

Sodium bicarbonate

CAS: 144-55-8

MF: NaHCO₃

MW: 84.01

Solubility: soluble in water.

Major uses

Sodium bicarbonate is a main constituent of baking soda/powder. Baking powder is composed of 30% of sodium bicarbonate, with cornstarch, sodium aluminium sulfate, calcium acid phosphate, and calcium sulfate [1]. Sodium bicarbonate may be an ingredient of folk remedies containing turpentine, castor oil, lemon and sugar. It is also added to mouthwashes and dentifrices to prevent dental caries. It is used as an additive in meat processing and used to clean and neutralize acidity in vegetables [2].

Sodium bicarbonate is used therapeutically, e.g. to neutralize gastric acids and in the patients with metabolic acidosis [1].

Human toxicity

Toxicity is rare following acute ingestion in healthy adults, but can be serious in small children and in persons with renal insufficiency. Chronic toxicity usually occurs within 4 to 10 days following ingestion of very large amounts.

With poisoning, metabolic abnormalities predominate, such as hypernatremia, hypokalemia, hypochloremia, alkalosis, and hypokalemia. Initial symptoms of hypernatremia and metabolic alkalosis are nausea, vomiting, weakness, and mental confusion. Later, muscle cramping, progressing to seizures, ventricular dysrhythmias and coma may be seen.

Following clinical effects were observed: a) cardiovascular: hypotension, tachycardia, and hypertension; b) respiratory: pulmonary irritation may occur following inhalation; apnea, cyanosis, and pulmonary edema secondary to alkalosis; c) neurologic: dizziness, irritability, seizures progressing to coma; d) gastrointestinal: severe abdominal pain; spontaneous rupture of the stomach has occurred rarely following ingestion on a very full stomach [3].

The minimum lethal human dose (TDL₀) of sodium bicarbonate is 20 mg/kg in an adult [3].

The normal blood serum bicarbonate (HCO₃⁻) concentration is approximately 24 to 28 mEq/l [5].

In the cases of poisoning, blood levels of bicarbonate greater than 40 mEq/l were reported (reviewed in [3]).

Kinetic data

There are very little data available on kinetics of sodium bicarbonate.

Absorption: sodium bicarbonate is well absorbed orally [3]. It is completely absorbed in the small intestine [2].

Elimination: via kidney.

Metabolism and excretion

Sodium bicarbonate rapidly reacts with hydrochloric acid to form sodium chloride, carbon dioxide, and water. The excess bicarbonate (HCO_3^-), that does not neutralize gastric acid, rapidly empties in to the small intestine and is absorbed [2].

Bicarbonate plays an important role in acid-base homeostasis. Of all the buffer systems, the most important for the maintenance of the pH of body fluids is the bicarbonate-carbonic acid system [4].

Bicarbonate plays a catalytic role in fatty acid synthesis since it is regenerated as CO_2 as each two-carbon unit is inserted into the growing fatty acid chain [5].

Excretion is predominantly in the urine. An increase in the serum bicarbonate leads to an increase in renal excretion of bicarbonate, which decreases the serum bicarbonate [4]. Sodium bicarbonate is excreted within 3 to 4 h [2].

Toxicological mechanisms

Sodium bicarbonate ingestion, either in the form of tablets or baking soda, may cause metabolic alkalosis (blood plasma pH is greater than 7.4; alkalemia) in the cases when the kidney's ability to excrete excess alkali is impaired or renal failure is present. Drastic changes of the pH at metabolic alkalosis lead to neuromuscular irritability, seizures, delirium, cardiac arrhythmias and other serious disturbances [4].

Target organs: unknown.

References

1. Ellenhorn, M., Schonwald, S., Ordog, G., Wasserberger, J. (1997) *Ellenhorn's Medical Toxicology: Diagnosis and Treatment of Human Poisoning*. 2nd ed., pp. 978-979. Williams & Wilkins.
2. Hazardous Chemicals Data Bank, HSDB (2006). Via Internet.
3. Poisindex, Thomson Micromedex (2006).
4. Haddad, L.M. & Winchester, J.F. (1990) *Clinical Management of Poisoning and Drug Overdose*. 2nd ed., pp. 119-147. W.B. Saunders Company.
5. Lehninger, A.L. (1975) *Biochemistry*. 2nd ed., pp. 663-667. Worth Publishers, Inc.

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