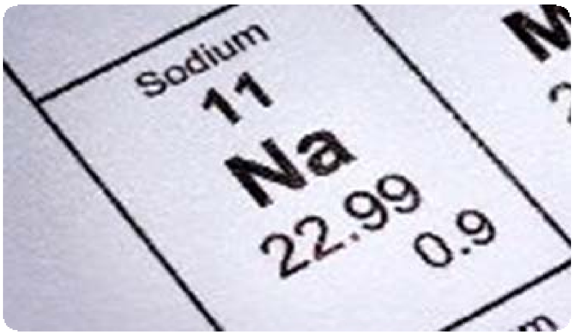
The role of sodium in the body

Munteanu Constantin[1], *Iliuţă Alexandru*[2]

[1]**Institutul National de Recuperare, Medicina Fizica si Balneoclimatologie**
[2] **SC BIOSAFETY SRL-D**

Is a metallic element with a symbol Na , the same group with Li, K, Rb, Cs is widespread in nature in the form of salts (nitrates, carbonates, chlorides), atomic number 11 and atomic weight 22,9898 . It,s a soft metal, reactive and with a low melting point , with a relative density of 0,97 at 200C (680 F). From the commercial point of view, sodium is the most important of all the alkaline metals. Elemental sodium was first isolated by Humpry Davy in 1807 by passing an electric current through molten sodium hydroxide. Elemental sodium does not occur naturally on earth, because it quickly oxidizes in air and is violently reactive with water, so it must be stored in a non-oxidizing medium, such as liquid hydrocarbon . The free metal is used for some chemical synthesis, analysis, and heat transfer applications .



(*source:*[*http://www.easywaterblog.com/*](http://www.easywaterblog.com/))

Sodium doesn,t react with nitrogen, not even at very high temperatures, but it can react with ammonia to form sodium amide. Sodium and hydrogen react above 2000C (3900) to form sodium hydride, react with carbon, but it does react with halogens. It also reacts with varios metallic halides to form the metal and sodium chloride. The reaction of sodium with alcohols is similar to the reaction of sodium with water, but slower. Sodium in its metallic form is very important in making esters and in the manufacture of organic compounds, is also a component of sodium chloride (NaCl) a very important compound found everywhere in the living environment. Other uses are: to improve the structure of certain alloys; in soap, in combination with fatty acids, in sodium vapor lamps, to descal metals, to purify molten metals.

Sodium is the sixth most abundant element in The Eart,s crust ,which contains 2,83% of sodium in all its forms. Na is , after chloride , the second most abundant element dissolved in seawater. The most important sodium salts found in nature are sodium chloride (halite or rock salt), sodium carbonate (trona or soda) sodium borate (borax) , sodium nitrate and sodium sulfate. Sodium salts are found in seawater (1,05%), salty lakes, alkaline lakes and mineral spring water. Is an essential element for all animal life (including human) and for some plant species .

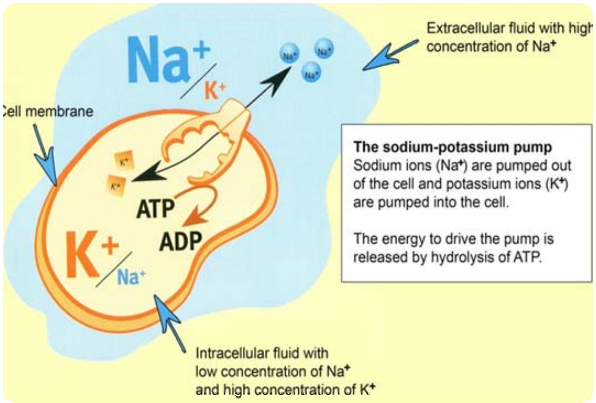
In animals, sodium ions are used in opposition to potassium ions, to allow the organism to build up an electrostatic charge on cell membranes and thus allow transmission of nerve impulse when the charge is allowed to dissipate by a moving wave of voltage change. Sodium is thus classified as a ”dietary inorganic macro-mineral” for animals.

Healt effects of sodium

Sodium is a compound of many foodstuff, for instance of common salt, its is necessary for humans to maintain the balance of the physical fluids system, is also required for nerve and muscle functioning. Too much sodium can damage our kidneys and increase the chances of high blood pressure. The amount of sodium a person consumes each day varies from individual to individual and from culture to culture , some people get as little as 2g\day, some as much as 20 grame. Sodium essential, but controversely surrounds the amount required.

Contact of sodium with water , including perspiration causes the formation of sodium hydroxide fumes , wich are highly irritating to skin , eyes , nose and throat. This may cause sneezing and coughing, very severe exposures may results in difficult breathing coughing and chemical bronchitis.

(sourcehttp://www.au.dksa)



Contact to the skin may cause itching ,tingling , thermal and caustic burns and permanent damage . Contact with eyes may result in permanent damage and loss of sight .

Environmental effects of sodium

Sodium,s powered from is highly explosive in water and a poison combined and uncombined with many other elements.

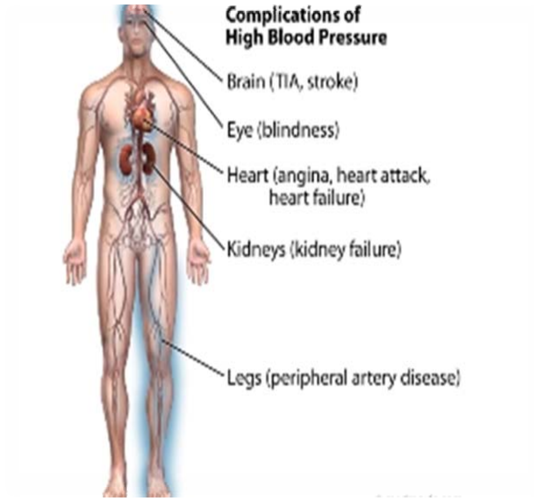
Ecotoxicity: Median tolerance limit (TLM) for the mosquito fish , 125 ppm\96hr (fresh water); Median tolerance limit (TML) for the bluegill , 88 mg\48hr (tap water).

Environmental fate : this chemical is nor mobile in solid form although it absorbs moisture very easily . Once liquid , sodium hydroxide leaches rapidly into the soil , possibly contaminating water sources .

Is found in blood and other fluids in the interstitial compartment andendocelular, sodium dedifuzie runing processes. A sodium test checks how much sodium (an electrolyte and mineral) is in the blood, sodium is both an electrolyte and mineral, it helps keeps the water (the amount of fluid inside and outside the body,s cells) and electrolyte balance of the body and is also important in how nerves and muscles work.

Most of the sodium in the body (about 85%) is found in blood and lymp fluid, sodium levels in the body are partly controlled by a hormone called aldosterone, which is made by the adrenal glands.

Aldosterone levels tell the kidneys when to hold sodium in the body instead of passing it in the urine Small amounts of sodium are also lost through the skin when you sweat .



(source;http://nileherb.blogspot.com)

Na+ balance between the three spaces by separating membranes is by diffusion together with other substances that. water, K, amino acids and active processes with differentspeeds. Interstitil balance and the intracellular radioactive water is obtained in 120 min for Na in 24 hours and for K in 25 min showing that regulation of Na is independent of thewater. These general types of balance are dependent on the balance between intake and elimination of a polynomial cation described above.

Sodium has an important role of monovalent cation is best represented vital blood is associated with metabolic and enzymatic processes as cell activator, is mainly associated cell membrane function, occurs.

- In the genesis and transmission of action potentials in acetilocolinergic synaptic transmission.

- activation of protein function in enzymatic reactions.

- In the blood clotting process.

By determining the concentration of sodium dosage form follows its assets and balancewith form-related and is achieved by biological methods, chemical, physico – chemical and physical.

The amount of sodium in the body is 3500-4500 mEq and found in two forms:

- Osmotic inactive in connective tissue 500 mEq , cartilage, bone, skin and adipose tissue 1400-1900 mEq

- Osmotic active, involved in stress-OSMO-regulatory processes.

This demonstrates the active pattern of fixed Na, Na inactive circulating osmotic and interstitial fluids andblood. This distribution showsthat outside factors Na metabolic andosmotic rheologici have a special contribution and physico-chemical factors that richanionic groups that interact with Na.

Sodium is found in blood in two forms, bound in ionic state, giving sodium levels withwell-defined values: 136mEq (hyponatremia) and 160 mEq (Hypernatraemia).Maintaining these valuesis achieved by neuroumorale and physicochemical Mechanism. In Hypernatraemia Na + passing the interstitium and is stored in bone and connectivetissue disorders, and hyponatremia, Na + is mobilized from storage and move intotissues . Many medicines and other products also have sodium in them , including laxatives , aspirin , mouthwash ,and toothpaste.

Of sodium homeostasis is maintained sanghina complex biological mechanisms andphysicochemical neuroumorale . The capillary membrane did not pass the excess is stored in the interstitium and connective tissue, bone, skin, and fat.

Too much sodium in the diet may raise blood pressure in some people .for those who have high blood pressure , eating foods with lot of sodium makes their chance of heart disease stroke, and kidney damage higher. Heart failure gets worse when too much sodium is eaten. It increase the amount of water the body holds in and this causes swelling of thelegs and hands. Some people have problems when they eat more than 4 miligrams (mg) of sodium per day.

Low sodium levels are uncommon and most often occur as a side effect of tacking medicines that make you urinate more, such as diuretics, severe diarrhea or vomiting or heavy sweating may also cause low sodium levels .

Role of sodium

Na+ is a cellular activator, plays a decisive role in cell excitability processes in the genesisand transmission of action potentials . Influneteaza accumulation of amino acids in the extracellular space. Acts as an activator of protein fraction in enzymatic reactions. Intervenes in synaptic transmission through acetilcholinergic channels, clouds form in the interstitial space pericelulari electropositive potentialrole in the genesis of action .

Na chemical activity in the blood is determined by the interaction of the local compenentii is mostly transported bound. In this method it is anionic sites of heparin interaction with Na cations and serotonin (5HT). Interaction is done with different energies according to the equation.

Na + heparin (H) → H-Na, the interaction energy E1 =

5HT + H → H-5HT, the interaction energy E2

Initially, E1> E2 and mixture we have:

5HT + Na + H → Na H-5 HT

If Na is involved in interactions with other substances will drop to E1 E1 <E2 and the equation becomes:

5HT + Na + H → Na + H-5HT.

In this case Na has higher chemical activity. So the chemical activity of the serum is about 5 HT interaction with H which is the reference to estimate the Na activity. Determinations show that the chemical activity of Na is lower than the reference value. It is compatible with normal neural excitability. Increased chemical activity is accompanied by increased neuromuscular excitability: convulsions in rats by audiogene hipermotricitate and behavioral disorders in humans with type constitutional amend EEG abnormalities, disorders of attention focused, hemodynamic disorders . Interaction between Na and protein in the blood is an energy barrier in the path of movement due to lower Na chemical activity.

Interaction of Na - blood proteins has important role in regulating physical and chemical cation transport and mass transfer to the space endocelular excitable structures.

Nature of chemical bonds between Na and possible protein was presented in the previous chapter. Intensity variation is dependent on chemical bonds of molecular substances and graduate parameters expressed by changes in the interaction potential. National Ligandarea depends primarily anionic and cationic composition of the solution, not only concetratia a ligand. Ligandare capacity depends among other factors extraproteice substances and molecular factors and protein density and reactive nature of anionic and cationic sites, conformation, hydration. Water, structured by hydrogen bonds is fixed at the side radicals and polarized covalent link, stabilizes the protein molecule. Breaking hydrogen bonds of water and protein loss distortion Na train.

Na, protein conformational changes induced nepolarizabil increases the field strength of anionic sites and interact with water diapolul. intensity of this influence is diminished in the presence of other anions in solution and depends on the cationic field strength of hydrated Na, loss of water molecules and thus shortens the ionic radius increases the interaction energy. Energy is so variable decreases asymptotically intercatie to 0 from center to periphery defining ion as a series of crystalline ion beams. Pregnancy induce Na ion energy of proteins and anionic sites nearby field reduces the interaction of cation radius. Not interact but any type of anions in the blood. The degree of interaction depends on their polarizabilitatea. Na interaction with anionic sites of proteins results in decreased activity of chemical and its ability to react with other anions. Proteins are substances but the most important for Na transport, they are amphoteric substances have high plasticity and thereby accommodate a variety of other ligands. Their transport capacity depends on their nativitatea. Interacting with the metal changes its electron charge transfer from metal. Anionic sites of protein interaction intensity with cations and other factors that depend on the coordination number, compzitia in amino acids, amino groups polarizabilitatea. Job strength is influenced by neighboring internal groups with variable polarity that interacts with strong intensity-dependent induction square of the distance between them.

Protein activity depends on the dissociation of anionic sites as mutiple balance theory: polypeptide chain length increases with solution pH and electrostatic forces with intensity. Denaturing protein affinity decreases intersand coordination number of radicals involving amino groups prototropice aspartic, glutamic, hidistina, teronina, cysteine, argnina. Charge density of proteins may influence the interaction with cations. Decrease, decreasing the affinity for cations. Charge density of anionic sites induces a cationic cloud around them and cause an uneven distribution of cations in the vicinity. Monovalent cations the selection depends on the density of anionic charge of electrostatic field and their degree of hydration. The charge density on protein activity inversely affects sodium in solution.

The central issue is deciphering the mechanisms of Na transport in the blood. The data presented so far does not suggest an individualized transportation but generally shows a process involving many proteins sanghine or anionic groups can interact with Na. Type of connection also is not identified, the interactions that were discussed at length. These are weak interactions that influence mainly by their number, by type and less by their strength. Therefore the balance between the three compartments cation gradient depends not only on distribution but also anionic groups between compartments. On the other hand, the links oligoenergetice (weaker than that of 5HT and heparin, taken as a referential value for establishing and using our method in this research) illustrates the physical and chemical properties of Na-protein interaction. Complex interactions involved in various National, is in equilibrium with the free form, active chemical, the method demonstrated by competition and conflict with the workings of excitable tissue. Increased chemical activity in humans and rats is accompanied by cerebral hyperexcitability, no data are available that explain, among other things, the mechanism of transfer of Na in the excitable membranes and those obtained by using ion channel blocking toxins. Determination of mental skills, in cents, corroborated with serum Na activity suggests that influence the intrinsic excitability last has on the brain, the socio-intellectual performance and adjustable. Attention was paid to the importance of focused and distribution processes, immediate auditory memory for words, psycho-nevroteice trends, type questionnaire for general image setting suitable for the child population of Romania. Correlation of serum Na activity show the state mental skills consistent with neuropsychological examination.

Determination of plasma sodium

Na interest has stimulated the development of a large number of quantitative methods in fluids where the dominant cation excitable structures reflecting mental position. National dosage is difficult, it is diamagnetic, which includes compounds are less colorful. Add to this biologic heterogeneity of the environment: high in electrolytes, anfotere substances, macromolecular, ETC. More total content determination is irrelevant to deciphering the physiological role . For this purpose it is necessary to determine the active Na and balance chemical forms related to the active form including membrane environment. So interested in continutultotal in Na, active free form concentration, interaction strength and nature-related forms of transport. Classic dosing methods are biological, chemical, physical, chemical and physical .

Biological methods

They follow the chemical state of Na. Sodium in red blood cells, which change slowly with medium suspension. In muscle there is a sequestered fraction of Na as in amphibian oocytes. In humans, using the principle of Gerbrandy to determine electrolytes fraction bound to the 6-10% of Na cnclus plasmtic is bound. This very small fraction is explained by the fact that venous stasis which involves the principle mentioned is accompanied by accumulation of H to deploy Na interactions with proteins. Other results show that activity in the presence of Na and K decreased alpha and beta proteins as in the presence of fibrinogen.

Chemical methods

Their use requires a cation preseparare compounds in solution interact with Na. Chemical methods are suitable for determining total Na sanghini after precipitation and centrifugation. Titrmetrica estimate (86.244).

Physical Methods

a) absorption spectrophotometry and fluorimetric interaction are based on metal and compounds containing it with electromagnetic radiation, according to Lambert-Beer law expressing depedendenta radiation absorption and linear concentration of the substance. Fluorometric methods consists in principle of linear dependence between the number of excited molecules and light emission during the return to ground state According to our law of Stokes. But require chelating compounds with aromatic organic compounds preferably fluorescent compounds formation. Chelating is used in absorption spectroscopy. Methods require a prior separation is the most common separation methods Chromatographs.

b) eimisie spectroscopy: atomic emission Flamfotometria is the method in which the atom is excited by the flame and the intensity is proportional to atomic concentration. emission lines are Na D lines of wavelengths 5890 and 5896 A. The method is applied to total dosages of cationic (Na and K), organic substances are completely destroyed by combustion has special value for the clinic. flamatomica spectrometry. Biological product is atomized and excitation occurs with a cathode lamp adjustable for specific wavelengths . Activation using atomic spectrometry X-ray and X register

c) Electroanalytical methods with potentiometric ion selective eletrozi-galvanic cell potential measured against the reference potential "0"-The principle potential from the active electrode is proportional to the concentration refernta chemically active species, selected ion-selective electrode similar electrodes H in determining the pH. The method is used in the determination of electrolytes in whole blood, undiluted plasma and other fluids. Method ion - selective active ionized form of adding value to Na and K (mM / l) lower than values obtained flamfotometric or due to Na binding protein or the formation of ion pairs. Accuracy increases with the dilution method is the maximum condition: infinite dilution. Ion-selective Electrodele can be used in vivo cell culture. This allows the study report Na / K during cell function. Voltametry anodic also uses selective electrodes to the reference electrode of mercury.

d) The methods include methods of isotopic analysis by isotope dilution

e) nuclear activation method. In this method sample radiate thermal neutron radiation emits β, α, y which can be determined.

f) methods also require presepararea Chromatographs cations with different methods: electrophoresis, precipitation, ultrafiltration, dialysis. Chromatographs was originally used to separate the organic species and then to metal ions.

Adapting these methods for inorganic analysis was done by modifying the two phases, stationary and mobile simultaneously or successively, as needed monovalent and divalent cations of interest for.