

More about Boron (Iodine Supplementation Support by VWT Team) 7/4/2007 912424

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Boron is the fifth element in the periodic table of elements and has a number of important functions that have only recently been discovered and have yet to be fully appreciated. Boron is essential for plant growth, and it has recently been shown to be essential in at least one species of animal (zebra fish), with evidence mounting that it is probably essential for humans as well. The first edition of The Merck Manual (1899) credits boric acid, the most common form of boron, with being a useful treatment for amenorrhea, dysmenorrhea, epilepsy and elevated uric acid.

Prior to 1981, boron was thought to be all but irrelevant in daily human nutrition. Since then, there have been a number of animal and human studies (including one by the U.S. Department of Agriculture) determining boron as essential for the hormonal influence of estrogen and testosterone as well as bone metabolism. It is also purported to have anti-carcinogenic potential as well as preserving cognitive function. From a scientific perspective, boron appears to have earned its place on our list of vital nutrients in the orchestration of health. It has, however, yet to receive any official recognition as an essential mineral – yet.

Sources of Boron

Boron is found in non-citrus fruits such as plums, red grapes, apples, pears, and avocados, as well as in legumes and nuts. It is also present in significant amounts in coffee and red wine. Dried fruits contain a much higher amount of boron than fresh fruit. Although boron currently is not considered an essential element in the diet of humans, many scientists believe it merits the status as an essential "ultratrace" element.

BORON'S EFFECT ON CANCER

Much of the recent research on boron's anti-carcinogenic potential has been particularly centered on prostate cancer. In a study presented at the annual Experimental Biology conference in Florida in 2001, boron was shown to have reduced the incidence of prostate cancer development by 64%. The study, from the Cancer Epidemiology Training Program at the UCLA School of Public Health, compared dietary patterns of 76 men with prostate cancer to that of 7,651 men without it. The greater the quantity of boron-rich foods these men consumed, the greater their reduction in risk of being

diagnosed with prostate cancer.

Another study published in the 2002 Proceedings of the American Association of Cancer Research attempted to isolate the mechanism of action for boron's effect on prostate cancer. While the exact explanation of the mechanism remained elusive, it was hypothesized that the prostate specific antigen (PSA) is actually an enzyme (a serine protease) that frees IGF-1 from insulin-like growth factor binding protein. This freed IGF-1 has been shown to promote the growth of prostate cancer. Boron's effect is to inhibit the activity of the PSA enzyme, thus decreasing the amount of freed IGF-1 which in turn should decrease the growth of prostate cancer tumors.

The anti-cancer effect of boron compounds has been the subject of prior studies that involved tumor cell lines of human malignancies grown in culture. These studies are summarized as follows:

Cancer Cell Type(s)	Effect on Tumor Cell
Acute lymphocytic leukemia Chronic lymphocytic leukemia	Growth inhibition after treatment with boron compounds
Ehrlich ascites tumor	Significant anti-tumor action that was further increased by combining with ultrasound therapy
Ehrlich ascites tumor	Significantly increased survival time
L1210 murine leukemia cells DU-145 prostate cancer cells A549 lung carcinoma cells MCF-7 breast cancer cells	Dose-dependently inhibited DNA synthesis
LNCaP prostate cancer cells	Reduced PSA by 86-89% and reduced tumor volume by 25-38%; mitoses and IGF-1 decreased in tissue studies
Mouse and human leukemias Human uterine, colon, and lung adenocarcinomas Human gliomas	Inhibited growth
Murine and human leukemia Uterine carcinoma tumor cell lines	Potent in vivo antineoplastic activity and in vitro cytotoxicity

Anti-Cancer Activity of Boron. Studies of the anti-cancer efficacy of boron against a wide range of tumor cell lines (shown above) may warrant clinical trials in humans.

BORON'S EFFECT ON BONE METABOLISM

Calcium-Magnesium <=> Boron Interactions

Large numbers of human experiments show that boron is vitally involved in bone metabolism. It is well accepted that calcium and magnesium are important constituents of healthy bone, and in situations of adequate calcium supply but deficient magnesium resources, boron appears to substitute for magnesium during the process of bone formation. Under such conditions, the concentration of boron within bone tissue increases.

Boron's effect on bone appears to be mediated by its ability to reduce the urinary excretion of calcium

and magnesium, and this ability is due to its actions in the kidney. As stated above, this calcium-preserving effect of boron becomes pronounced in circumstances in which dietary magnesium is low. Therefore, boron is in effect acting as a backup system for magnesium in order to preserve calcium in the blood and reduce urinary calcium loss.

The effect of boron intake was analyzed in a human study involving 12 post-menopausal women not on estrogen replacement therapy. Patients were first given a boron-deficient diet consisting of 0.25 mg of boron daily for 119 days. This was followed by a 48-day period in which the same patients received boron supplementation at a dose of 3 mg per day. Patients were also studied during periods of adequate magnesium intake versus magnesium deficiency. Deprivation of boron and/or magnesium caused changes that are similar to those seen in women with post-menopausal osteoporosis, including increased loss of urinary calcium. However, in women receiving 3 mg of boron per day, urinary losses of both calcium and magnesium were significantly diminished, especially if dietary magnesium was low. Also noted were increased levels of plasma ionized calcium, beta estradiol, and testosterone.

Boron also appears to enhance vitamin D, and although there is likely a relationship between this and its calcium-preserving effect, an accurate description for the mechanism of action of boron's vitamin D enhancement is unclear.

ANTI-INFLAMMATORY IMPLICATIONS

Boron's aforementioned theorized capability to inhibit carcinogenic enzymes led researchers to believe that it may also inhibit other harmful enzymatic activity as well. Boron has been shown to inhibit cyclooxygenase (COX) and lipoxygenase (LOX), two enzymes that mediate the inflammatory cascade and are pertinent to therapies directed against inflammatory conditions. Such anti-inflammatory capabilities of boron are clearly pertinent to its anti-cancer effect, because the reduction of COX II and LOX enzymes lead to a decrease in prostaglandin E₂ (PGE₂) and other unfavorable eicosanoids such as leukotrienes. We now know that omega-6 fatty acid metabolism that is allowed to continue down this pathway represents a vital stimulus for angiogenesis and cancer growth. We also now know that there are many parallels between the medical applications of non-steroidal anti-inflammatory drugs (NSAIDs) and the biological properties of boron.

ARTHRITIS

Prostaglandins and leukotrienes are mediators of inflammatory conditions such as degenerative joint disease and osteoarthritis. PGE₂ and leukotrienes have been implicated in causing problems with joint swelling, restricted joint motion, and other arthritic complaints. There is evidence that boron may inhibit COX II and PGE₂ by suppressing nuclear factor kappa beta (NfκB)—a proinflammatory cytokine. There is also evidence along these lines that boron can relieve arthritic conditions, which are essentially conditions of inflammation. These findings are clinically supported by evidence showing that areas of the world with low levels of boron in the soil have a higher

percentage of people suffering from arthritis in comparison to regions with higher soil levels of boron. In fact, epidemiologic evidence shows that in areas of the world where boron intake is 1 mg or less per day, the estimated incidence of arthritis ranges from 20%-70%, whereas in areas of the world where boron intake is usually 3-10 mg, the estimated incidence of arthritis ranges from 0-10%. In a study of 20 patients with osteoarthritis, the 50% who received a daily supplement of 6 mg of boron all reported improvement (less pain on movement), compared to only 10% who reported likewise in the control group.

In another study, it was revealed that bones adjacent to joints with osteoarthritis tend to be less mineralized and have significantly lower concentrations of boron.

COGNITIVE FUNCTION

It is now commonly accepted that the routine use of NSAIDs significantly reduces the incidence of Alzheimer's disease. Given their aforementioned similarities, it stands to reason that boron may also have a positive effect on cognitive function.

Studies were conducted involving the analysis of brain wave patterns using an electroencephalogram (EEG) based on tests designed to measure cognition and motor skills in human subjects who were given diets that were either boron-rich (approximately 3.25 mg boron/2000 kcal/day) or boron-deficient (approximately 0.25 mg boron/2000 kcal/day). The EEG and showed an increased proportion of low-frequency activity in those subjects on the boron-deprived diet. The authors of these studies concluded that boron appears to play a significant role in human brain function and cognitive performance, and that it is an essential nutrient.

BORON TOXICITY

Doses up to 18 mg of boron daily appear to be safe for adults even if taken for prolonged periods of time. This is double the dose of even the most liberal amounts suggested by advocates of boron use. There is also no evidence to suggest that boron is either carcinogenic or mutagenic.

In 1904, human volunteers consuming greater than 500 mg of boric acid daily (this is equivalent to about 180 mg of elemental boron) showed symptoms of poor appetite and digestive problems. Symptoms of acute toxicity typically include nausea, diarrhea and abdominal cramps.

In Conclusion

Although Boron has yet to receive official entry into the ranks of the much maligned yet all-powerful RDA charts, there is strong evidence to suggest that it soon will. Along with a number of other minerals, boron may soon be recognized as essential since it has undergone publicly-funded studies recognized by government agencies, some of whom are under increasing pressure to expand the list of minerals officially listed in the RDA charts.

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