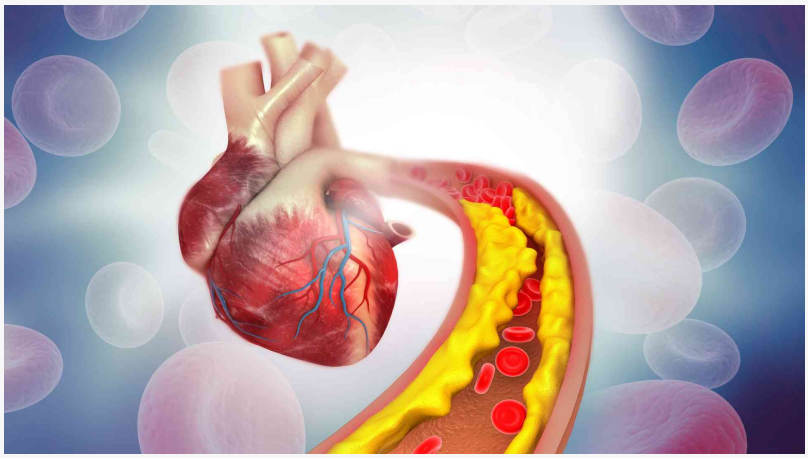
Cardiovascular Disease And Boron-Containing Compounds

Risk factors for cardiovascular diseases may be noticeably improved by the intake of boron-containing compounds. These compounds reduce blood pressure.



Cardiovascular Disease

NEW YORK, USA, July 13, 2022 /EINPresswire.com/ -- Boron -Containing Compounds

Boric acid and borates are boron-containing inorganic compounds found in soils. Plants and bacteria use them to produce all known boron-containing organic compounds. These organic compounds are often used in cell metabolism in humans, where they are partially converted into boric acid. This boric acid is then excreted as waste from the body.

Compared with their organic counterparts, inorganic boric acid and borates have significantly different chemical and biochemical properties. The biochemical activities of compounds that contain boron differ greatly depending on the organic ligands used and the binding constant of B compared to any specific molecule.

It has been recognized that B deficiency in soils, which leads to BCC depletion in fruits and vegetables in the food supply, is associated with a high occurrence of arthritis, an inflammatory disease also linked to cardiovascular health.

The term “cardioprotection” refers to all methods of preserving cardiovascular health. Perhaps the most important is nutrition. The typical Mediterranean diet, which includes BCC-rich staple foods, ensures a total BCC consumption of even more than 13 mg B/day/person, though as little as 1 mg B/day/person is presently assumed to provide health benefits.

We hypothesize here that the cardiovascular protection provided by Mediterranean diets is guided more by the types and varieties of BCCs that provide specific biochemical activities relating to cardiovascular health than the simple total elemental boron content.

The Action Of Boron-Containing Compounds

1. BCCs Facilitate CO_2 Hydration

Boron compounds have been shown to stimulate the reactive uptake of CO_2 into aqueous media. Several studies have found that BCCs act as catalysts for CO_2 hydration, ensuring the development of bicarbonate ions. It has been proposed that the process is equivalent to the action of enzymatic carbonic anhydrase. More interestingly, the buffering capacity of the borate anion combined with cis-diol esters to pH 7.4 is greater than the buffer capacity of bicarbonate due to complex formation with cis-diol organic acids polyalcohols and sugars (pKa 5–7.4).

The ability of BCCs to catalyze CO_2 hydration in the blood may open up a new research opportunity for the importance of B. The ratio of plasma CO_2 concentration to pCO_2 determines blood pH. As a result, if pCO_2 rises without an equal rise in bicarbonate, the pH drops. If pCO_2 falls without a corresponding drop in bicarbonate, the pH increases. Conversely, bicarbonate is required for optimal contractility in separated cardiac myocytes. The intracellular pH (pHi) is an essential regulator of myocardium contraction and a strong inducer of electrical arrhythmias.

2. BCCs as Pleiotropic Cell Signaling Pathway Modulators

BCCs, as cell signaling pathway modulators, interfere in both enzymatic and non-enzymatic reactions based on their speciation. BCCs can be thought of as super-switches for energy production, development, survival, reproduction, and life extension due to their assistance in biochemical reactions. Overall, BCCs affect signaling pathways that are involved in many cell functions.

3. BCCs Regulate Enzymatic Activity

BCCs interact with enzymes from microorganisms, plants, animals, and humans, likely to result in enzyme activation, stabilization, and inhibition. In human cells, BCCs' activity is involved in the regulation of specific enzymes, the binding of particular receptors, mRNA splicing, and inducing apoptosis. Furthermore, B stabilizes the phosphatase alkaline enzyme through some reactions, preventing oxidative stress.

Besides that, B-containing molecules improve the resistance of hemeproteins to denaturation, which may have cardioprotective effects due to their peroxide-induced stabilization. It was recently discovered that the fluoroborate complex is a powerful catalyst in various biological reactions in plants and may function as a coenzyme.

In addition to the benefits for joint health, cognitive function, bone density, and prostate health, researchers have started examining BCC's value as an antioxidant.

In one study, researchers looked at the effects of a BCC, such as calcium fructoborate (CFB), on skin wounds. They investigated whether CFB had antioxidant properties in human keratinocyte cultures (human skin cells). CFB-treated cells were exposed to exogenous hydrogen peroxide to recreate environmentally induced oxidative stress. The results showed that CFB limited the

development of intracellular reactive oxygen species, implying that CFB may have superoxide dismutase (SOD)-like activity that could be clinically relevant in protecting cells from oxidation-induced damage.

Furthermore, previous research suggested that a boron-rich diet may boost the enzyme activity by the SOD pathway. Extracellular SOD is also known to protect against atherosclerosis, hypertension, heart failure, and diabetes mellitus. All of these analysis yields the role of oxidative stress in cardiovascular disease.

BCCs and Cardiovascular Disease Risk Factors

1. BCCs And Dyslipidemia

Beneficial effects of BCCs on plasma lipids mainly were observed in animal studies, where sodium borate consumed directly caused a significant decline in overall cholesterol, lipoprotein fractions, and triglyceride (TG) levels. However, other authors would not confirm such effects, and an undesirable HDL-cholesterol reducing impact was found. They looked at how a 4-week BA supplementation affected rats' steroid hormones and plasma lipids.

After two weeks, BCCs supplementation caused a reduction in plasma TG (p 0.05) and total HDL-cholesterol concentrations (p 0.05). Still, after a month, HDL-cholesterol was the only dramatically lowered parameter (p 0.002).

Other animal studies have also observed a negative or neutral effect. According to some studies, adding boron to layer diets could significantly reduce total plasma lipids, cholesterol, and LDL while enhancing HDL. The hens fed a basal diet with just a relation of 200 mg boron/kg had the least overall lipids, cholesterol, and LDL.

The concentration levels of total cholesterol, triglycerides, high-density lipoprotein (HDL), low-density lipoprotein (LDL), very-low-density lipoprotein (VLDL), glucose, insulin, and non-esterified fatty acids all decreased after sodium tetraborate administration. Because BCCs can have different speciations depending on chemical structure, the contradictory results could be evidence of boron speciation in animal metabolism.

2. BCCs And Diabetes

Diabetes mellitus and other glucose metabolism illnesses are major risk factors for cardiovascular disease. Bakken and Hunt devised an analysis to find the influence of BCC as BA on insulin release. They discovered considerably higher plasma insulin concentrations in rats deficient in B but no change in plasma glucose levels. Dietary magnesium or vitamin D levels did not influence this effect.

Furthermore, boron-deprived chicks had vastly greater peak insulin values than those fed physiologic amounts. As a direct secretagogue, B did not affect peak insulin action or pancreatic mass.

These results indicate that BCCs may reduce the amount of insulin necessary to keep glucose homeostasis. B in some form could reduce plasma insulin concentration levels with no close link to vitamin D or magnesium status. Another study on 30 Sprague-Dawley rats fed a BA, and borax-supplemented diet with a dose of 100 mg B/kg found a reduction in leptin, insulin, and glucose levels; body weight reduced, probably due to a rise in T3 thyroid hormone level. Borax had the more significant effect of the two compounds tested.

3. BCCs as a Smoking Risk Factor

Tobacco use is considered an epidemic and a major public health threat by the WHO, as this is one of the significant risk factors for cardiovascular disease. The primary components released by smoking are nicotine and CO, which promote oxidative stress, endothelial damage, and dysfunction. It also raises serum total cholesterol and triglyceride levels, decreases cardioprotective HDL, and fosters intravascular inflammation, all of which are risk factors for developing atherosclerosis and cardiovascular disease.

Tobacco products involve a slew of potentially toxic molecules, the most cytotoxic of which is nicotine. Diets high in BCCs were linked to a lower risk of cervical cancer, prostate cancer, and lung cancer in women who smoked heavily. Furthermore, high-quality BCC intake has been linked to lower lung cancer risks in smokers, whereas the highest risk is found in smokers who lack hormone replacement therapy (HRT) and have a low B intake.

Recent research shows that the antioxidant properties of BA protect DNA and decrease nicotine-induced cytotoxicity in vitro. These findings raise the possibility that natural BCCs may also have the ability to counteract the adverse effects of smoking.

4. BCCs As an Aging Risk Factor

Oxidative stress is among the systems involved in the aging process. This happens when the production and disposal of reactive oxygen species are out of balance (ROS). It was recently discovered that low doses of numerous BCCs can enhance antioxidant capacity by adding enzymatic activities. Furthermore, BCCs may hinder Maillard's reactions. This is accomplished by stabilizing borate esters on furanose rings with cis-diol, which enables the chemical evolution of sugar and amino acids in aqueous media. As a result, this could aid in regulating the aging process.

5. Homocysteine Metabolism And BCCs

Hyperhomocysteinemia has been recognized as an independent risk factor for cardiovascular disease both in men and women. Homocysteine is an amino acid synthesized during methionine metabolism's methylation cycle. Numerous studies have found that hyperhomocysteinemia is associated with an increased risk of atherosclerosis, venous thromboembolism, fetal neural tube defects, and other pregnancy-related complications. There are numerous theories about the mechanisms of hyperhomocysteinemia's harmful effects, but it appears that the molecule's sulfhydryl group is implicated.

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