



MAGLUMI® ACTH (CLIA)

INTENDED USE

The kit is an *in vitro* chemiluminescence immunoassay for the quantitative determination of Adrenocorticotrophic hormone (ACTH) in human 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 and treatment of disorders of individuals with suspected or confirmed adrenal glands.

SUMMARY

Adrenocorticotrophic hormone (ACTH) is a polypeptide hormone which exists principally as a chain, 39 amino acids long, with a molecular mass of approximately 4,500 daltons. Synthesized in the anterior pituitary of the brain, and its precursor is opioid pro-melanin-stimulating hormone (POMC)^{1,2}.

The main driving force for hypothalamic–pituitary–adrenocortical (HPA) activation is hypothalamic corticotropin-releasing hormone (CRH) acting in synergy with vasopressin, which is produced in either the same or distinct neurons of the paraventricular nucleus, to enhance release of pituitary pro-opiomelanocortin (POMC)-derived peptides (corticotropin and endorphins). ACTH stimulates the adrenal glands to secrete glucocorticoids. Physiological circadian rhythm changes are the characteristics of ACTH secretion³.

Endogenous Cushing's syndrome can result from excess adrenocorticotrophic hormone (ACTH; corticotropin) production by a pituitary adenoma (Cushing's disease) or by ectopic tumors secreting ACTH or corticotropin-releasing hormone. If ACTH is elevated, combinations of high-dose dexamethasone tests, CRH/desmopressin tests, and pituitary magnetic resonance imaging can indicate a pituitary source⁴. Sustained exposure to excess cortisol suppresses the normal production of corticotropin-releasing hormone and ACTH. As a result, circulating plasma ACTH concentrations are low in primary adrenal disorders, and normal or increased in patients with excess ACTH secretion from a Cushing's disease or an ectopic source⁵. In cases of severe secondary adrenocortical insufficiency (SAI), the rapid ACTH test will also give a pathological result, because the adrenal cortex is atrophic⁶. Secondary adrenal insufficiency is a clinical disorder that results from hypothalamic or hypophyseal damage or from prolonged administration of supraphysiological doses of glucocorticoids. Because of the loss of glucocorticoid negative feedback and the presence of normal pituitary function, patients with primary AI have increased plasma ACTH concentration, sometimes at extremely high levels⁷. The definition 'ectopic ACTH syndrome' (EAS) applies to a condition of endogenous hypercortisolism sustained by an ACTH-secreting non-pituitary tumor⁸. EAS patients had significantly higher mean ACTH concentration⁹. Congenital adrenal hyperplasia (CAH) refers to a family of inherited disorders of adrenal steroidogenesis. The common functional defect in each disorder is impaired cortisol secretion, resulting in hypersecretion of corticotropin-releasing hormone and adrenocorticotrophic hormone and consequent hyperplasia of the adrenal glands¹⁰.

TEST PRINCIPLE

Sandwich chemiluminescence immunoassay.

The sample, ABEI labeled with ACTH monoclonal antibody, buffer and magnetic microbeads coated with ACTH monoclonal antibody are mixed thoroughly and incubated, reacting to form sandwich 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 proportional to the concentration of ACTH present in the sample.

REAGENTS

Kit Contents

Component	Description	100 tests/kit	50 tests/kit	30 tests/kit
Magnetic Microbeads	Magnetic microbeads coated with ACTH monoclonal antibody (~8.00 µg/mL) in PBS buffer, NaN ₃ (<0.1%).	2.5 mL	1.5 mL	1.0 mL
Calibrator Low	A low concentration of ACTH antigen in PBS buffer, NaN ₃ (<0.1%).	2.5 mL	2.5 mL	2.5 mL
Calibrator High	A high concentration of ACTH antigen in PBS buffer, NaN ₃ (<0.1%).	2.5 mL	2.5 mL	2.5 mL
Buffer	Tris-HCl buffer, NaN ₃ (<0.1%).	6.5 mL	4.0 mL	3.0 mL
ABEI Label	ABEI labeled with ACTH monoclonal antibody (~278 ng/mL) in Tris-HCl buffer, NaN ₃ (<0.1%).	12.5 mL	7.0 mL	4.8 mL
Control 1	A low concentration of ACTH antigen (35.0 pg/mL) in PBS buffer, NaN ₃ (<0.1%).	2.5 mL	2.5 mL	2.5 mL
Control 2	A high concentration of ACTH antigen (200 pg/mL) in PBS buffer, NaN ₃ (<0.1%).	2.5 mL	2.5 mL	2.5 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.



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130270003M: 100 tests/kit

130670003M: 50 tests/kit

130770003M: 30 tests/kit

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
Plasma	K2-EDTA, K3-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

- Collect blood with siliconized glass tubes, containing EDTA as anticoagulant, then put the tube into ice-bath, use low-temperature centrifuge to separate the plasma from the rest and recommend to put the plasma into -20°C for storage.
- Standardize the collection time of the plasma sample for interpretation of the results. Because ACTH concentrations show a diurnal variation with high levels in the morning and low levels in the evening.
- Do not use heat-inactivated samples or grossly hemolyzed/hyperlipidaemia specimens and specimens with obvious microbial contamination.
- 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 200 µL.

Specimen Storage

Specimens removed from the separator, red blood cells may be stored up to 2 hours at 10-30°C or 8 hours at 2-8°C, or 4 months frozen at -20°C. Frozen specimens subjected to up to one freeze/thaw cycle 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 ACTH concentrations above the analytical measuring interval, can be diluted with manual dilution procedure. The recommended dilution ratio is 1:10. The concentration of the diluted sample must be >200 pg/mL.
- For manual dilution, multiply the result by the dilution factor.
- Please choose applicable diluents or ask Snibe for advice before manual dilution.

PROCEDURE

Materials Provided

ACTH (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 X8, MAGLUMI X3, MAGLUMI X6, or Integrated System Biolumi 8000, 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 Snibe internal reference standard.

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 28 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 guidelines¹¹.

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 ACTH 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 ACTH (CLIA) Controls (REF: 160201473MT) from Snibe or our authorized distributors for more.

RESULTS

Calculation

The analyzer automatically calculates the ACTH 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 pg/mL. For further information please refer to the Analyzer Operating Instructions.

Conversion factors: pg/mL x 0.2202 = pmol/L.

Interpretation of Results

The expected range for the ACTH assay was obtained by testing 555 apparently healthy individuals in China, gave the following expected value:

7.2-63.5 pg/mL (5th-95th percentiles).

The plasma samples were drawn between 7 -10 a.m.

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 ACTH results are inconsistent with clinical evidence, additional testing is needed to confirm the result.
- 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 observed¹².
- Bacterial contamination or heat inactivation of the specimens may affect the test results.
- ACTH levels may only be interpreted in context with the clinical symptoms and other diagnostic procedures.

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 (pg/mL) (n=180)	Within-Run		Between-Run		Reproducibility	
		SD (pg/mL)	%CV	SD (pg/mL)	%CV	SD (pg/mL)	%CV
Plasma Pool 1	7.178	0.204	2.84	0.112	1.56	0.281	3.91
Plasma Pool 2	60.381	1.094	1.81	0.809	1.34	2.273	3.76
Plasma Pool 3	203.875	2.831	1.39	1.849	0.91	4.243	2.08
Control 1	34.757	1.013	2.91	0.686	1.97	1.468	4.22
Control 2	201.487	3.397	1.69	0.930	0.46	4.715	2.34

Linear Range

2.00-2000 pg/mL (defined by the Limit of Quantitation and the maximum of the master curve).

Reportable Interval

1.00-20000 pg/mL (defined by the Limit of Detection and the maximum of the master curve×Recommended Dilution Ratio).

Analytical Sensitivity

Limit of Blank (LoB) =0.500 pg/mL.

Limit of Detection (LoD) =1.00 pg/mL.

Limit of Quantitation (LoQ) =2.00 pg/mL.

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
Hemoglobin	512 mg/dL	Biotin	0.5 mg/dL
Intralipid	5000 mg/dL	Total protein	10 g/dL
Bilirubin	10 mg/dL	K2-EDTA	22.75 µmol/mL
HAMA	40 ng/mL	K3-EDTA	22.75 µmol/mL
ANA	398 AU/mL	Bovine Serum Albumin	50 µg/mL
Rheumatoid factor	2000 IU/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 measurement deviation of the interference substance is within ±10%. The following results were obtained:

Cross-reactant	No interference up to	Cross-reactant	No interference up to
ACTH 1-10	250000 pg/mL	Beta-MSH	2450 pg/mL
ACTH 1-17	5000 pg/mL	Beta-Endorphin	49000 pg/mL
ACTH 1-24	500000 pg/mL	Somatostatin	9800 pg/mL
ACTH 11-24	9800 pg/mL	Neurotensin	9800 pg/mL
ACTH 18-39	5000 pg/mL	Enkephalin	9800 pg/mL

ACTH 22-39	5000 pg/mL	Pro-opiomelanocortin	1560 pmol/L
Alpha-MSH	3000 pg/mL	-	-

High-Dose Hook

No high-dose hook effect was seen for ACTH concentrations up to 800000 pg/mL.

Method Comparison

A comparison of the ACTH assay with a commercially available immunoassay, gave the following correlations (pg/mL):

Number of samples measured: 118

Passing-Bablok: $\hat{y}$ =1.0041x+0.0766, τ =0.978.

The clinical specimen concentrations were between 2.45 and 1985 pg/mL.

REFERENCES

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SYMBOLS EXPLANATIONS

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

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