Monobind Inc.
Lake Forest, CA 92630, USA

AccuLite
CLIA Microwells

Cancer Antigen 19-9 (CA-19-9) Test System

Product Code: 3975-300

1.0 INTRODUCTION

Intended Use: The Quantitative Determination of Cancer Antigen (CA 19-9) Concentration in Human Serum by a Microplate Enzyme Immunoassay, Chemiluminescence

2.0 SUMMARY AND EXPLANATION OF THE TEST

A mucin type Sialyl Lewis Antigens group of glycoproteins (SLA) such as CA 19-9, 19-5 have been recognized as circulating cancer associated antigens for gastrointestinal cancer. The discovery of a monoclonal antibody clone (1116NS 19-9), which exhibited selective reactivity with human gastrointestinal carcinomas through the recognition of a carbohydrate determinant (CA 19-9) defined as a sialyl lacto-N-flucopenrose II, resulted in the successful purification and thus, determination of human gastrointestinal tumor associated glycoprotein antigen expressing CA 19-9 from colorectal carcinoma cell lines. Recently reports indicate that serum CA 19-9 level is frequently elevated in the circulation of patients with various gastrointestinal malignancies, such as pancreatic, colorectal, gastric and hepatic carcinomas. Together with CEA elevated CA 19-9 is suggestive of gallbladder disease. The tumor associated antigen may also be associated in some malignant conditions. Research studies demonstrate that serum CA 19-9 values may have utility in monitoring subjects with the above mentioned diagnosed malignancies.

In this method, CA19-9 calibrator, patient specimen or control is first added to a streptavidin coated well. Biotinylated monoclonal antibody (specific for CA19-9) is added and the reactants mixed. Reaction between the CA19-9 antibodies and native CA19-9 forms complex that binds with the streptavidin coated to the well. The excess serum proteins are washed away via a wash step. Another enzyme labeled monoclonal antibody specific to CA19-9 is added to the wells. The enzyme labeled antibody binds to the CA19-9 already immobilized on the well through its binding with the biotinylated monoclonal antibody. Excess enzyme is washed off via a wash step. Light is generated by the addition of a substrate. The intensity of the light generation is directly proportional to the concentration of the CA19-9 in the sample.

3.0 PRINCIPLE

Immunoenzymometric sequential assay (TYPE 4):
The essential reagents required for an immunoenzymometric assay include high affinity and specificity antibodies (enzyme and immobilized), with different and distinct epitope recognition, **in excess,** and native antigen. In this procedure, the immobilization takes place during the assay at the surface of a microplate well through the interaction of streptavidin coated on the well and exogenously added biotinylated monoclonal anti-CA19-9 antibody. Upon mixing monoclonal biotinylated antibody, and a serum containing the native antigen, reaction results between the native antigen and the antibody, forming an antibody-antigen complex. The interaction is illustrated by the following equation:

$$Ag_{(CA19\text{-}9)} + {}^{Btn}Ab_{(m)} \underset{k_{-a}}{\overset{k_a}{\rightleftharpoons}} Ag_{(CA19\text{-}9)} - {}^{Btn}Ab_{(m)}$$

${}^{Btn}Ab_{(m)}$ = Biotinylated Monoclonal Antibody (Excess Quantity)
$Ag_{(CA19\text{-}9)}$ = Native Antigen (Variable Quantity)
$Ag_{(CA19\text{-}9)} - {}^{Btn}Ab_{(m)}$ = Antigen-antibody complex (Variable Quantity)
k_a = Rate Constant of Association
k_{-a} = Rate Constant of Disassociation

Simultaneously, the complex is deposited to the well through the high affinity reaction of streptavidin and biotinylated antibody. This interaction is illustrated below:
$Ag_{(CA19\text{-}9)} - {}^{Btn}Ab_{(m)} + Streptavidin_{CW} \Rightarrow$ Immobilized complex (IC)
Streptavidin$_{CW}$ = Streptavidin immobilized on well
Immobilized complex (IC) = Ag-Ab bound to the well

After a suitable incubation period, the antibody-antigen bound fraction is separated from unbound antigen by decantation or aspiration. Another antibody (directed at a different epitope) labeled with an enzyme is added. Another interaction occurs to form an enzyme labeled antibody-antigen-biotinylated-antibody complex on the surface of the wells. Excess enzyme is washed off via a wash step. A suitable substrate is added to produce color measurable with the use of a microplate spectrophotometer. The enzyme activity, determined by reaction with a substrate (luminol) that generates light, in the antibody-bound fraction is directly proportional to the native antigen concentration. By utilizing several different serum references of known antigen concentration, a dose response curve can be generated from which the antigen concentration of an unknown can be ascertained.

$$(IC) + {}^{Enz}Ab_{(x\text{-}CA19\text{-}9)} \underset{k_{-b}}{\overset{k_b}{\rightleftharpoons}} {}^{Enz}Ab_{(x\text{-}CA19\text{-}9)} - IC$$

${}^{Enz}Ab_{(x\text{-}CA19\text{-}9)}$ = Enzyme labeled Antibody (Excess Quantity)
${}^{Enz}Ab_{(x\text{-}CA19\text{-}9)} - IC$ = Antigen-Antibodies Complex
k_b = Rate Constant of Association
k_{-b} = Rate Constant of Dissociation

4.0 REAGENTS

Materials Provided:

A. CA 19-9 Calibrators – 1.0 ml/vial - Icons A-F
Six (6) vials of human serum based reference calibrators at concentrations of 0 (**A**), 10 (**B**), 50 (**C**), 100 (**D**), 250 (**E**) and 500 (**F**) U/ml. Store at 2-8°C. A preservative has been added.
Note: The standards, human serum based, were made using a >99% pure affinity purified preparation of CA 19-9. The preparation was calibrated against Centocor CA 19-9 IRMA test.

B. CA 19-9 Biotin Reagent – 13 ml/vial – Icon ▽
One (1) vial contains Anti-Human CA19-9 (MoAb)-Biotin reagent in a protein-stabilized matrix. A preservative has been added. Store at 2-8°C.

C. CA19-9 Tracer Reagent – 13 ml/vial - Icon Ⓔ
One (1) vial contains Anti-Human CA19-9-HRP conjugate in a protein-stabilized matrix. A preservative has been added. Store at 2-8°C.

D. Light Reaction Wells 96 wells – Icon ⇓
One 96-well white microplate coated with streptavidin and packaged in an aluminum bag with a drying agent. Store at 2-8°C.

E. Wash Solution Concentrate – 20ml/vial - Icon
One (1) vial contains a surfactant in buffered saline. A preservative has been added. Store at 2-8°C (see Reagent Preparation Section).

F. Signal Reagent A – 7ml/vial - Icon C[A]
One (1) vial contains luminol in buffer. Store at 2-8°C (see Reagent Preparation Section).

G. Signal Reagent B – 7ml/vial - Icon C[B]
One (1) vial contains hydrogen peroxide (H_2O_2) in buffer. Store at 2-8°C (see Reagent Preparation Section).

H. Product Insert.

Note 1: Do not use reagents beyond the kit expiration date.
Note 2: Avoid extended exposure to heat and light. **Opened reagents are stable for sixty (60) days when stored at 2-8°C. Kit and component stability are identified on the label.**
Note 3: Above reagents are for a single 96-well microplate

4.1 Required But Not Provided:
1. Pipette capable of delivering 0.025ml (25µl) volumes with a precision of better than 1.5%.
2. Dispenser(s) for repetitive deliveries of 0.100ml (100µl) and 0.350ml (350µl) volumes with a precision of better than 1.5%.
3. Microplate washers or a squeeze bottle (optional).
4. Microplate Luminometer.
5. Absorbent Paper for blotting the microplate wells.
6. Plastic wrap or microplate cover for incubation steps.
7. Vacuum aspirator (optional) for wash steps.
8. Timer.
9. Quality control materials.

5.0 PRECAUTIONS

For In Vitro Diagnostic Use
Not for Internal or External Use in Humans or Animals

All products that contain human serum have been found to be non-reactive for Hepatitis B Surface Antigen, HIV 1&2 and HCV Antibodies by FDA licensed reagents. Since no known test can offer complete assurance that infectious agents are absent, all human serum products should be handled as potentially hazardous and capable of transmitting disease. Good laboratory procedures for handling blood products can be found in the Center for Disease Control / National Institute of Health, "Biosafety in Microbiological and Biomedical Laboratories," 2nd Edition, 1988, HHS Publication No. (CDC) 88-8395.

Safe Disposal of kit components must be according to local regulatory and statutory requirement.

6.0 SPECIMEN COLLECTION AND PREPARATION

The specimens shall be blood serum in type, and the usual precautions in the collection of venipuncture samples should be observed. For accurate comparison to established normal values, a fasting morning serum sample should be obtained. The blood should be collected in a plain redtop venipuncture tube without additives or anti-coagulants. Allow the blood to clot for samples. Centrifuge the specimen to separate the serum from the cells.

In patients receiving therapy with high biotin doses (i.e. >5mg/day), no sample should be taken until at least 8 hours after the last biotin administration, preferably overnight to ensure fasting sample.

Samples may be refrigerated at 2-8ºC for a maximum period of five (5) days. If the specimen(s) cannot be assayed within this time, the sample(s) may be stored at temperatures of -20ºC for up to 30 days. Avoid use of contaminated devices. Avoid repetitive freezing and thawing. When assayed in duplicate, 0.050ml (50µl) of the specimen is required.

7.0 QUALITY CONTROL

Each laboratory should assay controls at levels in the low, normal and elevated range for monitoring assay performance. These controls should be treated as unknowns and values determined in every test procedure performed. Quality control charts should be maintained to follow the performance of the supplied reagents. Pertinent statistical methods should be employed to ascertain trends. Significant deviation from established performance can indicate unnoticed change in experimental conditions or degradation of kit reagents. Fresh reagents should be used to determine the reason for the variations.

8.0 REAGENT PREPARATION

1. **Wash Buffer**
Dilute contents of Wash Concentrate to 1000ml with distilled or deionized water in a suitable storage container. Store diluted buffer at 2-30°C for up to 60 days.
2. **Working Signal Reagent Solution -** Store at 2 - 8°C.
Determine the amount of reagent needed and prepare by mixing equal portions of Signal Reagent A and Signal Reagent B in a clean container. For example, add 1 ml of A and 1ml of B per two (2) eight well strips (A slight excess of solution is made). **Discard the unused portion if not used within 36 hours after mixing.** If complete utilization of the reagents is anticipated, within the above time constraint, pour the contents of Signal Reagent B into Signal Reagent A and label accordingly.

Note: Do not use reagents that are contaminated or have bacteria growth.

9.0 TEST PROCEDURE

Before proceeding with the assay, bring all reagents, serum reference calibrators and controls to room temperature (20-27℃).
*****Test Procedure should be performed by a skilled individual or trained professional*****

1. Format the microplates' wells for each serum reference calibrator, control and patient specimen to be assayed in duplicate. **Replace any unused microwell strips back into the aluminum bag, seal and store at 2-8ºC.**
2. Pipette 0.025 ml (25 µl) of the appropriate serum reference calibrator, control or specimen into the assigned well.
3. Add 0.100 ml (100µl) of the biotinylated labeled antibody to each well. **It is very important to dispense all reagents close to the bottom of the coated well.**
4. Swirl the microplate gently for 20-30 seconds to mix and cover.
5. Incubate 30 minutes at room temperature.
6. Discard the contents of the microplate by decantation or aspiration. If decanting, tap and blot the plate dry with absorbent paper.
7. Add 0.350ml (350µl) of wash buffer (see Reagent Preparation Section), decant (tap and blot) or aspirate. Repeat four (4) additional times for a total of five (5) washes. **An automatic or manual plate washer can be used. Follow the manufacturer's instruction for proper usage. If a squeeze bottle is employed, fill each well by depressing the container (avoiding air bubbles) to dispense the wash. Decant the wash and repeat four (4) additional times.**
8. Add 0.100 ml (100µl) of the Ca19-9 Tracer Reagent labeled antibody to each well.
DO NOT SHAKE THE PLATE AFTER TRACER ADDITION
9. Cover and incubate 45 minutes at room temperature.
10. Discard the contents of the microplate by decantation or aspiration. If decanting, blot the plate dry with absorbent paper.
11. Add 0.350ml (350µl) of wash buffer (see Reagent Preparation Section), decant (tap and blot) or aspirate. Repeat four (4) additional times for a total of five (5) washes. **An automatic or manual plate washer can be used. Follow the manufacturer's instruction for proper usage. If a squeeze bottle is employed, fill each well by depressing the container (avoiding air bubbles) to dispense the wash. Decant the wash and repeat four (4) additional times.**
12. Add 0.100 ml (100µl) of working signal reagent to all wells (see Reagent Preparation Section).). **Always add reagents in the same order to minimize reaction time differences between wells.**
DO NOT SHAKE THE PLATE AFTER SIGNAL ADDITION
13. Incubate for five (5) minutes in the dark.
14. Read the relative light units in each well for 0.2 – 1.0 seconds. **The results should be read within thirty (30) minutes of adding the signal solution.**

10.0 CALCULATION OF RESULTS

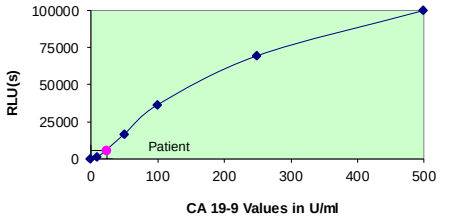
A dose response curve is used to ascertain the concentration of CA19-9 in unknown specimens.
1. Record the RLUs obtained from the printout of the microplate reader as outlined in Example 1.
2. Plot the absorbance for each duplicate serum reference versus the corresponding CA19-9 concentration in U/ml on linear graph paper (do not average the duplicates of the serum references before plotting).
3. Draw the best-fit curve through the plotted points.
4. To determine the concentration of CA19-9 for an unknown, locate the RLU of the duplicates for each unknown on the vertical axis of the graph, find the intersecting point on the curve, and read the concentration (in U/ml) from the horizontal axis of the graph (the duplicates of the unknown may be averaged as indicated). In the following example, the average RLUs (5563) intersects the dose response curve at 23.9U/ml CA19-9 concentration (See Figure 1).

Note: Computer data reduction software designed for chemiluminescence assays may also be used for the data reduction. If such software is utilized, the validation of the software should be ascertained.

EXAMPLE 1

Sample I.D.	Well Number	RLU (A)	Mean RLU (B)	Value (U/ml)
Cal A	A1	41	41	0
	B1	43		
Cal B	C1	1425	1345	10
	D1	1264		
Cal C	E1	17195	16878	50
	F1	16562		
Cal D	G1	34711	36557	100
	H1	38403		
Cal E	A2	69229	69599	250
	B2	69968		
Cal F	C2	99364	100000	500
	D2	100636		
Patient	E2	5137	5563	**23.9**
	F2	5989		

Figure 1



*

The data presented in Example 1 and Figure 1 is for illustration only and **should not** be used in lieu of a dose response curve prepared with each assay. In addition, the RLUs of the calibrators have been normalized to 100,000 RLUs for the F calibrator (greatest light output). This conversion minimizes differences caused by efficiency of the various instruments that can be used to measure light output.

11.0 Q.C. PARAMETERS

In order for the assay results to be considered valid the following criteria should be met:

1. The Dose Response Curve should be within established parameters.
2. Four out of six quality control pools should be within the established ranges.

12.0 RISK ANALYSIS

The MSDS and Risk Analysis Form for this product are available on request from Monobind Inc.

12.1 Assay Performance

1. It is important that the time of reaction in each well is held constant to achieve reproducible results.
2. Pipetting of samples should not extend beyond ten (10) minutes to avoid assay drift.
3. Highly lipemic, hemolyzed or grossly contaminated specimen(s) should not be used.
4. If more than one (1) plate is used, it is recommended to repeat the dose response curve.
5. The addition of signal reagent initiates a kinetic reaction, therefore the signal reagent(s) should be added in the same sequence to eliminate any time-deviation during reaction.
6. Failure to remove adhering solution adequately in the aspiration or decantation wash step(s) may result in poor replication and spurious results.
7. Use components from the same lot. No intermixing of reagents from different batches.
8. Patient specimens with CA 19-9 concentrations above 500U/ml may be diluted (for example 1/10 or higher) with CA19-9 zero calibrator and re-assayed. The sample's concentration is obtained by multiplying the result by the dilution factor (10).
9. Accurate and precise pipetting, as well as following the exact time and temperature requirements prescribed are essential. Any deviation from Monobind's IFU may yield inaccurate results.
10. All applicable national standards, regulations and laws, including, but not limited to, good laboratory procedures, must be strictly followed to ensure compliance and proper device usage.
11. It is important to calibrate all the equipment e.g. Pipettes, Readers, Washers and/or the automated instruments used with this device, and to perform routine preventative maintenance.
12. Risk Analysis- as required by CE Mark IVD Directive 98/79/EC - for this and other devices, made by Monobind, can be requested via email from Monobind@monobind.com.

12.2 Interpretation

1. ***Measurements and interpretation of results must be performed by a skilled individual or trained professional.***
2. Laboratory results alone are only one aspect for determining patient care and should not be the sole basis for therapy, particularly if the results conflict with other determinants.
3. The reagents for the test system have been formulated to eliminate maximal interference; however, potential interaction between rare serum specimens and test reagents can cause erroneous results. Heterophilic antibodies often cause these interactions and have been known to be problems for all kinds of immunoassays (Boscato LM, Stuart MC. 'Heterophilic antibodies: a problem for all immunoassays' Clin. Chem. 1988:3427-33). For diagnostic purposes, the results from this assay should be in combination with clinical examination, patient history and all other clinical findings.
4. For valid test results, adequate controls and other parameters must be within the listed ranges and assay requirements.
5. If test kits are altered, such as by mixing parts of different kits, which could produce false test results, or if results are incorrectly interpreted, Monobind shall have no liability.
6. If computer controlled data reduction is used to interpret the results of the test, it is imperative that the predicted values for the calibrators fall within 10% of the assigned concentrations.
7. CA 19-9 has a low clinical sensitivity and specificity as a tumor marker. Clinically an elevated **CA 19-9 value alone is not of diagnostic value as a test for cancer** and should only be used in conjunction with other clinical manifestations (observations) and diagnostic parameters.

13.0 EXPECTED RANGES OF VALUES

The serum CA 19-9 is elevated in 1% of normal healthy women, 3% of normal healthy women with benign ovarian diseases, 6% of patients with non-neoplastic conditions (including but not limited to first trimester pregnancy, menstruation, endometriosis uterine fibrosis, acute salphingitis, hepatic diseases and inflammation of peritoneum or pericardium).

TABLE I
Expected Values for the CA 19-9 CLIA Test System

Healthy and non-pregnant subjects	**≤ 40 U/ml**

It is important to keep in mind that establishment of a range of values which can be expected to be found by a given method for a population of "normal"-persons is dependent upon a multiplicity of factors: the specificity of the method, the population tested and the precision of the method in the hands of the analyst. For these reasons each laboratory should depend upon the range of expected values established by the Manufacturer only until an in-house range can be determined by the analysts using the method with a population indigenous to the area in which the laboratory is located.

14.0 PERFORMANCE CHARACTERISTICS

14.1 Precision

The within and between assay precision of the CA 19-9 AccuLite® CLIA test system were determined by analyses on three different levels of control sera. The number, mean value, standard deviation (σ) and coefficient of variation for each of these control sera are presented in Table 2 and Table 3.

TABLE 2
Within Assay Precision (Values in U/ml)

Sample	N	X	σ	C.V.
Level 1	24	10.49	0.74	7.1%
Level 2	24	22.83	1.43	6.3%
Level 3	24	54.32	2.84	4.7%

TABLE 3
Between Assay Precision* (Values in U/ml)

Sample	N	X	σ	C.V.
Level 1	16	12.31	1.97	16.0%
Level 2	16	29.27	3.15	10.8%
Level 3	16	66.71	7.36	11.0%

*As measured in ten experiments in duplicate.

14.2 Sensitivity

The CA 19-9 AccuLite® CLIA test system has a sensitivity of 0.04 U/ml. The sensitivity was ascertained by determining the variability of the 0 ng/ml serum calibrator and using the 2σ (95% certainty) statistic to calculate the minimum dose.

14.3 Accuracy

The CA 19-9 AccuLite® CLIA test system was compared with a reference method. Biological specimens from low, normal, and elevated concentrations were assayed. The total number of such specimens was 88. The least square regression equation and the correlation coefficient were computed for the CA 19-9 in comparison with the reference method. The data obtained is displayed in Table 4.

TABLE 4

Method	Mean (x)	Least Square Regression Analysis	Correlation Coefficient
Monobind (y)	21.34	y= 0.9837(x) + 1.32	0.976
Reference (x)	20.45		

14.4 Specificity

In order to test the specificity of the antibody pair used massive concentrations of possible cross-reactants were added to known serum pools and assayed in parallel with the base sera. No cross reaction was found. Percent cross-reactions for some of these additions are listed below in Table 5.

TABLE 5

Analyte	Concentration	Percent (%) Cross Reaction
CA 19-9	-	100
CA 125	10000 U/ml	0.001
CA 15-3	1000 U/ml	ND*
PSA	5000 ng/ml	ND*
AFP	10000 ng/ml	ND*
CEA	10000 ng/ml	ND*
HCG	10000 mIU/ml	ND*
RF	**1000 kIU/ml**	**ND***

15.0 REFERENCES

1. Zamcheck, N, *Adv Intern Med,* 19, 413 (1974).
2. Rayncao G, Chu TM, *JAMA*, 220, 381 (1972).
3. Harrison, *Principles of Internal Medicine,* McGraw Hill Book Company, New York, 12th Ed.
4. Wild D, *The Immunoassay Handbook*, Stockton Press, 444 (1994).
5. Hasholzner U, Steiber P, Baumgartner L, Pahl H, Meier W, Fateh-Moghadam A, "Methodological and clinical evaluation of three automated CA 19-9 assays compared with CA 19-9 II RIA (Centocor)", *Tumor Diagnosis & Ther*, 15,114-117(1994).
6. Hasholzner U, Steiber P, Baumgartner L, Pahl H, Meier W, Fateh-Moghadam A, "Clinical significance of the tumor markers CA 19-9 II and CA 72-4 in ovarian carcinoma", *Int J Cancer* , 69, 329-34 (1996).
7. Ovarian Cancer – NIH Consensus Conference, *JAMA,* 273, 491-497 (1995).
8. Daoud E, Bodor G, Weaver C, Landenson JH and Scott MG, *"CA 19-9* concentrations in malignant and non-malignant disease*"*, Washington University Case Conference, *Clin Chem,* 37, 1968-74 (1991).
9. De Bruijn HWA, Van Der Zee AGJ & Alders JG, "The value of Cancer Antigen 125 (CA 19-9) during treatment and follow up of patients with ovarian cancer", *Curr Opin Gynecol*, 9, 8-13 (1997).

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Size		96(A)	192(B)
Reagent (fill)	A)	1ml set	1ml set
	B)	1 (13ml)	2 (13ml)
	C)	1 (13ml)	2 (13ml)
	D)	1 plate	2 plates
	E)	1 (20ml)	1 (20ml)
	F)	1 (7ml)	2 (7ml)
	G)	1 (7ml)	2 (7ml)

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Glossary of Symbols
(EN 980/ISO 15223)

IVD — In Vitro - Diagnostic Medical Device
Temperature Limitation Storage Condition (2-8° C)
Consult Instructions for Use
REF — Catalogue Number
Contains Sufficient Test for Σ
LOT — Batch Code
Used By (Expiration Day)
Date of Manufacturer
Manufacturer
EC REP — Authorized Rep in European Country
CE — European Conformity