MAYO CLINIC LABORATORIES

Test Definition: CUS1

Copper, Serum

Overview

Useful For

Diagnosis of:
-Wilson disease
-Primary biliary cholangitis
-Primary sclerosing cholangitis

Special Instructions

- Metals Analysis Specimen Collection and Transport

Method Name

Triple-Quadrupole Inductively Coupled Plasma Mass Spectrometry (ICP-MS/MS)

NY State Available

Yes

Specimen

Specimen Type

Serum

Specimen Required

Patient Preparation: High concentrations of gadolinium, iodine, and barium are known to potentially interfere with most inductively coupled plasma mass spectrometry-based metal tests. If either gadolinium-, iodine-, and barium containing contrast media has been administered, **a specimen should not be collected for 96 hours.**
Supplies:
-Metal Free Specimen Vial (T173)
-Metal Free B-D Tube (No Additive), 6 mL (T184)
Collection Container/Tube: 6-mL Plain, royal blue-top Vacutainer plastic trace element blood collection tube
Submission Container/Tube: 7-mL Metal-free, screw-capped, polypropylene vial
Specimen Volume: 0.8 mL serum
Collection Instructions:
1. Allow the specimen to clot for 30 minutes; then centrifuge the specimen to separate serum from the cellular fraction.
2. Remove the stopper. Carefully **pour** specimen into metal-free, polypropylene vial, avoiding transfer of the cellular components of blood. **Do not** insert a pipet into the serum to accomplish transfer, and **do not ream** the specimen with a wooden stick to assist with serum transfer.
3. See Metals Analysis Specimen Collection and Transport for complete instructions.

Forms

If not ordering electronically, complete, print, and send 1 of the following with the specimen:

-General Test Request (T239)
-Gastroenterology and Hepatology Test Request (T728)
-Biochemical Genetics Test Request (T798

Specimen Minimum Volume

Serum: 0.2 mL

Reject Due To

Gross hemolysis	OK
Gross lipemia	OK
Gross icterus	OK

Specimen Stability Information

Specimen Type	Temperature	Time	Special Container
Serum	Refrigerated (preferred)	28 days	METAL FREE
	Ambient	28 days	METAL FREE
	Frozen	28 days	METAL FREE

Clinical & Interpretive

Clinical Information

Copper (Cu) is an important trace element that is associated with a number of metalloproteins. Copper in biological material is complexed with proteins, peptides, and other organic ligands. Up to 90% of copper exported from the liver into peripheral blood is protein bound to ceruloplasmin, transcuprein, or metallothionein. A smaller amount of copper in plasma (<10%) is bound to albumin by specific peptide sequences, and this copper is in equilibrium with plasma amino acids. The ceruloplasmin molecule contains 6 to 8 atoms of Cu per molecule with 6 atoms of Cu involved in the protein's ferroxidase and free radical scavenging activities. The other 1 to 2 atoms of Cu are termed "labile" and may allow ceruloplasmin to act as a copper transporter, with a pool of copper being exchanged between albumin, transcuprein, and the labile sites of ceruloplasmin.

Low serum copper, most often due to excess iron or zinc ingestion and infrequently due to dietary copper deficit, results in severe derangement in growth and impaired erythropoiesis. Low serum copper is also observed in hepatolenticular degeneration (Wilson disease) due to a decrease in the synthesis of ceruloplasmin and allelic variances in cellular metal ion transporters. In Wilson disease, the albumin-bound copper may actually be increased, but ceruloplasmin-bound copper is low, resulting in low serum copper. However, during the acute phase of Wilson disease (fulminant hepatic failure), ceruloplasmin and copper levels may be normal; in this circumstance, hepatic inflammation causes increased release of ceruloplasmin. It is useful to relate the degree of liver inflammation to the ceruloplasmin and copper-see discussion on hypercupremia below. Significant hepatic inflammation with normal ceruloplasmin and copper suggest acute Wilson disease.

Other disorders associated with decreased serum copper concentrations include malnutrition, hypoproteinemia,

malabsorption, nephrotic syndrome, Menkes disease, copper toxicity, and megadosing of zinc-containing vitamins (zinc interferes with normal copper absorption from the gastrointestinal [GI] tract).

Hypercupremia is found in primary biliary cholangitis (previously primary biliary cirrhosis), primary sclerosing cholangitis, hemochromatosis, malignant diseases (including leukemia), thyrotoxicosis, and various infections. Serum copper concentrations are also elevated in patients taking contraceptives or estrogens and during pregnancy.

Since the GI tract effectively excludes excess copper, it is the GI tract that is most affected by copper ingestion. Increased serum concentration does not, by itself, indicate copper toxicity.

Reference Values

0-2 months: 40-140 mcg/dL
3-6 months: 40-160 mcg/dL
7-9 months: 40-170 mcg/dL
10-12 months: 80-170 mcg/dL
13 months-10 years: 80-180 mcg/dL
11-17 years: 75-145 mcg/dL

Males:
> or =18 years: 73-129 mcg/dL

Females:
> or =18 years: 77-206 mcg/dL

Interpretation

Serum copper below the normal range is associated with Wilson disease, as well as a variety of other clinical situations (see Clinical Information). Excess use of denture cream containing zinc can cause hypocupremia.

Serum concentrations above the normal range are seen in primary biliary cholangitis (previously primary biliary cirrhosis), primary sclerosing cholangitis, and a variety of other clinical situations (see Clinical Information).

Cautions

No significant cautionary statements

Clinical Reference

1. McCullough AJ, Fleming CR, Thistle JL, et al. Diagnosis of Wilson's disease presenting as fulminant hepatic failure. Gastroenterology. 1983;84(1):161-167
2. Wiesner RH, LaRusso NF, Ludwig J, Dickson ER. Comparison of the clinicopathologic features of primary sclerosing cholangitis and primary biliary cirrhosis. Gastroenterology. 1985;88(1 Pt 1):108-114
3. Spain RI, Leist TP, De Sousa EA. When metals compete: a case of copper-deficiency myeloneuropathy and anemia. Nat Clin Pract Neurol. 2009;5(2):106-111
4. Kaler SG, Holmes CS, Goldstein DS, et al. Neonatal diagnosis and treatment of Menkes disease. N Engl J Med. 2008;358(6):605-614
5. Nations SP, Boyer PJ, Love LA, et al. Denture cream: An unusual source of excess zinc, leading to hypocupremia and neurologic disease. Neurology. 2008;71(9);639-643
6. Strathmann FG, Blum LM. Toxic elements. In: Rifai N, Chiu RWK, Young I, Burnham CAD, Wittwer CT, eds. Tietz

Textbook of Laboratory Medicine. 7th ed. Elsevier; 2023:chap 44
7. Schilsky ML, Roberts EA, Bronstein JM, et al. A multidisciplinary approach to the diagnosis and management of Wilson disease: 2022 Practice Guidance on Wilson disease from the American Association for the Study of Liver Diseases. Hepatology. 2025;82(3):E41-E90. doi:10.1002/hep.32801
8. Marino Z, Schilsky ML. Wilson Disease: Novel Diagnostic and Therapeutic Approaches. Semin Liver Dis. 2025;45(2):221-235. doi:10.1055/a-2460-8999
9. Bornhorst JA, Bitzer AC, Day PL, et al. Total Copper and Labile Bound Copper Fraction as a Selective and Sensitive Tool in the Evaluation of Wilson Disease. J Appl Lab Med. 2024;9(6):1014-1027. doi:10.1093/jalm/jfae090
10. European Association for Study of Liver. EASL Clinical Practice Guidelines: Wilson's disease. J Hepatol. 2012;56(3):671-685. doi:10.1016/j.jhep.2011.11.007

Performance

Method Description
The metal analytes of interest are analyzed by triple-quadrupole inductively coupled plasma mass spectrometry.(Unpublished Mayo method).

PDF Report
No

Day(s) Performed
Monday through Saturday

Report Available
1 to 3 days

Specimen Retention Time
14 days

Performing Laboratory Location
Mayo Clinic Laboratories - Rochester Superior Drive

Fees & Codes

Fees
- Authorized users can sign in to Test Prices for detailed fee information.
- Clients without access to Test Prices can contact Customer Service 24 hours a day, seven days a week.
- Prospective clients should contact their account representative. For assistance, contact Customer Service.

Test Classification
This test was developed and its performance characteristics determined by Mayo Clinic in a manner consistent with CLIA requirements. It has not been cleared or approved by the US Food and Drug Administration.

Test Definition: CUS1

Copper, Serum

CPT Code Information

82525

LOINC® Information

Test ID	Test Order Name	Order LOINC® Value
CUS1	Copper, S	5631-7

Result ID	Test Result Name	Result LOINC® Value
616155	Copper, S	5631-7