CE

AccuDiag™ 25-OH Vitamin D (total) ELISA Kit

REF 2065-P1

IVD See External Label 2°C 8°C 96 Tests

25-OH Vitamin D (total) ELISA	
Method	Enzyme Linked Immunosorbent Assay
Principle	Competitive ELISA
Detection Range	0-150 ng/ml
Sample	25 µL Serum
Incubation Time	80 minutes
Sensitivity	1.14 ng/mL
Specificity	See Table
Shelf Life	12-14 Months from the manufacturing date

PRODUCT FEATURES

- Very easy to use with little training
- Highly specific and consistent Assay
- Provides accurate results quickly
- Reading of results both visually and as absorbance data

INTENDED USE

The DAI 25-OH Vitamin D (total) ELISA is intended for the quantitative determination of 25-OH Vitamin D Concentration in Human Serum by a Microplate Enzyme Immunoassay, Colorimetric.

SUMMARY AND EXPLANATION

Vitamin D is a fat soluble secosteroid hormone that is important in the management of calcium and phosphorus concentrations required in the mineralization of bone. Vitamin D has two important forms: cholecalciferol (D_3) formed in the skin from ultraviolet light and ergocalciferol (D_2) found in dairy products. However, these forms do not have significant biological activity. The hormonal active form, 1-25-dihydroxylcholecalciferol, is produced through transformations in the liver and kidney. The first step in this conversion is an enzymatic reaction of D_2 or D_3 into 25OH-D_2 or 25OH-D_3. These 25OH D forms are not freely circulating in blood, but are primarily bound to vitamin D binding protein (VDBP). The high binding affinity of the 25OH D ($_{2 \text{ or } 3}$) compared to other derivatives of vitamin D leads to a long half-life in blood and its use as an accurate indicator of Vitamin D status. Vitamin D deficiency has been associated to diseases related to bone damage such as osteomalacia and rickets. Vitamin D can be dietarily supplemented through the use of Vitamin D_2 or Vitamin D_3. The sum of the 25OH D ($_{2 \text{ and } 3}$) in serum or plasma is referred to as total 25OH Vitamin D. The accurate measurement of total Vitamin D is necessary in monitoring deficient Vitamin D patients to achieve the optimum dosage and avoid excessive levels, which are considered toxic.

ASSAY PRINCIPLE

Sequential Competitive Method (TYPE 6):
The essential reagents required for a sequential enzyme immunoassay include antibody, enzyme-antigen conjugate and native antigen. Upon mixing the releasing agent with a serum containing the antigen, a reaction results between the release antigen and the antibody. The interaction is illustrated by the following equation:

$$Ag + Ab_{cw} \underset{k_{-a}}{\overset{k_a}{\rightleftharpoons}} AgAb_{cw}$$

Ab_{cw} = Monospecific Immobilized Antibody (Constant Quantity)
Ag = Native Antigen (Variable Quantity)
$AgAb_{cw}$ = Antigen-Antibody Complex
k_a = Rate Constant of Association
k_{-a} = Rate Constant of Disassociation
$K = k_a / k_{-a}$ = Equilibrium Constant

After removing any unreacted native antigen by a wash step, the enzyme-conjugated antigen is introduced. The conjugate reacts with sites of the antibody unoccupied by the native antigen.

$$^{ENZ}Ag + Ab_{cw} \underset{k_{-a}}{\overset{k_a}{\rightleftharpoons}} {}^{ENZ}AgAb_{cw}$$

^{ENZ}Ag = Enzyme-antigen Conjugate (Constant Quantity)
$^{ENZ}AgAb_{cw}$ = Enzyme-antigen Conjugate-Antibody Complex

After a short second incubation, the antibody-bound fraction is separated from unbound antigen by decantation or aspiration. The enzyme activity in the antibody-bound fraction is inversely proportional to the native antigen concentration. By utilizing several different calibrators of known antigen concentration, a dose response curve can be generated from which the antigen concentration of an unknown can be ascertained.

REAGENTS

Materials provided with the test kit

A. **Vit D Calibrators – 1 ml/vial, A-G**
Seven (7) vials containing human serum albumin reference calibrators for 25-OH Vitamin D at approximate* concentrations of 0 (**A**), 5 (**B**), 10 (**C**), 25 (**D**), 45 (**E**), 85 (**F**), and 150 (**G**) in ng/ml. A preservative has been added. Store at 2-8°C.
* Exact levels are given on the labels on a lot specific basis
The calibrators can be expressed in molar concentrations (nM/L) by multiplying by 2.5. For example:

10ng/ml x 2.5 = 25nM/L

B. **Vit D Controls – 1 ml/vial**
Two (2) vials containing human serum reference controls at concentrations established (exact value listed on label). A preservative has been added. Store at 2-8°C.

C. **Vit D Releasing Agent – 12 ml/vial**
One (1) vial containing vitamin D binding protein releasing agents. Store at 2-8°C.

D. **Vit D Enzyme Reagent – 12 ml/vial**
One (1) vial containing 25-OH Vitamin D_3 (Analog)-horseradish peroxides (HRP) conjugate in a protein-stabilizing matrix. Store at 2-8°C.

E. **Vit D Antibody Coated Plate – 96 wells**
One 96-well microplate coated with < 1.0 µg/ml anti-Vitamin D sheep IgG and packaged in an aluminum bag with a drying agent. Store at 2-8°C.

F. **Wash Solution Concentrate – 20 ml/vial**
One (1) vial containing a surfactant in buffered saline. A preservative has been added. Store at 2-8°C.

G. **Substrate Reagent – 12 ml/vial**
One (1) vial containing tetramethylbenzidine (TMB) and hydrogen peroxide (H_2O_2) in buffer. Store at 2-8°C.

H. **Stop Solution – 8 ml/vial**
One (1) vial containing a strong acid (H_2SO_4). Store at 2-8°C.

I. **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 label.
Note 3: Above reagents are for a single 96-well microplate.

Materials required but not provided

1. Pipette capable of delivering 0.025 & 0.100 ml (50 & 100µl) with a precision of better than 1.5%.
2. Dispenser(s) for repetitive deliveries of 0.100 & 0.350ml (100 & 350µl) volumes with a precision of better than 1.5%.
3. Microplate washer or a squeeze bottle (optional).
4. Microplate Reader with 450nm and 620nm wavelength absorbance capability.
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.

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 required tests. 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) 8808395.

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

SPECIMEN COLLECTION AND PREPARATION

The specimens shall be blood, serum in type, and taken with the usual precautions in the collection of venipuncture samples. For accurate comparison to establish normal values, a fasting morning serum sample should be obtained. The blood should be collected in a redtop (with or without gel additives) venipuncture tube(s) with no anti-coagulants. Allow the blood to clot for serum samples. Centrifuge the specimen to separate the serum from the cells.

Samples may be refrigerated at 2-8°C 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 temperature of -20°C 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.

QUALITY CONTROL

Each laboratory should assay controls at levels in the low, normal and high 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. The individual laboratory should set acceptable assay performance limits. In addition, maximum absorbance should be consistent with past experience. 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.

REAGENT PREPARATION

Wash Buffer: Dilute contents of wash solution to 1000ml with distilled or deionized water in a suitable storage container. Diluted buffer can be stored at 2-30°C for up to 60 days.

ASSAY PROCEDURE

*Before proceeding with the assay, bring all reagents, reference calibrators and controls to room temperature (20-27°C). **Test Procedure should be performed by 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 2-8°C.**
2. Pipette 0.025ml (25µl) of the appropriate extracted 25-OH Vitamin D calibrator, control or specimen into the assigned well.
3. Add 0.100 ml (100µl) of 25-OH Vitamin D Releasing Agent to all wells.
4. Mix (**Note 3**) the microplate for 20-30 seconds until homogeneous.
5. Cover and incubate for 30 minutes at room temperature.
6. Discard the contents of the microplate by decantation or aspiration. If decanting, blot the plate dry with absorbent paper.
7. Add 0.350 ml (350µl) of wash buffer (see Reagents Preparation Section), decant (tap and blot) or aspirate. Repeat two (2) additional times for a total of three (3) washed. 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 two (2) additional times.
8. Add 0.100ml (100µl) of 25-OH Vitamin D Enzyme Reagent to all wells.

DO NOT SHAKE THE PLATE AFTER ADDITION

9. Cover and incubate for 30 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 two (2) additional times for a total of three (3) 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 two (2) additional times.
12. Add 0.100ml (100µl) of substrate reagent to all wells. Always add reagents in the same order to minimize reaction time difference between wells.

DO NOT SHALE (MIX) THE PLATE AFTER SUBSTRATE ADDITION

13. Incubate at room temperature for twenty (20) minutes.
14. Add 0.050ml (50µl) of stop solution to each well and gently mix for 15-20 seconds. **Always add reagents in the same order to minimize reaction time difference between wells.**
15. Read the absorbance in each well at 450nm (using a reference wavelength of 620-630nm. The results should be read within fifteen (15) minutes of adding the stop solution.

***Note 1*:** Do not use the working substrate if it looks blue.
***Note 2*:** Do not use reagents that are contaminated or have bacteria growth.
***Note 3*:** Cycle (start and stop) mixing (4 cycles) for 5-8 seconds/cycle is more efficient than one continuous (20-30 seconds) cycle to achieve homogeneity. A plate mixer can be used to perform the mixing cycles.
***Note 4*:** It is extremely important to accurately dispense the correct volume with a calibrated pipette and by adding near the bottom of the microwells at an angle while touching the side of the well.

RESULTS

A dose response curve is used to ascertain the concentration of 25-OH Vitamin D in unknown specimens.

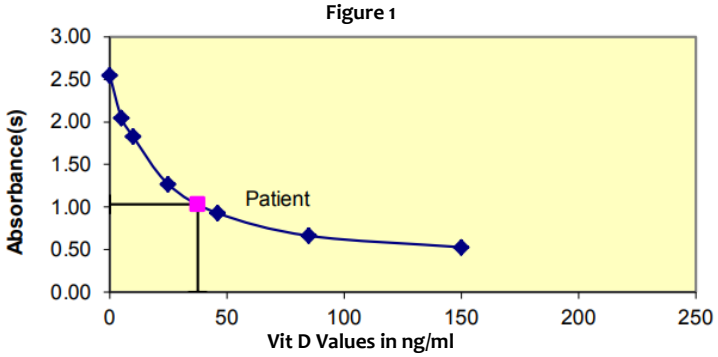
1. Record the absorbance obtained from the printout of the microplate reader as outlined in Example 1.
2. Plot the absorbance for each duplicate calibrator versus the corresponding 25-OH Vitamin D concentration in ng/ml on linear graph paper (do not average the duplicates of the calibrators before plotting).
3. Connect the points with a best-fit curve.
4. To determine the concentration of 25-OH Vitamin D for an unknown, locate the average absorbance of the duplicate for each unknown on the vertical axis of the graph, find the intersecting point on the curve, and read the concentration (in ng/ml) from the horizontal axis of the graph (the duplicate of the unknown may be average as indicated). In the following example, the average absorbance (1.033) intersects the dose response curve at 39.9 ng/ml 25-OH Vitamin D concentration (See figure 1).

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

Sample I.D.	Well Number	Abs (A)	Mean Abs (B)	Value (%U)
Cal A	A1	2.559	2.548	0
	B1	2.537		
Cal B	C1	2.041	2.047	5
	D1	2.054		
	E1	1.848	1.826	10
Cal C	F1	1.804		
Cal D	G1	1.286	1.267	25
	H1	1.249		
Cal E	A2	0.934	0.930	46
	B2	0.927		
Cal F	C2	0.654	0.663	85
	D2	0.712		
Cal G	G2	0.511	0.529	150
	H2	0.546		
Pat#1	A3	1.027	1.033	37.5
	A4	1.039		

*The above data and figure below is for example only. Do not use utilize it for calculating results.

Figure 1



Note: Multiply the horizontal values by 2.5 to convert into nM/ml.

Q.C. PARAMETERS

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

1. The absorbance (OD) of calibrator 0 ng/ml should be ≥ 1.3.
2. Four out six quality control pools should be within the established ranges.

ASSAY PERFORMANCE

1. It is important that the time of reaction in each well is held constant to achieve reproducible results.
2. Pipetting of sample 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 substrate solution initiates a kinetic reaction, which is terminated by the addition of the stop solution. Therefore, the substrate to eliminate any time-deviation during reaction.
6. Plate readers measure vertically. Do not touch the bottom of the wells.
7. Failure to remove adhering solution adequately in the aspiration or decantation wash step(s) may result in poor replication and spurious results.

8. Use components from the same lot. No intermixing of reagents from different batches.
9. Accurate and precise pipetting, as well as following the exact time and temperature requirement prescribed, is essential. Any deviation from the procedure 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, Reader, 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 Diagnostic Automation, Inc., can be requested via email from Tech@rapidtest.com.

INTERPRETATION

1. **Measurements and interpretation of results must be performed by skilled individual or trained professional.**
2. Laboratory results alone are only one aspect for determining patient care and should not be sole basis for therapy, particularly if the results conflict with other determinants.
3. The reagents for the test system procedure 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. 1998:3427033*). For diagnostic purposes, the results from this assay should be used 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, Diagnostic Automation, Inc. 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.

EXPECTED RANGE OF VALUES

Based on the published literature the following ranges have been assigned. **These ranges should be used as guidelines only:**

TABLE 1
Expected values for the Vitamin D ELISA

LEVEL	RANGE (ng/ml)
Very severe vitamin D deficiency	< 5
Severe vitamin D deficiency	5-10
Vitamin D deficiency	10-20
Suboptimal vitamin D provision	20-30
Optimal vitamin D level	30-50
Upper norm	50-70
Overdose, but not toxic	70-150
Vitamin D intoxication	>150

It is important to keep in mind that establishment of a range of values, which can be expected to be found by 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.

PERFORMANCE CHARACTERISTICS

Precision

The within and between assay precision of the DAI 25-OH Vitamin D ELISA were determined by analyses on three different levels of pool controls sera. The number, mean value, standard deviation and coefficient of variation for each of these control sera are presented in Table 2 and Table 3.

TABLE 2
Within Assay Precision

Serum	N	X	σ	%C.V.
1	20	22.16	1.35	6.10
2	20	34.96	1.44	4.11
3	20	86.09	6.37	7.40

TABLE 3
Between Assay Precision

Serum	N	X	σ	%C.V.
1	45	23.88	2.14	8.96
2	45	37.53	3.44	9.17
3	45	87.91	7.1	8.08

Sensitivity

The sensitivity of the DAI 25-OH Vitamin D ELISA was ascertained by determining the variability of the "0" calibrator and using the 2σ (95% certainty) statistic to calculate the minimum dose. The test system has an analytical sensitivity of 1.14 ng/ml of Vitamin D concentrations.

Accuracy

The DAI 25-OH Vitamin D ELISA test system was compared with a reference method. A total of 83 biological specimens from low, normal, and high Vit D level populations were used; the values ranged from 9.5ng/ml to 200ng/ml. The least square regression equation and the correlation coefficient were computed for this method when compared to the reference method. The data obtained is displayed in Table 4.

Method	Mean	Least Square Regression Analysis	Correlation Coefficient
DAI (y)	52.08	y=1.02(x)+1.33	0.918
Reference (x)	49.98		

Specificity

The % cross-reactivity of the 25-OH Vitamin D antibody to selected substance was evaluated by adding the interfering substance to a serum matrix at various concentrations. The cross-reactivity was calculated by deriving a ratio between doses of interfering substance to dose of 25-OH Vitamin D needed to displace the same amount of labeled analog.

TABLE 5

Substance	Cross Reactivity
25-OH Vitamin D3	1.000
25-OH Vitamin D2	1.000

Substance	Cross Reactivity
Vitamin D2	0.0076
Vitamin D3	0.0039
D2 Active 1,3,25-Hydroxy Vitamin D2	1.9000
D3 Active 1,3,25-Hydroxy Vitamin D3	1.1500

REFERENCES

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MANUFACTURER AND BRAND DETAILS

ISO 13485:2016

ISO 13485 Quality Management for Medical Devices CERTIFIED

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Date Adopted	**2022-09**
Brand Name	**AccuDiag™**
REF 2065-P1	**AccuDiag™ - 25-OH Vitamin D (total) ELISA Kit**
EC REP	**CEpartner4U, Esdoornlaan 13, 3951 DB Maarn, The Netherlands** www.cepartner4u.eu
Revision Date: 2018-01-10	