New liquid stable Na^+-, K^+- and Cl^--assays for the fast and easy assessment of electrolytes on clinical chemistry analyzers

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Introduction:

In all higher life forms a precise maintenance of an electrolyte balance is crucial to regulate pH and hydration of the body and is critical for nerve and muscle function. In patients electrolytes such as Na^+, K^+ and Cl^- are frequently measured as part of the clinical routine to evaluate acute or chronic diseases and to monitor treatment of certain problems. This includes high blood pressure, heart failure, liver and kidney diseases or diabetes-related complications.

Here we present a new ready-to-use electrolyte reagent panel to measure Na^+, K^+ and Cl^- on clinical chemistry analyzers (CCA). Established methods for the determination of electrolytes are flame emission spectroscopy (FES) and potentiometry with ion selective electrodes (ISE). These systems are cumbersome to integrate into routine testing or require a lot of regular maintenance to ensure a reliable performance. The liquid-stable DiaSys electrolyte tests are optimized for laboratories with small or mid-sized clinical analyzers without an ISE.

Sodium FS

The Sodium FS assay is based on a Na^+ sensitive ß-galactosidase. This reaction is assessed by enzymatic release of *o*-nitrophenol from its substrate. The absorbance increase at 405 nm is directly proportinal to the sodium concentration of a sample.

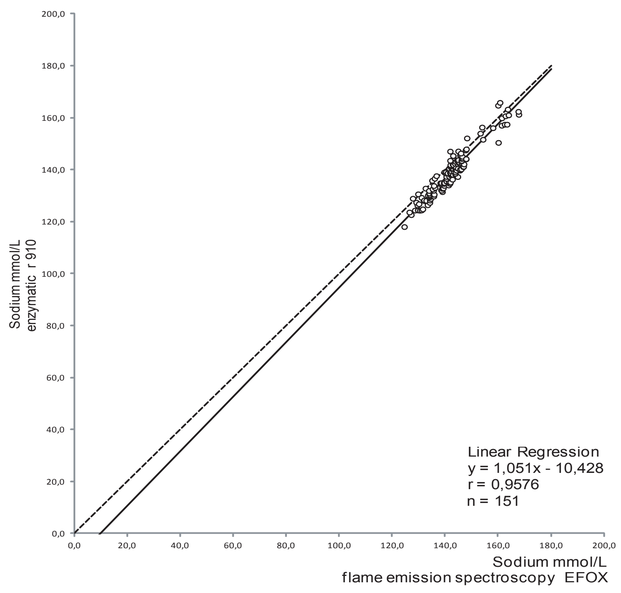
Reaction principle of sodium:

Na^+

ß-galactosidase

ONPG → *o*-nitrophenol + galactose

Method comparison:



A comparison of n=151 serum samples with FES is shown. DiaSys Sodium FS is calibrated on a respons®910 with the DiaSys TruCal E traceable to the NIST Standard Reference Material® SRM 956.

Precision within run (n=20) on respons®920:

Precision in series	Sample 1	Sample 2	Sample 3
Mean [mmol/L]	130	144	150
CV [%]	**0.95**	**0.69**	**0.59**

Potassium FS

Potassium FS is an enzymatic method using a K^+-dependent pyruvate kinase which is connected to a lactate dehydrogenase/NADH system for detection. The absorbance decrease at 340 nm is proportinal to the potassium concentration of a sample.

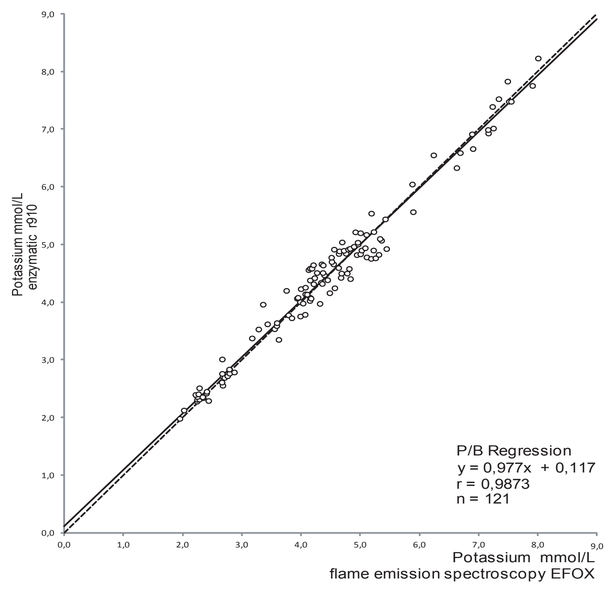
Reaction principle of potassium:

K^+

ADP + PEP → (Pyruvate kinase) → Pyruvate + ATP

Pyruvate + NADH + H^+ → (LDH) → Lactate + NAD

Method comparison:



A comparison of n=121 serum samples with FES is shown. DiaSys Potassium FS is calibrated on a respons®910 with the DiaSys TruCal E traceable to the NIST Standard Reference Material® SRM 956.

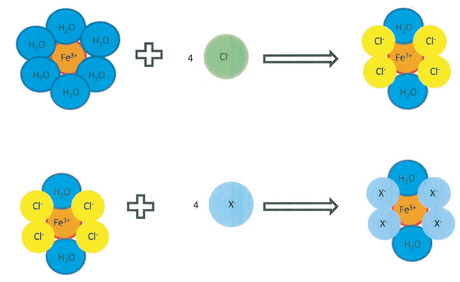
Precision within run (n=20) on respons®920:

Precision in series	Sample 1	Sample 2	Sample 3
Mean [mmol/L]	4.40	4.83	7.05
CV [%]	**1.03**	**1.08**	**1.17**

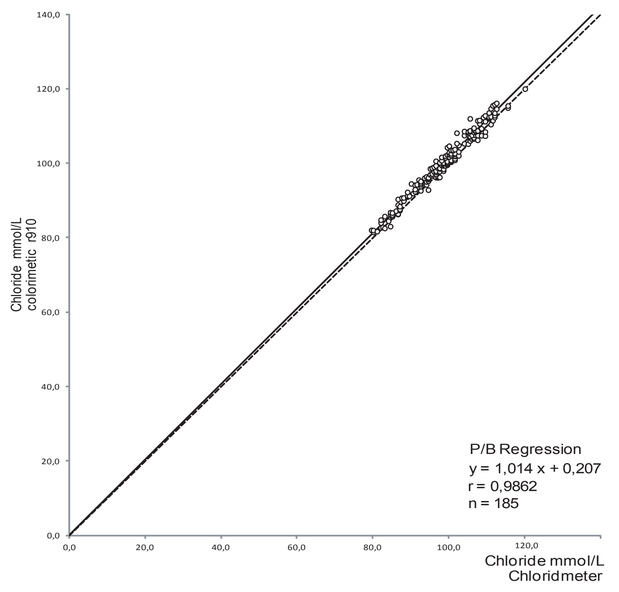
Chloride 21 FS

Chloride 21 FS is a new colorimetric principle, using a specific Cl^--dependent iron(III)-chloride-complex. Chloride forms a colored complex with ferric ions. In a second step this is decolored by a chelating agent replacing the chloride in the complex. The difference of absorbance at 340 nm is proportional to the concentration of chloride in the sample.

Reaction principle of chloride:



Method comparison:



A comparison of n=185 serum samples with Chloridmeter is shown. DiaSys Chloride 21 FS is calibrated on a respons®910 with the DiaSys TruCal E traceable to the NIST Standard Reference Material® SRM 956.

Precision within run (n=20) on respons®920:

Precision in series	Sample 1	Sample 2	Sample 3
Mean [mmol/L]	89.3	101	115
CV [%]	**1.08**	**0.72**	**0.90**

Conclusion:

All three tests show a wide linear range and allow the robust determination of electrolyte values in serum or plasma samples on routine CCA without prior dilution. Using a DiaSys respons® analyzer the tests demonstrated very strong correlation to the reference methods and an extraordinary precision of < 2% within run and < 3% between day. No significant interferences within ±3% (Na^+) and ±4.5% limits (K^+, Cl^-) are given for all test assays. Our results demonstrate, that the DiaSys Na^+, K^+ and Cl^- reagent panel offers a great opportunity for small and mid-sized labs to automate routine electrolyte diagnosis. The reagents can be used manually as well as on CCAs with a comparable performance to ISE or FES.