tTG IgG ELISA

Instructions for Use

REF 2811FE00 12 x 8 determinations

IVD CE

SBA Part of BBI Solutions

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Contents

The product described here complies with the requirements of the IVD Directive 98/79/EC and transitional provisions of Article 110 of 2017/746 IVD Regulation.

1. Overview

1.1 Introduction and background

Celiac disease (CD; synonyme: gluten-sensitive enteropathy) affects the upper small intestine and is caused by a hypersensitive reaction to gluten, a set of proteins present in many kinds of cereal grain, e.g. wheat, oats, barley and rye (1). Its morphological manifestation, the more or less complete atrophy of the villi of the mucous membrane, leads to malabsorption problems, e.g. chronic vitamin deficiency (2).

It has been known for many years that elevated levels of gluten-specific antibodies occur in the sera of celiac patients. Also, autoantibodies directed against endomysium of the smooth muscle are specifically associated with this disease (3, 4, 5, 6). Tissue transglutaminase (tTG) has been identified as the predominant endomysial CD autoantigen (7).

The present enzyme-linked immunosorbent assay (ELISA) is intended for the quantitative or qualitative determination of IgG antibodies directed against tTG in human serum or plasma (cf. section 7). The immobilised antigen is a highly purified preparation of human recombinant tTG, expressed in the baculovirus system. The test is fast (incubation time 30 / 30 / 30 minutes) and flexible (divisible solid phase, ready-to-use reagents). Six calibrators allow quantitative measurements; a negative and a positive control check the assay performance.

1.2 Intended Purpose

tTG IgG ELISA is an enzyme-linked immunosorbent assay (ELISA) intended for the quantitative or qualitative determination of IgG class antibodies directed against tissue Transglutaminase (tTG) in human serum or plasma samples.
Its function is the aid to diagnosis of gluten-sensitive enteropathies like celiac disease and dermatitis herpetiformis.
This product is intended for manual or automated professional in vitro diagnostic use only.

2. Warnings and precautions

The test kit is intended for in vitro diagnostic use only; not for internal or external use in humans or animals. It must be executed by trained professional staff.

The kit has been tested for transport stability and can be shipped unrefrigerated for up to 3 days. Store at 2 - 8°C on arrival. In case of doubt, contact your local distributor or the manufacturer.

Do not use reagents beyond their expiration dates.

Adherence to the protocol is strongly recommended.

The sample buffer, calibrators and controls contain Na-azide as antimicrobial agent. The wash buffer contains bromonitrodioxane and the conjugate methylisothiazolone / bromonitrodioxane as preservative. The substrate contains 3, 3', 5, 5'-tetramethylbenzidine (TMB) and hydrogen peroxide (H_2O_2). The stop solution, 0,2 M sulfuric acid (H_2SO_4), is acidic and corrosive.

The above mentioned reagents may be toxic if ingested. Follow routine precautions for handling hazardous chemicals. Avoid all body contact, wear gloves and eye protection. If one of the reagents comes into contact with skin or mucous membrane, wash thoroughly with water. Never pipette by mouth. Dispose in a manner complying with local/national regulations.

Na-Azide may react with lead and copper plumbing to form explosive metal azides. On disposal, flush with a large amount of water to prevent azide build-up.

The calibrators and controls contain components of human origin. They were tested for human immunodeficiency virus (HIV)-Ag, hepatitis B surface (HBs)-Ag and antibodies against HIV 1/2 and hepatitis C virus (HCV) and showed negative results; either in an FDA-approved or a CE-compliant test, according to European Directive 98/79/EC.

However, no test can guarantee that material of human origin is not actually infectious. The preparations should therefore be treated as potentially infectious and disposed of accordingly, as should the samples (and residues thereof); according to CDC (Center of Diseae Control, Atlanta, USA) or other local / national guidelines on laboratory safety and decontamination.

3. Principle of the test

The wells of the solid phase are coated with tTG. On this surface, the following immunological reactions take place:

1st reaction: tTG-specific antibodies present in the sample bind to the immobilised antigen, forming the antigen-antibody complex. Then, non-bound sample components are washed away from the solid phase.

2nd reaction: A second antibody, directed at human IgG antibodies and conjugated with horse-radish peroxidase (HRP), is added. This conjugate binds to the complex. Then, excess conjugate is washed away from the solid phase.

3rd reaction: The enzyme-labelled complex converts a colourless substrate into a blue product. The degree of colour development reflects the concentration of tTG IgG in the sample.

4. Contents of the kit

a. tTG Coated Microwell Plate

1 microwell plate, coated with tTG and hermetically packed in a foil laminate pouch together with a desiccant bag. The plate consists of 12 strips, each of which can be broken into 8 individual wells.

MWP	12x8

b. Sample buffer

Sample buffer, 100 mL, ready-to-use, orange coloured. Contains Tris-buffered saline (TBS), bovine serum albumin (BSA), Tween and Na-azide.

BUF	SPL

c. Wash buffer

Wash buffer, 100 mL, 10x-concentrate, blue coloured. Contains TBS, Tween and bromonitrodioxane.

BUF	WASH	10x

d. tTG IgG Calibrator 1-6

6 calibrators, 2,0 mL each, 0 - 1,0 - 3,0 - 10 - 30 and 100 U tTG IgG / mL, ready-to-use, gradually blue coloured. Contain TBS, BSA, Tween and Na-azide.

CAL	1-6

e. tTG IgG Negative and Positive Control

Negative and positive control, 2,0 mL each, ready-to-use, green and red coloured, respectively. Contain TBS, BSA, Tween and Na-azide.

CONTROL	−

CONTROL	+

f. tTG IgG 14 mL Conjugate

Anti-human IgG HRP conjugate, 14 mL, ready-to-use, red coloured. Buffered solution containing stabilising protein, methylisothiazolone and bromonitrodioxane.

CONJ	IgG

g. Substrate
Substrate solution, 14 mL, ready-to-use, colourless. Contains a buffered solution of TMB and H_2O_2. Contained in a vial impermeable to light.

SUBS	TMB

h. Stop solution
Stop solution (0,2 M H_2SO_4), 14 mL, colourless, ready-to-use. Caution: sulfuric acid is corrosive.

SOLN	STOP

i. Instructions for Use

j. Lot-specific certificate of analysis

5. Materials required but not supplied

a. Deionised or distilled water

b. Graduated cylinder, 1000 mL

c. Tubes for sample dilution (transfer tubes in the microwell plate format recommended)

d. Pipettes for 10, 100 and 1000 µL (1- and 8-channel pipettes recommended)

e. Microwell plate washer (optional)

f. Microwell plate photometer fitted with a 450 nm filter

g. ELISA evaluation program (recommended)

6. Storage of the kit

Store kit at 2 - 8°C, do not freeze. It is stable up to the expiry date stated on the label of the box. Do not use kit beyond its expiry date.

7. Reagent and sample preparation / specimen requirements

Do not exchange or pool corresponding components from different kits, due to possibly different shipping or storage conditions. If the kit is to be used for several tests, only the currently needed amount of reagents should be withdrawn. It is **crucially important** that no cross-contamination between the reagents occurs. Use only clean pipettes and do **not pour back** residues into the original flasks.

a. The solid phase must reach room temperature before opening the pouch. Remove the supernumerary microwells from the frame and immediately put them back into the pouch, together with the desiccant bag. Reseal the pouch hermetically and keep it refrigerated for future use.

b. Dilute the wash buffer 10x-concentrate (100 mL, blue) with 900 mL deionised water. Mix thoroughly. The diluted buffer is stable for several weeks if stored refrigerated (2 - 8°C).

c. Preparation of the samples: handle patient specimens as potentially infectious agents. Besides serum, EDTA-, citrate- or heparin-treated plasma is suitable sample material as well.

   Specimen requirements: highly lipemic, haemolysed or microbially contaminated samples may cause erroneous results and should be avoided.

   Prepare samples using normal laboratory techniques. Turbid samples must first be clarified (centrifuged). The clarified or clear samples are mixed and then diluted 1/100, e.g. 10 µL serum or plasma + 990 µL sample buffer. Also mix the dilution.

   For rapid dispensing during the assay procedure, preparation of the calibrators, controls and samples in microwell transfer tubes is recommended. This allows the operation of an 8-channel pipette during the assay procedure.

   If samples are not assayed immediately, they should be stored at 2 - 8°C and assayed within 3 days. Repeated freezing and thawing of samples should be avoided. Thawed samples must be mixed prior to diluting.

8. Assay procedure

8.1. Manual operation

Before starting the assay, all components of the kit must have reached room temperature (23 ± 3°C).

To achieve best results, i.e. the maximum ratio between specific and background signal, **careful washing** is essential (steps a, c and e). It is **crucially important to remove the wash solution completely.** For that purpose, tap the plate firmly on several layers of absorbent tissue. Automated washers must be verified according to results obtained by manual washing.

a. Immediately prior to use, wash the solid phase once: fill wells with 350 µL wash buffer each, let soak for about 10 seconds in the wells and remove.

b. Dispense the calibrators (2,0 mL each, ready-to-use, gradually blue), controls (2,0 mL each, ready-to-use, green and red) and the diluted samples rapidly into the microwells; 100 µL per well. Duplicate measurements are recommended.

   Incubate the plate for 30 minutes at room temperature (23 ± 3°C).

c. Wash the wells 4 times as in step a.

d. Rapidly (preferably using an 8-channel pipette) dispense the conjugate (14 mL, ready-to-use, red); 100 µL per well. Incubate the plate as in step b.

e. Repeat wash step c.

f. Rapidly (preferably using an 8-channel pipette) dispense the substrate solution (14 mL, ready-to-use, colourless, black vial); 100 µL per well. Incubate the plate as in step b. As the substrate is photosensitive, avoid intense light exposure (e.g. direct sunlight) during incubation.

g. Rapidly (preferably using an 8-channel pipette) dispense the stop solution (14 mL, ready-to-use, colourless. Caution: corrosive!); 100 µL per well. Use the same sequence as for the substrate. The colour changes from blue to yellow. Agitate the plate, preferably on an orbital shaker, for about 10 seconds.

h. Immediately read the absorbance in the microwell plate photometer at 450 nm.

Refrigerate the remainder of the reagents (2 - 8°C) if they are to be used again.

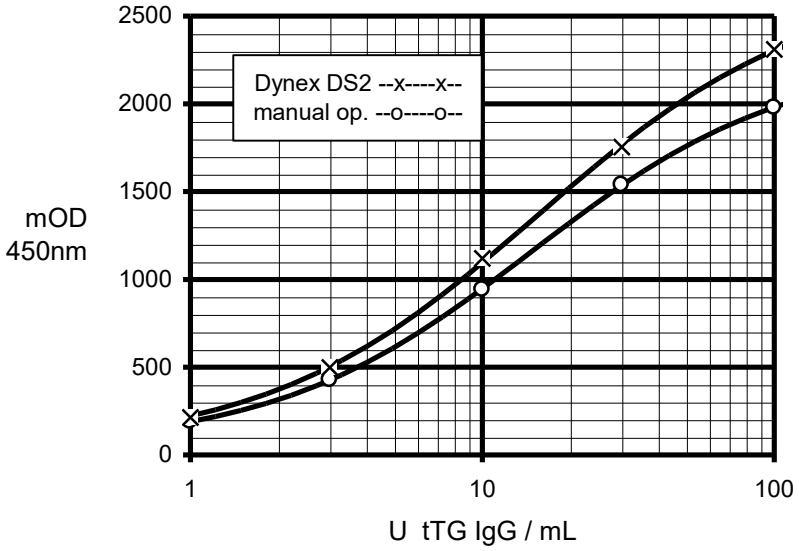
8.2. Dynex DS2 automated ELISA system

This product has been validated for use with the Dynex DS2 automated ELISA system. A description of the program flow for the assay execution and evaluation can be provided as a pdf file. The parameters of this program are merely a proposal and may need to be adapted by the operator to the requirements of the actual assay. In general terms, we have attempted to stick as close as possible to the protocol of manual operation, as above. However, due to the necessarily elevated temperature within the DS2, the substrate incubation period had to be shortened.

Section 11.8. gives a performance comparison between manual assay operation and the DS2 ELISA system.

9. Evaluation and quality control

Quantitative evaluation: the data obtained are quantitatively evaluated with the standard curve, as shown below. However, the depicted curve can only serve as a model. It can not substitute the measurement of the calibrators, together with the controls and actual samples. The curve has been constructed with a conventional ELISA evaluation program, using a 4-parameter function. The Spline approximation is also appropriate.



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If no computer-supported evaluation is possible, the standard curve may be drawn by hand. It allows transformation of the absorbance value of a sample into its concentration, i.e. into U tTG IgG per mL sample.

Qualitative evaluation: the test may also be evaluated in a qualitative manner. This requires measurement of the positive control only. Nevertheless, measurement and examination of the negative control is recommended (see below: quality control).

In qualitative test evaluation, the absorbance of the samples is compared with the borderline absorbance (= cut-off). It is determined according to the following formula:

$$absorbance_{borderline} = absorbance_{positive\ control} \times factor$$

The factor depends on the kit lot and is quoted in the lot-specific certificate of analysis which is included with each test kit. Example:

$absorbance_{positive\ control}$ = 1250 mOD
factor = 0,35
$absorbance_{borderline}$ = 1250 mOD x 0,35 = 438 mOD

In order to gain an impression of how positive a particular sample is for tTG IgG, one may calculate the ratio, according to the formula:

$$ratio = absorbance_{sample} / absorbance_{borderline}$$

Example:

$absorbance_{borderline}$ = 438 mOD
$absorbance_{sample}$ = 1480 mOD
ratio = 1480 mOD / 438 mOD = 3,4

Quality control: the positive and negative control check the assay performance. Their authorised values and acceptable ranges, respectively, are quoted in the lot-specific certificate of analysis. Values of the controls must fall within the indicated ranges; otherwise, the results of the assay are invalidated.

10. Interpretation of results / limitations of the procedure

Based on the measurement of a blood donor and a positive collective of sera (see below), we suggest for the assessment of patient sera:

	quantitative evaluation U tTG IgG / mL sample	qualitative evaluation ratio
normal (negative) range	< 2,6	< 0,89
cut-off	3,0	1,00
equivocal range	2,6 - 3,5	0,89 - 1,12
positive range	> 3,5	> 1,12

These specifications are given as an indication only; in order to check their accuracy, each analysis should include parallel samples of normal sera.

A negative test result indicates that the patient does not have an elevated level of IgG antibodies to tTG. In view of the low sensitivity of the ELISA (cf. section 11.7), such a result does not preclude the presence of CD. If clinical signs are observed,

IgA antibodies directed at tTG and/or IgG/IgA antibodies against Modified Gliadin Peptide (MGP) should be determined.

Due to the high specificity of tTG IgG for CD (cf. article 11.7), a positive result should be considered as an indication of the disease.

Specimens exhibiting results between the borderlines quoted above should be considered as equivocal and reported as such. It is recommended that a second sample be collected two weeks later and run in parallel with the first sample to document a possible change of antibody titer.

As with any serological test, the results should be interpreted in the light of the patient's symptoms and other diagnostic criteria. In more detail, the definitive diagnosis of celiac disease requires at least the following 3 criteria:

a. serological test: tTG IgA antibodies in the patients serum;

b. histological test: biopsy and histologic evaluation according to the Oberhuber-Marsh classification;

c. nutritional test: remission (of symptomes and of serological findings) on a gluten-free diet. Hence, during diagnosis period, blood samples should be taken several times of a patient and monitored (8 - 11).

In case one of these criteria is not met, the attending physician shall refer to official guidelines to decide on the follow up steps to take for diagnosis and treatment (12 - 15).

11. Performance characteristics

11.1. Standardisation

The test is standardised with a purified serum preparation containing IgG antibodies specifically directed at tTG. This preparation is calibrated against a set of gradually positive sera, solely reserved for this purpose.

The degree of sample reactivity is measured in arbitrary units (U/mL) since no international standard is available.

11.2. Analytical specificity

The test allows the specific determination of human IgG antibodies directed against tTG.

Interference with anticoagulants (EDTA, Citrat, Heparin) in samples has been tested and no interference effects have been observed.

11.3. Detection limit (analytical sensitivity)

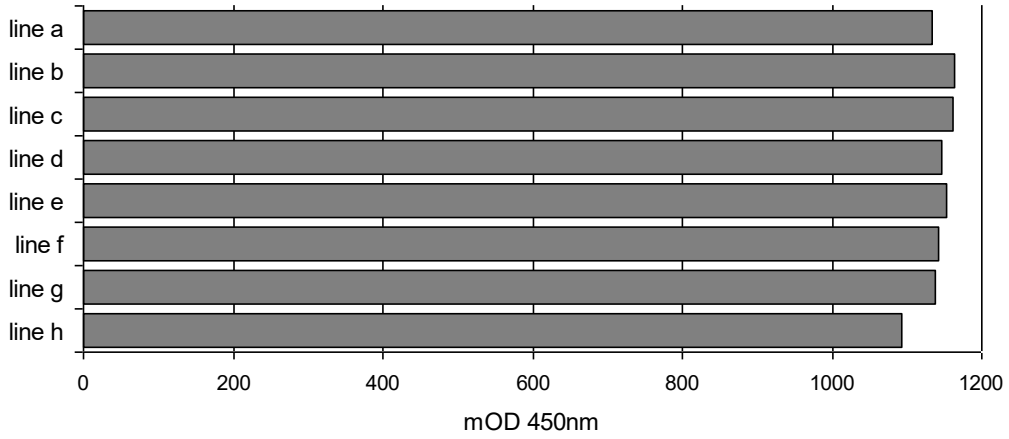
The detection limit is defined as that concentration of analyte that corresponds to the mean absorbance of sample buffer plus 3-fold standard deviation (s). It was determined as < 0,1 U tTG IgG per mL sample (n = 24). Recommended measuring range: 0,5 - 80 U /mL.

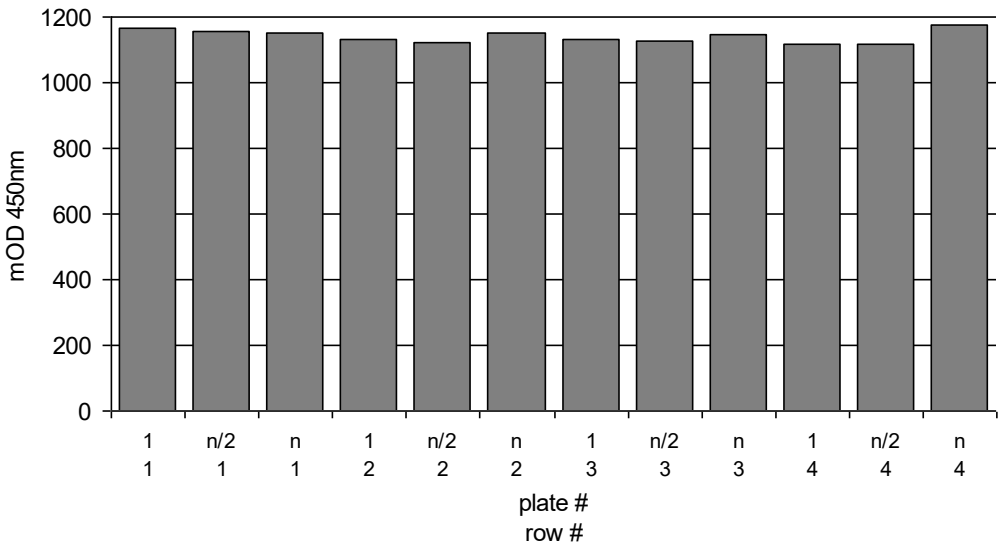
11.4. Homogeneity of the solid phase

Measurement of the solid phase homogeneity is a regular QC part of each production lot. This is determined by 288-fold measurement of an IgA-positive but non-saturating sample on 3 selected plates. Acceptance criterion: mOD-coefficient of variation (cv) over the plates < 8%.

The figure below shows a representative excerpt (solid phase lot no. 1211R) of such an analysis.

plate #	1	n/2	n	1	n/2	n	1	n/2	n	1	n/2	n	mean	cv %
row #	1	1	1	2	2	2	3	3	3	4	4	4		
line a	1180	1141	1156	1121	1124	1145	1149	1109	1154	1077	1096	1157	1134	2,6
line b	1189	1179	1166	1143	1146	1172	1151	1147	1172	1159	1152	1192	1164	1,5
line c	1201	1180	1161	1133	1156	1170	1147	1143	1157	1160	1150	1174	1161	1,6
line d	1167	1151	1164	1134	1138	1158	1143	1120	1142	1134	1136	1168	1146	1,3
line e	1194	1165	1158	1138	1147	1173	1141	1146	1164	1117	1135	1164	1154	1,8
line f	1137	1149	1162	1139	1109	1158	1135	1132	1159	1127	1120	1181	1142	1,8
line g	1154	1158	1162	1133	1093	1144	1120	1134	1146	1131	1098	1189	1139	2,4
line h	1095	1116	1096	1094	1064	1096	1082	1089	1094	1050	1068	1167	1093	2,7
mean	1165	1155	1153	1129	1122	1152	1134	1128	1149	1119	1119	1174	**1142**	
cv %	3,0	1,8	2,0	1,4	2,8	2,2	2,0	1,8	2,1	3,4	2,7	1,1		**2,7**





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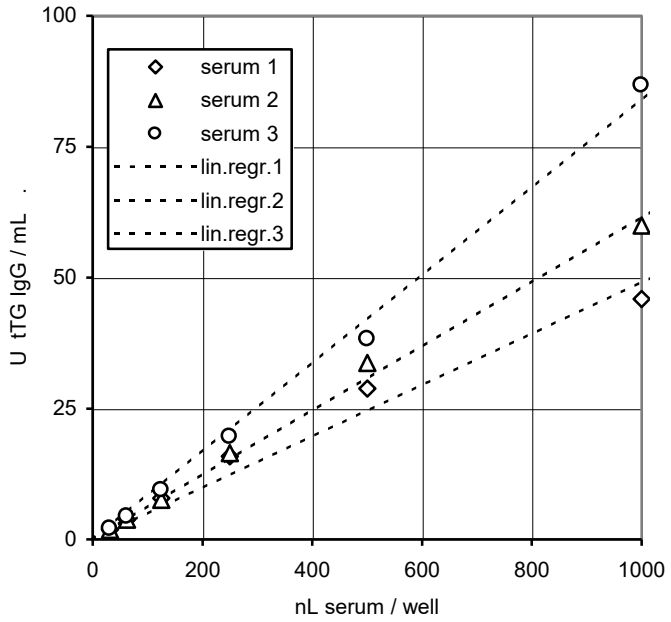
11.5. Linearity

In order to assess the dose-response relationship of the test, positive sera were measured in serial 2-fold dilution. Acceptance criterion: linear regression of 4 successive dilutions must yield a correlation factor > 0,98. A typical result is depicted below.



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11.6. Precision

For the assessment of the test precision, the variability of results under the following conditions was determined: a. within 1 assay and between 3 assays, b. between 3 operators and c. between 2 kit lots.

a. Intra- and inter-assay variability (n = 24 and 72, respectively)

sample	mean U/mL	variability (cv, %) intra-assay	inter-assay
1	4,6	3,2	3,4
2	11,5	5,2	5,8
3	40,5	4,2	6,6

b. Operator to operator variability (n = 12)

sample	mean U/mL	variability (cv, %)
1	4,5	3,4
2	11,3	5,6
3	35,2	8,2

c. Variability between 2 kit lots (n = 6)

sample	mean U/mL	variability (cv, %)
1	4,7	10,0
2	10,0	5,2
3	40,2	11,2

11.7. Frequency distribution of tTG IgG

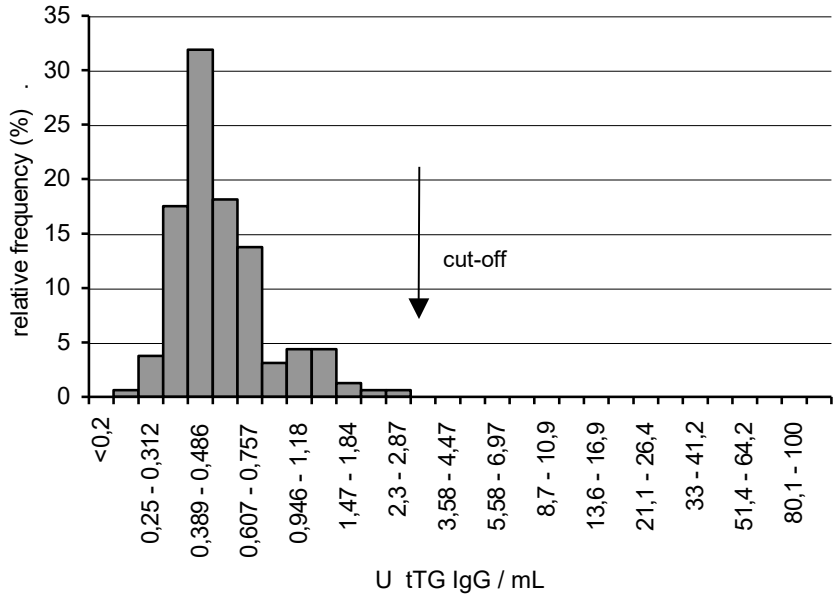
This was analysed in a sera collective of blood donors, equally distributed by sex and age, and a collective of sera found positive for both gliadin IgA and tTG IgA according to CE-compliant reference ELISAs. The following distribution of the analyte was observed:

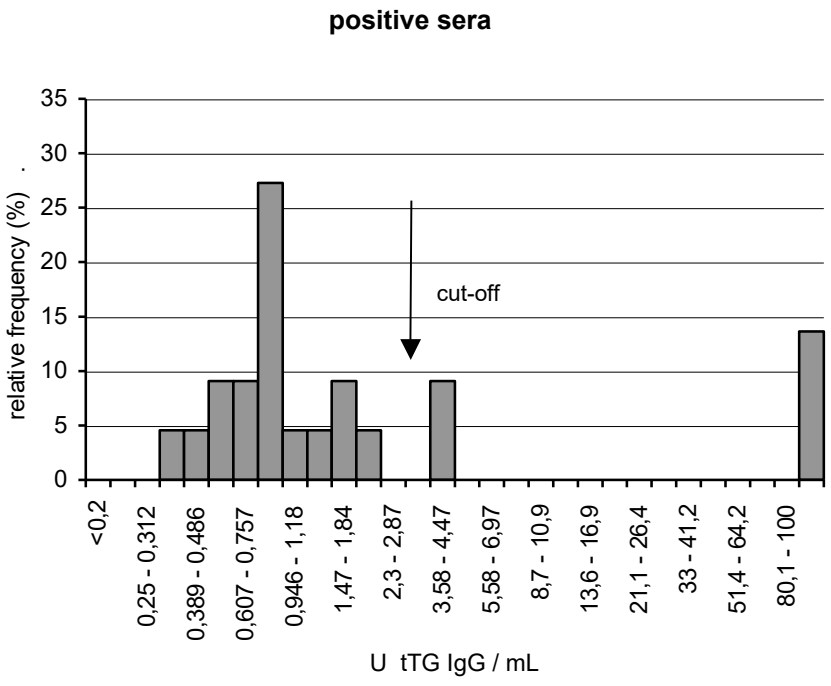
blood donor sera			**positive sera**		
n:	160		n:	22	
mean:	0,6	U/mL	mean:	16,9	U/mL
mean + s:	0,9	U/mL	mean - s:	< 0	U/mL
mean + 2s:	1,2	U/mL	mean - 2s:	< 0	U/mL
median:	0,5	U/mL	median:	0,9	U/mL
95th percentile:	1,5	U/mL	5th percentile:	0,4	U/mL

Analysis of the frequency distribution data was used to determine the cut-off as 3,0 U/mL (16). The data presented here suggest a diagnostic specificity and sensitivity of the ELISA of nearly 100 and about 23 %, respectively.

The low sensitivity (as compared to > 90 % of tTG IgA) constitutes an obvious disadvantge of the parameter. Measurement of tTG IgG is advisable in cases of selective IgA deficiency, a condition with 10-fold higher prevalence in celiac patients, as compared to the normal population (17). In such IgA-deficient collectives, a sensitivity of about 90 % of the tTG IgG parameter has been reported (18); a finding that emphasizes the valuble role of the tTG IgG ELISA as complement of the tTG IgA ELISA.

blood donor sera





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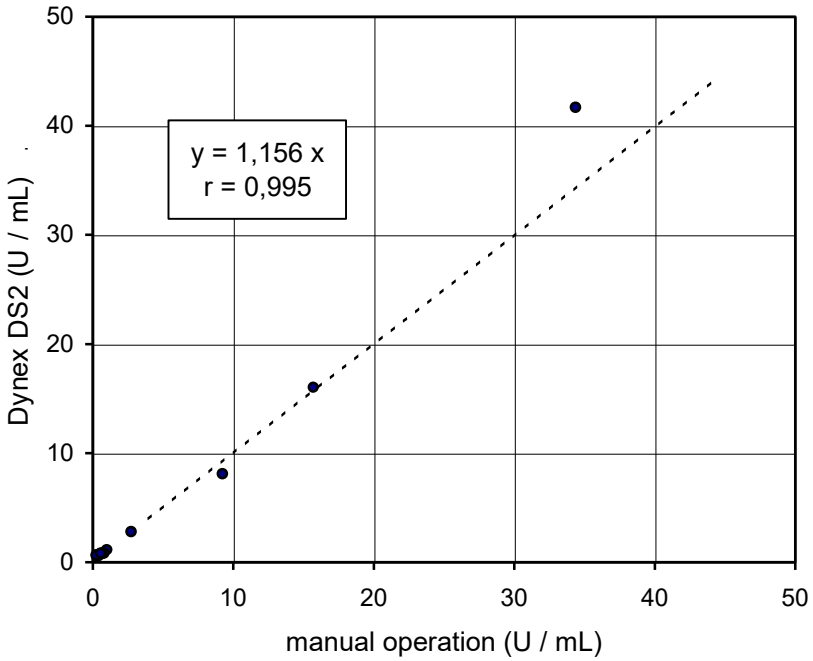
11.8. Manual operation vs. Dynex DS2 automated ELISA system

Variability: Using specimen of one and the same kit lot, the variability of assay results were compared between manual operation and the Dynex DS2 automated ELISA system:

	manual operation	Dynex DS2
intra-assay variability (n = 16)	mean cv = 2,7 %	mean cv = 5,6 %
inter-assay variability (n = 48)	mean cv = 4,1 %	mean cv = 6,0 %

Standard curve: depicted in section 9

Correlation:



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12. Declaration

Steffens biotechnische Analysen GmbH (SBA) guarantees that the product delivered has been thoroughly tested to ensure that its properties specified herein are fulfilled. No further warranties are given.

The performance data presented here were obtained using the procedure indicated. Any modification in the procedure may affect the results in which case SBA disclaims all warranties whether expressed, implied or statutory. Moreover, SBA accepts no liability for any damage, whether direct, indirect or consequential, which results from inappropriate use or storage of the product.

13. Symbols

Catalogue number

Batch code

Unique Device Identification

Contains sufficient for <n> tests

In Vitro diagnostic medical device

Conformité Européenne

Keep away from sunlight

Store at 2 - 8°C

Use-by Date

Consult “Instructions for Use”

Caution

Biological risk

Manufacturer

Distributor

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15. Summary flow chart

a. Dilute the samples 1/100 in sample buffer (100 mL, ready-to-use, orange) and mix.

b. Dilute the wash buffer 10x-concentrate (100 mL, blue) with water and mix.

c. Wash the wells once with 350 µL wash buffer each. Dispense 100 µL of the calibrators (2,0 mL each, ready-to-use, gradually blue) and controls (2,0 mL each, ready-to-use, green and red) and of the diluted samples into the wells of the solid phase. Duplicate measurements are recommended. Incubate for 30 minutes at room temperature (23 ± 3°C).

d. Wash the wells 4 times with 350 µL wash buffer each.

e. Dispense 100 µL of the conjugate (14 mL, ready-to-use, red) into the wells. Incubate as in step c.

f. Repeat washing step d.

g. Dispense 100 µL of the substrate solution (14 mL, ready-to-use, black vial) per well. Incubate as in step c. Then, add 100 µL stop solution (14 mL, ready-to-use, colourless) per well and agitate the plate briefly.

h. Immediately measure the absorbance at 450 nm.

i. Quantitative evaluation: determine the standard curve and, using this curve, transform the absorbance of the samples into their respective antibody concentration (U/mL).

j. Qualitative evaluation: determine the borderline absorbance by multiplying the absorbance of the positive control with the factor shown in the certificate of analysis. Then, calculate the ratio of the samples by dividing their absorbance by the borderline absorbance.