

DRIED URINE TEST SPECIFICATIONS

Arsenic

Clinical Information

Arsenic is an environmental toxin, found in well water as well as some foods such as fish, shellfish, seaweed, rice, and fruit.

Arsenic is a heavy metal with multiple toxic effects in the body including carcinogenesis, goiter, diabetes, skin diseases, and damage to the liver, kidney, and the cardiovascular, nervous, and endocrine systems. It also competes with selenium, preventing its incorporation into the selenoproteins.

This reduces the levels of selenium-containing antioxidants and also the selenoenzymes that are essential for thyroid hormone production, thereby severely compromising thyroid function. Dried urinary arsenic is a good indicator of recent arsenic exposure, since around 80% of dietary arsenic is excreted into urine with 3 days.

Two dried urine samples are collected for arsenic testing; first morning and last night. The arsenic content is averaged for the two samples, which we have found to correlate excellently with results from a simultaneous 24-hour urine collection.

Arsenic levels are corrected using urinary creatinine to allow for variations in hydration status.

The reference range is <42 µg arsenic/g creatinine.

References:

Zava TT, Zava DT. Determination of iodine, bromine, selenium and arsenic by ICP-DRC-MS using urine dried on filter paper. *Thyroid* 2013;23(1):A21. (Poster presented at the 83rd Annual Meeting of the American Thyroid Association, October 16-20, 2013, San Juan, Puerto Rico).

Kapaj S, Peterson H, Liber K, Bhattacharya P. Human health effects from chronic arsenic poisoning--a review. *J Environ Sci Health A Tox Hazard Subst Environ Eng.* 2006;41:2399-428.

Ciarrocca M, Tomei F, Caciari T, et al. Exposure to arsenic in urban and rural areas and effects on thyroid hormones. *Inhal Toxicol.* 2012;24:589-98.

Van Hulle M, Zhang C, Schotte B, et al. Identification of some arsenic species in human urine and blood after ingestion of Chinese seaweed *Laminaria*. *J Anal At Spectrom.* 2004;19:58-64.
Zava TT, Kapur S, Zava DT. Iodine and creatinine testing in urine dried on filter paper. *Anal Chim Acta* 2013;764:64-9.

Assay Method: ICP-MS

Intra-assay Precision

Intra-assay precision was determined by choosing three dried urine samples spanning the reference range for arsenic, and analyzing them 20 times within the same run. Results are shown below:

Mean Arsenic Concentration (µg/L)	Standard Deviation	Coefficient of Variation (C.V. %)
4.7	0.2	4.5
51.2	1.5	2.9
201.6	6.5	3.2

Inter-assay Precision

Inter-assay precision was determined by choosing three samples spanning the reference range for arsenic, and analyzing them over a 1-month period. Results are shown below:

Mean Arsenic Concentration (µg/L)	Standard Deviation	Coefficient of Variation (C.V. %)
5.1	0.4	7.4
51.3	2.4	4.7
202.8	10.1	5.0

Accuracy

To test the accuracy of the dried urine assay for arsenic, external urine controls containing known concentrations of arsenic were analyzed. An inter-laboratory comparison was also performed with matching samples. Results are shown below:

External Control	Expected Arsenic (µg/L)	ZRT Arsenic (µg/L)	Inter-Laboratory Comparison	Other Lab Result (µg/L)	ZRT Result (µg/L)
SeroNorm Trace Elements Level 1	158	171	Sample 1	13.0	11.5
SeroNorm Trace Elements Level 2	261	257.6	Sample 2	14.0	13.6
ClinChek Trace Elements Level 1	43	37.5			
ClinChek Trace Elements Level 2	83.3	70.7			
BioRad 400 Lyphocheck Metals Level 1	66.8	60.5			
BioRad 405 Lyphocheck Metals Level 2	162	156			

Analyte Stability

The dried urine arsenic samples are stable for more than one month at room temperature and for more than six months when stored at -80°C. Three freeze-thaw cycles did not cause a significant change in concentration.

Specimen Collection

Kits for dried urine collection contain two filter paper collection strips, easy-to-follow instructions, and a mailer to return the sample for analysis.