Boron

SCIENTIFIC NAME
Boron; B; Atomic number 5

FAMILY

Other Common Names

Acide Borique, Anhydride Borique, B (symbole chimique), Borate, Borate de Sodium, Borates, Bore, Bore Chélaté, Boric Acid, Boric Anhydride, Boric Tartrate, Boro, Boro Quelado, Boron Ascorbate, Boron Chelate, Calcium Fructoborate, Chélate de Bore, Chelated Boron, Quelato de Boro, Numéro Atomique 5, Sodium Borate, Sodium Pentaborate Pentahydrate.

Overview

Boron is an element found in water and in foods such as nuts and vegetables, often as part of natural compounds such as calcium fructoborate. Boric acid is used as an astringent, to prevent skin infection, and as an ophthalmic irrigant (7135,95428). Historically, both the Babylonians and Egyptians are thought to have used borax (sodium borate) either as a flux for working gold or as a mummifying and medicinal agent (36859,36873).

Safety

LIKELY SAFE ...when used orally and appropriately. Boron is safe in amounts that do not exceed the tolerable upper intake level (UL) 20 mg daily (7135). ...when used vaginally. Boric acid, the most common form of boron, has been safely used for up to six months (15443,15444,15445,15446,15458,15449,15451,15453,15454). ...when used topically. Boron, in the form of sodium pentaborate pentahydrate 3% gel, has been applied to the skin with apparent safety up to four times daily for up to 5 weeks (95660,109557).

POSSIBLY UNSAFE ...when used orally in doses exceeding the UL of 20 mg daily. Higher doses might adversely affect the testes and male fertility (7135). Poisoning has occurred after ingestion of boron 2.12 grams daily for 3-4 weeks (17). Death has occurred after ingesting a single dose of 30 grams (36848,36863).

CHILDREN: **LIKELY SAFE** ...when used orally and appropriately. Boron is safe in amounts that do not exceed the tolerable upper intake level (UL). The UL by age is 3 mg daily at 1-3 years, 6 mg daily at 4-8 years, 11 mg daily at 9-13 years, and 17 mg daily at 14 years or older (7135). The UL for infants has not been determined (7135). **POSSIBLY UNSAFE** ...when used orally in doses exceeding the age-based UL (7135). ...when applied topically in large quantities. Infant deaths have occurred after the use of topical boric acid powder to prevent diaper rash (36873,36874).

PREGNANCY AND LACTATION: **LIKELY SAFE** ...when used orally and appropriately. Boron is safe in amounts that do not exceed the UL during pregnancy or lactation, which is 20 mg daily in those 19-50 years of age or 17 mg daily for those 14-18 years of age (7135). **POSSIBLY UNSAFE** ...when used orally in doses exceeding the UL. Higher doses might impair growth and cause adverse effects in the developing fetus (7135,102058). ...when used vaginally. Intravaginal boric acid has been associated with a 2.7- to 2.8-fold increased risk of birth defects when used during the first 4 months of pregnancy (15443,15645).

Adverse Effects

General: Orally, boron is generally well tolerated when used in doses below the tolerable upper intake level (UL) of 20 mg. Vaginally, boron is well tolerated.

Most Common Adverse Effects:

Orally: Anorexia, dermatitis, erythema, indigestion.

Vaginally: Burning and pain.

Dermatologic

Orally, chronic use of 1 gram daily of boric acid or 25 grams daily of boric tartrate can cause dermatitis and alopecia (7135).

Larger doses can result in acute poisoning. Symptoms of poisoning in adults and children may include skin erythema, desquamation, and exfoliation (17).

Gastrointestinal

Orally, chronic use of 1 gram daily of boric acid or 25 grams daily of boric tartrate can cause anorexia and indigestion (7135).

Larger doses can result in acute poisoning. Children who have ingested 5 grams or more of borates can have persistent nausea, vomiting, and diarrhea leading to acute dehydration, shock, and coma. Adults who have ingested 15-20 grams of borate can exhibit nausea, vomiting, diarrhea, epigastric pain, hematemesis, and a blue-green discoloration of feces and vomit (17).

Genitourinary

Vaginally, boric acid can cause vulvovaginal burning and dyspareunia in males if intercourse occurs shortly after vaginal treatment (15447).

Neurologic/CNS

Orally, large doses can result in acute poisoning. Poisoning with boron can cause hyperexcitability, irritability, tremors, convulsions, weakness, lethargy, and headaches (17).

Ocular/Otic

Exposure to boric acid or boron oxide dust has been reported to cause eye irritation (36852).

Pulmonary/Respiratory

Exposure to boric acid and boron oxide dust has been reported to cause mouth and nasal passage irritation, sore throat, and productive cough (36852).

Effectiveness

LIKELY EFFECTIVE

Boron deficiency. Oral boron treats and prevents boron deficiency.
Details: Taking boron orally is effective for preventing and treating boron deficiency (7135).

POSSIBLY EFFECTIVE

Radiation dermatitis. Topical application of sodium pentaborate pentahydrate gel to radiation sites may reduce the risk of dermatitis in patients with breast cancer who are receiving radiotherapy.
Details: A small clinical study in patients with breast cancer shows that applying a hydrogel containing sodium pentaborate pentahydrate 3% four times daily during radiotherapy for 5 weeks reduces the risk of moderate to severe dermatitis by 50% when compared with petroleum jelly (Vaseline). However, there is no difference in patient satisfaction (95660). Additionally, a larger clinical trial in patients with breast cancer shows that applying a sodium pentaborate pentahydrate 3% gel to radiation sites 15 minutes before each session for 25 sessions reduces the risk of dermatitis by 90%, erythema by 87%, dry desquamation by 92%, and moist desquamation by 97% when compared with a placebo gel (109557).

Vaginal candidiasis. Boric acid applied intravaginally seems to reduce vaginal candidiasis.
Details: Some limited clinical research shows that applying boric acid powder intravaginally 600 mg once or twice daily for up to 3 weeks can treat candidiasis and other vaginal fungal infections, including resistant and chronic infections (15443,15444,15446,15449,15450,15451,15453); however, this research is limited by low study quality.

For Candida glabrata yeast infections, which are less prevalent than Candida albicans infections, some evidence shows that intravaginal boric acid capsules are effective in about 65% to 70% of azole-resistant infections; however, boric acid capsules appear to be less effective than intravaginal flucytosine (Ancobon) (15445,15454). For Candida krusei infections, which are rare and resistant to azole antifungal treatment, boric acid capsules also appear to be effective in some cases (15448).

POSSIBLY INEFFECTIVE

Athletic performance. Oral boron does not seem to improve athletic performance.
Details: A small clinical study in male bodybuilders shows that taking boron 2.5 mg daily for 7 weeks does not increase lean body mass, muscle mass, or testosterone levels when compared with placebo (944). Furthermore, the International Society of Sports Nutrition (ISSN) does not recommend boron supplementation as a nutritional ergogenic aid due to a lack of supportive evidence (101009).

INSUFFICIENT RELIABLE EVIDENCE to RATE

Age-related cognitive decline. It is unclear if oral boron is beneficial for age-related cognitive decline.
Details: Two very small clinical studies in healthy older adults show that taking boron 3.25 mg daily for up to 49 days orally might improve cognitive function and fine motor skills when compared with lower amounts of boron (943).

Diabetic foot ulcers. It is unclear if topical boron is beneficial for use in diabetic foot ulcers.
Details: A large clinical study in adults with diabetic foot ulcers shows that applying boron (sodium pentaborate 3%) gel twice daily for 1 month marginally reduces ulcer severity, measured by the Wagner Classification system at 25 days and 2 months, when compared with control; recurrence and infection rate were also modestly reduced at 2 months (112423). However, it is unclear whether the analysis controlled for systemic antibiotic use among the two groups, which effects the validity of these findings.

Dysmenorrhea. It is unclear if oral boron is beneficial for reducing pain during menstruation.
Details: A small clinical study in young females with moderate to severe dysmenorrhea suggests that taking boron tetraborate 10 mg daily, starting two days before and continuing until three days after the start of menstruation for two menstrual cycles, reduces pain levels by 24% and pain duration by 1.5 hours, or 34%. Both pain and pain duration were decreased by only 9% in patients receiving placebo (95428).

Kidney stones (nephrolithiasis). It is unclear if boron is beneficial for medical expulsive therapy after extracorporeal shockwave lithotripsy.
Details: A large clinical study in adults undergoing extracorporeal shockwave lithotripsy for kidney stones conducted in Iran shows that taking boron 10 mg twice daily for 2 weeks does not statistically improve the rate of stone expulsion when compared with tamsulosin; however, boron may have fewer side effects (i.e., orthostatic hypotension, headache, nausea, erectile dysfunction) (112414).

Kidney transplant. It is unclear if oral boron is beneficial in patients receiving a kidney transplant.
Details: Observational research in kidney transplant recipients has found that higher boron intake, as measured by urinary boron levels, is associated with a lower risk of mortality when compared with lower intake. Patients with 24-hour urinary boron levels in the top tertile had a 49% lower risk of all-cause mortality when compared with those in the lowest tertile; however, there was no association with graft failure (109556). It is unclear if these findings can be generalized to boron supplements.

Obesity. Although there has been interest in using oral boron for obesity, there is insufficient reliable information about the clinical effects of boron for this purpose.

Osteoarthritis. It is unclear if oral boron is beneficial for osteoarthritis symptoms.
^ Details: Small low quality studies in patients with osteoarthritis suggest that taking boron tetraborate 3-6 mg daily for up to 8 weeks might improve pain and other symptoms when compared with a lower intake of boron (941,36870).

Osteoporosis. It is unclear if oral boron is beneficial for osteoporosis.
^ Details: Preliminary clinical research in postmenopausal adults shows that taking boron 3 mg daily does not improve bone density when compared with placebo (36872).

Periodontitis. Small clinical studies suggest that adding topical boric acid to scaling and root planing treatment may be beneficial in periodontitis.
^ Details: A meta-analysis of four small clinical studies in 117 patients with periodontitis shows that using boric acid 0.75% gel or solution in addition to scaling and root planing seems to slightly improve probing pocket depth (PPD) and clinical attachment level (CAL) when compared with placebo or saline control (105690). Another small clinical study in patients with periodontitis shows that using boric acid 0.5% for irrigation in addition to scaling and root planing seems to improve CAL and PPD to a similar degree as using povidone-iodine 0.1% (105691). The available research was conducted in Turkey, Vietnam, and India; it is unknown if these findings are generalizable to other geographic locations.

Tooth extraction. It is unclear if boron is beneficial for use in periodontal healing after impacted third molar surgery.
^ Details: A moderate-sized clinical study in adults 18 to 40 years old shows that using boron 0.1% to 2.5% and chlorhexidine 0.12% mouthwash for 7 days after impacted third molar surgery marginally improves swelling and self-reported pain on day 7, and the higher boron concentrations also improve pain at day 4 when compared with chlorhexidine alone, but does not improve the number of analgesics used or periodontal scores (112379). However, the validity of these results is limited by a lack of statistical adjustment for multiple comparisons which can lead studies to show differences between treatment groups in error (i.e., false positive findings). Additionally, the study period coincides with the expected recovery time (i.e., 2-7 days), making it unclear if any effects are due to the intervention or control.

More evidence is needed to rate boron for these uses.

Dosing & Administration

- **Adult**

  Oral:

  General: Although boron has been shown to have various biochemical effects in the body, an essential role for boron in humans has not yet been identified. Thus, there is no recommended dietary allowance (RDA) or adequate intake (AI) for boron (7135). The World Health Organization (WHO) estimates that the average daily intake of boron for adults is about 1-1.5 mg (106001).

  Topical:

  Boron has been used in various topical formulations, including as a sodium pentaborate pentahydrate gel and a boric acid gel or solution. See Effectiveness section for condition-specific information.

  Vaginal:

  Boric acid powder has most often been used in doses of 600 mg once or twice daily for up to 3 weeks.

- **Standardization & Formulation**

  Boron used in clinical trials has included sodium tetraborate. In a clinical trial, sodium tetraborate 88.5 mg (Sigma) contained 10 mg of boron (95428).

Interactions with Drugs

None known.

Interactions with Supplements

MAGNESIUM: Boron might increase levels of magnesium.
^ Details
Boron supplements can reduce urinary excretion of magnesium and increase serum levels in females (940,9529,9623). In postmenopausal females, the effect is more marked in those with low dietary magnesium intake (9623). The clinical significance of these effects, and whether they occur in males, is unknown.

Interactions with Conditions

^ HORMONE SENSITIVE CANCERS/CONDITIONS

Theoretically, boron might exacerbate hormone sensitive conditions. Some research suggests that boron might have estrogenic effects (945); patients with hormone sensitive conditions should avoid supplemental boron or high amounts of boron from foods. Some of these conditions include breast cancer, uterine cancer, ovarian cancer, endometriosis, and uterine fibroids.

KIDNEY DISEASE

Theoretically, boron excretion might be impaired in patients with kidney disease. Boron appears to be largely excreted by the kidneys (939).

Interactions with Lab Tests

None known.

Overdose

Presentation

Large doses of boron can cause toxicity. In children who have ingested 5 grams or more of borates, persistent gastrointestinal symptoms lead to acute dehydration, shock, and coma. Severe gastrointestinal symptoms also occur in adults who have ingested 15-20 grams of borate (17). Other poisoning symptoms in both adults and children may include skin erythema, desquamation, exfoliation, and neurological symptoms (17). Death has occurred after the ingestion of 30 grams of boric acid in a single dose (36863).

There are also case reports of infants who died after exposure to boron. Historically, a honey and borax solution was used to clean infant pacifiers, and topical boric acid powder was used to prevent diaper rash. However, these practices were associated with several infant deaths due to boron toxicity (36873,36874).

Treatment

There is insufficient reliable information available about the treatment of overdose with boron.

Commercial Products Containing: Boron

View All

View Health Canada Licensed Products

View Certified Products

USP Verified Products

NSF Contents Certified Products

NSF Certified for Sport Products

Pharmacokinetics

Absorption: Boron is well-absorbed when consumed in dietary beverages including prune juice, grape juice, wine, coffee, milk, and, in some geographical locations, water. Boron is also absorbed from avocados, peanuts, pecans, apples, dried beans, and potatoes (7135). Intravaginally, boric acid has minimal systemic absorption. Serum levels are typically undetectable (15444,15446).

Distribution: Boron distributes to all tissues with highest concentration in bone and lowest in adipose tissue. Boron levels generally achieve steady state in three to four days (36864).

Metabolism: Boric acid and borates are not well metabolized by humans as greater than 90% of the administered dose is excreted unchanged (36854).

Excretion: When taken orally, boron is excreted unchanged in the urine, with a half-life of 21 hours (7135,36854). More than 50% of the oral dose is reported to be eliminated during the first 24 hours in healthy volunteers (36854). The half-life of boron is between 13-23 hours (7135,36847,36854).

Mechanism of Action

General: Boron is a trace mineral for which a clear biological function in humans has not been established. Boric acid is the most common form of boron. In the diet, boron is commonly found in nuts, beans, prune juice, grape juice, wine, coffee, and milk. In some geographic regions boron is found in water (7135).

Antifungal effects: Boric acid is used for vulvovaginitis due to its activity against Candida albicans and Candida glabrata (15444,15445,15446).

Antioxidant effects: Boron is used for prevention of radiation dermatitis due to its potential to reduce oxidative damage by increasing cellular glutathione and non-reactive oxygen (95660).

Bone mineral effects: Boron seems to be important in mineral metabolism (943). Boron may also increase calcium absorption and decrease urinary loss of calcium and magnesium (940,942,9623,36862). Boron supplementation decreases levels of serum phosphorus (940,942). An impact on vitamin D metabolism as shown in animal research may pay a role in the effects of boron on

these minerals (36858).

Cognitive effects: Boron may improve cognition; however the mechanism is unclear (943).

Hormonal effects: Diets low in boron seem to decrease serum 17beta-estradiol levels in postmenopausal adults (106001). Also, a small exploratory study in postmenopausal adults shows that increasing boron intake to 3 mg daily seems to increase serum 17beta-estradiol levels. However, these patients were previously consuming a low-boron diet (0.25 mg daily), which may have caused an initial reduction in 17beta-estradiol levels (9623).

Metabolic effects: Some preliminary research shows that increasing the amount of boron in the daily diet by 10 mg or more for one month decreases fasting plasma glucose by 4 mg/dL, total cholesterol by 16 mg/dL, low-density lipoprotein (LDL) cholesterol by 13 mg/dL, body weight by 0.8 kg, and body mass index (BMI) by 0.37 kg/m^2 when compared to baseline in healthy females (102057). A lack of placebo control limits the validity of these findings, and whether these effects will also be seen in patients with diabetes, hyperlipidemia, and/or obesity is unclear. The mechanism of boron's purported metabolic effects is unknown.

Neurological effects: Preliminary evidence suggests that boron may have a role in hand-eye coordination, attention span, and short-term memory; however, the mechanism of these effects is unclear (7135).

Reproductive effects: There is some evidence that boron might have a role in reproduction and development (945,7135). However, there is concern that boric acid has teratogenic effects and can result in birth defects when used intravaginally during pregnancy (15443,15645,15646). Boric acid is thought to be an inhibitor of histone deacetylases, which results in histone hyperacetylation. In specific tissues, histone hyperacetylation is associated with skeletal malformations (15644).

Weight loss effects: Several animal studies suggest that boron supplementation can cause weight loss. While the mechanism of this effect is unclear, researchers suggest that boron has anti-adipogenic effects in adipocytes and plays a role in glycolysis and lipolysis pathways in the liver and adipose tissue (109558).

References

See Monograph References

Monographs are reviewed on a regular schedule. See our Editorial Principles and Process for details. The literature evaluated in this monograph is current through 10/3/2024. This monograph was last modified on 4/11/2024. If you have comments or suggestions, please tell the editors.