AccuDiag™ Free Triiodothyronine Free T3 ELISA Kit

REF 3148-15

Test	Free T3 ELISA
Method	Enzyme Linked Immunosorbent Assay
Principle	Competitive Enzyme Immunoassay
Detection Range	0-16pg/mL
Sample	50µL
Specificity	97%
Sensitivity	0.05pg/mL
Total Time	~75 min
Shelf Life	24 Months from the manufacturing date

INTENDED USE

The Quantitative Determination of Free Triiodothyronine Concentration in Human Serum by a Microplate Enzyme Immunoassay. Levels of ft3 are thought to reflect the amount of T3available to the cells and may therefore determine the clinical metabolic status of T3.

SUMMARY AND EXPLANATION

Triiodothyronine, a thyroid hormone, circulates in blood to carrier proteins (1,2). The main transport protein is thyroxine-binding globulin (TBG). However, only the free (unbound) portion of triiodothyronine is believed to be responsible for the biological action. Further, the concentrations of the carrier proteins are altered in many clinical conditions, such as pregnancy. In normal thyroid function as the concentrations of the carrier proteins alters, the total triiodothyronine level changes so that the free triiodothyronine concentration remains constant. Thus, measurements of free triiodothyronine concentrations correlate more reliably with clinical status than total triiodothyronine levels.

For example, the increase in total triiodothyronine levels associated with pregnancy, oral contraceptives and estrogen therapy result in higher total T3 levels while the free T3 concentration remains basically unchanged.

This microplate enzyme immunoassay methodology provides the technician with optimum sensitivity while requiring few technical manipulations in a direct determination of free T3. In this method, serum reference, patient specimen, or control is first added to a microplate well. Enzyme-T3 conjugate (analog method) is added, then the reactants are mixed. A competition reaction results between the enzyme conjugate and the free triiodothyronine for a limited number of antibody combining sites immobilized on the well.

After the completion of the required incubation period, the antibody bound enzyme- triiodothyronine conjugate is separated from the unbound enzyme-triiodothyronine conjugate by aspiration or decantation. The activity of the enzyme present on the surface of the well is quantitated by reaction with a suitable substrate to produce color.

The employment of several serum references of known free triiodothyronine concentration permits construction of a graph of activity and concentration. From comparison to the dose response curve, an unknown specimen's activity can be correlated with free triiodothyronine concentration.

TEST PRINCIPLE

Competitive Enzyme Immunoassay Type 5 – Analog Method for Free T3

The essential reagents required for a solid phase enzyme immunoassay include immobilized T3 antibody, enzyme-T3 conjugate and native free T3 antigen. The enzyme-T3 conjugate should have no measurable binding to serum proteins especially TBG and albumin. The method achieves this goal.

Upon mixing immobilized antibody, enzyme-T3 conjugate and a serum containing the native free T3 antigen, a competition reaction results between the native free T3 and the enzyme-T3 conjugate for a limited number of insolubulized binding sites. The interaction is illustrated by the followed equation:

$$^{Enz}Ag + Ag + Ab_{C.W.} \underset{k_{-a}}{\overset{k_a}{\rightleftharpoons}} AgAb_{C.W.} + {}^{Enz}AgAb_{C.W.}$$

$Ab_{C.W.}$ = Monospecific Immobilized Antibody (Constant Quantity)

Ag = Native Antigen (Variable Quantity)

^{Enz}Ag = Enzyme-antigen Conjugate (Constant Quantity)

$AgAb_{C.W.}$ = Antigen-Antibody Complex

$^{Enz}Ag\ Ab_{C.W.}$ = Enzyme-antigen Conjugate -Antibody Complex

k_a = Rate Constant of Association
k_{-a} = Rate Constant of Disassociation
$K = k_a / k_{-a}$ = Equilibrium Constant

After equilibrium is attained, 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 free 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.

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 red-top

venipuncture tube without additives or gel barrier. Allow blood to clot. Centrifuge the specimen to separate the serum from the cells.

Specimen may be refrigerated at 2-8°C for a maximum period of 5 days. If the specimen(s) cannot be assayed within 48 hours, the sample(s) may be stored at temperatures of -20°C for up to 30 days. Avoid use of contaminated devices. Avoid repetitive freezing and thawing. When assayed in duplicate, 0.050ml of the specimen is required.

MATERIALS AND COMPONENTS

Materials provided with the test kits

1. **Human Serum References -- 1ml/vial**
   Six (6) vials of human serum based reference calibrators for free triiodothyronine at **approximate*** concentrations of 0 (A), 1.0 (B), 3.0 (C), 5.0 (D), 8.0 (E) and 16.0 (F) pg/ml. Store at 2-8°C. A preservative has been added. For Sl units use the conversion factor 1.536 to convert pg/ml to pmol/L. * Exact levels are given on the labels on a lot specific basis.
2. **fT3 –Enzyme Reagent - 13ml/vial**
   One (1) vial of triiodothyronine-horseradish peroxidase (HRP) conjugate in a bovine albumin-stabilizing matrix. A preservative has been added. Store at 2-8°C.
3. **T3 Antibody Coated Plate -- 96 wells**
   One 96-well microplate coated with sheep anti-triiodothyronine serum and packaged in an aluminum bag with a drying agent. Store at 2-8°C.
4. **Wash Solution -20ml -**
   One (1) vial containing a surfactant in phosphate buffered saline. A preservative has been added. Store at 2-8°C.
5. **Substrate A –7 ml/vial**
   One (1) bottle containing tetramethylbenzidine (TMB) in buffer. Store at 2-8°C.
6. **Substrate B -- 7ml/vial**
   One (1) bottle containing hydrogen peroxide (H_2O_2) in buffer. Store at 2-8°C.
7. **Stop Solution – 8ml/vial- Icon**
   One (1) bottle containing a strong acid (1N HCl) Store at 2-30°C

Materials required but not provided

1. Pipette capable of delivering 50µl & 100µl volumes with a precision of better than 1.5%.
2. Dispenser(s) for repetitive deliveries of 0.100ml and 0.350ml volumes with a precision of better than 1.5%.
3. Microplate washers 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

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

REAGENT PREPARATION

1. Wash Buffer
Dilute contents of Wash Concentrate to 1000ml with distilled or deionized water in a suitable storage container. Store at room temperature 2-30°C for up to 60 days.

2. Working Substrate Solution
Pour the contents of the amber vial labeled Solution A into the clear vial labeled Solution B. Place the yellow cap on the clear vial for easy identification. Mix and Label accordingly. Store at 2 -8 °C
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.

ASSAY PROCEDURE

Before proceeding with the assay, bring all reagents, serum, references and Controls to room temperature (20 - 27•C). ** Test procedure should be performed by a skilled individual or trained professional.**

1. Format the microplate wells for each serum reference, control and patient specimen to be assayed in duplicate. **Replaced any unused microwell strips back into the aluminum bag, seal and store at 2 -8°C.**
2. Pipette 0.050 ml (50 µl) of the appropriate serum reference, control or specimen into the assigned well
3. Add 0.100 ml (100µl) of fT3-enzyme reagent solution to all wells.
4. Swirl the microplate gently for 20-30 seconds to mix and cover.
5. Incubate 60 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 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.**
8. Add 0.100 ml (100µl) of working substrate solution to all wells (see Reagent Preparation Section) **always add reagents in the same order to minimize reaction time differences between wells.**
   DO NOT SHAKE PLATE AFTER SUBSTRATE ADDITION
9. Incubate for 15 minutes at room temperature
10. Add 0.050ml (50 µl) of stop solution to each well and gently mix for 15-20 seconds**. Always add reagents in the same order to minimize reaction time differences between wells.**
11. Read the absorbance in each well at 450nm (using a reference wavelength of 620-630nm to minimize well imperfections) in a microplate reader. **The results should be read within 30 minutes of adding the stop solution.**

RESULTS

A dose response curve is used to ascertain the concentration of free triiodothyronine 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 serum reference versus the corresponding fT3 concentrationin pg/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 FT3 for an unknown, locate the average absorbance of the duplicates for each unknown on the vertical axis of the

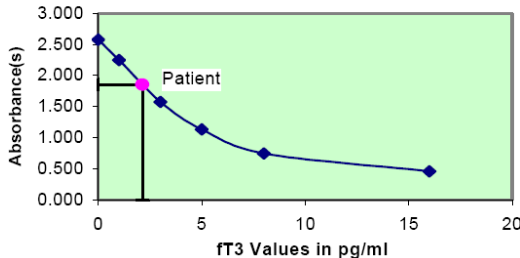
graph, find the intersecting point on the curve and read the concentration in pg/ml from the horizontal axis of the graph (the duplicates of the unknown may be averaged as indicated) In the following example, the average absorbance (1.855) (intersects the standard curve at (2.1pg/ml) FT3 concentration (See Figure 1).

EXAMPLE 1

Sample I.D.	Well Number	Abs (A)	Mean Abs (B)	Value* (pg/ml)
Cal A	A1	2.658	2.579	0.0
	B1	2.531		
Cal B	C1	2.264	2.248	1.0
	D1	2,233		
Cal C	E1	1.570	1.578	3.0
	F1	1.585		
Cal D	G1	1.124	1.135	5.0
	H1	1.145		
Cal E	A2	0.749	0.748	8.0
	B2	0.748		
Cal F	C2	0.463	0.463	16.0
	D2	0.462		
Patient	E2	1.860	1.855	**2.1**
	F2	1.849		

The data presented in Example 1 and Figure 1 is for illustration only and **should not** be used in lieu of a standard curve prepared with each assay. **Assigned values for calibrators are lot specific.**

Figure 1



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 A should be ≥1.3
2. Four out of six quality control pools should be within the established ranges.

A. ASSAY PERFORMANCE

1. It is important that the time of reaction in each well is held constant for 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 additional of substrate solution initiates a kinetic reaction, which terminated by the addition of the stop solution. Therefore, the substrate and stop solution should be added in the same sequence 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 steps(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 requirements prescribed are essential. Any deviation from DAI 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.

B. 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. For valid test results, adequate controls and other parameters must be within the listed ranges and assay requirements.
4. 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, DAI shall have not liability.
5. If computer controlled data reduction is used to calculate the results of the test. It is imperative that the predicted values for the calibrators fall within10% of the assigned concentrations.
6. If a patient for some reason reads higher that the highest calibrator report as such (e.g >16pg/ml). ***Do not try to dilute the sample. TBG variations in different matrices will not allow FT3 hormone to dilute serially.***
7. Several drugs are known to affect the binding of Triiodothyronine to the Thyroid hormone carrier proteins or metabolism to T3 and complicate the interpretation of FT3 results (3).
8. Circulating autoantibodies to T3 and hormone binding inhibitors may interfere (4).
9. Heparin has been reported to have in vivo and in vitro effects on FT3 concentration (5). Therefore, do not obtain samples in which this anti-coagulant has been used.
10. In severe nonthyroidal illness (NTI) the assessment of thyroid status becomes very difficult. TSH measurements are recommended to identify thyroid dysfunction (6).

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11. Familiar dysalbuminemic conditions may yield erroneous results on direct free T3 assays (7).

"NOT INTENDED FOR NEWBORNS SCREENING"

EXPECTED VALUES

A study of euthyroid adult population was undertaken to determine expected values for the FT3 DAI ELISA test system. The mean values (X), standards deviations (σ) and expected ranges (±2σ.) are presented in Table 1

TABLE 1
Expected Values for the Free T3 ELISA Test System (in pg/ml)

	Adult (110 specimens)	Pregnancy (75 specimens)
Mean X	2.8	3.0
Standard Deviation (σ)	0.7	0.6
Expected Ranges (±2σ)	1.4 - 4.2	1.8 - 4.2

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 analysts. 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

A. Precision

The within and between assay precisions of the FT3 DAI ELISA test system were determined by analyses on three different levels of pool control sera. The number (N) mean values (X), standard deviation (σ) and coefficient of variation (C.V.) for each of these control sera are presented in Table 2 and Table 3.

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

Sample	N	X	σ	C.V.
Low	24	1.85	0.09	4.9%
Medium	24	4.49	0.16	3.6%
High	24	8.00	0.25	3.1%

TABLE 3
Inter Assay Precision (in pg/ml)

Sample	N	X	σ	C.V.
Low	12	2.16	0.29	13.1%
Medium	12	5.09	0.40	7.9%
High	12	9.13	0.94	10.2%

*As measured in twelve experiments in duplicate.

B. Accuracy

The FT3 DAI ELISA test system was compared with a coated tube radioimmunoassay analog method. Biological specimens from hypothyroid, euthyroid and hyperthyroid populations were used (The values ranged from 0.1pg/ml – 14pg.ml) . The total number of such specimens was 151. The least square regression equation and the correlation coefficient were computed for this FT3 DAI ELISA method in comparison with the reference method. The data obtained is displayed in Table 4.

TABLE4
Least Square

Regression Method	Correlation Mean (X)	Regression Analysis	Correlation Coefficient
This Method (Y)	3.05	y=0.35+0.922(x)	0.902
Reference (X)	2.92		

Only slight amounts of the bias between this method and the reference method are indicated by the closeness of the mean values. The least square regression equation and correlation coefficient indicates excellent method agreement.

C. Sensitivity

The FT3 DAI ELISA test system has a sensitivity of 0.835 pg/ml. The sensitivity was ascertained by determining the variability of the 0 pg/ml serum calibrator and using the 2 б (95% certainty) statistic to calculate the minimum dose.

D. Specificity

The cross-reactivity of the triiodothyronine antibody to selected substances was evaluated by adding the interfering substance to a serum matrix at various concentrations. The cross-reactivity was calculated by deriving a ratio between dose of interfering substance to dose of triiodothyronine needed to displace the same amount of conjugate.

Substance	Cross Reactivity	Concentration
I-triidothyronine	1.0000	-
I-Thyroxine	<0.0002	10µg/ml
Iodothyrosine	<0.0001	10µg/ml
Diidothyrosine	<0.0001	10µg/ml
Diiodothyronine	<0.0001	10µg/ml
Phenylbutazone	<0.0001	10µg/ml
Sodium Salicylate	<0.0001	10µg/ml

QUALITY CONTROL

Each laboratory should assay controls at levels in the hypothyroid, euthyroid and hyperthyroid 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.

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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.

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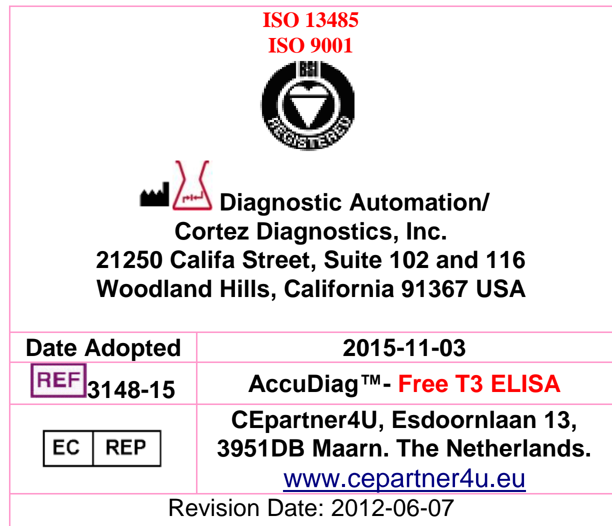

ISO 13485
ISO 9001

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Date Adopted	2015-11-03
REF 3148-15	AccuDiag™- Free T3 ELISA
EC REP	CEpartner4U, Esdoornlaan 13, 3951DB Maarn. The Netherlands. www.cepartner4u.eu

Revision Date: 2012-06-07