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Boron: An Overlooked Micronutrient that Plays an Important Role In Human Physiology

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Editorial

Despite having many important functions, boron is generally overlooked by most nutritionists. This is surprising since boron accounts for 17 mg kg-1 of the earth's crust with soils ranging in content from 3-100 mg kg-1 [1]. While early research suggested a role for boron in bone development, it is now known to play a far more extensive role in human health [2,3]. Studies feeding high doses of boron to experimental animals suggested it may be toxic to reproductive development. Based on these studies, the EU established a no observed adverse level (NOEL) for intake by humans. Basaran and co-workers [4], however, examined 204 male workers exposed to high boron levels in a factory in Turkey. No reproductive toxicity biomarkers were observed in any of the male workers in spite of their high boron blood levels which averaged around 223.89±69.49 ng/g. Occupational exposure to high levels of boron did not appear to have any detrimental effects which confirms previous studies reported in China [5,6].

Early studies on chicks showed that diets without boron were extremely detrimental to the growth and development of bone [7]. Subsequent animal studies showed the importance of boron to trabecular and alveolar bone growth and maintenance. The decrease in alveolar bone, needed to support teeth, was reported in rats suffering from boron deprivation. A recent study by Hakki and co-workers [8] found that while boron did not affect tooth strength or composition, it was a significant factor in maintaining alveolar bone density around the teeth in rabbits fed a high energy diet. Earlier work by Hakki and co-workers [9] with pre-osteoblastic cells (MC3T3-E1), provided the first evidence of the molecular role of boron in regulating osteoblastic behaviour. The strengthening of bones by boron suggests that it may be beneficial for treating arthritis. This was evident in patients suffering from primary knee osteoarthritis as supplementation with calcium fructoborate significant improved the inflammatory stress biomarkers [10]. Further studies on human subjects, however, are still needed to better understand the role that boron plays in bone health.

Boron may have a beneficial effect on the function of such hormones as vitamin D, estrogen, thyroid hormone, insulin, and progesterone [3]. Early work by Nielsen et al [11] found serum 17β-estradiol and testosterone levels increased when postmenopausal women on a low boron diet were treated with dietary boron. Similar effects were also found by Naghui and co-workers [12] in healthy males following supplementation with boron after 4 weeks. While the role of boron on sex hormones is unclear, boron supplementation has been shown to increase sex hormones in both male and female and be required for activation of selected steroid hormones. Naghui et al. [12] was the first to report an increase in free testerosterone levels in healthy men following boron supplementation. The change in steroid levels further supports a role for boron in human nutrition, particularly in relation to bone health. They also provided the first evidence that supplementation with boron reduced inflammatory biomarkers TNFα, hsCPP and 1L6.

Earlier findings also associated boron and borates with possible anticancer effects [13,14]. Such reports included evidence that boron inhibits the progression of prostate cancer in humans [15] and cervical cancer. In fact it was suggested that dietary boron may exhibit a similar effect as hormonal replacement therapy (HYR) for reducing lung cancer. The possible benefits of boron on brain functions such as memory has also been reported [16].

In an effort to better understand the effect of boron deprivation, Nielsen [17] conducted experiments on Weanling rats. They found that the bioactivity of boron resulted from its effect on the formation and utilization of S-adenosylmethionine. Deprivation of boron increased plasma cysteine and homocysteine while decreasing S-adenosylmethionine, S-adenosylcysteine and spermidine.

Boron clearly plays many important roles in enhancing human health and is unlikely to be deficient in our diet as fruits and vegetables are excellent sources. As research reveals more details about the benefits of boron in our diet, it should receive a more prominent place with the other essential trace minerals.

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