Corynebacterium diphtheriae toxin

IgG - ELISA

Enzyme immunoassay for the quantitative determination of IgG-class antibodies against Corynebacterium diphtheriae toxin in human serum or plasma

Only for in-vitro diagnostic use

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Product Number: GWB-F06CAF (96 Determinations)
1. INTRODUCTION

Corynebacteria are aerobic non spore-forming gram-positive rods of irregular shape (0.5 –1 µm thick and 2-6 µm long). They comprise skin commensals, opportunistic pathogens and several major pathogens, including Corynebacterium diphtheriae. In general, they are isolated from throat swabs on selective media containing tellurite. The bacterial infection caused by C. diphtheriae, Diphtheria, has two forms. Respiratory diphtheria is typically caused by toxin-producing (toxigenic) strains; cutaneous disease can be caused by either toxigenic or nontoxigenic strains. In the respiratory form of the disease, a membrane is formed; this membrane is usually visible on the throat or tonsils. Persons may die from asphyxiation when the membrane obstructs breathing. Other complications are caused by remote effects of the diphtheria toxin (myocarditis, nerve paralysis) Cutaneous diphtheria is usually mild, typically consisting of non-distinctive sores or shallow ulcers and only rarely involving toxic complications (1-2% of infections with toxigenic strains). Diphtheria was one of the most common causes of death among children during the prevaccine era.

Since the introduction and widespread use of diphtheria toxoid vaccine (formalin-inactivated diphtheria toxin) in most industrialized countries the disease is now characterized by sporadic cases and intermittent outbreaks of low intensity. But recent large epidemics of diphtheria in several eastern European countries have again drawn attention to this „forgotten” disease – and, the majority of these cases have occurred among adolescents and adults instead of children.

### Table: Species, Disease, Symptoms, Mechanism of Infection

<table>
<thead>
<tr>
<th>Species</th>
<th>Disease</th>
<th>Symptoms</th>
<th>Mechanism of Infection</th>
</tr>
</thead>
<tbody>
<tr>
<td>Corynebacterium</td>
<td>Diphtheria</td>
<td>sore throat and low-grade fever</td>
<td>Transmission from person to person through close</td>
</tr>
<tr>
<td>diphtheriae</td>
<td>(respiratory)</td>
<td>swelling of the neck (“bull neck”)</td>
<td>physical and respiratory contact</td>
</tr>
<tr>
<td></td>
<td></td>
<td>from inflammation</td>
<td>Transmission is increased in overcrowded and poor</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Complications: exotoxin-induced</td>
<td>socio-economic conditions</td>
</tr>
<tr>
<td></td>
<td></td>
<td>damage to other organs</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The only effective way to control diphtheria is by prophylactic immunization with diphtheria toxoid. Antibody to the toxoid protects against the action of the toxin; immunized persons can be infected by toxin-producing strains of diphtheria, but the systemic manifestations of diphtheria do not occur. The outcome of the disease improves with early, appropriate treatment. Prompt recognition and reporting of the disease is important to assure early, appropriate treatment with diphtheria anti-toxin. Infection may be identified by

- Microscopy: Gram stain
- Serology: Detection of toxin production by ELISA

2. INTENDED USE

The GenWay Corynebacterium diphtheriae toxin IgG-ELISA is intended for the quantitative determination of IgG class antibodies against Corynebacterium diphtheriae toxin in human serum or plasma (citrate). This allows the determination of the immune status of the patients facilitating individual recommendations about the necessity of a basic immunization or booster injection.

3. PRINCIPLE OF THE ASSAY

The quantitative immunoenzymatic determination of IgG-class antibodies against C. diphtheriae toxin is based on the ELISA (Enzyme-linked Immunosorbent Assay) technique. Microtiterstrip wells are precoated with inactivated specific Corynebacterium diphtheriae toxin (toxoid) antigens to bind corresponding antibodies of the specimen. After washing the wells to remove all unbound sample material horseradish peroxidase (HRP) labelled anti-human IgG conjugate is added. This conjugate binds to the captured C. diphtheriae toxin-specific antibodies. The immune complex formed by the bound conjugate is visualized by adding Tetramethylbenzidine (TMB) substrate which gives a blue reaction product. The intensity of this product is proportional to the amount of C. diphtheriae toxin-specific IgG antibodies in the specimen. Sulphuric acid is added to stop the reaction. This produces a yellow endpoint colour. Absorbance at 450 nm is read using an ELISA microwell plate reader.

4. MATERIALS

4.1. Reagents supplied

- **C. diphtheriae toxin Coated Wells (IgG):** 12 breakapart 8-well snap-off strips coated with C. diphtheriae toxin (toxoid) antigens; in resealable aluminium foil.
- **IgG Sample Diluent***: 1 bottle containing 100 ml of buffer for sample dilution; pH 7.2 ± 0.2; coloured yellow; ready to use; white cap.
- **Stop Solution:** 1 bottle containing 15 ml sulphuric acid, 0.2 mol/l; ready to use; red cap.
- **Washing Solution (20x Concentrate)**: 1 bottle containing 50 ml of a 20-fold concentrated buffer for washing the wells; pH 7.2 ± 0.2; white cap.
- **C. diphtheriae toxin anti-IgG Conjugate**: 1 bottle containing 20 ml of peroxidase labelled antibodies to human IgG; coloured blue; ready to use; black cap.
- **TMB Substrate Solution:** 1 bottle containing 15 ml 3,3’,5,5’-tetramethylbenzidine (TMB); ready to use; yellow cap.
- **C. diphtheriae toxin IgG Standards***: 4 vials, each containing 2ml, coloured yellow; ready to use.
4.2. Materials supplied
- 1 Strip holder
- 1 Cover foil
- 1 Test protocol
- 1 distribution and identification plan

4.3. Materials and Equipment needed
- ELISA microwell plate reader, equipped for the measurement of absorbance at 450/620nm
- Incubator 37°C
- Manual or automatic equipment for rinsing wells
- Pipettes to deliver volumes between 10 and 1000 µl
- Vortex tube mixer
- Deionised or (freshly) distilled water
- Disposable tubes
- Timer

5. STABILITY AND STORAGE
The reagents are stable up to the expiry date stated on the label when stored at 2...8 °C.

6. REAGENT PREPARATION

It is very important to bring all reagents, samples and standards to room temperature (20...25°C) before starting the test run!

6.1. Coated Snap-off Strips
The ready to use breakapart snap-off strips are coated with C. diphtheriae toxin (toxoid) antigens. Store at 2...8°C. Immediately after removal of strips, the remaining strips should be resealed in the aluminium foil along with the desiccant supplied and stored at 2...8°C; stability until expiry date.

6.2. C. diphtheriae toxin anti-IgG Conjugate
The bottle contains 20 ml conjugate with the components anti-human IgG horseradish peroxidase, buffer, stabilizers, preservatives and an inert blue dye. The solution is ready to use. Store at 2...8°C. After first opening stability until expiry date when stored at 2...8°C.

6.3. Standards
The vials labelled with Standard A, B, C and D contain a ready to use standard solution. The concentration of the standards, calibrated in accordance with the "International Standard for Diphtheria Antitoxin (00/496)”, are:
- Standard A: 0.000 IU/ml; blue cap
- Standard B: 0.015 IU/ml; green cap
- Standard C: 0.075 IU/ml; yellow cap
- Standard D: 0.150 IU/ml; red cap

* contains 0.1 % Bronidox L after dilution
** contains 0.2 % Bronidox L
*** contains 0.1 % Kathon

6.4. IgG Sample Diluent
The bottle contains 100 ml phosphate buffer, stabilizers, preservatives and an inert yellow dye. It is used for the dilution of the patient specimen. This ready to use solution has to be stored at 2...8°C. After first opening stability until expiry date when stored at 2...8°C.

6.5. Washing Solution (20x conc.)
The bottle contains 50 ml of a concentrated buffer, detergents and preservatives. Dilute Washing Solution 1+19; e.g. 10 ml Washing Solution + 190 ml fresh and germ free redistilled water. The diluted buffer is stable for 5 days at room temperature. After first opening stability until expiry date when stored at 2...8°C.
6.6. TMB Substrate Solution
The bottle contains 15 ml of a Tetramethylbenzidine/hydrogen peroxide system. The reagent is ready to use and has to be stored at 2...8°C, away from the light. The solution should be colourless or could have a slight blue tinge. If the substrate turns into blue, it may have become contaminated and should be thrown away. After first opening stability until expiry date when stored at 2...8°C.

6.7. Stop Solution
The bottle contains 15 ml 0.2 M sulphuric acid solution (R 36/38, S 26), ready to use, store at 2...8°C. After first opening stability until expiry date.

7. SPECIMEN COLLECTION AND PREPARATION
Use human serum or plasma (citrate) samples with this assay. If the assay is performed within 5 days after sample collection, the specimen should be kept at 2...8°C; otherwise they should be aliquoted and stored deep-frozen (-20 to -70°C). If samples are stored frozen, mix thawed samples well before testing. Avoid repeated freezing and thawing. Heat inactivation of samples is not recommended.

7.1. Sample Dilution
Before assaying, all samples should be diluted 1+100 with IgG Sample Diluent. Dispense 10µl sample and 1ml IgG Sample Diluent into tubes to obtain a 1+100 dilution and thoroughly mix with a Vortex.

For patients with expected antitoxin concentrations greater than Standard D (0.15 IU/ml) a second 1 + 1 dilution of this 1 + 100 diluted patient sample should be performed; e.g. 100 µl of first sample dilution + 100 µl of IgG sample diluent (mix well). Dilution factor: 2

8. ASSAY PROCEDURE
8.1. Test Preparation
Please read the test protocol carefully before performing the assay. Result reliability depends on strict adherence to the test protocol as described. The following test procedure is only validated for manual procedure. If performing the test on ELISA automatic systems we recommend to increase the washing steps from three to five and the volume of washing solution from 300µl to 350µl to avoid washing effects. Prior to commencing the assay, the distribution and identification plan for all specimens and controls should be carefully established on the result sheet supplied in the kit. Select the required number of microtiter strips or wells and insert them into the holder.

Please allocate at least:
1 well (e.g. A1) for the substrate blank,
4 wells (e.g. B1, C1, etc.) for Standard A, B, C and D.

It is recommended to determine patient samples in duplicate.

Perform all assay steps in the order given and without any appreciable delays between the steps.

A clean, disposable tip should be used for dispensing each standard and sample.

Adjust the incubator to 37° ± 1°C.

1. Dispense 100µl of each Standard (A, B, C and D) and diluted sample into the respective wells. Leave well A1 for substrate blank.
2. Cover wells with the foil supplied in the kit.
3. Incubate for 1 hour ± 5 min at 37±1°C.
4. When incubation has been completed, remove the foil, aspirate the content off the wells and wash each well three times with 300µl of washing solution. Avoid overflows from the reaction wells. The soak time between each wash cycle should be >5sec. At the end carefully remove remaining fluid by tapping strips on tissue paper prior to the next step!

Note: Washing is critical! Insufficient washing results in poor precision and falsely elevated absorbance values.

5. Dispense 100µl C. diphtheriae toxin anti-IgG Conjugate into all wells except for the blank well (e.g. A1). Cover with foil.
6. Incubate for 30 min at room temperature (20…25°C). Do not expose to direct sunlight.
7. Repeat step 4.
8. Dispense 100µl TMB Substrate Solution into all wells
9. Incubate for exactly 15 min at room temperature (20…25°C) in the dark.
10. Dispense 100µl Stop Solution into all wells in the same order and at the same rate as for the TMB Substrate Solution. Any blue colour developed during the incubation turns into yellow.

Note: Highly positive patient samples can cause dark precipitates of the chromogen! These precipitates have an influence when reading the optical density. Dilute the specimen as mentioned under 7.1. Sample Dilution.

11. Measure the absorbance of the specimen at 450/620nm within 30 min after addition of the Stop Solution.
8.2. Measurement
Adjust the ELISA Microwell Plate Reader to zero using the substrate blank in well A1.

* If - due to technical reasons - the ELISA reader cannot be adjusted to zero using the substrate blank in well A1, subtract the absorbance value of well A1 from all other absorbance values measured in order to obtain reliable results!

Measure the absorbance of all wells at 450 nm and record the absorbance values for each standard and patient sample in the distribution and identification plan.

* Dual wavelength reading using 620 nm as reference wavelength is recommended.

Where applicable calculate the mean absorbance values of all duplicates.

9. RESULTS

9.1. Assay Validation Criteria
In order for an assay to be considered valid, the following criteria must be met:

- **Substrate blank** in A1: Absorbance < 0.100
- **Standard A** in B1: Absorbance < 0.200
- **Standard B** in C1: Absorbance > 0.100
- **Standard C** in D1: Absorbance > 0.500
- **Standard D** in E1: Absorbance > 1.000

Standard A < Standard B < Standard C < Standard D

If these criteria are not met, the test is not valid and must be repeated.

9.2. Calculation of Results
In order to obtain *quantitative results in IU/ml* plot the (mean) absorbance values of the 4 Standards A, B, C and D on (linear/linear) graph paper in a system of coordinates against their corresponding concentrations (0.000, 0.015, 0.075, 0.150 IU/ml) and draw a standard calibration curve (absorbance values on the vertical y-axis, concentrations on the horizontal x-axis).

Read results from this standard curve employing the (mean) absorbance values of each patient specimen and control.

*Note:* Readings of additionally (1+1) diluted patient samples must be multiplied by the appropriate dilution factor in order to obtain correct results! (Dilution: 1+1 = Dilution factor: 2).

All suitable computer programs available can be used for automated result reading and calculation.

9.3. Typical Calibration Curve
9.4. Interpretation of Results and Recommendations [IU/ml]*

Each result should be carefully assessed by a physician.

- \(<0.01\): No protective antibody level! Immediate full course of basic immunization is recommended!
- \(0.01 - 0.09\): No reliable protection! Immediate booster injection is recommended.
- \(0.1 - 1.0\): Reliable protection! After about 10 years after last booster control and booster injection is recommended.
- \(>1.0\): Reliable long term protection!

After about 10 years after last booster control and booster injection is recommended.

It is recommended that the basic immunisation or booster is checked 4-6 weeks after immunisation and to record the data on the certificate of vaccination.

* according to: RKI 1999

10. SPECIFIC PERFORMANCE CHARACTERISTICS

10.1. Precision

<table>
<thead>
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<th>Intraassay</th>
<th>n</th>
<th>Mean value (OD)</th>
<th>CV (%)</th>
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<tbody>
<tr>
<td>Weak pos.</td>
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<td>0.95</td>
<td>12.1</td>
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<tr>
<td>Pos.</td>
<td>24</td>
<td>3.02</td>
<td>2.1</td>
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<table>
<thead>
<tr>
<th>Interassay</th>
<th>n</th>
<th>Mean value (IU/ml)</th>
<th>CV (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Weak pos.</td>
<td>12</td>
<td>0.04</td>
<td>11.4</td>
</tr>
<tr>
<td>Pos.</td>
<td>12</td>
<td>0.16</td>
<td>2.8</td>
</tr>
</tbody>
</table>

10.2. Diagnostic Specificity

The diagnostic specificity is defined as the probability of the assay of scoring negative in the absence of the specific analyte. It is 84.6%.

10.3. Diagnostic Sensitivity

The diagnostic sensitivity is defined as the probability of the assay of scoring positive in the presence of the specific analyte. It is 100%.

10.4. Analytical sensitivity

The analytical sensitivity – defined as the apparent concentration of the analyte that can be distinguished from the zero calibrator – is 0.01 IU/ml.

10.5. Interferences

Interferences with hemolytic, lipemic or icteric sera are not observed up to a concentration of 10 mg/ml hemoglobin, 5 mg/ml triglycerides and 0.2 mg/ml bilirubin.

**Note:** The results refer to the groups of samples investigated; these are not guaranteed specifications.

11. LIMITATIONS OF THE PROCEDURE

Bacterial contamination or repeated freeze-thaw cycles of the specimen may affect the absorbance values. Diagnosis of an infectious disease should not be established on the basis of a single test result. A precise diagnosis should take into consideration clinical history, symptomatology as well as serological data. In immunocompromized patients and newborns serological data only have restricted value.

12. PRECAUTIONS AND WARNINGS

- In compliance with article 1 paragraph 2b European directive 98/79/EC the use of the in vitro diagnostic medical devices is intended by the manufacturer to secure suitability, performances and safety of the product. Therefore the test procedure, the information, the precautions and warnings in the instructions for use have to be strictly followed. The use of the testkits with analyzers and similar equipment has to be validated. Any change in design, composition and test procedure as well as for any use in combination with other products not approved by the manufacturer is not authorized; the user himself is responsible for such changes. The manufacturer is not liable for false results and incidents for these reasons. The manufacturer is not liable for any results by visual analysis of the patient samples.
- Only for in-vitro diagnostic use.
- All components of human origin used for the production of these reagents have been tested for anti-HIV antibodies, anti-HCV antibodies and HBsAg and have been found to be non-reactive. Nevertheless, all materials should still be regarded and handled as potentially infectious.
- Do not interchange reagents or strips of different production lots.
- No reagents of other manufacturers should be used along with reagents of this test kit.
- Do not use reagents after expiry date stated on the label.
- Use only clean pipette tips, dispensers, and lab ware.
- Do not interchange screw caps of reagent vials to avoid cross-contamination.
- Close reagent vials tightly immediately after use to avoid evaporation and microbial contamination.
- After first opening and subsequent storage check conjugate and standard vials for microbial contamination prior to further use.
- To avoid cross-contamination and falsely elevated results pipette patient samples and dispense conjugate without splashing accurately to the bottom of wells.
- The GenWay Biotech ELISA is only designed for qualified personnel who are familiar with good laboratory practice.

| WARNING | In the used concentration Bronidox L has hardly any toxicological risk upon contact with skin and mucous membranes! |
| WARNING | Sulphuric acid irritates eyes and skin. Keep out of the reach of children. Upon contact with the eyes, rinse thoroughly with water and consult a doctor! |

12.1. Disposal Considerations
Residues of chemicals and preparations are generally considered as hazardous waste. The disposal of this kind of waste is regulated through national and regional laws and regulations. Contact your local authorities or waste management companies which will give advice on how to dispose hazardous waste.

13. ORDERING INFORMATION
Prod. No.: GWB-F06CAF Corynebacterium diphtheriae toxin IgG-ELISA (96 Determinations)
BIBLIOGRAPHY

BGA, Impfempfehlung der Ständigen Impfkommission (STIKO) des Bundesgesundheitsamtes vom 22.2.1994, Bundesgesundheitsblatt 8/94


WHO (7.5.1993): Expanded Programme on Immunization-Outbreak of diphtheria, update Wkly Epid Rec No.19, 134-138


<table>
<thead>
<tr>
<th>Symbols Key</th>
<th>Description</th>
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<td>Manufactured by</td>
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<tr>
<td>IVD</td>
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<tr>
<td>MTP</td>
<td>Microplate</td>
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<tr>
<td>CONJ</td>
<td>Conjugate</td>
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<tr>
<td>CAL</td>
<td>Calibrator</td>
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<tr>
<td>DIL G</td>
<td>Sample diluent buffer IgG</td>
</tr>
<tr>
<td>SOLN STOP</td>
<td>Stop solution</td>
</tr>
<tr>
<td>SUB TMB</td>
<td>TMB Substrate solution</td>
</tr>
<tr>
<td>WASHBUF</td>
<td>Washing solution 20x concentrated</td>
</tr>
<tr>
<td>20x</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Contains sufficient for “n” tests</td>
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</table>
SCHEME OF THE ASSAY
Corynebacterium diphtheriae toxin IgG-ELISA

Assay Preparation

Prepare reagents and samples as described.
Establish the distribution and identification plan for all specimens and standards on the result sheet supplied in the kit
Select the required number of microtiter strips or wells and insert them into the holder.

Assay Procedure

<table>
<thead>
<tr>
<th></th>
<th>Substrate blank (e.g. A1)</th>
<th>Standard A</th>
<th>Standard B</th>
<th>Standard C</th>
<th>Standard D</th>
<th>Sample (1+100 diluted)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Standard A</td>
<td>-</td>
<td>100µl</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>100µl</td>
</tr>
<tr>
<td>Standard B</td>
<td>-</td>
<td>100µl</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Standard C</td>
<td>-</td>
<td>-</td>
<td>100µl</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Standard D</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>100µl</td>
<td>100µl</td>
<td>-</td>
</tr>
<tr>
<td>Sample (1+100 diluted)</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>100µl</td>
<td>100µl</td>
</tr>
</tbody>
</table>

Cover wells with foil supplied in the kit
**Incubate for 1 h at 37°C**
Wash each well three times with 300µl of washing solution

<table>
<thead>
<tr>
<th>Conjugate</th>
<th>-</th>
<th>100µl</th>
<th>100µl</th>
<th>100µl</th>
<th>100µl</th>
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</tr>
</thead>
</table>

Cover wells with foil supplied in the kit
**Incubate for 30 min at room temperature**
Wash each well three times with 300µl of washing solution

<table>
<thead>
<tr>
<th>TMB Substrate</th>
<th>100µl</th>
<th>100µl</th>
<th>100µl</th>
<th>100µl</th>
<th>100µl</th>
<th>100µl</th>
</tr>
</thead>
</table>

**Incubate for 15 min at room temperature in the dark**

<table>
<thead>
<tr>
<th>Stop Solution</th>
<th>100µl</th>
<th>100µl</th>
<th>100µl</th>
<th>100µl</th>
<th>100µl</th>
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Photometric measurement at 450 nm (reference wavelength: 620 nm)