Sodium in urine

Sodium ions are the major cations of the extracellular fluid and contribute the most to the osmolality of blood plasma. Daily intake of sodium ranges between 100 and 260 mmol and is significantly affected by salting the meals. Excretion of sodium from the body is mostly provided by the kidney. The renal glomeruli filter about 25 moles of Na^+ daily, but majority of this amount is absorbed back. 60-70% of filtered sodium is absorbed in the proximal tubuli, 25-30% in the Henle's loops and about 5% in the distal tubuli. Only about 1% of the filtered amount of Na^+ remains in the final urine.

Basic information on the body exchange of sodium can be obtained from examination of **Na^+ concentration in serum and urine**. The urinary Na^+ concentration can be used for calculation of:

- **Daily output of sodium** (requires a 24-hour collection of urine)
- **Fractional excretion (FE)** and **tubular resorption (TR)** of sodium. The fractional excretion represents the part of filtered Na^+ that is excreted into urine. Tubular resorption is the part of filtered Na^+ that is absorbed back by renal tubuli. An advantage of these parameters is that measurements of Na^+ and creatinine concentrations in a single sample of urine are sufficient; 24-hour collection of urine is not needed.

Concentrations of Na^+ in serum and urine together with daily balance of Na^+ represent important parameters of the body water and electrolyte exchange. Their assessment is helpful in diagnosis and treatment of various disorders of the body water, electrolyte and acid-base balance, as well as renal diseases, hypertension, endocrine and other disorders. For instance, the value of FE_{Na+} is a valuable marker in differentiation of renal (parenchyma of the kidney itself is damaged) and extrarenal (restriction of kidney blood flow) causes of acute kidney failure. In case of the failure originating in the kidney parenchyma the FE_{Na+} value is above 1%; whereas if the cause of kidney failure is extrarenal, the FE_{Na+} is between 0.2-1%.

Physiological values:
Concentration of Na^+ in blood plasma: 137 – 144 mmol/l
Daily output of Na^+ into urine: 120 – 240 mmol/24 hours
FE_{Na+}: 0.4 – 1.2 % (0.004-0.012)
TR_{Na+}: 99.6 – 98.8 % (0.996-0.988)

Estimation of sodium in biological fluids

Nowadays many ions are conveniently estimated by means of **potentiometry**, using **ion-selective electrodes (ISE)**. The activity of Na^+ ions is measured with a cell consisting of a sodium ion-selective electrode and a reference electrode, such as the calomel electrode. The **sodium electrode** resembles pH electrode, only the material from which the electrode is made has a different composition – calcium oxide in sodium-calcium glass is replaced with aluminium oxide.

For simplicity, the glass bulb of the sodium electrode can be considered permeable for sodium ions; an exchange of Na^+ ions between the hydrated glass surface and the measured solution results in a change in the electrode potential (c.f. analogous principle of the pH electrode). Other cations pass the glass membrane much less, the only exception is H^+ that must be present in the measured solution in much lower concentration than Na^+ – that is why the samples are diluted with an alkaline buffer.

The resulting potential between the sodium electrode and the reference electrode is measured with a millivoltmeter; often a pH-meter is employed for this purpose. As described by the Nernst equation, the measured **potential is directly proportional to logarithm of the Na^+ concentration**.

According to http://www.wikiskripta.eu/index.php/Sod%C3%ADk_v_mo%C4%8Di. (retrieved 30/4/2015)
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