Meditsiiniline keemia/Medical chemistry LOKT.00.009

Determination of sodium and potassium by flame photometry

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http://tera.chem.ut.ee/~koit/arstpr/nak_en.pdf

1 Introduction

Potassium (K) is the major cation found inside of cells. The proper level of potassium is essential for normal cell function. An abnormal increase of potassium (hyperkalemia) or decrease of potassium (hypokalemia) can profoundly affect the nervous system and heart, and when extreme, can be fatal. The normal blood potassium level is 3.5 - 5.0 millimoles/liter (mmol/l).
Sodium (Na) is the major extracellular cation and it plays a role in body fluid distribution. Concentration of sodium ions inside the plasma (extracellular) is 130-145 mmol/l. Higher and lower concentrations are referred to as hypernatremia and hyponatremia, respectively.
When a solution containing cations of sodium and potassium is spayed into flame, the solvent evaporates and ions are converted into atomic state. In the heat of the flame (temperature about 1800ºC), small fraction of the atoms is excited. Relaxation of the excited atoms to the lower energy level is accompanied by emission of light (photons) with characteristic wavelength (Na: 589 nm, K: 766 nm). Intensity of the emitted light depends on the concentration of particular atoms in flame.

2 Instruments, reagents and glassware

1. Flame photometer FLAPHO or Eppendorf.
2. Stock solutions of Na^+ and K^+, c = 1 mg/ml.
3. 6 numbered 100 ml volumetric flasks.
4. Glass pipettes: 1, 2, 10 ml.

3 Analytical procedure

3.1 Preparation of standard solutions

Standard solutions are prepared by dilution of stock solutions. Use different glass pipettes and numbered 100 ml volumetric flasks and prepare the solutions according to the following table:

Flask number	1	2	3	4	5	6
Vol. of pipette to use	1	1	2	10	10	10
Vol. of Na stock solution to pipette	0.5	1	2	4	6	8
Vol. of K stock solution to pipette	0.5	1	2	4	6	8
Conc. of solution obtained (μg/ml)	5	10	20	40	60	80

3.2 Sample preparation

Test solution is given in 100 ml flask. Fill it up to the mark with distilled water and mix.

3.3 Measurement procedure

Attention: Flame photometer uses flammable gases which can cause explosions if used improperly! Switch the instrument on and off under supervision!
Note: Check the flame during work if it goes out, close the gas valve immediately!

With Eppendorf flame photometer:

1. Let the instrument warm up for 5-10 minutes.
2. Feed distilled water to the instrument.
3. Select the element Na by turning the selector “Elementwahl”.
4. Turn the outer knob “Messbereich” into position “100”. Pull the “Kompensaton I” knob slightly out and adjust readout to 0. Press the “Kompensation I” knob back. Readjust 0 reading with “Kompensation II” if necessary.
5. Aspirate the most concentrated standard solution (solution number 6) and adjust readout to approximately 350 (on uppermost scale) using inner “Messbereich” knob.
6. Aspirate distilled water – the instrument should read 0.
7. Aspirate standard solutions no. 1, 2, 3, test solution, and then standards 4, 5, 6. Record the results.
8. Repeat 3-7 for solutions of potassium.
9. Aspirate distilled water for at least 5 minutes to clean the system.

With FLAPHO flame photometer:
(FLAPHO is a dual channel instrument, which measures concentrations of Na and K simultaneously. Channel 1 (upper indicator) shows Na, and channel 2 (lower) K.

1. Let the instrument warm up for 5-10 minutes.
2. Feed distilled water to the instrument.
3. Using knobs $\overset{0}{\blacktriangle}$ adjust the indicators to 0 reading.
4. Aspirate the most concentrated standard solution (solution number 6) and adjust readout to approximately 90 (on uppermost scale) using the big knobs.
5. Aspirate distilled water – the instrument should read 0.
6. Aspirate standard solutions no. 1, 2, 3, test solution, and then standards 4, 5, 6. Record the results.
7. Aspirate distilled water for at least 5 minutes to clean the system.

4 Calculation of the results

1. Draw calibration curves for sodium and potassium on a sheet of millimeter-paper. Use concentrations as abscissa and instrument readouts as ordinate values. Mind the units!
2. Find concentration of sodium and potassium ions in test solution from calibration curves.