



## Total Triiodothyronine (tT3) Test System Product Code: 125-300

### 1.0 INTRODUCTION

**Intended Use: The Quantitative Determination of Total Triiodothyronine Concentration in Human Serum or Plasma by a Microplate Enzyme Immunoassay**

### 2.0 SUMMARY AND EXPLANATION OF THE TEST

Measurement of serum triiodothyronine concentration is generally regarded as a valuable tool in the diagnosis of thyroid dysfunction. This importance has provided the impetus for the significant improvement in assay methodology that has occurred in the last two decades. The advent of monospecific antiserum and the discovery of blocking agents to the T3 binding serum proteins have enabled the development of procedurally simple radioimmunoassays (1,2).

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

After the completion of the required incubation period, the antibody bound T3-enzyme conjugate is separated from the unbound T3-enzyme 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 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 T3 concentration.

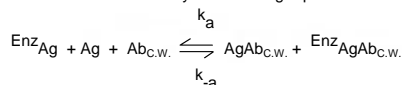
### 3.0 PRINCIPLE

#### Competitive Enzyme Immunoassay (TYPE 5):

The essential reagents required for a solid phase enzyme immunoassay include immobilized antibody, enzyme-antigen conjugate and native antigen.

Upon mixing immobilized antibody, enzyme-antigen conjugate and a serum containing the native antigen, a competition reaction results between the native antigen and the enzyme-antigen conjugate for a limited number of insolubilized binding sites.

The interaction is illustrated by the following equation:



$\text{Ab}_{\text{c.w.}}$  = Monospecific Immobilized Antibody (Constant Quantity)

$\text{Ag}$  = Native Antigen (Variable Quantity)

$\text{Enz}_{\text{Ag}}$  = Enzyme-antigen Conjugate (Constant Quantity)

$\text{AgAb}_{\text{c.w.}}$  = Antigen-Antibody Complex

$\text{Enz}_{\text{Ag}} \text{Ab}_{\text{c.w.}}$  = 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 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.

### 4.0 REAGENTS

#### Materials Provided:

#### A. Human Serum References – 1ml/vial - Icons A-F

Six (6) vials of serum reference for triiodothyronine at concentrations of 0 (A), 0.5 (B), 1.0 (C), 2.5 (D), 5.0 (E) and 7.5 (F) ng/ml. Store at 2-8°C. A preservative has been added. **For SI units: ng/ml x 1.536 = nmol/L**

#### B. T3 Enzyme Reagent – 1.5ml/vial - Icon E

One (1) vial of T3-horseradish peroxidase (HRP) conjugate in an albumin-stabilizing matrix. A preservative has been added. Store at 2-8°C

#### C. T3/T4 Conjugate Buffer – 13ml - Icon B

One (1) bottle reagent containing buffer, red dye, preservative, and binding protein inhibitors. Store at 2-8°C.

#### D. T3 Antibody Coated Plate – 96 wells - Icon Y

One 96-well microplate coated with Sheep anti-T3 serum and packaged in an aluminum bag with a drying agent. Store at 2-8°C.

#### E. Wash Solution Concentrate – 20ml - Icon D

One (1) vial containing a surfactant in buffered saline. A preservative has been added. Store at 2-8°C.

#### F. Substrate A – 7 ml/vial - Icon A

One (1) bottle containing tetramethylbenzidine (TMB) in buffer. Store at 2-8°C.

#### G. Substrate B – 7 ml/vial - Icon B

One (1) bottle containing hydrogen peroxide ( $\text{H}_2\text{O}_2$ ) in buffer. Store at 2-8°C.

#### H. Stop Solution – 8ml/vial - Icon S

One (1) bottle of stop solution containing a strong acid (1N HCL). Store at 2-30°C.

#### I. Product Instructions.

**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 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 Materials Required But Not Provided:

- Pipettes capable of delivering 50µl volumes with a precision of better than 1.5%.
- Dispenser(s) for repetitive deliveries of 0.100ml and 0.350ml volumes with a precision of better than 1.5%.
- Adjustable volume (20-200µl) and (200-1000µl) dispenser(s) for conjugate and substrate preparation.
- Microplate washers or a squeeze bottle (optional).
- Microplate Reader with 450nm and 620nm wavelength absorbance capability.
- Test tubes for preparation of enzyme conjugate and substrate A plus B.
- Absorbent Paper for blotting the microplate wells.
- Plastic wrap or microplate cover for incubation steps.
- Vacuum aspirator (optional) for wash steps.
- Timer.
- 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 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) 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 or plasma 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 (for serum) or evacuated tube(s) containing EDTA or heparin. Allow the blood to clot for serum samples. Centrifuge the specimen to separate the serum or plasma 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 temperatures of -20°C for up to 30 days. Avoid use of contaminated devices. Avoid repetitive freezing and thawing. When assayed in duplicate, 0.100ml of the specimen is required.

### 7.0 QUALITY CONTROL

Each laboratory should assay external 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. 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.

### 8.0 REAGENT PREPARATION

#### 1. Working Reagent A - T3-enzyme Conjugate Solution

Dilute the T3-enzyme conjugate 1:11 with T3/T4 conjugate buffer in a suitable container. For example, dilute 160µl of conjugate with 1.6ml of buffer for 16 wells (A slight excess of solution is made). This reagent should be used within twenty-four hours for maximum performance of the assay. Store at 2-8°C.

General Formula:

Amount of Buffer required = Number of wells \* 0.1

Quantity of T3-Enzyme necessary = # of wells \* 0.01

i.e. = 16 x 0.1 = 1.6ml for Total T3/T4 Conjugate

Buffer

16 x 0.01 = 0.16ml (160µl) for T3 enzyme conjugate

#### 2. 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.

#### 3. 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.

### 9.0 TEST 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\*\***

- Format the microplates' wells for each serum reference, 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.**
- Pipette 0.050 ml (50µl) of the appropriate serum reference, control or specimen into the assigned well.
- Add 0.100 ml (100µl) of Working Reagent A, T3 Enzyme Reagent to all wells (see Reagent Preparation Section).
- Swirl the microplate gently for 20-30 seconds to mix and cover.
- Incubate 60 minutes at room temperature.
- Discard the contents of the microplate by decantation or aspiration. If decanting, blot the plate dry with absorbent paper.
- Add 350µl of wash buffer (see Reagent Preparation Section), decant (tap and blot) and 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.**
- 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 THE PLATE AFTER SUBSTRATE ADDITION**

- Incubate at room temperature for fifteen (15) minutes.
- 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 differences between wells.**
- 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 thirty (30) minutes of adding the stop solution.**

**Note:** For re-assaying specimens with concentrations greater than 7.5ng/ml, pipette 25µl of the specimen and 25µl of the 0 serum reference into the sample well (this maintains a uniform protein concentration). Multiply the readout value by 2 to obtain the triiodothyronine concentration.

### 10.0 CALCULATION OF RESULTS

**A dose response curve is used to ascertain the concentration of triiodothyronine in unknown specimens.**

- Record the absorbance obtained from the printout of the microplate reader as outlined in Example 1.
- Plot the absorbance for each duplicate serum reference versus the corresponding T3 concentration in ng/ml on linear graph paper (do not average the duplicates of the serum references before plotting).
- Draw the best-fit curve through the plotted points.
- To determine the concentration of T3 for an unknown, locate the average absorbance of the duplicates for each unknown on the vertical axis (y-axis) of the graph, find the intersecting point on the curve, and read the concentration (in ng/ml) from the horizontal axis (X-axis) of the graph (the duplicates of the unknown may be averaged as indicated). In the following example, the average absorbance (1.130) intersects the dose response curve at 1.95ng/ml T3 concentration (See Figure 1).

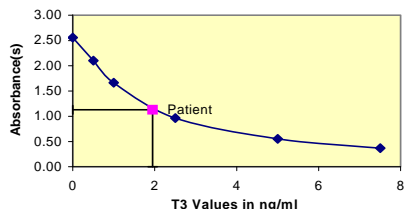
**Note:** Computer data reduction software designed for ELISA assays may be used for the data reduction. **If such software is utilized, the validation of the software should be ascertained.**

**EXAMPLE 1**

| Sample I.D. | Well Number | Abs (A) | Mean Abs (B) | Value (ng/ml) |
|-------------|-------------|---------|--------------|---------------|
| Cal A       | A1          | 2.604   | 2.556        | 0             |
|             | B1          | 2.507   |              |               |
| Cal B       | C1          | 2.073   | 2.101        | 0.5           |
|             | D1          | 2.128   |              |               |
| Cal C       | E1          | 1.678   | 1.662        | 1.0           |
|             | F1          | 1.646   |              |               |
| Cal D       | G1          | 0.964   | 0.966        | 2.5           |
|             | H1          | 0.969   |              |               |
| Cal E       | A2          | 0.550   | 0.551        | 5.0           |
|             | B2          | 0.551   |              |               |
| Cal F       | C2          | 0.372   | 0.370        | 7.5           |
|             | D2          | 0.369   |              |               |
| Ctrl 1      | E2          | 1.701   | 1.726        | 0.92          |
|             | F2          | 1.638   |              |               |
| Ctrl 2      | G2          | 0.755   | 0.734        | 3.58          |
|             | H2          | 0.791   |              |               |
| Patient     | A3          | 1.145   | 1.130        | 1.95          |
|             | B3          | 1.115   |              |               |

\*The data presented in Example 1 and Figure 1 are for illustration only and **should not** be used in lieu of a dose response curve prepared with each assay.

**Figure 1**



**11.0 Q.C. PARAMETERS**

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

- The absorbance (OD) of calibrator 0 ng/ml should be  $\geq 1.3$ .
- 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 is available on request from Monobind Inc.

**12.1 Assay Performance**

- It is important that the time of reaction in each well is held constant to achieve reproducible results.
- Pipetting of samples should not extend beyond ten (10) minutes to avoid assay drift.
- Highly lipemic, hemolyzed or grossly contaminated specimen(s) should not be used.
- If more than one (1) plate is used, it is recommended to repeat the dose response curve.
- The addition of substrate solution initiates a kinetic reaction, which is 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.
- Plate readers measure vertically. Do not touch the bottom of the wells.

- Failure to remove adhering solution adequately in the aspiration or decantation wash step(s) may result in poor replication and spurious results.
- Use components from the same lot. No intermixing of reagents from different batches.
- Patient specimens with T3 concentrations above 7.5 ng/mL may be diluted 1/2 with '0' serum reference. The sample's concentration is obtained by multiplying the result by the dilution factor, 2.
- 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.
- 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.
- 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.
- 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](mailto:Monobind@monobind.com).

**12.2 Interpretation**

- Measurements and interpretation of results must be performed by a skilled individual or trained professional.** 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.
- For valid test results, adequate controls and other parameters must be within the listed ranges and assay requirements.
- 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.**
- 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.
- Total serum triiodothyronine concentration is dependent upon a multiplicity of factors: thyroid gland function and its regulation, thyroxine binding globulin (TBG) concentration, and the binding of triiodothyronine to TBG (3, 4). **Thus, total triiodothyronine concentration alone is not sufficient to assess clinical status.**
- A decrease in total triiodothyronine values is found with protein-wasting diseases, certain liver diseases and administration of testosterone, diphenylhydantoin or salicylates. A table of interfering drugs and conditions, which affect total triiodothyronine values, has been compiled by the Journal of the American Association of Clinical Chemists<sup>2</sup>.

**13.0 EXPECTED RANGES OF VALUES**

A study of euthyroid adult population was undertaken to determine expected values for the T3 AccuBind™ ELISA Test System. The mean (R) values standard deviations ( $\sigma$ ) and expected ranges ( $\pm 2 \sigma$ ) are presented in Table 1. The total number of samples was 105.

| TABLE 1<br>Expected Values for the T3 ELISA Test System<br>(in ng/ml) |             |
|---|-------------|
| Mean (X)  | 1.184       |
| Standard Deviation ( $\sigma$ )                                       | 0.334       |
| Expected Ranges ( $\pm 2 \sigma$ )                                    | 0.52 – 1.85 |

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 precisions of the tT3 AccuBind™ ELISA test system were determined by analyses on three different levels of pool control sera. The number (N), mean value (X), standard deviation ( $\sigma$ ) and coefficient of variation (C.V.) for each of these control sera are presented in Table 2 and Table 3.

| TABLE 2<br>Within Assay Precision (Values in ng/ml) |    |      |          |      |
|---|----|------|----------|------|
| Sample  | N  | X    | $\sigma$ | C.V. |
| Low   | 16 | 0.78 | 0.06     | 7.9% |
| Normal  | 16 | 1.92 | 0.10     | 5.4% |
| High  | 16 | 3.55 | 0.14     | 3.9% |

| TABLE 3<br>Between Assay Precision (Values in ng/ml) |    |      |          |      |
|--|----|------|----------|------|
| Sample   | N  | X    | $\sigma$ | C.V. |
| Low  | 10 | 0.76 | 0.07     | 8.9% |
| Normal   | 10 | 1.85 | 0.13     | 6.7% |
| High   | 10 | 3.43 | 0.16     | 4.5% |

\*As measured in ten experiments in duplicate over a ten day period.

**14.2 Sensitivity**

The tT3 AccuBind™ ELISA test system has a sensitivity of 0.04 ng/ml. The sensitivity was ascertained by determining the variability of the 0 ng/ml serum calibrator and using the 2 $\sigma$  (95% certainty) statistic to calculate the minimum dose.

**14.3 Accuracy**

The tT3 AccuBind™ ELISA method was compared with a reference radioimmunoassay method. Biological specimens from hypothyroid, euthyroid and hyperthyroid populations were used (The values ranged from 0.15ng/ml – 8.0ng/ml). The total number of such specimens was 120. The least square regression equation ( $y = mx+b$ ) and the correlation coefficient were computed for the tT3 AccuBind™ ELISA method 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 |
| This Method | 1.62     | $y = 3.8 + 0.947(x)$             | 0.987                   |
| Reference   | 1.68     |                                  |                         |

Only slight amounts of 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.

**14.4 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 n |
|--------------------|------------------|-----------------|
| I-Triiodothyronine | 1.0000           | -               |
| I-Thyroxine        | < 0.0002         | 10µg/ml         |
| Iodothyrosine      | < 0.0001         | 10µg/ml         |
| Diiodothyrosine    | < 0.0001         | 10µg/ml         |
| Diiodothyronine    | < 0.0001         | 10µg/ml         |
| Phenylbutazone     | < 0.0001         | 10µg/ml         |
| Sodium Salicylate  | < 0.0001         | 10µg/ml         |

**15.0 REFERENCES**

- Gharib H., Ryan R.J, Mayberry W.E, & Hockett T., "Radioimmunoassay for Triiodothyronine (T3): Affinity and Specificity of Antibody for T3", *J Clinical Endocrinol.* **33**,509 (1971).
- Chopra I.J., Ho R.S., & Lam R. "An improved radioimmunoassay of triiodothyronine in human serum", *J. Lab Clinical Med* **80**, 729 (1971).

- Young D.S., Pestaner L.C., and Gilberman U., "Effects of Drugs on Clinical Laboratory Tests", *Clinical Chemistry* **21**, 3660 (1975).
- Sterling L., "Diagnosis and Treatment of Thyroid Disease", *Cleveland CRC Press*, p. **9-51** (1975).
- Braverman L.E.:"Evaluation of thyroid status in patients with thyrotoxicosis", *Clin.Chem.* **42**, 174-178 (1996).
- Braverman L.E., Utigen R.D., Eds.: Werner and Ingbar's "The Thyroid - A Fundamental and Clinical Text", 7<sup>th</sup> Ed. Philadelphia, Lippincott-Raven (1996).
- Comeau L., Pianan U., Leo-Mensah T, et al.:"An automated chemiluminescent immunoassay test for total triiodothyronine", *Clin.Chem.***37**, 941 (1991).
- Chopra I.J.:"Radioimmunoassay of iodothyronines-*Handbook of Radioimmunoassay*", G.E. Abraham.Ed.New York, Marcel Dekker, Inc. (1977).
- Kozwicz D., Davis G., Sockol C.:"Development of total triiodothyronine enzyme immunoassay in microtiter plate format", *Clin.Chem.* **37**, 1040 (1991).
- Papanastasiou-Diamandi A., Khosravi M.:"Total T3 (triiodothyronine) measurement in serum by time resolved fluorescence immunoassay", *Clin.Chem.* **37**, 1029 (1991).

Revision: 3 Date: 061112 DCO: 0640  
Cat #: 125-300

| Size           | 96(A) | 192(B)    | 480(D)    | 960(E)     |
|----------------|-------|-----------|-----------|------------|
| Reagent (fill) | A)    | 1ml set   | 1ml set   | 2ml set x2 |
|                | B)    | 1 (1.5ml) | 2 (1.5ml) | 1 (8ml)    |
|                | C)    | 1 (13ml)  | 2 (13ml)  | 1(60ml)    |
|                | D)    | 1 plate   | 2 plates  | 5 plates   |
|                | E)    | 1 (20ml)  | 1 (20ml)  | 1 (60ml)   |
|                | F)    | 1 (7ml)   | 2 (7ml)   | 1 (30ml)   |
|                | G)    | 1 (7ml)   | 2 (7ml)   | 1 (30ml)   |
|                | H)    | 1 (8ml)   | 2 (8ml)   | 1 (30ml)   |

For Orders and Inquiries, please contact

**Monobind Inc.**  
100 North Pointe Drive  
Lake Forest, CA 92630 USA

Tel: +1 949.951.2665 Email: [info@monobind.com](mailto:info@monobind.com)  
Fax: +1 949.951.3539 Web: [www.monobind.com](http://www.monobind.com)

Please visit our website to learn more about our other interesting products and services.



EC REP **CEpartner4U**, Esdoornlaan 13,  
3951DB Maarn, The Netherlands  
[www.cepartner4u.eu](http://www.cepartner4u.eu)