Sodium fluoride

CAS: 7681-49-4
MF: NaF
MW: 41.9
Sodium fluoride is soluble in water (4 g in 100 ml of water). It is insoluble in alcohol.

Major uses
Sodium fluoride (NaF) is an anticaries preventive; it is widely used in toothpastes and in other dental products. NaF is also used for the treatment of osteoporosis. Other uses include: fluoridation of water, chemical cleaning products, glass manufacture, preservation of wood, and as a component of many other products [1].

Human toxicity
NaF and ionic fluoride, later only fluoride (1 mg of NaF corresponds to 0.45 mg of fluoride, also called "fluor") are toxic for humans at the higher doses; gastrointestinal symptoms have occurred following fluoride ingestion from 3 to 5 mg/kg of body weight. The lethal doses of NaF in adults range from 70 to 140 mg/kg, which corresponds to 31.5-63 mg fluoride/kg of body weight [2]. The minimum lethal dose of fluoride is approximately 1 g/70 kg person [3].

The therapeutic blood level of fluoride is in the order of 0.05 mg/l [3].

Mean clinically measured acute lethal serum concentration, based on data from several handbooks, was 8.6 mg/l (range 3-14.2 mg/l) [4]. The average fluoride blood concentration in 14 fatal cases was 15 mg/l (range 2.6-56 mg/l) (reviewed in [5]).

Fluoride is corrosive to the eyes, skin and mucous membranes. Symptoms of poisoning can include e.g. nausea, vomiting, gastrointestinal disorders, weakness, seizures, coma, respiratory arrest, hypotension, cardiovascular collapse and metabolic acidosis [1].

Kinetic data
Absorption: Ingested NaF is rapidly absorbed from the gastro-intestinal tract. 75-90% of NaF is absorbed within 90 min.

Kinetics is biphasic [4].

Volume of distribution (V_d)=0.6 (0.5-0.7) l/kg [5].

Blood protein binding: fluoride is not bound by plasma proteins or by any other components of plasma; about 72% of whole blood fluoride is found in plasma as a free ion [5].

Fluoride is accumulated in bone (over several hours), and it is then slowly released [4].

Peak plasma concentration is reached within 30 min, following single oral doses of 1.5-10 mg of fluoride in healthy subjects. Elimination half-lives were 2-9 hours [5].

Time to peak was >1h for the overdose situation [4].

Elimination half-life is 5.5 h for the overdose situation [4].

Metabolism and excretion
Our knowledge about metabolism of NaF and its F^- ion (fluoride) is restricted.

Excretion: Fluoride is excreted via kidney. Within 24 h, 50% of absorbed fluoride is found in urine, about 6-10% in the feces, and from 13-23% in sweat [5].

Toxicological mechanisms
NaF is a direct cellular poison which interferes with calcium metabolism (fluoride ion lowers the plasma calcium concentration by formation of calcium fluoride), as well as with enzyme action mechanisms. It diminishes tissue respiration, decreases oxygen consumption and carbon dioxide production in muscle, and diminishes glycolysis in erythrocytes [1, 4].

Target organs: none.

References
1. Poisindex, Thomson Micromedex (2005).
2. Whitford GM (1990) The physiological and toxicological characteristics of fluoride. J Dent Res, 69:539-557.
3. Kaye, S. (1980) *Handbook of Emergency Toxicology: A Guide for the Identification, Diagnosis and Treatment of Poisoning*, 4th edn., Springfield, IL, USA.
4. Ekwall, B., Clemedson, C., Crafoord, B., Ekwall, Ba., Hallander, S., Walum, E., Bondesson, I. (1998) MEIC evaluation of acute systemic toxicity. Part V. Rodent and human toxicity data for the 50 reference chemicals. ATLA 26, 571-616.
5. Baselt RC and Cravey RH (1995) Disposition of Toxic Drugs and Chemicals in Man. 4th ed., Foster City, CA, USA: Chemical Toxicology Institute.

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