

Boron and Inflammation

By

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General Information About Boron

- Boron is a metalloid element with similar properties to silicon.
- It is best known for its role in bone health because of its effects on steroid hormones
- (Miljkovic D 2004)
- In the body the highest concentration is in the parathyroid glands, heart, spleen, and bone

General Information about Boron

Metals, Nonmetals, and Metalloids

H																	He																												
Li	Be											B	C	N	O	F	Ne																												
Na	Mg											Al	Si	P	S	Cl	Ar																												
K	Ca	Sc	Ti	V	Cr	Mn	Fe	Co	Ni	Cu	Zn	Ga	Ge	As	Se	Br	Kr																												
Rb	Sr	Y	Zr	Nb	Mo	Tc	Ru	Rh	Pd	Ag	Cd	In	Sn	Sb	Te	I	Xe																												
Cs	Ba	La	Hf	Ta	W	Re	Os	Ir	Pt	Au	Hg	Tl	Pb	Bi	Po	At	Rn																												
Fr	Ra	Ac	Rf	Db	Sg	Bh	Hs	Mt	Ds	Rg	Uub	—	Uuq	—	—	—	—																												
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Ce	Pr	Nd	Pm	Sm	Eu	Gd	Tb	Dy	Ho	Er	Tm	Yb	Lu																																
Th	Pa	U	Np	Pu	Am	Cm	Bk	Cf	Es	Fm	Md	No	Lr																																

metals

metalloids

nonmetals

General information about Boron

- Occurs naturally in soil, water, and food
- Daily intake in Canadian adults is .86 mg from water and 2.5mg from food: with a
- total 3.4mg / day
- Half-life of 21 hours: mostly excreted by the kidney
- accumulation mostly in the bone
- Lethal dose Adults: 15-20gm, 5-6 gram for children and 2-3 gram in infants

Boron in the USA



General information about Boron

- There is epidemiological evidence to suggest that levels as high as 29mg of boron/liter in drinking water (Turkey) does not cause overt symptoms of toxicity. If drinking 2 liters per day = 58mg / day
- www.hc-sc.gc.ca/dhp-mps/pubs/natur/boron-bore-eng.php

General information about Boron

- Oral intake of boron is readily and completely absorbed (>90%) through the human gut as boric acid (Hunt 1996; Murray 1998)
- In body blood/soft tissue ratio 1:1
- Ratio in blood/ bone is 1:4 (Murray 1998)
- In bone, a steady state is reached in one week when given to rats at high doses 3000 to 9000 ppm

How Essential is Boron ?

- NaBC1 Transporter was first identified and shown to be expressed in the kidney and salivary glands.
- In the absence of borate NaBC1 conducts sodium and OH. In the presence of borate, NaBC1 functions as a electronic Na –coupled borate co-transporter
- The presence of this transporter in humans suggest it is essential for the body function.

Boron is essential for the body function.

NaBC1 Is a Ubiquitous Electrogenic Na⁺-Coupled Borate Transporter Essential for Cellular Boron Homeostasis and Cell Growth and Proliferation

- Molecular Cell
- Volume 16, Issue 3, 5 November 2004, Pages 331-341
- MeeyoungParkQinLiNikolayShcheynikovWeizongZengShmuelMuallem
- <https://doi.org/10.1016/j.molcel.2004.09.030>Get rights and content

How Essential is Boron ?

- Boron appears to have a regulatory role in 26 enzymes, including those involved in energy metabolism, none of them require boron as a cofactor (Devirian TA: 2003)
- Boron is essential for normal growth of plants, where its functions involve sugar transport, cell wall synthesis, and RNA metabolism (Nielsen 1986)

Boron and Inflammation

- There is evidence that dietary boron helps control the normal inflammatory process
- Boron may serve as a signal suppressor that down-regulates specific enzymatic activities typically elevated during inflammation at the inflammation site.
- Suppression, but not elimination, of these enzyme activities by boron is hypothesized to reduce the incidence and severity of inflammatory disease.
- Boron insufficiency is related to the inflammatory process, including joint swelling, restricted movement, fever, antibody production, hemostasis, serine protease (PSA) and lipoxygenase activities, and leukotriene metabolism (Hunt CD; 1999)

Boron and Inflammation

- Boron has anti-inflammatory activity when it combines with the amino acids of the body to form amine cyanoboranes (Iris H. Hall et al 1980)
- Arthritic bone is associated with almost a 20-fold decrease in boron content. (Newnham RE 1991)

Boron and Inflammation

- Human clinical evidence for boron's use in the treatment of OA patients was first provided by a double-blind, placebo-controlled supplementation trial conducted in Australia, in which a significantly favorable response to a supplement of 6 mg of boron per day (sodium tetraborate decahydrate) was seen in 20 subjects with OA

- 50% of subjects receiving supplemental boron improved, compared with only 10% of those receiving the placebo.
- L. Pizzorno August 2015

Boron and Inflammation

- Boron down regulates production and activity of serine protease enzymes involved in the inflammatory response.
- Consider PSA in this case. The more boron in the system, the less PSA in the prostate
- Human studies of boron deprivation and repletion have shown that boron significantly increases erythrocyte superoxide dismutase (SOD) activity.

Boron and Inflammation

- After 63 days of boron depletion were followed by 49 days of boron supplementation 3 mg/d, SOD rose from 3091 U/g Hb to 3231 U/g Hb in men older than 45 years; from 2666 U/g Hb to 3169 U/g Hb in postmenopausal women; from 2520 U/g Hb to 3327 U/g Hb in postmenopausal women on estrogen therapy. (L. Pizzorno August 2015)

Boron and Inflammation

- There is evidence that Boron down-regulates inflammation through the NF-(kappa) B pathway

EVIDENCE THAT BORON DOWN-REGULATES INFLAMMATION THROUGH THE NF-(KAPPA)B PATHWAY **Author**

Durick, Kathy, Tomita, Michiyo et al

Boron and Inflammation

- Boron helps control the normal inflammatory process by modulating the response of key immune cells to antigens by an undefined mechanism. Boron may act to regulate the normal inflammatory process by serving as a signal suppressor that down-regulates the activities of specific enzymes involved in the inflammatory process and thus may play a role in modulating the development of inflammatory disease.

Boron and Inflammation

- Suppression, but not elimination, of activities of these enzymes is hypothesized to reduce the incidence and severity of the symptoms of inflammatory disease.
- Dietary Boron is a Physiological Regulator of the Normal Inflammatory Response Trace Elements in Man and Animals by C.D. Hunt in year 2000 . Trace Elements in Man and Animals 10 pp 1071-1076

Boron and Inflammation

- Boron as a safe and effective treatment for osteoarthritis (OA). Examining the relationship between boron administration and OA prevalence around the world, researchers discovered that in areas where boron intake is greater than or equal to 1 mg/d, the estimated incidence of arthritis ranges from 20% to 70%.

Boron and Inflammation

- In areas where boron intake is usually 3 to 10 mg/d, estimated incidence of arthritis ranges from 0% to 10%.
- The boron concentration has been found to be lower in the femur heads, bones, and synovial fluid of OA patients compared with individuals without OA.

Boron and Inflammation

- A number of papers have indicated that boron reduces levels of inflammatory biomarkers. In a recent human trial involving healthy male volunteers (n = 8), a significant increase in concentrations of plasma boron occurred 6 hours after supplementation with 11.6 mg of boron, coupled with significant decreases in levels of hs-CRP and TNF- α .

Boron and Inflammation

- One week of boron supplementation 10 mg/d resulted in a 20% decrease in the in plasma concentration of TNF- α , from 12.32 to 9.97 pg/mL hs-CRP, from 1460 to 795 ng/mL, IL-6, from 1.55 to 0.87 pg/mL

L. Pizzorno August 2015.

<https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4712861/> 7/27

Elevated Hs-CRP Associated with:

- An increased risk for breast cancer, obesity and metabolic syndrome (MetS) in children, atherosclerosis, unstable angina, insulin resistance, type 2 diabetes , nonalcoholic fatty liver disease (NAFLD), metastatic prostate cancer, lung cancer, adult depression, depression in childhood and psychosis in young adult life, coronary heart disease, and stroke.
- L. Pizzorno August 2015

Boron helps in wound healing

- Mechanisms implicated in the effects of boron on wound healing / fibroblast control by boron

- Journal of Trace Elements in Medicine and Biology Volume 16, Issue 4, 2002, Pages 239-244 Rosine Mayap Nzietchueng, Brigitte Dousset, et al