DOCTOR'S DATA INC

LAB #: H150128-2430-1
PATIENT: Daryna Goncharenko
ID: GONCHARENKO-D-00001
SEX: Female
AGE: 4

CLIENT #: 24237
DOCTOR: Anna Davis, MD
Direct Laboratory Services
4040 Florida St Ste 101
Mandeville , LA 70448 U.S.A.

Toxic & Essential Elements; Hair

TOXIC METALS

		RESULT µg/g	REFERENCE INTERVAL	PERCENTILE 68th 95th
Aluminum	(Al)	5.3	< 8.0	
Antimony	(Sb)	0.029	< 0.066	
Arsenic	(As)	0.076	< 0.080	
Barium	(Ba)	0.19	< 0.75	
Beryllium	(Be)	< 0.01	< 0.020	
Bismuth	(Bi)	0.099	< 2.0	
Cadmium	(Cd)	0.020	< 0.070	
Lead	(Pb)	0.42	< 1.0	
Mercury	(Hg)	1.0	< 0.40	
Platinum	(Pt)	< 0.003	< 0.005	
Thallium	(Tl)	< 0.001	< 0.002	
Thorium	(Th)	0.001	< 0.002	
Uranium	(U)	0.004	< 0.060	
Nickel	(Ni)	0.18	< 0.30	
Silver	(Ag)	0.10	< 0.20	
Tin	(Sn)	0.15	< 0.30	
Titanium	(Ti)	0.34	< 0.90	
Total Toxic Representation				

ESSENTIAL AND OTHER ELEMENTS

		RESULT µg/g	REFERENCE INTERVAL	PERCENTILE 2.5th 16th 50th 84th 97.5th
Calcium	(Ca)	152	140- 500	
Magnesium	(Mg)	10	15- 45	
Sodium	(Na)	66	18- 180	
Potassium	(K)	76	10- 150	
Copper	(Cu)	9.5	11- 24	
Zinc	(Zn)	85	100- 190	
Manganese	(Mn)	0.17	0.10- 0.50	
Chromium	(Cr)	0.41	0.43- 0.70	
Vanadium	(V)	0.041	0.030- 0.10	
Molybdenum	(Mo)	0.040	0.050- 0.13	
Boron	(B)	1.7	0.40- 3.5	
Iodine	(I)	11	0.25- 1.3	
Lithium	(Li)	0.006	0.007- 0.020	
Phosphorus	(P)	150	150- 220	
Selenium	(Se)	0.37	0.70- 1.1	
Strontium	(Sr)	0.24	0.19- 2.0	
Sulfur	(S)	44800	45500- 53000	
Cobalt	(Co)	0.007	0.005- 0.030	
Iron	(Fe)	11	7.0- 16	
Germanium	(Ge)	0.035	0.030- 0.040	
Rubidium	(Rb)	0.10	0.012- 0.16	
Zirconium	(Zr)	0.23	0.030- 1.0	

SPECIMEN DATA

COMMENTS:

Date Collected: **12/03/2014**
Date Received: **01/28/2015**
Date Completed: **01/29/2015**
Methodology: **ICP/MS**

Sample Size: **0.198 g**
Sample Type: **Head**
Hair Color: **Blond**
Treatment:
Shampoo:

RATIOS

ELEMENTS	RATIOS	RANGE
Ca/Mg	15.2	4- 30
Ca/P	1.01	1- 12
Na/K	0.868	0.5- 10
Zn/Cu	8.95	4- 20
Zn/Cd	> 999	> 800

HAIR ELEMENTS REPORT
INTRODUCTION

Hair is an excretory tissue for essential, nonessential and potentially toxic elements. In general, the amount of an element that is irreversibly incorporated into growing hair is proportional to the level of the element in other body tissues. Therefore, hair elements analysis provides an indirect screening test for physiological excess, deficiency or maldistribution of elements in the body. Clinical research indicates that hair levels of specific elements, particularly potentially toxic elements such as cadmium, mercury, lead and arsenic, are highly correlated with pathological disorders. For such elements, levels in hair may be more indicative of body stores than the levels in blood and urine.

All screening tests have limitations that must be taken into consideration. The correlation between hair element levels and physiological disorders is determined by numerous factors. Individual variability and compensatory mechanisms are major factors that affect the relationship between the distribution of elements in hair and symptoms and pathological conditions. It is also very important to keep in mind that scalp hair is vulnerable to external contamination of elements by exposure to hair treatments and products. Likewise, some hair treatments (e.g. permanent solutions, dyes, and bleach) can strip hair of endogenously acquired elements and result in false low values. Careful consideration of the limitations must be made in the interpretation of results of hair analysis. The data provided should be considered in conjunction with symptomology, diet analysis, occupation and lifestyle, physical examination and the results of other analytical laboratory tests.

Caution: The contents of this report are not intended to be diagnostic and the physician using this information is cautioned against treatment based solely on the results of this screening test. For example, copper supplementation based upon a result of low hair copper is contraindicated in patients afflicted with Wilson's Disease.

Mercury High

Hair mercury (Hg) is an excellent indiator of exposure to methylmercury from fish. Mercury is toxic to humans and animals. Individuals vary greatly in sensitivity and tolerance to Hg burden.

Hg can suppress biological selenium function and may cause or contribute to immune dysregulation in sensitive individuals. Hallmark symptoms of excess Hg include: loss of appetite, decreased senses of touch, hearing, and vision, fatigue, depression, emotional instability, peripheral numbness and tremors, poor memory and cognitive dysfunction, and neuromuscular disorders. Hair Hg has been reported to correlate with acute myocardial infarction and on average each 1 µg/g of hair Hg was found to correlate with a 9% increase in AMI risk (Circulation 1995; 91:645-655).

Sources of Hg include dental amalgams, fish, water supplies, some hemorrhoidal preparations, skin lightening agents, instruments (thermometers, electrodes, batteries), and combustion of fossil fuels, Ayurvedic herbs, some fertilizers, and the paper/pulp and gold industries. After dental amalgams are installed or removed a transient (several months) increase in hair Hg is observed. Also, "baseline" hair Hg levels for individuals with dental amalgams are higher (about 1 to 2 µg/g) than are baseline levels for those without (below 1 µg/g).

Confirmatory tests for elevated Hg are measurement of whole blood as an indication of recent/ongoing

exposure (does not correlate with whole body accumulation) and measurement of urine Hg before and after administration of a dithiol metal binding agent such as DMSA or DMPS (an indication of total body burden).

Magnesium Low

Low hair Magnesium (Mg) levels may be indicative of Mg deficiency, but this has not been unequivocally demonstrated. When hair Mg is low, dietary intake and malabsorption should be considered. Mg is an essential element/electrolyte that is necessary for the activity of many important enzymes. Low hair Mg may or may not be associated with physiological dysfunction.

Causes of Mg deficiency include: consumption of a ”junk food” diet or Mg-deficient foods, intestinal malabsorption, hypocalcemia with decreased Mg retention, chemical toxicity with renal wasting, alcoholism, alkalosis, prolonged diarrhea/laxative abuse, and iatrogenic causes (digoxin therapy, occasionally from oral contraceptives, hypercalcemic drugs, gentamicin, neomycin).

Symptoms of Mg deficiency include: muscle twitching, cramps, tremor or muscle spasms, paresthesia, and mental depression. Low Mg status is associated with arrythmias and increased cardiovascular risk.

Mg status can be difficult to assess; whole blood and packed red cell levels are more indicative than serum/plasma levels. Amino acid analysis can be helpful in showing rate-limited steps that are Mg-dependent such as phosphorylations. Taurine deficiency is often associated with urinary loss of Mg. The Mg challenge method may be indicative: baseline 24-hour urine Mg measurement, followed by 0.2 mEq/Kg intravenous mg, followed by 24-hour Mg measurement. A deficiency is judged to be present if less than 80% of the administrered Mg is excreted in the urine.

Copper Low

Hair Copper (Cu) levels are usually indicative of body status with two exceptions: (1) addition of exogenous Cu (occasionally found in hair preparations or algaecides in swimming pools/hot tubs), and (2) low hair Cu in Wilson’s or Menkes’ diseases. In Wilson’s disease, Cu transport is defective and Cu accumulates, sometimes to toxic levels, in intestinal mucosa, liver and kidneys. At the same time, it is low in hair and deficient in other peripheral tissues. In Menkes’ disease, the activity of Cu dependent enzymes is very low. Cu supplementation is contraindicated in these diseases.

Cu is an essential element that is required for the activity of certain enzymes. Erythrocyte superoxide dismutase (SOD) is a Cu (and zinc) dependent enzyme; lysyl oxidase which catalyzes crosslinking of collagen is another Cu dependent enzyme. Adrenal catecholamine synthesis is Cu dependent, because the enzyme dopamine beta-hydroxylase, which catalyzes formation of norepinephrine from dopamine, requires Cu.

Symptoms of Cu deficiency include: elevated cholesterol, increased inflammatory responses, anemia, bone and collagen disorders, reproductive failure, and impaired immunity. Possible reasons for a Cu deficiency include: intestinal malabsorption, insufficient dietary intake,molybdenum excess,zinc excess, and chelation therapy. Cu status is adversely affected by excess of antagonistic metals such as mercury, lead, cadmium, and manganese.

Confirmatory tests for Cu deficiency are serum ceruloplasmin to rule out Wilson’s disease (ceruloplasmin

is deficient in Wilson's disease), a whole blood or packed red blood cell elements analysis, and a functional test for Cu (barring zinc deficiency) is measurement of erythrocytes SOD activity. Erythrocyte SOD activity is subnormal with Cu deficiency.

Zinc Low

A result of low hair Zinc (Zn) may be indicative of low Zn in whole blood, red blood cells, and other tissues. Hair analysis is a good screen for Zn deficiency provided that the hair sample has not been chemically treated (permanent solutions, dyes, and bleaches); such hair treatments can significantly lower the level of Zn in hair. Other laboratory tests to confirm Zn status are whole blood or packed red blood cell elements analysis.

Zn is an essential element that is required in numerous biochemical processes including protein, nucleic acid and energy metabolism. Zn is an obligatory co-factor for numerous enzymes including alcohol dehydrogenase, carbonic anhydrase, and superoxide dismutase.

Zn competes for absorption with copper and iron. Cadmium, lead and mercury are potent Zn antagonists. Zn deficiency can be caused by malabsorption, chelating agents, poor diet, excessive use of alcohol or diuretics, metabolic disorder of metallothionein metabolism, surgery, and burns. Hair levels of Zn (copper and selenium) were decreased in human subjects after switching from a mixed to a lactovegetarian diet (Am. J. Clin. Nutr.; 55:885-90,1992).

Hair Zn is commonly low in diabetics, and in association with ADD/ADHD and autism (DDI observation). Reported symptoms of Zn deficiency include: fatigue, apathy, hypochlorhydria, decreased vision and dysgeusia, anorexia, anemia, dermatitis, weak/brittle nails and hair, white spots on nails, alopecia, impaired would healing, sexual dysfunction (males), and hypogonadism.

Chromium Low

Hair Chromium (Cr) is a good indicator of tissue levels and may provide a better indication of status than do urine or blood plasma/serum (Nielsen, F.H. In Modern Nutrition on Health and Disease; 8th Edition, 1994. Ed. Shils, Olson and Shike. Lea and Febiger, Philadelphia). Hair Cr is seldom affected by permanent solutions, dyes and bleaches.

Cr (trivalent) is generally accepted as an essential trace element that is required for maintenance of normal glucose and cholesterol levels; it potentiates insulin function, i.e., as a part of "glucose tolerance factor". Deficiency conditions may include hyperglycemia, transient hyper/hypoglycemia, fatigue, accelerated atherosclerogenesis, elevated LDL cholesterol, increased need for insulin and diabetes-like symptoms, and impaired stress responses. Marginal or insufficient Cr is common in the U.S., where average tissue levels are low compared to those found in many other countries. Low hair Cr appears to be associated with increased risk of cardiovascular disease and an atherogenic lipoprotein profile (low HDL, high LDL). Common causes of deficiency are ingestion of highly processed foods, inadequate soil levels of Cr, gastrointestinal dysfunction, and insufficient vitamin B-6. Cr status is also compromised in patients with iron overload/high transferrin saturation because transferrin is a major transport protein for Cr.

Confirmatory tests for Cr adequacy include glucose tolerance and packed red blood cell elements analysis.

Molybdenum Low

Low Molybdenum (Mo) in hair is a possible indication of Mo deficiency. Hair is very rarely contaminated with exogenous Mo.

Mo is an essential trace element that is an activator of specific enzymes such as: xanthine oxidase (catalyzes formation of uric acid), sulfite oxidase (catalyzes oxidation of sulfite to sulfate), and aldehyde dehydrogenase (catalyzes oxidation of aldehydes). Possible effects or symptoms consistent with Mo deficiency are: subnormal uric acid in blood and urine, sensitivity or reactivity to sulfites, protein intolerance (specifically to sulfur-bearing amino acids), and sensitivity or reactivity to aldehydes.

True Mo deficiency is uncommon but may result from: a poor-quality diet, gastrointestinal dysfunctions, or tungsten exposure. Tungsten (from "TIG" welding) can be a powerful antagonist of Mo retention in the body. Copper overload can also reduce Mo retention.

Because normal blood and blood cell Mo levels are very low (a few parts per billion), blood measurement is not an appropriate tissue for confirmation of subnormal molybdenum.

Confirmatory tests for Mo deficiency include measurement of urine sulfite concentration (increased in Mo deficiency), measurement of blood/urine uric acid level (decreased in Mo deficiency), and measurement of urinary Mo content.

Iodine High

Hair Iodine (I) levels have been noted to vary according to I status levels and dietary intake. I is nutritionally essential for humans and is used in the formation of thyroid hormones. I is bound to the tyrosine residue in thyroglobulin to form triiodothyronine (T-3) and thyroxine (T-4). However, there is no scientific support indicating that high hair I levels, per se, are diagnostic of thyroid function.

External contamination of hair with I from hair treatments is possible. Contamination is often accompanied by elevated aluminum, silver, nickel, and titanium if there is exogenous I contamination from hair preparations.

Conditions that may be associated with excessive I include: hypersensitivity reactions, hypothyroidism, thyroiditis, and iodide goiter. Hypersensitivity reactions can be immunologic or nonimmunologic, but usually include dermatological irritation or contact dermatoses. Other possible hypersensitivity reactions include: angio-edema, burning or soreness of mouth and throat, and nausea/diarrhea. Autonomous thyrotoxicosis (Plummer's disease) and autoimmune thyrotoxicosis (Graves' disease) may occur in I excess if thyroid function is poorly controlled by hypothalamic-pituitary action. If questionable, thyroid function should be assessed by measurement of TSH, T-4, and T-3.

Selenium Low

Selenium (Se) is normally found in hair at very low levels, and several studies provide evidence that low hair Se is reflective of dietary intake and associated with cardiovascular disorders.

Utilization of hair Se levels to assess nutritional status, however, is complicated by the fact that use of Se- or sulfur-containing shampoo markedly increases hair Se (externally) and can give a false high value.

Se is an extremely important essential element due to its antioxidative function as an obligatory component of the enzyme glutathione peroxidase. Se is also protective in its capacity to bind and ”inactivate” mercury, and Se is an essential cofactor in the deiodination of T-4 to active T-3 (thyroid hormone). Some conditions of functional hypothyroidism therefore may be due to Se deficiency (Nature; 349:438-440, 1991); this is of particular concern with mercury exposure. Studies have also indicated significant inverse correlations between Se and heart disease, cancer, and asthma.

Selenium deficiency is common and can result from low dietary intake of Se or vitamin E, and exposure to toxic metals, pesticides/herbicides and chemical solvents.

Symptoms of Se deficiency are similar to that of vitamin E deficiency and include muscle aches, increased inflammatory response, loss of body weight, alopecia, listlessness, skeletal and muscular degeneration, growth stunting, and depressed immune function.

Confirmatory tests for Se deficiency are Se content of packed red blood cells, and activity of glutathione peroxidase in red blood cells.

Sulfur Low

Sulfur (S) in hair is covalently bound within the cysteinyl residues of hair protein. On average, cysteine constitutes about sixteen percent of the total amino acid content of hair. Although not well documented, hair S levels may vary with S-containing amino acid status in the body. Interpretation of hair S levels is confounded by the fact some hair conditioners and permanent treatments increase hair S while straighteners can significantly lower hair S levels.

Observations at DDI indicate that hair S and urine sulfhydryl amino acid levels are often low in Hg burdened patients.

Appropriate tests to determine sulfhydryl amino acid status are plasma or urine amino acid analyses.

Total Toxic Element Indication

The potentially toxic elements vary considerably with respect to their relative toxicities.
The accumulation of more than one of the most toxic elements may have synergistic adverse effects, even if the level of each individual element is not strikingly high. Therefore, we present a total toxic element ”score” which is estimated using a weighted average based upon relative toxicity. For example, the combined presence of lead and mercury will give a higher total score than that of the combination of silver and beryllium.