

FREE TRIIODOTHYRONINE (fT3) ELISA

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

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INTENDED USE

For the direct quantitative determination of Free Triiodothyronine 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 fT3 in the sample. A set of standards is used to plot a standard curve from which the amount of fT3 in patient samples and controls can be directly read.

The labelled T3 (conjugate) employed in this assay system has shown no substantial binding properties towards thyroxine-binding globulin (TBG) or human serum albumin (HSA). The binding sites on the microplates are designed to be of a low binding-capacity in order not to disturb the equilibrium between T3 and its carrying proteins. The assay is carried out under normal physiological conditions of pH, temperature and ionic strength.

CLINICAL APPLICATIONS

Triiodothyronine (T3) is a thyroid hormone found circulating in the bloodstream. T3 contains three iodine atoms and is produced largely through the extrathyroidal conversion of thyroxine (T4), the principal thyroid hormone with four iodine atoms. Most of the T3 that circulates in the blood is bound to carrier proteins such as TBG, pre-albumin and albumin. The free fraction of T3 (fT3), which represents only 0.25% of the total amount, is considered to be the physiological active fraction.

Total T3 levels depend not only on thyroid status and the peripheral conversion of T4 to T3, but also on the concentration of thyroid hormone-binding proteins. Free T3 (fT3) on the other hand, is largely unaffected by variations in these carrier proteins which can occur under conditions such as pregnancy, estrogen therapy and the use of oral contraceptives. Therefore, free T3 typically reflects a patient's actual thyroid status more reliably than total T3.

Measurement of free T3 is generally recommended for patients with symptoms of hyperthyroidism as found in Graves' disease, toxic adenoma and toxic multinodular goiter.

PROCEDURAL CAUTIONS AND WARNINGS

- 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.

- Control materials or serum pools should be included in every run at a high and low level for assessing the reliability of results.
- When the use of water is specified for dilution or reconstitution, use deionized or distilled water.
- In order to reduce exposure to potentially harmful substances, gloves should be worn when handling kit reagents and human specimens.
- 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.
- A calibrator curve must be established for every run.
- The controls should be included in every run and fall within established confidence limits.
- 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.
- 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.
- 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.
- When dispensing the substrate and stopping solution, do not use pipettes in which these liquids will come into contact with any metal parts.
- To prevent contamination of reagents, use a new disposable pipette tip for dispensing each reagent, sample, standard and control.
- 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.
- Kit reagents must be regarded as hazardous waste and disposed of according to national regulations.

LIMITATIONS

- All the reagents within the kit are calibrated for the direct determination of fT3 in human serum. The kit is not calibrated for the determination of fT3 in other specimens of human or animal origin.
- Do not use grossly hemolyzed, grossly lipemic, icteric or improperly stored serum.
- Any samples or control sera containing azide or thimerosal are not compatible with this kit, as they may lead to false results.
- Samples reading higher than 40 pg/mL should be reported as such and should not be diluted. Dilution will alter the existing equilibrium and may lead to false results.
- The interpretation of free T3 results can be complicated by a variety of drugs, severe nonthyroidal illness and some rare conditions such as familial dysalbuminemic hyperthyroxinemia (FDH). For diagnostic purposes, the results of this assay should always be used in combination with the clinical examination, medical history and other findings.

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

- Precision pipette to dispense 25, 50, 100, 150 and 300 µL
- Disposable pipette tips
- Distilled or deionized water
- A 37°C incubator
- Microplate reader with a filter set at 450 nm and an upper OD limit of 3.0 or greater* (see assay procedure step 11)

REAGENTS PROVIDED

1. Rabbit Anti-fT3 Antibody-Coated Break-Apart Well Microplate — Ready To Use

Contents: One 96-well (12x8) polyclonal antibody-coated microplate in a resealable pouch with desiccant.

Storage: Refrigerate at 2–8°C

Stability: 12 months or as indicated on label.

2. fT3-Horseradish Peroxidase (HRP) Conjugate Concentrate — Requires Preparation [X50](#)

Contents: fT3-HRP conjugate in a protein-based buffer with a non-mercury preservative.

Volume: 300 µL/vial

Storage: Refrigerate at 2–8°C

Stability: 12 months or as indicated on label.

Preparation: Dilute 1:50 in assay buffer before use (eg. 40 µL of HRP in 2 mL of assay buffer). If the whole plate is to be used dilute 240 µL of HRP in 12 mL of assay buffer. Discard any that is left over.

3. fT3 Calibrators — Ready To Use

Contents: Six vials containing fT3 in a human serum-based matrix with a non-mercury preservative. Prepared by spiking serum with a defined quantity of T3.

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

Calibrator	Concentration	Volume
Calibrator A	0 pg/mL	0.5 mL
Calibrator B	2 pg/mL	0.5 mL
Calibrator C	4 pg/mL	0.5 mL
Calibrator D	8 pg/mL	0.5 mL
Calibrator E	16 pg/mL	0.5 mL
Calibrator F	40 pg/mL	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 fT3 in a human serum-based matrix with a non-mercury preservative. Prepared by spiking serum with defined quantities of T3. Refer to vial labels for 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: 15 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 fT3-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 25 µL of each calibrator, control and specimen sample into correspondingly labelled wells in duplicate.
4. Pipette 100 µL of the conjugate working solution into each well. (We recommend using a multichannel pipette.)
5. Gently shake the plate for 10 seconds.
6. Incubate the plate at 37°C for 1 hour.
7. 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.)
8. Pipette 150 µL of TMB substrate into each well at timed intervals.
9. Incubate the plate at 37°C for 10–15 minutes (or until calibrator A attains dark blue colour for desired OD).
10. Pipette 50 µL of stopping solution into each well at the same timed intervals as in step 8.
11. 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

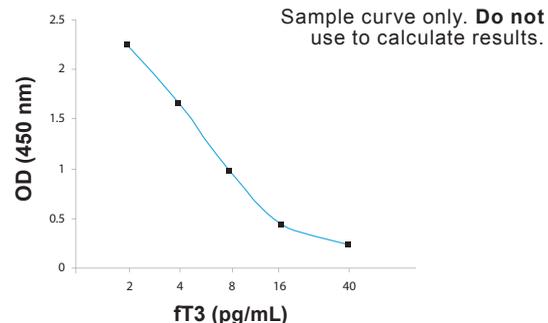
1. Calculate the mean optical density of each calibrator duplicate.
2. Draw a calibrator curve on semi-log paper with the mean optical densities on the Y-axis and the calibrator concentrations on the X-axis. If immunoassay software is being used, a 4-parameter or 5-parameter curve is recommended.
3. Calculate the mean optical density of each unknown duplicate.
4. Read the values of the unknowns directly off the calibrator curve.

TYPICAL TABULATED DATA

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

Calibrator	OD 1	OD 2	Mean OD	Value (pg/mL)
A	2.798	2.734	2.764	0
B	2.284	2.216	2.250	2
C	1.697	1.638	1.668	4
D	1.002	0.956	0.979	8
E	0.452	0.437	0.444	16
F	0.247	0.238	0.242	40
Unknown	1.460	1.439	1.450	4.8

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 fT3 ELISA kit is **0.3 pg/mL**.

SPECIFICITY (CROSS-REACTIVITY)

The following compounds were tested for cross-reactivity with the Direct fT3 ELISA kit with T3 cross-reacting at 100%.

Compound	% Cross Reactivity
L-Triiodothyronine	100
D-Triiodothyronine	34
Triiodothyropropionic acid	20
Diiodo-D-thyronine	0.5
D-Thyroxine	0.3
L-Thyroxine	0.9

The following compounds were tested but cross-reacted at less than 0.1%: Diiodotyrosine, Iodotyrosine, Phenytoin, Sodium Salicylate and r-Triiodothyronine.

INTRA-ASSAY PRECISION

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

Sample	Mean	SD	CV %
1	5.182	0.501	9.7
2	8.560	0.598	7.0
3	48.200	1.686	3.5

INTER-ASSAY PRECISION

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

Sample	Mean	SD	CV %
1	3.306	0.284	8.6
2	5.154	0.402	7.8
3	8.698	0.713	8.2

EXPECTED NORMAL VALUES

As for all clinical assays each laboratory should collect data and establish their own range of expected normal values. The following reference range (pg/mL) was established with 44 apparently healthy adults:

Group	N	Mean	Central 95% Range
Euthyroid Adults	44	3.7	2.2–5.3

EFFECT OF THYROXINE BINDING GLOBULIN (TBG)

The purpose of this study was to investigate a possible interference caused by the binding of TBG to the fT3-HRP conjugate. The zero calibrator was spiked with purified TBG and assayed. The results are tabulated below:

TBG (µg/mL added)	OD	% B/B ₀
0	1.255	100
12.5	1.229	98
25	1.170	93
50	1.137	91
100	1.168	93
200	1.174	94
400	1.118	89

The results show no binding of labelled T3 to TBG even at higher than normal levels. In conclusion, results showed that there was no significant influence by TBG in the DBC Direct Free T3 Direct ELISA Kit.

EFFECT OF HUMAN SERUM ALBUMIN (HSA)

The purpose of this study was to investigate a possible interference of HSA on the assay procedure. The zero calibrator was spiked with purified HSA and assayed. The results are tabulated below:

HSA (mg/mL added)	OD	% B/B ₀
0	1.255	100
3.125	1.228	98
6.25	1.331	100
12.5	1.245	99
25	1.197	95
50	1.217	97
100	1.063	85

The results show no significant binding of labelled T3 to HSA even at higher than normal levels.

EFFECT OF NON-ESTERIFIED FATTY ACIDS (NEFA)

The purpose of this study was to investigate a possible interference of NEFA on the assay procedure. Two samples were spiked with oleic acid and assayed. The results are tabulated below:

NEFA (mmol/L added)	Sample 1 (pg/mL)	Sample 2 (pg/mL)
0	4.4	8.7
0.5	4.6	7.5
3.5	4.6	8.3
25	4.6	10.9

The results show that NEFA may increase the free T3 values, only at higher than normal concentrations.

EFFECT OF LIPEMIA

The purpose of this study was to investigate a possible interference of lipemic samples on the assay procedure. Two samples were spiked with triglycerides and assayed. The results are tabulated below:

Triglycerides (mg/dL added)	Sample 1 (pg/mL)	Sample 2 (pg/mL)
0	4.4	8.7
50	5.5	9.9
75	5.9	10.8

Results show that lipemic samples may increase the free T3 values. Therefore, lipemic samples should not be used in this assay.

REFERENCES

1. Mullinger RN, et al. Free Triiodothyronine in Nonthyroidal Illness. *Clin Chem*. 1993; 39(7):1555.
2. Wilkins TA, et al. Assay Performance and Tracer Properties for Two Analog-based of Free Triiodothyronine. *Clin Chem*. 1986; 32(3):465–9.
3. Ekins R. Measurement of Free Hormones in Blood. *Endocr Rev*. 1990; 11(1):5–46.
4. John R, et al. Concentration of Free Thyroxine and Free Triiodothyronine in Serum with Patients with Thyronine and Triiodothyronine Binding Autoantibodies. *Clin Chem*. 1990; 36(3):470–3.
5. Chopra IJ. RIA of iodothyronines. In: Abraham GE ed. Handbook of radioimmunoassay. New York: Marcel Dekker Inc; 1997:679.
6. Demers LM. Thyroid function testing and automation. *J Clin Ligand Assay*. 1999; 22:38.
7. Kalra J, Hart IR. Value of Free Thyroxine (FT4), Free Triiodothyronine (FT3) and Sensitive Thyrotropin (TSH) Assay in the Assessment of Optimal Thyronine Therapy. *Clin Biochem*. 1987; 20(4):265–7.
8. Bergmann PJ, Van Tricht L. Free Triiodothyronine in Hypothyroidism and Nonthyroidal Illness. *Clin Chem*. 1994; 40(3):496–7.
9. Cohen JH, et al. Thyrotoxicosis Due to Ingestion of Excess Thyroid Hormone. *Endocr Rev*. 1993; 10(2):113–24.
10. Ingbar SH, et al. A New Method for Measuring the Free Thyroid Hormone in Human Serum and an Analysis of the Factors That Interfere its Concentration. *J Clin Invest*. 1965; 44(10):1679–89.
11. Pedersen KO. Simultaneous Determination of the Free Thyroxine and Triiodothyronine Fractions in Serum. *Scand J Clin Lab Invest*. 1974; 34(3):241–6.
12. Weeke J, Orskov H. Ultrasensitive Radioimmunoassay for Direct Determination of Free Triiodothyronine Concentration in Human Serum. *Scand J Clin Lab Invest*. 1975; 35(3):237.
13. Oddie TH et al. Triiodothyronine Turnover in Euthyroid Subjects. *J Clin Endocrinol Metab*. 1971; 33:653.
14. Nauman JA, et al. Total and Free Triiodothyronine in Human Serum. *J Clin Invest*. 1967; 46(8):1346–55.

DBC-Diagnostics Biochem Canada Inc.

384 Neptune Crescent
London, Ontario, Canada N6M 1A1
Tel: (519) 681-8731
Fax: (519) 681-8734
e-mail: dbc@dbc-labs.com
www.dbc-labs.com

An ISO 13485 Registered Company

EMERGO EUROPE
Prinsessegracht 20
2514 AP The Hague
The Netherlands

SYMBOLS

European Conformity	In vitro diagnostic device	Consult instructions for use
Contains sufficient for Zn^{2+} tests	Storage Temperature	Legal Manufacturer
Use by	Catalogue Number	Authorized representative
Lot number	Dilute 1: # Before use	