in 1997 were set too high**
- **Resulted in people not actually magnesium deficient being considered magnesium deficient and not showing any pathology**

# Balance Data Supporting Revised EARs and RDAs

- **Neutral balance without surface loss**
  - **165 mg/day, 95% prediction interval of 113 and 237 mg/day**
  - **2.36 mg/kg body weight/day, 95% prediction interval of 1.58 and 3.38 mg/day**
- **Data suggests for 70, 80, 90, and 100 kg persons**
  - **EARs of 170, 195, 220, and 245 mg/day**
  - **RDAs of 245, 280, 315, and 350 mg/day**

# Association Between Low Magnesium Intakes and Decreased Indicators of Bone Health

(38% of 224 subjects <237 mg/d)

| Whole Body Bone                    | Ca              |                 | Ca + Cu + Zn   |                 |
|------------------------------------|-----------------|-----------------|----------------|-----------------|
|                                    | ≥237 mg<br>Mg/d | <237 mg<br>Mg/d | ≥237mg<br>Mg/d | <237 mg<br>Mg/d |
| Subjects                           |                 |                 |                |                 |
| Mineral Content, g                 | 2103            | 2007            | 2120           | 2018            |
| Mineral Density, g/cm <sup>3</sup> | 1.094           | 1.056           | 1.100          | 1.068           |
| T Score                            | -0.09           | -0.53           | -0.03          | -0.40           |

# Magnesium Deficiency and Chronic Inflammatory Stress

- Dietary magnesium significantly and inversely associated with serum C-reactive protein (CRP) concentrations
- **CRP concentrations  $>3.0$  mg/L (threshold for chronic inflammatory stress) consistently found with magnesium intakes  $<250$  mg/day**
- **Magnesium supplementation alleviates elevated serum CRP and increases deficient serum magnesium concentrations.**

## Effect of Magnesium Supplementation on Plasma C-Reactive Protein in Subjects with Baseline Values >3.0 mg/L

| Treatment      | Number of Subjects | $\Delta$ C-Reactive Protein 5&7 Week Mean-Baseline | Ratio C-Reactive Protein 5&7 Week Mean/Baseline |
|----------------|--------------------|--|---|
| Placebo        | 17                 | +1.51±0.77   | 1.23±0.13                                       |
| +300 mg Mg/day | 19                 | -1.66±0.46   | 0.80±0.06                                       |
| P Value        |                    | 0.001  | 0.008   |

**Studies showing no effect of magnesium supplementation on serum C-reactive protein (CRP) or magnesium concentrations often involve subjects without elevated serum CRP or deficient serum magnesium concentrations**

**The lack of response indicates that some dietary factor, including perhaps an adequate magnesium intake, prevented chronic inflammatory stress and thus diseases with chronic inflammatory stress component**

**Subclinical or chronic latent magnesium deficiency may be a predisposing factor for chronic inflammatory stress, and the risk of chronic diseases such as cardiovascular disease and diabetes mellitus, especially in obese individuals, which are a significant portion of populations throughout the world.**

**Rich food sources of magnesium include green leafy vegetables, whole grains, nuts, and pulses; these foods are also rich in phytonutrients or phytochemicals with anti-inflammatory and anti-oxidant action.**

**Milk is a moderate source of magnesium and contains anti-inflammatory conjugated linoleic acid.**

**Meat is a moderate source of magnesium**

**Refined and processed foods generally have the lowest magnesium content**

# Magnesium in Plants

- Magnesium fertilization increases magnesium in grains and vegetative parts of plants
- Most magnesium deficiency in cultivated crops caused by excessive potassium fertilization or concentrations in the soil
- **Magnesium preferentially accumulates in grain when magnesium availability is low**
- **When magnesium supplies approach adequacy, vegetative structures become storage sinks for magnesium**

# Conclusions

- **Marginal to moderate magnesium deficiency commonly occurs and significantly contributes to the occurrence of chronic diseases through being a predisposing or risk factor for chronic inflammatory stress**
- **The magnesium content of foods of plant origin can be a significant determinant of whether a diet provides adequate magnesium for health**