

THYROXINE (T4) ELISA

EU:  IVD CAN:  USA: For Research Use Only. Not for Use in Diagnostic Procedures

REF: CAN-T4-4240 Version: 8.1 (COMB)
Effective: October 17, 2023

INTENDED USE

For the direct quantitative determination of Thyroxine by an enzyme immunoassay in human serum.

PRINCIPLE OF THE TEST

The principle of the following enzyme immunoassay test follows the typical competitive binding scenario. Competition occurs between an unlabelled antigen (present in standards, controls and patient samples) and an enzyme-labelled antigen (conjugate) for a limited number of antibody binding sites on the microplate. The washing and decanting procedures remove unbound materials. After the washing step, the enzyme substrate is added. The enzymatic reaction is terminated by addition of the stopping solution. The absorbance is measured on a microtiter plate reader. The intensity of the colour formed is inversely proportional to the concentration of T4 in the sample. A set of standards is used to plot a standard curve from which the amount of T4 in patient samples and controls can be directly read.

CLINICAL APPLICATIONS

Clinical Trends:

- The level of T4 in hypothyroid patients is decreased.
- The level of T4 in hyperthyroid patients is increased.
- In euthyroid individuals the level of T4 is within the normal range.

Thyroid binding globulin (TBG) levels have reportedly been elevated by the following conditions: increased estrogens from oral contraceptives, androgens, glucocorticoids and pregnancy. Consequently, borderline T4 values should be viewed with caution when any of the above conditions are present.

PROCEDURAL CAUTIONS AND WARNINGS

1. Users should have a thorough understanding of this protocol for the successful use of this kit. Reliable performance will only be attained by strict and careful adherence to the instructions provided.
2. Control materials or serum pools should be included in every run at a high and low level for assessing the reliability of results.
3. When the use of water is specified for dilution or reconstitution, use deionized or distilled water.
4. In order to reduce exposure to potentially harmful substances, gloves should be worn when handling kit reagents and human specimens.
5. All kit reagents and specimens should be brought to room temperature and mixed gently but thoroughly before use. Avoid repeated freezing and thawing of reagents and specimens.

6. A calibrator curve must be established for every run.
7. The controls should be included in every run and fall within established confidence limits.
8. Improper procedural techniques, imprecise pipetting, incomplete washing as well as improper reagent storage may be indicated when assay values for the controls do not reflect established ranges.
9. When reading the microplate, the presence of bubbles in the wells will affect the optical densities (ODs). Carefully remove any bubbles before performing the reading step.
10. The substrate solution (TMB) is sensitive to light and should remain colourless if properly stored. Instability or contamination may be indicated by the development of a blue colour, in which case it should not be used.
11. The assay buffer is sensitive to light and should be stored in the original dark bottle away from direct sunlight.
12. When dispensing the substrate and stopping solution, do not use pipettes in which these liquids will come into contact with any metal parts.
13. To prevent contamination of reagents, use a new disposable pipette tip for dispensing each reagent, sample, standard and control.
14. Do not mix various lot numbers of kit components within a test and do not use any component beyond the expiration date printed on the label.
15. Kit reagents must be regarded as hazardous waste and disposed of according to national regulations.

LIMITATIONS

1. All the reagents within the kit are calibrated for the direct determination of T4 in human serum. The kit is not calibrated for the determination of T4 in other specimens of human or animal origin.
2. Do not use grossly hemolyzed, grossly lipemic, icteric or improperly stored serum.
3. Any samples or control sera containing azide or thimerosal are not compatible with this kit, as they may lead to false results.
4. Only calibrator A may be used to dilute any high serum samples. The use of any other reagent may lead to false results.
5. The results obtained with this kit should never be used as the sole basis for a clinical diagnosis. For example, the occurrence of heterophilic antibodies in patients regularly exposed to animals or animal products has the potential of causing interferences in immunological tests. Consequently, the clinical diagnosis should include all aspects of a patient's background including the frequency of exposure to animals/products if false results are suspected.

SAFETY CAUTIONS AND WARNINGS

POTENTIAL BIOHAZARDOUS MATERIAL

Human serum that may be used in the preparation of the standards and controls has been tested and found to be non-reactive for Hepatitis B surface antigen and has also been tested for the presence of antibodies to HCV and Human Immunodeficiency Virus (HIV) and found to be negative. No test method however, can offer complete assurance that HIV, HCV and Hepatitis B virus or any infectious agents are absent. The reagents should be considered a potential biohazard and handled with the same precautions as applied to any blood specimen.

CHEMICAL HAZARDS

Avoid contact with reagents containing TMB, hydrogen peroxide and sulfuric acid. If contacted with any of these reagents, wash with plenty of water. TMB is a suspected carcinogen.

SPECIMEN COLLECTION AND STORAGE

Approximately 0.1 mL of serum is required per duplicate determination. Collect 4–5 mL of blood into an appropriately labelled tube and allow it to clot. Centrifuge and carefully remove the serum layer. Store at 4°C for up to 24 hours or at -10°C or lower if the analyses are to be done at a later date. Consider all human specimens as possible biohazardous materials and take appropriate precautions when handling.

SPECIMEN PRETREATMENT

This assay is a direct system; no specimen pretreatment is necessary.

REAGENTS AND EQUIPMENT NEEDED BUT NOT PROVIDED

1. Precision pipette to dispense 20, 50, 150 and 300 µL
2. Disposable pipette tips
3. Distilled or deionized water
4. Plate shaker
5. Microplate reader with a filter set at 450 nm and an upper OD limit of 3.0 or greater (see assay procedure step 10)

REAGENTS PROVIDED

1. Mouse Anti-T4 Antibody-Coated Break-Apart Well Microplate — Ready To Use

Contents: One 96-well (12x8) monoclonal antibody-coated microplate in a resealable pouch with desiccant.
Storage: Refrigerate at 2–8°C
Stability: 12 months or as indicated on label.

2. T4 Horseradish Peroxidase (HRP) Conjugate Concentrate — Requires Preparation X25

Contents: T4-HRP conjugate in a protein-based buffer with a non-mercury preservative.
Volume: 1 mL/vial
Storage: Refrigerate at 2–8°C
Stability: 12 months or as indicated on label.
Preparation: Dilute 1:25 in assay buffer before use (eg. 80 µL of HRP in 2 mL of assay buffer). If the whole plate is to be used dilute 800 µL of HRP in 20 mL of assay buffer. Discard any that is left over.

3. T4 Calibrators — Ready To Use

Contents: Five vials containing T4 in a protein-based buffer with a non-mercury preservative. Prepared by spiking buffer with a defined quantity of T4.

* Listed below are approximate concentrations, please refer to bottle labels for exact concentrations.

Calibrator	Concentration	Volume
Calibrator A	0 µg%	2.0 mL
Calibrator B	1 µg%	0.5 mL
Calibrator C	4 µg%	0.5 mL
Calibrator D	12 µg%	0.5 mL
Calibrator E	32 µg%	0.5 mL

Storage: Refrigerate at 2–8°C
Stability: 12 months in unopened vials or as indicated on label. Once opened, the standards should be used within 14 days or aliquoted and stored frozen. Avoid multiple freezing and thawing cycles.

4. Controls — Ready To Use

Contents: Two vials containing T4 in a protein-based buffer with a non-mercury preservative. Prepared by spiking buffer with defined quantities of T4. Refer to vial labels for the acceptable range.
Volume: 0.5 mL/vial
Storage: Refrigerate at 2–8°C
Stability: 12 months in unopened vials or as indicated on label. Once opened, the controls should be used within 14 days or aliquoted and stored frozen. Avoid multiple freezing and thawing cycles.

5. Wash Buffer Concentrate — Requires Preparation X10

Contents: One bottle containing buffer with a non-ionic detergent and a non-mercury preservative.
Volume: 50 mL/bottle
Storage: Refrigerate at 2–8°C
Stability: 12 months or as indicated on label.
Preparation: Dilute 1:10 in distilled or deionized water before use. If the whole plate is to be used dilute 50 mL of the wash buffer concentrate in 450 mL of water.

6. Assay Buffer — Ready To Use

Contents: One bottle containing a protein-based buffer with a non-mercury preservative.
Volume: 25 mL/bottle
Storage: Refrigerate at 2–8°C
Stability: 12 months or as indicated on label.

7. TMB Substrate — Ready To Use

Contents: One bottle containing tetramethylbenzidine and hydrogen peroxide in a non-DMF or DMSO containing buffer.
Volume: 16 mL/bottle
Storage: Refrigerate at 2–8°C
Stability: 12 months or as indicated on label.

8. Stopping Solution — Ready To Use

Contents: One bottle containing 1M sulfuric acid.
Volume: 6 mL/bottle
Storage: Refrigerate at 2–8°C
Stability: 12 months or as indicated on label.

ASSAY PROCEDURE

Specimen Pretreatment: **None**.

All reagents must reach room temperature before use. Calibrators, controls and specimen samples should be assayed in duplicate. Once the procedure has been started, all steps should be completed without interruption.

1. Prepare working solutions of the T4-HRP conjugate and wash buffer.
2. Remove the required number of well strips. Reseal the bag and return any unused strips to the refrigerator.
3. Pipette 20 µL of each calibrator, control and specimen sample into correspondingly labelled wells in duplicate.
4. Pipette 150 µL of the conjugate working solution into each well. (We recommend using a multichannel pipette).
5. Incubate on a plate shaker (approximately 200 rpm) for 30 minutes at room temperature.
6. Wash the wells **3 times** with 300 µL of diluted wash buffer per well and tap the plate firmly against absorbent paper to ensure that it is dry. (The use of a washer is recommended.)
7. Pipette 150 µL of TMB substrate into each well at timed intervals.
8. Incubate on a plate shaker for 15–20 minutes at room temperature (or until calibrator A attains dark blue colour for desired OD).
9. Pipette 50 µL of stopping solution into each well at the same timed intervals as in step 7.
10. Read the plate on a microplate reader at 450 nm within 20 minutes after addition of the stopping solution.

* If the OD exceeds the upper limit of detection or if a 450 nm filter is unavailable, a 405 or 415 nm filter may be substituted. The optical densities will be lower, however, this will not affect the results of patient/control samples.

CALCULATIONS

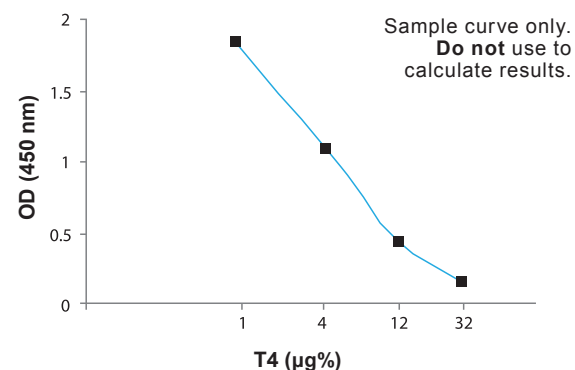
1. Calculate the mean optical density of each calibrator duplicate.
2. Draw a calibrator curve on semi-log paper with the mean optical densities on the Y-axis and the calibrator concentrations on the X-axis. If immunoassay software is being used, a 4-parameter or 5-parameter curve is recommended.
3. Calculate the mean optical density of each unknown duplicate.
4. Read the values of the unknowns directly off the calibrator curve.
5. If a sample reads more than 32 µg%, then dilute it with calibrator A at a dilution of no more than 1:8. The result obtained should be multiplied by the dilution factor.

TYPICAL TABULATED DATA

Sample data only. **Do not** use to calculate results.

Calibrator	OD 1	OD 2	Mean OD	Value (µg%)
A	2.176	2.174	2.175	0
B	1.850	1.820	1.835	1
C	1.092	1.109	1.101	4
D	0.434	0.468	0.451	12
E	0.152	0.158	0.155	32
Unknown	0.635	0.634	0.635	8.3

TYPICAL CALIBRATOR CURVE



PERFORMANCE CHARACTERISTICS SENSITIVITY

The lower detection limit is calculated from the standard curve by determining the resulting concentration of the mean OD of Calibrator A (based on 10 replicate analyses) minus 2 SD. Therefore, the sensitivity of the DBC Direct T4 ELISA kit is **0.6 µg%**.

SPECIFICITY (CROSS-REACTIVITY)

The following compounds were tested for cross-reactivity with the Direct T4 ELISA kit with T4 cross-reacting at 100%.

Compound	% Cross Reactivity
L-Thyroxine	100
D-Thyroxine	94
3,3',5'-Triiodo-L-Thyronine (Reverse T3)	86
3,3',5'-Triiodo-L-Thyronine (T3)	3.3
3,3',5'-Triiodo-D-Thyronine	1.8
3,3',5'-Triiodothyropropionic acid	0.6

The following compounds were tested but cross-reacted at less than 0.04%: Acetylsalicylic acid, 3,5-Diiodo-L-Thyronine, 3,5-Diiodo-L-Tyrosine and 3-Iodo-L-Tyrosine.

INTRA-ASSAY PRECISION

Three samples were assayed ten times each on the same calibrator curve. The results (in µg%) are tabulated below:

Sample	Mean	SD	CV %
1	2.48	0.23	9.2
2	8.58	0.60	6.9
3	20.46	1.33	6.4

INTER-ASSAY PRECISION

Three samples were assayed ten times over a period of four weeks. The results (in µg%) are tabulated below:

Sample	Mean	SD	CV %
1	3.33	0.41	12.3
2	10.30	1.19	11.5
3	14.5	1.44	9.9

RECOVERY

Spiked samples were prepared by adding defined amounts of T4 to three patient serum samples. The results (in µg%) are tabulated below:

Sample	Obs. Result	Exp. Result	Recovery %
1 Unspiked	2.03	-	-
+ 2.91	4.64	4.94	93.9
+ 7.38	9.28	9.41	98.6
+ 13.70	17.93	15.73	114.0
2 Unspiked	9.43	-	-
+ 2.91	13.17	12.32	106.9
+ 7.38	19.56	16.81	116.4
+ 13.70	25.81	23.13	111.6
3 Unspiked	24.03	-	-
+ 2.91	26.74	26.94	99.3
+ 7.38	30.65	31.41	97.6
+ 13.70	> 32	37.73	-

LINEARITY

Two patient serum samples were diluted with calibrator A. The results (in µg%) are tabulated below:

Sample	Obs. Result	Exp. Result	Recovery %
1	22.50	-	-
1:2	11.74	11.25	104.4
1:4	5.70	5.63	101.2
1:8	2.71	2.81	96.4
2	25.64	-	-
1:2	14.50	12.82	113.1
1:4	6.90	6.41	107.6
1:8	3.31	3.21	103.1

EXPECTED VALUES

As for all clinical assays each laboratory should collect data and establish their own range of expected normal values.

Group	Range (µg%)
Euthyroid	4–12
Hyperthyroid	> 12
Hypothyroid	< 4

REFERENCES

1. Ingbar SH, et al. A New Method for Measuring the Free Thyroid Hormone in Human Serum and an Analysis of the Factors That Influence its Concentration. *J Clin Invest.* 1965; 44(10):1679–89.
2. Robbins J. Radioassay and the Thyroid Gland. *Metabolism.* 1973; 22(8):1021–6.
3. Schall RF Jr, et al. A Sensitive Manual Enzyme Immunoassay for Thyroxine. *Clin Chem.* 1978; 24(10):1801–4.
4. Selenkow HA, Robin NI. The Diagnosis and Management of Common Thyroid Diseases. *J Maine Med Assoc.* 1970; 61:199–211.
5. Oppenheimer JH, et al. Binding of Thyroxine by Serum Proteins Evaluated by Equilibrium Dialysis and Electrophoretic Techniques. Alterations in Nonthyroidal Illness. *J Clin Invest.* 1963; 42:1769–82.
6. Young DS, et al. Effects of Drugs on Clinical Laboratory Tests. *Clin Chem.* 1975; 21(5):1D–432D.
7. Sterling K, Hegedus A. Measurement of Free Thyroxine Concentration in Human Serum. *J Clin Invest.* 1962; 41: 1031–40.
8. Cavalieri RR, et al. *Clin Res.* 1967; 15:124.
9. Comoglio S, Celada F. An Immuno-Enzymatic Assay of Cortisol Using E. Coli Beta-Galactosidase as Label. *J Immunol Methods.* 1976; 10(2–3):161–70.
10. McComb RB, Bowers GN, Posen S. In: Alkaline Phosphatase, 1st Ed. New York: Plenum Press; 1979: 525–704.

Other related ELISA kits also available from DBC:

DBC Direct Free T4 ELISA Kit, [REF](#): CAN-FT4-4340

DBC Direct Total T3 ELISA Kit, [REF](#): CAN-T3-4220

DBC Direct Free T3 ELISA Kit, [REF](#): CAN-FT3-4230

DBC Direct TSH ELISA Kit, [REF](#): CAN-TSH-4080



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