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# **ADMA Ultrasensitive ELISA**

Catalog Number:

**AMU39-K01 (1 x 96 wells)**

*For Research Use Only. Not for use in diagnostic procedures.*

*v. 1.0*

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## 1. Introduction and Principle of the Test

The Eagle Biosciences ADMA Ultrasensitive ELISA Assay kit is an Enzyme-linked immunosorbent assay used for the quantitative and very sensitive determination of ADMA (Asymmetric Dimethylarginine) in human / mouse / rat plasma and serum samples as well as cell culture samples. The ADMA Ultrasensitive ELISA Assay kit is for research use only and should not be used in diagnostic procedures.

The vascular endothelium plays a central role in the regulation of vascular structure and function, mainly due to the formation of endothelium-derived nitric oxide (NO). NO has been named an “endogenous anti-atherogenic molecule” due to its diverse regulatory functions in vascular homeostasis. NO is formed by the enzyme NO synthetase (NOS) from the amino acid precursor L-arginine. NOS activity can be down-regulated by asymmetric dimethylarginine (ADMA), an endogenous inhibitor of NOS.

The effects of ADMA on NO synthesis and NO-mediated pathophysiological processes have been described in numerous experimental studies. Moreover, elevated ADMA levels in plasma have been found in clinical studies including patients with hypercholesterolemia, hypertension, chronic heart failure, chronic renal failure and other internal disorders.

Recent prospective and cross-sectional studies indicated that elevated ADMA levels are a risk factor for future cardiovascular events and total mortality. ADMA may have diagnostic relevance as a novel cardiovascular risk marker.

The new competitive ADMA - high sensitive - ELISA uses the microtiter plate format. ADMA is bound to the solid phase of the microtiter plate. ADMA in the samples is acylated and competes with solid phase bound ADMA for a fixed number of rabbit anti-ADMA antiserum binding sites. When the system is in equilibrium, free antigen and free antigen-antiserum complexes are removed by washing. The antibody bound to the solid phase ADMA is detected by anti-rabbit/peroxidase. The substrate TMB / peroxidase reaction is monitored at 450 nm. The amount of antibody bound to the solid phase ADMA is inversely proportional to the ADMA concentration of the sample.

## 2. Precautions

- The ADMA Ultrasensitive ELISA Assay kit is for research use only.
- Disposable gloves should be used.
- Material of animal origin used in the preparation of the ADMA Ultrasensitive ELISA Assay kit has been obtained from animals certified as healthy but these materials should be handled as potentially infectious.



### 3. Storage and Stability

- On arrival, store the ADMA Ultrasensitive ELISA Assay kit at 2-8 °C. Once opened the kit is stable until its expiry date.
- For stability of prepared reagents refer to Preparation of Reagents.
- Do not use components beyond the expiration date shown on the labels.
- Do not mix various lots of any ADMA Ultrasensitive ELISA Assay kit component within an individual assay.

### 4. Contents of the Kit

- 4.1 **MT-Strips** **STRIPS** 12 strips  
8 wells each, break apart  
coated with ADMA
- 4.2 **Standards 1 - 7** **CAL 1 - 7** 7 vials  
each 4 ml, ready for use  
Concentrations:
- | Standard | 1 | 2   | 3   | 4   | 5   | 6   | 7   |
|----------|---|-----|-----|-----|-----|-----|-----|
| µmol/l   | 0 | 0.1 | 0.3 | 0.6 | 1.0 | 2.0 | 5.0 |
- 4.3 **Control 1 & 2** **CON 1 & 2** 2 vials  
each 4 ml, ready for use  
Range: see q.c. certificate
- 4.4 **Acylation Buffer** **ACYL-BUFF** 1 vial  
3.5 ml, ready for use
- 4.5 **Acylation Reagent** **ACYL-REAG** 3 vials  
lyophilised, dissolve content  
in 2.8 ml Solvent before use; if required  
combine the contents of both vials (see also 6.)
- 4.6 **Antiserum** **AS** 1 vial  
5.5 ml, colour coded blue, ready for use  
Rabbit-anti-N-Acyl-ADMA
- 4.7 **Enzyme Conjugate** **CONJ** 1 vial  
12 ml, ready for use  
goat anti-rabbit-IgG-peroxidase
- 4.8 **Wash Buffer** **WASH** 1 bottle  
20 ml, concentrated  
Dilute content with dist. water to 500 ml total volume.



4.9	<b>Substrate</b> 12 ml TMB solution, ready for use	<b>SUB</b>	1 vial
4.10	<b>Stop Solution</b> 12 ml, ready for use Contains 0.3 M sulphuric acid, not corrosive	<b>STOP</b>	1 vial
4.11	<b>Reaction Plate</b> for acylation	<b>ACYL-PLATE</b>	1 piece
4.12	<b>Equalizing Reagent</b> lyophilized, dissolve content with 20.5 ml dist. water, dissolve carefully to minimize foam formation	<b>EQUA-REAG</b>	1 vial
4.13	<b>Solvent</b> each 6 ml, contains acetone/ DMSO (please note that Solvent reacts with many plastic materials including plastic trays; Solvent does not react with normal pipette tips and with glass devices)	<b>SOLVENT</b>	2 vials

Additional materials and equipment required but not provided:

- Pipettes (20, 25, 50, 100 and 200 µl)
- Orbital shaker
- Microplate washing device
- Microplate photometer (450 nm)
- Vortex mixer
- Roll mixer

## 5. Sample Collection

- The test can be performed with serum, EDTA or heparin plasma from a human, mouse, or rat as well as cell culture media.
- Culture media containing high concentrations of Arginine may influence the steepness of the standard curve and the sensitivity of the test. Therefore, it is recommended to use media with no or low level Arginine.
- Hemolytic and lipemic samples should not be used.
- The samples can be stored up to 24 hours at 2 - 8 °C. For a longer storage (at least 12 months) the samples must be kept frozen at -20 °C
- Repeated freezing and thawing should be avoided.



## 6. Preparation of Reagents

### Microtiter strips **STRIPS**

Before opening the packet of strip wells, allow it to stand at room temperature for at least 10 minutes. After opening, keep any unused wells in the original foil packet with the desiccant provided. Reseal carefully and store at 2-8 °C.

### Wash Buffer **WASH**

Dilute the content with dist. water to a total volume of 500 ml.  
The diluted wash buffer has to be stored at 2 - 8 °C.

### Equalizing Reagent **EQUA-REAG**

Dissolve the content with 20.5 ml dist. water, mix shortly and leave on a roll mixer or orbital shaker for 30 minutes. Handle carefully in order to minimize foam formation. The reconstituted Equalizing Reagent should be stored frozen at -20 °C and is stable for a minimum of 1 year.

### Acylation Reagent **ACYL-REAG**

Dissolve the content of one bottle in 2.8 ml Solvent and shake for 5 minutes on a orbital shaker. After use the reagent has to be discarded. The Acylation Reagent has always to be prepared immediately before use. The three bottles allow three separate runs of the test. If the whole kit is to be used in one run it is recommended to pool the dissolved contents of two vials of Acylation Reagent.

Please note that Solvent reacts with many plastic material including plastic trays. Solvent does not react with normal pipette tips and with glass devices.

#### Attention

Solvent is volatile and the dissolved Acylation Reagent evaporates quickly. Therefore, please do not use a tray with big surface together with a multichannel pipette for pipetting Acylation Reagent. Rather, use an Eppendorf multipipette, or similar device, fill the syringe directly from the vial (using a yellow tip) with dissolved Acylation Reagent and add well by well.

All other reagents of the ADMA Ultrasensitive ELISA Assay kit are ready for use.



## 7. Test Procedure for Serum and Plasma Samples

### 7.1. Preparation of Serum and Plasma Samples (Acylation)

The wells of the reaction plate for the acylation can be used only once. Please mark the respective wells before use to avoid repeated use.

1. Pipette each 20  $\mu$ l standard 1 - 7, each 20  $\mu$ l control 1 & 2 and each 20  $\mu$ l sample into the respective wells of the Reaction Plate.
2. Pipette 25  $\mu$ l Acylation Buffer into all wells.
3. Pipette 200  $\mu$ l Equalizing Reagent into all wells.
4. Mix the reaction plate for 10 seconds.
5. Prepare Acylation Reagent just before use and pipette 50  $\mu$ l prepared Acylation Reagent each into all wells, mix immediately.

#### Attention

Solvent is volatile and the dissolved Acylation Reagent evaporates quickly. Therefore, please do not use a tray with big surface together with a multichannel pipette for pipetting Acylation Reagent. Rather, use an Eppendorf multipipette with a yellow tip (or similar device), fill the syringe directly from the vial with dissolved Acylation Reagent and add well by well.

6. Incubate for 90 minutes at room temperature (approx. 20 °C) on an orbital shaker. Do not cover the wells or the plate; leave the plate open on the shaker.

Take each 25  $\mu$ l for the ELISA.

### 7.2. ELISA for Serum and Plasma Samples

Bring all reagents to room temperature and mix them carefully, avoid development of foam.

#### **Sample Incubation**

Pipette each 25  $\mu$ l prepared Standards 1 to 7, 25  $\mu$ l prepared controls and 25  $\mu$ l prepared samples into the respective wells of the coated microtiter strips (duplicates are recommended).

Pipette each 50  $\mu$ l Antiserum into all wells and shake briefly on an orbital shaker.

Cover the plate with adhesive foil and incubate Microtiter Strips for 15 –20 hours (overnight) at 2 – 8 °C.

#### **Washing**

Discard or aspirate the contents of the wells and wash thoroughly with each 250  $\mu$ l Wash Buffer (Shake shortly on an orbital shaker). Repeat the washing procedure 4 times. Remove residual liquid by tapping the inverted plate on clean absorbent paper.



### **Conjugate Incubation**

Pipette each 100 µl enzyme conjugate into all wells.  
Incubate for 60 minutes at room temperature on an orbital shaker.

### **Washing**

Repeat washing as described above.

### **Substrate Incubation**

Pipette each 100 µl Substrate into all wells and incubate for 25 to 35 minutes at room temperature on an orbital shaker.

### **Stopping**

Pipette each 100 µl Stop Solution into all wells.

### **Reading**

Read the optical density at 450 nm (reference wavelength between 570 and 650 nm) in a microplate photometer.

## **8. Test Procedure for Cell Culture Samples**

### **8.1. Preparation of Cell Culture Samples (Acylation)**

The wells of the reaction plate for the acylation can be used only once. Please mark the respective wells before use to avoid repeated use.

1. Pipette each 20 µl standard 1 - 7, each 20 µl control 1 & 2 and each 20 µl cell culture sample into the respective wells of the Reaction Plate.
2. Pipette 20 µl standard 1 (zero standard) into all wells containing cell culture samples.
3. Pipette 20 µl cell culture medium into all wells containing standards 1 – 7 and controls 1 & 2 (to balance matrix differences).
4. Pipette 25 µl Acylation Buffer into all wells.
5. Pipette 200 µl Equalizing Reagent into all wells.
6. Mix the reaction plate for 10 seconds.
7. Prepare Acylation Reagent just before use and pipette 50 µl prepared Acylation Reagent each into all wells, mix immediately.

#### Attention

Solvent is volatile and the dissolved Acylation Reagent evaporates quickly. Therefore, please do not use a tray with big surface together with a multichannel pipette for pipetting Acylation Reagent. Rather, use an Eppendorf multipipette with a yellow tip (or similar device), fill the syringe directly from the vial with dissolved Acylation Reagent and add well by well.



8. Incubate for 90 minutes at room temperature (approx. 20 °C) on an orbital shaker. Do not cover the wells or the plate; leave the plate open on the shaker.

Take each 25 µl for the ELISA.

## **8.2. ELISA for Cell Culture Samples**

Bring all reagents to room temperature and mix them carefully, avoid development of foam.

### **Sample Incubation**

Pipette each 25 µl prepared Standards 1 to 7, 25 µl prepared controls and 25 µl prepared samples into the respective wells of the coated microtiter strips (duplicates are recommended).

Pipette each 50 µl Antiserum into all wells and shake briefly on an orbital shaker.

Cover the plate with adhesive foil and incubate Microtiter Strips for 15 –20 hours (overnight) at 2 – 8 °C.

### **Washing**

Discard or aspirate the contents of the wells and wash thoroughly with each 250 µl Wash Buffer (Shake shortly on an orbital shaker). Repeat the washing procedure 4 times. Remove residual liquid by tapping the inverted plate on clean absorbent paper.

### **Conjugate Incubation**

Pipette each 100 µl enzyme conjugate into all wells.

Incubate for 60 minutes at room temperature on an orbital shaker.

### **Washing**

Repeat washing as described above.

### **Substrate Incubation**

Pipette each 100 µl Substrate into all wells and incubate for 25 to 35 minutes at room temperature on an orbital shaker.

### **Stopping**

Pipette each 100 µl Stop Solution into all wells.

### **Reading**

Read the optical density at 450 nm (reference wavelength between 570 and 650 nm) in a microplate photometer.



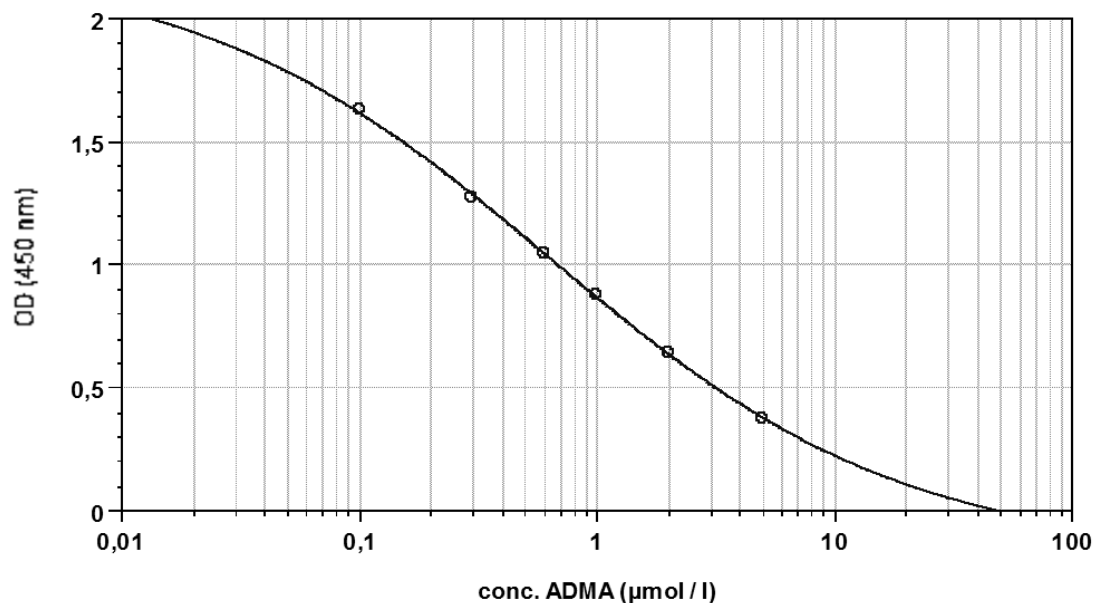


## 9. Calculation of the Results

On a semilogarithmic graph paper the concentration of the standards (x-axis, logarithmic) are plotted against their corresponding optical density (y-axis, linear). Cubic spline, 4 parameter or similar iteration procedures are recommended for evaluation of the standard curve.

The concentration of the controls and samples can be read directly from this standard curve by using their average optical density.

### Typical standard curve:



$$y = ((A - D)/(1 + (x/C)^B)) + D$$

	A	B	C	D	R <sup>2</sup>
Std (Standards: Concentration vs MeanValue)	2,221	0,586	0,645	-0,178	1

## 10. Assay Characteristics

### Sensitivity

The lower limit of detection of the ADMA Ultrasensitive ELISA Assay kit was determined by taking the 2fold standard deviation of the absorbance of the Zero Reference and reading the corresponding value from the standard curve.

lower limit of detection: **0.01 µmol/l**



## Specificity (Cross Reactivity)

Structural related components were tested for possible interference with the antisera against ADMA used in the ELISA method. The tested compounds were Arginine, Monomethylarginine (NMMA) und SDMA.

Substance	ED-50-Value ( $\mu\text{mol/l}$ )	Cross Reactivity (%)
ADMA	0.745	100
Arginine	3,993	< 0.020
SDMA	2,990	0.025
NMMA	51	1.460

## Reproducibility

The reproducibility of the ELISA method was investigated by determining the intra-assay-coefficients of variation (cv) by repeated measurements of different samples.

### Intra-Assay Variation

sample	n =	mean value	sd	cv (%)
Rat Plasma	40	0.40	0.033	8.3
Rat Serum	40	0.99	0.075	7.6

## Recovery

Increasing amounts of ADMA were added to a sample. Each spiked sample was assayed. The analytical recovery of ADMA was calculated at different concentrations by using the theoretically expected and the actually measured values. Shown concentrations are in  $\mu\text{mol/l}$ .

### Rat Heparin Plasma

added	measured	expected	% recovery
0	0.58		
0.10	0.71	0.68	104
0.19	0.80	0.77	104
0.28	0.89	0.86	103
0.37	0.95	0.95	100
0.45	0.98	1.03	95
0.61	1.21	1.19	102
0.85	1.43	1.43	100
1.11	1.97	1.69	116
1.36	2.14	1.94	110
1.61	2.34	2.19	107
1.92	2.64	2.50	106

**mean 104**



### Rat EDTA Plasma

added	measured	expected	% recovery
0	0.51		
0.10	0.59	0.61	97
0.19	0.75	0.70	107
0.28	0.82	0.79	104
0.37	0.98	0.88	111
0.45	0.86	0.96	90
0.61	1.07	1.12	96
0.85	1.34	1.36	99
1.11	1.68	1.62	104
1.36	1.94	1.87	104
1.61	2.04	2.12	96
1.92	2.36	2.43	97

**mean 100**

### Rat Serum

added	measured	expected	% recovery
0	1.05		
0.10	1.16	1.15	101
0.19	1.22	1.24	98
0.28	1.31	1.32	99
0.37	1.27	1.42	89
0.45	1.26	1.50	84
0.61	1.51	1.66	91
0.85	2.23	1.90	117
1.11	2.42	2.16	112
1.36	2.25	2.41	93
1.61	2.63	2.66	99
1.92	2.74	2.97	92

**mean 98**



## Mouse Serum

added	measured	expected	% recovery
0	0.23		
0.19	0.47	0.42	112
0.28	0.55	0.51	108
0.37	0.60	0.60	100
0.45	0.69	0.68	101
0.61	0.88	0.84	105
0.85	1.14	1.08	106
1.11	1.22	1.34	91
1.36	1.52	1.59	96
1.61	1.90	1.84	103
1.92	1.96	2.15	91

**mean 101**

## RPMI Cell Culture Medium

added	measured	expected	% recovery
0	0.25		
0.10	0.38	0.35	109
0.19	0.44	0.44	100
0.28	0.52	0.53	98
0.37	0.55	0.62	89
0.45	0.68	0.70	97
0.67	1.05	0.92	114
0.85	1.11	1.10	101
1.11	1.26	1.36	93
1.36	1.46	1.61	91
1.74	1.83	1.99	92
2.11	2.07	2.36	88
2.56	2.52	2.81	90

**mean 97**



## DMEM Cell Culture Medium

added	measured	expected	% recovery
0	0.23		
0.10	0.33	0.33	100
0.19	0.38	0.42	90
0.28	0.44	0.51	86
0.37	0.56	0.60	93
0.45	0.65	0.68	96
0.67	1.09	0.90	121
0.85	1.09	1.08	101
1.11	1.19	1.34	89
1.36	1.34	1.59	84
1.74	1.62	1.97	82
2.11	1.87	2.34	80
2.56	2.41	2.79	86

**mean 92**

## Linearity

The linearity of the ADMA Ultrasensitive ELISA Assay method was investigated using different dilutions of a sample. Shown concentrations are in  $\mu\text{mol/l}$ .

## Rat Heparin Plasma

dilution	measured	recalculated value	recovery %
orig.	2.55		
3 + 1	1.86	2.48	97
2 + 1	1.61	2.42	95
1 + 1	1.26	2.52	99
1 + 2	0.82	2.46	96
1 + 3	0.60	2.40	94
1 + 5	0.41	2.46	96
1 + 9	0.27	2.70	106
1 + 15	0.18	2.88	113
1 + 20	0.11	2.31	91

**mean recovery 99**

**Rat EDTA Plasma**

<b>dilution</b>	<b>measured</b>	<b>recalculated value</b>	<b>recovery %</b>
orig.	2.40		
3 + 1	1.96	2.61	109
2 + 1	1.61	2.42	101
1 + 1	1.40	2.80	117
1 + 2	0.78	2.34	98
1 + 3	0.62	2.48	103
1 + 5	0.41	2.46	103
1 + 9	0.24	2.40	100
1 + 15	0.15	2.40	100
1 + 20	0.11	2.31	96

**mean recovery            103**

**Rat Serum**

<b>dilution</b>	<b>measured</b>	<b>recalculated value</b>	<b>recovery %</b>
orig.	2.72		
3 + 1	1.84	2.45	90
2 + 1	1.68	2.52	93
1 + 1	1.45	2.90	107
1 + 2	0.95	2.85	105
1 + 3	0.76	3.04	112
1 + 5	0.49	2.94	108
1 + 9	0.28	2.80	103
1 + 15	0.19	3.04	112
1 + 20	0.15	3.15	116

**mean recovery            105**

**Mouse Serum**

<b>dilution</b>	<b>measured</b>	<b>recalculated value</b>	<b>recovery %</b>
orig.	3.31		
3 + 1	2.27	3.03	92
2 + 1	2.08	3.12	94
1 + 1	1.62	3.24	98
1 + 2	1.07	3.21	97
1 + 3	0.74	2.96	89
1 + 5	0.53	3.18	96
1 + 9	0.33	3.30	100
1 + 15	0.18	2.88	87
1 + 20	0.15	3.15	95

**mean recovery            94**



**RPMI Cell Culture Medium**

<b>dilution</b>	<b>measured</b>	<b>recalculated value</b>	<b>recovery %</b>
orig.	2.25		
3 + 1	1.89	2.52	112
2 + 1	1.82	2.74	122
1 + 1	1.22	2.45	109
1 + 2	0.79	2.38	106
1 + 3	0.62	2.49	111
1 + 5	0.38	2.30	102
1 + 9	0.20	1.98	88

**mean recovery 107**

**DMEM Cell Culture Medium**

<b>dilution</b>	<b>measured</b>	<b>recalculated value</b>	<b>recovery %</b>
orig.	1.97		
3 + 1	1.51	2.01	102
2 + 1	1.52	2.29	116
1 + 1	1.05	2.10	107
1 + 2	0.72	2.16	110
1 + 3	0.55	2.18	111
1 + 5	0.34	2.05	104
1 + 9	0.24	2.36	120

**mean recovery 110**



## 11. Literature

### Literature using the ADMA-ELISA from Eagle Biosciences / DLD Diagnostika

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Eur Heart J. 2003; 24: 1912-1919

### Pipetting Scheme Sample Preparation Plasma and Serum

		Standards	Control	Sample
Standard 1 - 7	μl	20		
Control 1 & 2	μl		20	
Sample	μl			20
Acylation Buffer	μl	25	25	25
Equalizing Reagent	μl	200	200	200

shake for 10 seconds

freshly prepared Acylation Reagent	μl	50	50	50
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incubate for 90 minutes at room temperature on an orbital shaker  
do not cover wells or plate, leave the plate open on the shaker

### Pipetting Scheme Sample Preparation Cell Culture Samples

		Standards	Control	Sample
Standard 1 - 7	μl	20		
Control 1 & 2	μl		20	
Sample	μl			20
Standard 1	μl			20
Cell Culture Medium	μl	20	20	
Acylation Buffer	μl	25	25	25
Equalizing Reagent	μl	200	200	200

shake for 10 seconds

freshly prepared Acylation Reagent	μl	50	50	50
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incubate for 90 minutes at room temperature on an orbital shaker  
do not cover wells or plate, leave the plate open on the shaker



### Pipetting Scheme ELISA

		Standard	Control	Sample
Standard 1 - 7	µl	25		
Control 1 & 2	µl		25	
Sample	µl			25
Antiserum	µl	50	50	50

shake shortly on an orbital shaker

incubate 15 – 20 hours (overnight) at 2 - 8 °C covered with foil

wash 4 x with each 250 µl Wash Buffer

Enzyme Conjugate	µl	100	100	100
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shake for 60 minutes at room temperature

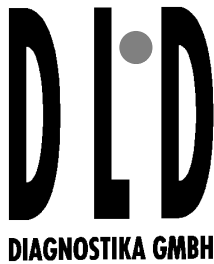
wash 4 x with each 250 µl Wash Buffer

Substrate	µl	100	100	100
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shake for 25 - 35 minutes at room temperature

Stop Solution	µl	100	100	100
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read absorbance at 450 nm



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