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Charcoal

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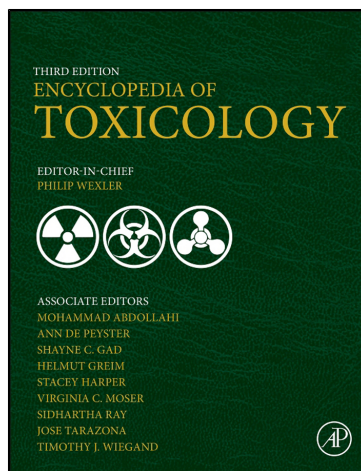
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Academic Press

Channel Blockers *see* Calcium Channel Blockers

Charcoal

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- Name: Charcoal
- Chemical Abstracts Service Registry Number: 16291-96-6, Other registry number: 1333-85-3.
- Synonyms: Charcoal, Charcoal, activated, Charcoal, except activated, Charcoal briquettes, EINECS 240-383-3, HSDB 2017, Swine fly ash, UNII-2P3VWU3H10, Whetlerite.
- Molecular Formula: Unspecified
- Chemical Structure:
 - removal of jet fumes from airports
 - removal of sulfur dioxide from stack gases and 'clean' rooms
 - deodorant
 - catalyst in natural-gas purification
 - brewing
 - chromium electroplating
 - air conditioning

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Background (Significance/History)

The first use of charcoal comes from the black pigment used in European cave paintings around 32 000 years ago. It is possible that the earliest use of charcoal as a fuel in the smelting of copper began over 7000 years ago. The first definite evidence of human involvement with charcoal as a fuel goes back to 5500 years ago in the Middle East and Southern Europe, when the Egyptians, who were expert metal workers, discovered the smelting of iron using charcoal.

Uses

Charcoal has been used since the earliest times for several of purposes, including medicine and art, but by far its most important use has been as a metallurgical, cooking, industrial, and automotive fuel. Charcoal is used as a conventional fuel where an intense heat is wanted. Charcoal was also used historically as a source of carbon black in chemical reactions by grinding it up. In this form charcoal was a constituent of formulas for mixtures such as gunpowder and was important to early chemists. Due to its high surface area, charcoal can be used as a catalyst, a filter, or an adsorbent.

Other uses of charcoal include in:

- the decolorizing of sugar
- water and air purification
- waste treatment
- solvent recovery

Environmental Fate and Behavior

Relevant Physiochemical Properties

Charcoal is an odorless, tasteless, fine black powder or black porous solid. It is typically encountered as coarse granules or powder. It is insoluble in water and also in organic solvents. Other physical properties include specific gravity: 0.08 to 0.5; heat of combustion: 14 100 Btu/lb = 7830 cal g⁻¹ = 3.28 × 10⁴ J kg⁻¹; boiling point: 4200 °C.

Partition Behavior in Water, Sediment, and Soil

The presence of charcoal in a compound elevates the K_{oc} value, resulting in reduction of mobility of compounds through the sediment and soil.

Environmental Persistency (Degradation/Speciation)

Charcoal is stable under ambient environmental conditions.

Bioaccumulation and Biomagnification

Hazardous short-term degradation products of charcoal are not likely. Charcoal and its products of degradation are not toxic. Special remarks on the products of biodegradation are not available.

Toxicokinetics

Activated charcoal is neither absorbed in the gastrointestinal (GI) tract nor metabolized and excreted in the feces. The

adsorptive capacity of activated charcoal may be decreased by concurrent use of iso-osmolar electrolyte solution and polyethylene glycol for whole-bowel irrigation. The adsorptive efficacy of activated charcoal may also be decreased by the emesis induced by ipecac syrup. In general, activated charcoal can reduce the absorption of and therapeutic response to other orally administered drugs; therefore medications other than those used for GI decontamination or antidotes for ingested toxins should not be taken orally within at least 2 h of administration of activated charcoal. When concomitant drug therapy is needed, drugs can be given parenterally.

Mechanism of Toxicity and Clinical Use in Gastrointestinal Decontamination

Due to its large surface area, charcoal exerts its effects by absorbing a wide variety of drugs and chemicals. After the toxic substance attaches to the surface of the charcoal and because charcoal is not absorbed, it stays inside the GI tract, being eliminated in the feces along with the charcoal. In single-dose therapy, activated charcoal adsorbs the toxic substance ingested, and thus inhibits GI absorption and prevents or reduces toxicity. When used repeatedly, as in multiple-dose therapy, activated charcoal also creates and maintains a concentration gradient across the wall of the GI tract that facilitates passive diffusion of the toxic substance from the blood stream into the GI tract lumen, where it is adsorbed onto the charcoal and thus prevented from reabsorption. In this process, activated charcoal interrupts the enterohepatic or enteroenteric cycle or recirculation and increases the rate of elimination of the toxic substance from the body. Use of multiple-dose charcoal in this manner is also called GI (gut) dialysis.

Acute and Short-Term Toxicity (to Include Irritation and Corrosivity)

Animal

Special remarks on toxicity of charcoal to animals are not available and no LD₅₀ has been reported.

Human

Acute exposure to charcoal irritates skin, eyes, GI, and the respiratory tract. Redness, swelling, and pain may occur with dermal exposure. Stinging pain, watering of eyes, inflammation of eyelids, and conjunctivitis may happen with eye exposure. Aspiration pneumonitis, decreased GI transit time, vomiting, GI obstruction, constipation, pulmonary fibrosis and subsequent emphysema, intestinal perforation, charcoal deposits in the esophageal and gastric mucosa, and ulceration of rectal mucosa are possible if charcoal is ingested. Cough, tachypnea, wheezing, rapid irregular breathing, headache, fatigue, mental confusion, nausea, and vomiting may occur after inhalation. Burning charcoal in a fireplace or in a grill may be hazardous as carbon monoxide (CO) is produced. CO is a tasteless, odorless, invisible gas that is toxic when inhaled in

significant amounts. Symptoms of CO poisoning include headaches, confusion, dizziness, nausea, and, at high concentrations, loss of consciousness and death.

Chronic Toxicity

Animal

Special remarks on charcoal toxicity to animals are not available.

Human

Chronic exposure to charcoal may damage mucous membranes and lungs. Chronic skin exposure can result in dryness, rashes, and clogging of hair follicles, rendering them black. Chronic inhalation can cause accumulation of carbon particles in the lungs. Chronic exposure to coal causes a pneumoconiosis called coal workers pneumoconiosis or black lung disease. No evidence has been found for the equivalent with occupational exposure to charcoal.

Immunotoxicity

There is no evidence on immunotoxicity of charcoal in animals or human.

Reproductive Toxicity

There is no evidence that charcoal causes reproductive or developmental problems.

Genotoxicity

No genotoxicity was reported.

Carcinogenicity

Charcoal is not listed as a potential carcinogen by any agency.

Clinical Management

In oral exposure, emesis is not indicated due to the irritant nature of charcoal. Dilution is recommended with 120–240 ml of water or milk, not exceeding 120 ml in children. In inhalation exposure, move patient to fresh air and monitor for respiratory distress. If cough or difficulty in breathing develops, the patient should be evaluated for respiratory tract irritation, bronchitis, or pneumonitis. Assist ventilation and administer oxygen as required. Bronchospasm can be treated with inhaled beta2 agonists and oral or parenteral corticosteroids. In eye exposure, wash exposed eyes with copious amounts of room-temperature water for at least 15 min and if pain, irritation, swelling, lacrimation, or photophobia persists, the patient should be seen in a health care facility.

Ecotoxicology

Charcoal in its original state is not harmful to the environment. No specific information is available on the effect of charcoal on animals or plants in the environment. No specific information is available on the effect of charcoal on aquatic life.

Exposure Standards and Guidelines

Drug products containing charcoal are offered over the counter for certain uses for instance in GI tract. Charcoal (activated) is included in antidiarrheal and digestive aid drug products.

US Consumer Product Safety Commission regulations require that two highly visible warning labels are included at the top of every bag of charcoal briquettes that identify the hazard of carbon monoxide poisoning.

US Occupational Safety and Health Administration: Hazardous by definition of Hazard Communication Standard (29 CFR 1910.1200). This product is on the European Inventory of Existing Commercial Chemical Substances. This product is not classified according to the EU regulations. Not applicable.

See also: Toxicity, Acute; Toxicity, Subchronic and Chronic; Gastrointestinal System; Carbon Monoxide.

Further Reading

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Relevant Websites

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<http://toxnet.nlm.nih.gov> – Toxicology Data Network, US National Library of Medicine.

<http://chem.sis.nlm.nih.gov/chemidplus> – US National Library of Medicine: ChemIDplus Advanced: Search for: Charcoal.

<http://www.cpsc.gov/en/Newsroom/News-Releases/1985/Burning-Charcoal-Causes-Deaths-From-Carbon-Monoxide/> – Consumer Product Safety Commission.