Snibe Diagnostic

CE 0123 REF

130206024M:100 tests/kit
130606024M: 50 tests/kit
130706024M: 30 tests/kit

MAGLUMI® Homocysteine (CLIA)

INTENDED USE

The kit is an *in vitro* chemiluminescence immunoassay for the quantitative determination of Homocysteine in human serum and plasma using the MAGLUMI series Fully-auto chemiluminescence immunoassay analyzer and Biolumi series Integrated System, and the assay is used for an aid in the diagnosis of hyperhomocysteinemia and the evaluation of cardiovascular disease risk.

SUMMARY

Homocysteine (HCY) is produced from methionine (Met) which is one of the eight essential amino acids in the human body through demethylation. It is the only known source of HCY in the human body[1-3]. HCY reacts with sulfhydryl groups of proteins and low-molecular-weight thiols to form disulfides in plasma[1]. In plasma, most (80%) of the plasma total HCY is disulfide bound to the conserved Cys34 residue of albumin, and only 1% is present as free reduced HCY[1]. The term total HCY (tHCY) refers to the totality of HCY present after the quantitative reductive cleavage of all disulphide bonds[3].

The metabolism of homocysteine is at the intersection of two metabolic pathways: remethylation and transsulfuration[4, 5]. In remethylation, the methionine synthase (MS), catalyses the methyl transfers from 5-methyltetrahydrofolate to HCY, forming Met and tetrahydrofolate (THF). The betaine-dependent remethylation recycles HCY into Met and nonfolate methyl donors by the enzyme betaine homocysteine methyltransferase (BHMT)[3]. In the transsulfuration pathway, homocysteine condenses with serine to form cystathionine catalyzed by cystathionine β-synthase and further forming cysteine through hydrolyzed by γ-cystathionase[5]. In such cases, either a genetic defect in one of the enzymes of homocysteine metabolism or a nutritional deficiency of one or more of the vitamins that participate in homocysteine metabolism can lead to metabolic disruption and potentially to hyperhomocysteinemia. The severity and type of the resulting hyperhomocysteinemia is dependent on the extent to which the particular disturbance affects the coordination of the two pathways of homocysteine metabolism[5].

Clinical and epidemiologic studies have shown a relation between total homocysteine levels and coronary artery disease, peripheral artery disease, stroke, or venous thrombosis[6]. Among 587 patients with angiographically confirmed coronary artery disease, Kaplan–Meier et al found that the mortality were 3.8% for patients with total homocysteine levels below 9 μmol/L, and 24.7% for those with levels of 15 μmol/L or higher[6]. In patients with cardiovascular disease(CVD) or persons with high risk of CVD events, a high tHCY concentration should be used as a prognostic factor for CVD events and mortality. Prospective studies have demonstrated that tHCY concentrations predict both CVD morbidity and mortality, particularly in individuals with tHCY >30 μmol/L[7].

TEST PRINCIPLE

Competitive chemiluminescence immunoassay.

The sample and buffer are mixed thoroughly and incubated, and the different forms of HCY in the sample are reduced to free HCY by the reducing agent in the buffer. After adding the enzyme reagent, the free HCY is converted into S-adenosyl-L-homocysteine (SAH) by the S-adenosyl-L-homocysteine hydrolase (SAHH) in the enzyme reagent. Magnetic microbeads coated with SAH antigen conjugate, ABEI labeled with SAH antibody are added and incubated. SAH converted in the sample compete with SAH antigen conjugate immobilized on the magnetic microbeads for binding SAH antibody labeled with ABEI, forming immuno-complexes. After precipitation in a magnetic field, the supernatant is decanted and then a wash cycle is performed. Subsequently, the Starter 1+2 are added to initiate a chemiluminescent reaction. The light signal is measured by a photomultiplier as relative light units (RLUs), which is inversely proportional to the concentration of HCY present in the sample.

REAGENTS

Kit Contents

Component	Description	100 tests/kit	50 tests/kit	30 tests/kit
Magnetic Microbeads	Magnetic microbeads coated with SAH antigen conjugate (~10.0 μg/mL) in PBS buffer, NaN_3 (<0.1%).	2.5 mL	1.5 mL	1.0 mL
Calibrator Low	A low concentration of HCY antigen in 0.9% NaCl.	1.0 mL	1.0 mL	1.0 mL
Calibrator High	A high concentration of HCY antigen in 0.9% NaCl.	1.0 mL	1.0 mL	1.0 mL
Enzyme Reagent	SAHH in 4-(2-hydroxyethyl) piperazine-1-propane sulfonic acid (EPPS) buffer, NaN_3 (<0.1%).	6.5 mL	3.5 mL	2.3 mL
Buffer	Containing Tris (2-carboxyethyl) phosphine (TCEP), NaN_3 (<0.1%).	12.5 mL	7.0 mL	4.8 mL
ABEI Label	ABEI labeled with SAH monoclonal antibody (~0.250 μg/mL) in Tris-HCl buffer, NaN_3 (<0.1%).	7.5 mL	4.5 mL	3.3 mL
Diluent	PBS buffer, NaN_3 (<0.1%).	5.5 mL	3.5 mL	3.5 mL
Control 1	A low concentration of HCY antigen (4.00 μmol/L) in 0.9% NaCl.	1.0 mL	1.0 mL	1.0 mL
Control 2	A high concentration of HCY antigen (14.0 μmol/L) in 0.9% NaCl.	1.0 mL	1.0 mL	1.0 mL
All reagents are provided ready-to-use.				

Warnings and Precautions

- For *in vitro* diagnostic use.
- For professional use only.
- Exercise the normal precautions required for handling all laboratory reagents.
- Personal protective measures should be taken to prevent any part of the human body from contacting samples, reagents, and controls, and should comply with local operating requirements for the assay.
- A skillful technique and strict adherence to the package insert are necessary to obtain reliable results.
- Do not use kit beyond the expiration date indicated on the label.
- Do not interchange reagent components from different reagents or lots.
- Avoid foam formation in all reagents and sample types (specimens, calibrators and controls).
- All waste associated with biological samples, biological reagents and disposable materials used for the assay should be considered potentially infectious and should be disposed of in accordance with local guidelines.
- This product contains sodium azide. Sodium azide may react with lead or copper plumbing to form highly explosive metal azides. Immediately after disposal, flush with a large volume of water to prevent azide build-up. For additional information, see Safety Data Sheets available for professional user on request.

Note: If any serious incident has occurred in relation to the device, please report to Shenzhen New Industries Biomedical Engineering Co., Ltd. (Snibe) or our authorized representative and the competent authority of the Member State in which you are established.

Reagent Handling

- To avoid contamination, wear clean gloves when operating with a reagent kit and sample. When handling reagent kit, replace the gloves that have been in contact with samples, since introduction of samples will result in unreliable results.
- Do not use kit in malfunction conditions; e.g., the kit leaking at the sealing film or elsewhere, obviously turbid or precipitation is found in reagents (except for Magnetic Microbeads) or control value is out of the specified range repeatedly. When kit in malfunction conditions, please contact Snibe or our authorized distributor.
- To avoid evaporation of the liquid in the opened reagent kits in refrigerator, it is recommended that the opened reagent kits to be sealed with reagent seals contained within the packaging. The reagent seals are single use, and if more seals are needed, please contact Snibe or our authorized distributor.
- Over time, residual liquids may dry on the septum surface. These are typically dried salts and have no effect on assay efficacy.
- Use always the same analyzer for an opened reagent integral.
- For magnetic microbeads mixing instructions, refer to the Preparation of the Reagent section of this package insert.
- For further information about the reagent handing during system operation, please refer to Analyzer Operating Instructions.

Storage and Stability

- Do not freeze the integral reagents.
- Store the reagent kit upright to ensure complete availability of the magnetic microbeads.
- Protect from direct sunlight.

Stability of the Reagents	
Unopened at 2-8°C	until the stated expiration date
Opened at 2-8°C	6 weeks
On-board	4 weeks

Stability of Controls	
Unopened at 2-8°C	until the stated expiration date
Opened at 10-30°C	6 hours
Opened at 2-8°C	6 weeks
Frozen at -20°C	3 months
Frozen and thawed cycles	no more than 3 times

SPECIMEN COLLECTION AND PREPARATION

Specimen Types

Only the specimens listed below were tested and found acceptable.

Specimen Types	Collection Tubes
Serum	Tubes containing clot activator or clot activator with gel
Plasma	K2-EDTA

- The sample types listed were tested with a selection of sample collection tubes that were commercially available at the time of testing, i.e. not all available tubes of all manufacturers were tested. Sample collection systems from various manufacturers may contain differing materials which could affect the test results in some cases. Follow tube manufacturers' instructions carefully when using collection tubes.

Specimen Conditions

- After blood collection, but before removal of the blood cells, there is a time- and temperature-dependent increase in tHCY. This is attributable to an ongoing release of HCY from erythrocyte[7, 8]. The increase in tHCY is prevented by immediate centrifugation and removal of the blood cells or by keeping samples cooled on ice until centrifugation. The use of gel separator tubes that are rapidly centrifuged also prevents the increase of tHCY in serum[7].
- Do not use heat-inactivated samples or hemolyzed, grossly hyperlipidaemia specimens and specimens with obvious microbial contamination.
- Ensure that complete clot formation in serum specimens has taken place prior to centrifugation. Some serum specimens, especially those from patients receiving anticoagulant or thrombolytic therapy, may exhibit increased clotting time. If the serum specimen is centrifuged before a complete clotting, the presence of fibrin may cause erroneous results.
- Samples must be free of fibrin and other particulate matter.
- To prevent cross contamination, use of disposable pipettes or pipette tips are recommended.

Preparation for Analysis

- Inspect all specimens for foam. Remove foam with an applicator stick before analysis. Use a new applicator stick for each specimen to prevent cross contamination.
- Frozen specimens must be completely thawed before mixing. Mix thawed specimens thoroughly by low speed vortexing or by gently inverting. Visually inspect the specimens. If layering or stratification is observed, mix until specimens are visibly homogeneous. If specimens are not mixed thoroughly, inconsistent results may be obtained.
- Specimens should be free of fibrin, red blood cells, or other particulate matter. Such specimens may give reliable results and must be centrifuged prior to testing. Transfer clarified specimen to a sample cup or secondary tube for testing. For centrifuged specimens with a lipid layer, transfer only the clarified specimen and not the lipemic material.
- The sample volume required for a single determination of this assay is 20 μL.

Specimen Storage

Specimens removed from the separator, red blood cells or clot may be stored up to 48 hours at 2-8°C, or 4 months frozen at -20°C. Frozen specimens subjected to up to 3 freeze/thaw cycles have been evaluated.

Specimen Shipping

- Package and label specimens in compliance with applicable local regulations covering the transport of clinical specimens and infectious substances.
- Do not exceed the storage limitations listed above.

Specimen Dilution

- Samples, with HCY concentrations above the analytical measuring interval, can be diluted with Diluent either by following automated dilution protocol or manual dilution procedure. The recommended dilution ratio is 1:5. The concentration of the diluted sample must be >18.0 μmol/L.
- For manual dilution, multiply the result by the dilution factor. For dilution by the analyzers, the analyzer software automatically takes the dilution into account when calculating the sample concentration.

PROCEDURE

Materials Provided

Homocysteine (CLIA) assay, control barcode labels.

Materials Required (But Not Provided)

- General laboratory equipment.
- Fully-auto chemiluminescence immunoassay analyzer Maglumi 600, Maglumi 800, Maglumi 1000, Maglumi 2000, Maglumi 2000 Plus, Maglumi 4000, Maglumi 4000 Plus, MAGLUMI X3, MAGLUMI X6, MAGLUMI X8, or Integrated System Biolumi 8000 and Biolumi CX8.
- Additional accessories of test required for the above analyzers include Reaction Module, Starter 1+2, Wash Concentrate, Light Check, Tip, and Reaction Cup. Specific accessories and accessories' specification for each model refer to corresponding Analyzer Operating Instructions.
- Please use accessories specified by Snibe to ensure the reliability of the test results.

Assay Procedure

Preparation of the Reagent

- Take the reagent kit out of the box and visually inspect the integral vials for leaking at the sealing film or elsewhere. If there is no leakage, please tear off the sealing film carefully.
- Open the reagent area door; hold the reagent handle to get the RFID label close to the RFID reader (for about 2s); the buzzer will beep; one beep sound indicates successful sensing.
- Keeping the reagent straight insert to the bottom along the blank reagent track.
- Observe whether the reagent information is displayed successfully in the software interface, otherwise repeat the above two steps.
- Resuspension of the magnetic microbeads takes place automatically when the kit is loaded successfully, ensuring the magnetic microbeads are totally resuspended homogenous prior to use.

Assay Calibration

- Select the assay to be calibrated and execute calibration operation in reagent area interface. For specific information on ordering calibrations, refer to the calibration section of Analyzer Operating Instructions.
- Execute recalibration according to the calibration interval required in this package insert.

Quality Control

- When new lot used, check or edit the quality control information.
- Scan the control barcode, choose corresponding quality control information and execute testing. For specific information on ordering quality controls, refer to the

quality control section of the Analyzer Operating Instructions.

Sample Testing

- After successfully loading the sample, select the sample in interface and edit the assay for the sample to be tested and execute testing. For specific information on ordering patient specimens, refer to the sample ordering section of the Analyzer Operating Instructions.

To ensure proper test performance, strictly adhere to Analyzer Operating Instructions.

Calibration

Traceability: This method has been standardized against the NIST reference standard SRM 1950.

Test of assay specific calibrators allows the detected relative light unit (RLU) values to adjust the master curve.

Recalibration is recommended as follows:

- Whenever a new lot of Reagent or Starter 1+2 is used.
- Every 14 days.
- The analyzer has been serviced.
- Control values lie outside the specified range.

Quality Control

Controls are recommended for the determination of quality control requirements for this assay and should be run in singlicate to monitor the assay performance. Refer to published guidelines for general quality control recommendations, for example Clinical and Laboratory Standards Institute (CLSI) Guideline C24 or other published guidelines[9].

Quality control is recommended once per day of use, or in accordance with local regulations or accreditation requirements and your laboratory's quality control procedures, quality control could be performed by running the HCY assay:

- Whenever the kit is calibrated.
- Whenever a new lot of Starter 1+2 or Wash Concentrate is used.

Controls are only applicable with MAGLUMI and Biolumi systems and only used matching with the same top seven LOT numbers of corresponding reagents. For each target value and range refer to the label.

The performance of other controls should be evaluated for compatibility with this assay before they are used. Appropriate value ranges should be established for all quality control materials used.

Control values must lie within the specified range, whenever one of the controls lies outside the specified range, calibration should be repeated and controls retested. If control values lie repeatedly outside the predefined ranges after successful calibration, patient results must not be reported and take the following actions:

- Verify that the materials are not expired.
- Verify that required maintenance was performed.
- Verify that the assay was performed according to the package insert.
- If necessary, contact Snibe or our authorized distributors for assistance.

If the controls in kit are not enough for use, please order Homocysteine (CLIA) Controls (REF: 160201269MT) from Snibe or our authorized distributors for more.

RESULTS

Calculation

The analyzer automatically calculates the HCY concentration in each sample by means of a calibration curve which is generated by a 2-point calibration master curve procedure. The results are expressed in μmol/L. For further information please refer to the Analyzer Operating Instructions.

Interpretation of Results

The expected range for the HCY assay was obtained by testing 555 apparently healthy individuals in China, gave the following expected value:
4.390-14.650 μmol/L(2.5^{th}-97.5^{th} percentiles).

Results may differ between laboratories due to variations in population and test method. It is recommended that each laboratory establish its own reference interval.

LIMITATIONS

- Results should be used in conjunction with patient's medical history, clinical examination and other findings.
- If the HCY results are inconsistent with clinical evidence, additional testing is needed to confirm the result.
- The following drugs may elevate levels of homocysteine: carbamazepin, phenytoin, valproate, phenobarbital, methotrexate, nitrous oxide, anticonvulsants and 6-azauridine triacetate. The mechanism of action of these drugs affects different parts of the metabolic pathway of homocysteine[10,11].
- S-adenosyl-methionine is an antidepressant whose molecular form is similar to S-adenosyl-homocysteine. This drug may interfere with the HCY assay.
- Do not use in individuals with folate or cobalamin deficiency or increased creatinine as well as individuals with diseases or who are taking drugs that increase HCY concentrations[12].
- Routine measurement of HCY before or during pregnancy is currently not recommended[12].
- Specimens from patients who have received preparations of mouse monoclonal antibodies for diagnosis or therapy may contain human anti-mouse antibodies (HAMA). Such specimens may show either falsely elevated or depressed values when tested with assay kits which employ mouse monoclonal antibodies[13,14]. Additional information may be required for diagnosis.
- Heterophilic antibodies in human serum can react with reagent immunoglobulins, interfering with *in vitro* immunoassays. Patients routinely exposed to animals or animal serum products can be prone to this interference and anomalous values may be observed[15].
- Bacterial contamination or heat inactivation of the specimens may affect the test results.

SPECIFIC PERFORMANCE CHARACTERISTICS

Representative performance data are provided in this section. Results obtained in individual laboratories may vary.

Precision

Precision was determined using the assay, samples and controls in a protocol (EP05-A3) of the CLSI (Clinical and Laboratory Standards Institute): duplicates at two independent runs per day for 5 days at three different sites using three lots of reagent kits (n = 180). The following results were obtained:

Sample	Mean (μmol/L) (n=180)	Within-Run		Between-Run		Reproducibility	
		SD (μmol/L)	%CV	SD (μmol/L)	%CV	SD (μmol/L)	%CV
Serum Pool 1	4.301	0.153	3.56	0.064	1.49	0.246	5.72
Serum Pool 2	14.558	0.441	3.03	0.192	1.32	0.587	4.03
Serum Pool 3	49.672	0.792	1.59	0.391	0.79	1.201	2.42
Plasma Pool 1	4.293	0.141	3.28	0.078	1.82	0.207	4.82
Plasma Pool 2	14.981	0.409	2.73	0.260	1.74	0.577	3.85
Plasma Pool 3	50.173	0.903	1.80	0.614	1.22	1.565	3.12
Control 1	4.044	0.138	3.41	0.109	2.70	0.214	5.29
Control 2	13.676	0.395	2.89	0.194	1.42	0.655	4.79

Linear Range

0.800-90.0 μmol/L (defined by the Limit of Quantitation and the maximum of the master curve).

Reportable Interval

0.500-450 μmol/L (defined by the Limit of Detection and the maximum of the master curve×Recommended Dilution Ratio).

Analytical Sensitivity

Limit of Blank (LoB) =0.300 μmol/L.
Limit of Detection (LoD) =0.500 μmol/L.
Limit of Quantitation (LoQ) =0.800 μmol/L.

Analytical Specificity

Interference

Interference was determined using the assay, three samples containing different concentrations of analyte were spiked with potential endogenous and exogenous interferents in a protocol (EP7-A2) of the CLSI. The measurement deviation of the interference substance is within ±10%. The following results were obtained:

Interference	No interference up to	Interference	No interference up to
Bilirubin	40 mg/dL	Rheumatoid factor	1500 IU/mL
Hemoglobin	2000 mg/dL	ANA	398 AU/mL
Intralipid	1000 mg/dL	K2-EDTA	22.75 μmol/mL
HAMA	30 ng/mL	/	/

Cross-Reactivity

Cross-reactivity was determined using the assay, three samples containing different concentrations of analyte were spiked with potential cross-reactant in a protocol (EP7-A2) of the CLSI. The assay shows high specificity for S-adenosyl-homocysteine, the enzymatically converted form of L-homocysteine. The following compounds were added at the concentration indicate to a sample with known HCY concentration. The results from the spiked samples were compared with those of unspiked control samples. Percent cross-reactivity is calculated as:

$$\%\ \text{Cross} - \text{Reactivity} = \frac{Observed\ Test\ Concentration\ (\mu mol/L) - Control\ Concentration\ (\mu mol/L)}{Concentration\ of\ Cross - Reactant\ (\mu mol/L)} \times 100$$

Test Compound	Concentration (μmol/L)	% Cross-Reactivity	Test Compound	Concentration (μmol/L)	% Cross-Reactivity
S-adenosyl-L-methionine	80	6.36	Adenosine	900	0.17
L-Cysteine	8000	0.08	Glutathione	500	0.03
L-Cystathionine	500	0.04	L-methionine	800	0.26

Method Comparison

A comparison of the HCY assay with a commercially available immunoassay, gave the following correlations (μmol/L):
Number of samples measured: 120
Passing-Bablok: y=0.9854x+0.1659, τ=0.964.
The clinical specimen concentrations were between 0.78 and 85.46 μmol/L.

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SYMBOLS EXPLANATIONS

	Consult instructions for use		Manufacturer
2°C 8°C	Temperature limit (Store at 2-8°C)		Use-by date
Σ	Contains sufficient for<n> tests		Keep away from sunlight
	This way up	EC REP	Authorized representative in the European Community
IVD	*In vitro* diagnostic medical device	CONTENTS	Kit component
REF	Catalogue number	LOT	Batch code
CE 0123	CE marking with notified body ID number		

Summary of safety and performance is available at Eudamed.

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