Application Note
#AA3006

Determination of Major Electrolytes, Minor Minerals, and Trace Heavy Metals in Physiological Fluids by Flame and Graphite Furnace Atomic Absorption Spectroscopy

Accurate measurements of specific metals in various biological systems is extremely important. These metals can be classified into several groups: the high level major electrolytes (Na, K, Ca, Mg), which are crucial to normal primary physiological processes like cellular activity and metabolism; the minor minerals (Fe, Mn, Zn, Co, Cu), which are present in lower levels to act as metabolic agents and enzyme catalysts; and the trace heavy metals, or toxics, that should not be present in a healthy organism (Ag, Al, As, Se, Pb, Cr, Cd, Hg, Ni, Tl, Sr, Ba, and V). These last elements are either known to be detrimental to the body, or have a currently unknown activity that is purported to be harmful.

Such a listing of elements is prone to rapid changes. Some vitamin metabolic processes and enzymatic reactions appear to need very small amounts of "poisonous" metals like Se and Cr. Metals like Al and Sn do not have any well documented harmful effects, but are believed to be related to Alzheimer's Disease and kidney disfunction, respectively. Even certain "odd" metals like Mo and Au, not normally found in the food system, are found to disturb digestion and skeletal processes. Other elements like Li, Pt, and La are being used in drug products and require monitoring in the body. Obviously, there is a need for an analytical system to be able to differentiate and quantitate these 20+ elements easily and reproducibly.

The most economical instrument suitable for this work is the Buck 210VGP Atomic Absorption Spectrophotometer. The Buck 210, based on a unique "Stable-Beam" technology that gives superior sensitivity and stability over older double-beam systems, is extremely simple to install and operate. The various excitation "sources" (air, nitrous oxide, hydride, and graphite furnace) allow analyses to be made in a multitude of matrices (tissue digests, serum, plasma, whole blood, packed RBC's, urine, amnion, CSF, etc.) for metals from the parts-per-billion to the percentage level. Most clinical environments refer to mg% or mEq/L for the major electrolytes, and in mg/dL (or µg/dL) for the toxic elements.

Chemical considerations are quite simple for handling physiological matrices, particularly if employing the Buck 210 AA with its perfectly balanced "in-line" deuterium lamp background corrector. This feature permits the analyst to use a single, simple aqueous standard for calibration of many different sample matrices, which would have required individual matrix-matched standards for each type of sample.

The enclosed data show a simplified, standardized technique for the preparation of various body fluids, and the conditions for the precise determination of a range of metals.

Analysis of Electrolytes, Minerals, and Trace Heavy Metals....

Samples:
[1] Whole blood, collected in EDTA or Citrate & chilled
[2] Serum, centrifuged to separate all solids
[3] Reconstituted Packed Cells, in isotonic saline
[4] Urine, collected, and refrigerated

Preparation: A "Physio-Sol" diluent developed at Buck Scientific is used for cell hemolysis (TX-100), stabilization (EDTA & Tartrate), and spectrographic buffering (Lanthanum) of the sample.
High concentration electrolytes are measured in a 1:50 dilution:
[1] 1.0ml sample in 50ml. centrifuge tube, add 10.0ml of Physio-Sol™, vortex for 60 seconds, dilute to 50ml. with DI Water, re-vortex to mix.
Low level minerals and toxics are determined in a 1:5 dilution:
[2] 2.0ml sample in 10ml centrifuge tube, add 2.0ml of "Physio-Sol"™, vortex for 60 seconds, dilute to 10ml final volume and re-vortex.

Calibration: A 20% "Physio-Sol"™ Blank (0) is used with a High-Std of 1.0 ppm (mg/L) made up in a 20% "Physio-Sol"™ matrix. Use for all analyses.

Instrument: Buck Model 210VGP AAS with attachments as described below:

Conditions: Air Flame for Na, Mg, Cu, Zn, Fe // Nitrous Flame for Ca //
Furnace for Pb, Cr, Al // Hydride for As // Cold Vapor for Hg //
Values are mg/L (ppm) in the original sample unless otherwise noted.

Element	Wave-Length (nm)	Detection Limit	SMP-1	SMP-2	SMP-3	SMP-4
Na	589	n/a	1890	3220	255	750
Mg	285	n/a	44	26	79	7.8
Ca	422	n/a	83	96	6.1	56
Cu	324	0.2	0.94	1.2	0.66	n/d
Zn	214	0.1	7.9	1.3	5.7	~0.1
Fe	248	0.05	1.85	1.2	2.2	0.07
Cr	357	0.01	0.02	0.05	n/d	n/d
Al	309	0.07	0.13	0.19	n/d	0.08
Pb	283	0.02	0.48	0.04	0.40	n/d
As	193	0.01	0.27	0.12	n/d	0.05
Hg	253	0.005	n/d	n/d	n/d	0.02

The above data shows the powerful flexibility and stability of the Buck 210VGP systems for the wide-ranging requirements of the Clinical Laboratory. The high precision of the Major and Trace data exemplifies the stability of the instrument. The overall high sensitivity of the various Trace metals supports the interference-free quality of the data. The result is an unmatched system in economy and performance.

Basic System: $12,950.00

Turnkey System: $36,027.00   Includes: 210VGPAA, 220 Graphite Furnace, 420 Hydride Generator, all recommended lamps, standards, and accessories for normal operation.

For detailed configuration, refer to Quote #AA4006

1-800-562-5566

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