




## Instructions for Use


# BI-CAT<sup>®</sup> - ELISA

Enzyme Immunoassays  
for the Quantitative Determination of  
**Adrenaline / Noradrenaline**  
in Plasma and Urine



REF EA613/192

 2 x 96

 2 – 8 °C

DLD Gesellschaft für Diagnostika und medizinische Geräte mbH  
Adlerhorst 15 • 22459 Hamburg • Germany • Tel: +49 40 5558710 • Fax: +49 40 55587111  
Internet: <http://www.dld-diagnostika.de> • E-Mail: [contact@dld-diagnostika.de](mailto:contact@dld-diagnostika.de)

October 2011

## Contents

1. Introduction and Principle of the Test	Page	3
2. Precautions	Page	4
3. Storage and Stability	Page	4
4. Contents of the Kit	Page	4
5. Sample Collection and Storage	Page	7
6. Preparation of Reagents and Samples	Page	8
7. Test Procedure ELISA	Page	11
Adrenaline ELISA	Page	11
Noradrenaline ELISA	Page	12
8. Calculation of Results	Page	13
9. Assay Characteristics	Page	15
Pipetting Scheme Sample Preparation	Page	19
Pipetting Scheme ELISA	Page	20

## 1. Introduction and Principle of the Test

Catecholamine is the name of a group of aromatic amines (noradrenaline, adrenaline, dopamine, and their derivatives) which act as hormones and neurotransmitter, respectively. Adrenaline and noradrenaline are formed from dopamine. They act on the cardiac musculature and the metabolism (adrenaline) as well as on the peripheral circulation (noradrenaline) and help the body to cope with acute and chronic stress.

An increased production of catecholamines can be found with tumours of the chromaffine system (pheochromocytoma, neuroblastoma, ganglioglioma). An increased or decreased concentration of the catecholamines can also be found with hypertension, degenerative cardiac diseases, schizophrenia and manic-depressive psychosis.

The assay kit provides materials for the quantitative measurement of adrenaline and noradrenaline in plasma and urine. Noradrenaline and adrenaline are extracted using a cis-diol-specific affinity gel and acylated to N-acylnoradrenaline and N-acyladrenaline and then converted enzymatically into N-acylnormetanephrine and N-acylmetanephrine.

The competitive BI-CAT<sup>®</sup> - ELISA kit uses the microtitre plate format. Adrenaline and noradrenaline, respectively, are bound to the solid phase of the microtiter plate. Acylated catecholamine from the sample and solid phase bound catecholamine compete for a fixed number of 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 catecholamine is detected by anti-rabbit IgG / peroxidase. The substrate TMB / peroxidase reaction is monitored at 450 nm. The amount of antibody bound to the solid phase catecholamine is inversely proportional to the catecholamine concentration of the sample.

## 2. Precautions

- For in vitro use only.
- Some reagents contain sodium azide as preservative. Avoid skin contact.
- Material of animal origin used in the preparation of the kit has been obtained from animals certified as healthy but these materials should be handled as potentially infectious.
- Some components of this kit are containing hazardous reagents. These components are marked with the adequate hazard label.

## 3. Storage and Stability

On arrival, store the 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 kit labels.

Do not mix various lots of any kit component within an individual assay.

## 4. Contents of the Kit

### Reagents for Sample Preparation:

4.1	<b>Extraction Plate</b> 48 wells coated with boronate affinity gel	<b>EX-PLATE</b>	2 plates
4.2.	<b>Extraction-Buffer</b> 6 ml, ready for use	<b>EX-BUFF</b>	1 vial
4.3	<b>HCl</b> 21 ml, ready for use 0.025 M HCl	<b>HCL</b>	1 vial

4.4 **Standards (1 - 7)** **CAL 1 - 7** 7 vials  
 Each 4 ml, ready for use

Concentrations:

Standard	1	2	3	4	5	6	7
<b>Adrenaline</b> (ng/ml)	0	0.5	1.5	5	15	50	250
<b>Adrenaline</b> (nmol/l)	0	2.7	8.2	27.3	81.9	273	1,365
<b>Noradrenaline</b> (ng/ml)	0	1.5	5	15	50	150	500
<b>Noradrenaline</b> (nmol/l)	0	8.9	29.6	88.9	296	887	2,955

For only determination of urine samples: Standard 2 is not required.

For only determination of plasma samples: Standard 7 is not required.

4.5 **Control 1 & 2** **CON 1 & 2** 2 vials  
 Each 4 ml, ready for use  
 Concentrations: see q.c. certificate

4.6 **Acylation Reagent** **ACYL-REAG** 1 vial  
 6 ml, ready for use  
 Contains DMSO and DMF  
 (please note that solvent reacts with many plastic materials including plastic trays; it does not react with normal pipette tips and with glass devices).

4.7 **Acylation Buffer** **ACYL-BUFF** 1 vial  
 20 ml, ready for use

4.8 **Enzyme** **ENZYME** 3 vials  
 each 1.7ml, lyophilized  
 Catechol-O-methyltransferase

4.9 **Coenzyme** **COENZYME** 1 vial  
 1 ml, ready for use  
 S-adenosyl-L-methionine

4.10 **Enzyme Buffer** **ENZYME-BUFF** 1 vial  
 3.5 ml, ready for use

## Reagents for ELISA:

4.11	<b>Adrenaline-Antiserum</b> 2.5 ml, ready for use, rabbit colour coded blue	<b>AS-AD</b>	1 vial
4.12	<b>Noradrenaline-Antiserum</b> 11 ml, ready for use, rabbit colour coded yellow	<b>AS-NAD</b>	1 vial
4.13	<b>MT-Strips</b> 2 x 12 strips 8 wells each, break apart, precoated with: derivatized adrenaline (12 strips), colour coded blue derivatized noradrenaline (12 strips), colour coded yellow	<b>STRIPS-AD</b> <b>STRIPS-NAD</b>	
4.14	<b>POD Conjugate</b> Each 12 ml, ready for use, Anti-rabbit IgG-POD conjugate/ peroxidase	<b>CONJ</b>	2 vials
4.15	<b>Wash Buffer</b> 20 ml, concentrate Dilute content with dist. water to 500 ml total volume	<b>WASH</b>	3 vials
4.16	<b>Substrate</b> 12 ml TMB solution, ready for use	<b>SUB</b>	2 vials
4.17	<b>Stop Solution</b> 12 ml, ready for use Contains 0.3 M sulphuric acid	<b>STOP</b>	2 vials
4.18	<b>Adhesive Foil</b> Ready for use	<b>FOIL</b>	10 pieces

Additional materials and equipment required but not provided:

- Pipettes (15, 25, 50, 120, 300, 700  $\mu$ l)
- Repeating dispenser for 10, 20, 50, 100, 150, 200, 250  $\mu$ l und 1 ml
- Horizontal shaker
- Microplate washing device
- Microplate photometer
- Distilled water

## **5. Sample Collection and Storage**

### **Plasma**

EDTA plasma samples are required for the assay. Physical and psychical stress usually causes a high increase of the catecholamine concentration. Therefore, it is recommended to let the patient rest for 20 to 30 minutes after the venipuncture and before collecting the blood sample.

Haemolytic and especially lipemic samples should not be used for the assay, because false low values will be obtained with such samples.

The plasma samples can be stored at 2 - 8  $^{\circ}$ C up to 6 hours. For a longer period (up to 1 week) the samples should be stored at -20  $^{\circ}$ C.

### **Urine**

The total volume of urine excreted during a 24-hours period should be collected and mixed in a single bottle containing 10 - 15 ml of 6 M hydrochloric acid as preservative. Avoid exposure to direct sun light. Determine the total volume and take an aliquot for the measurement. For patients with suspected kidney disorders the creatinine concentration should be tested, too. Urine samples can be stored at -20  $^{\circ}$ C for at least 6 months.

## 6. Preparation of Reagents and Samples

### 6.1. Preparation of Reagents

#### Wash Buffer

Dilute the content of the bottle with distilled water to a total volume of 500 ml.

For further use the diluted wash buffer must be stored at 2 - 8 °C for a maximum period of 4 weeks.

#### Enzyme Mix

NOTE: The enzyme mix has to be prepared freshly prior to the assay (not longer than 10 - 15 minutes in advance). After use the reagent has to be discarded.

Reconstitute the content of one vial labelled **ENZYME** with 1.7 ml distilled water.

Add 0.3 ml **COENZYME** and 0.7 ml **ENZYME-BUFF** (total volume: 2.7 ml) and mix thoroughly.

The two additional bottles of **ENZYME** are allowing a second and a third run of the test. If the whole kit is to be used in one run it is recommended to pool the contents of at least two prepared enzyme mix.



## 6.2. Preparation of Samples

Allow reagents and samples to reach room temperature.

Determinations in duplicates are recommended.

Each 20  $\mu$ l of Standards, Control 1 & 2 and urine samples are extracted.

Each 300  $\mu$ l of plasma samples are extracted.

1. Pipette each 20  $\mu$ l Standard 1 - 7, 20  $\mu$ l Control 1 & 2 and each 20  $\mu$ l Urine Sample into the respective wells of the extraction plate. Add 250  $\mu$ l of distilled water to these wells to correct for volume. Pipette each 300  $\mu$ l Plasma Sample into the respective wells (no volume correction required).
2. Pipette each 50  $\mu$ l Extraction Buffer into all wells.
3. Incubate 60 minutes at room temperature on an orbital shaker (400 - 600 r/min).
4. Decant the plate and remove residual liquid by tapping the inverted plate on a paper towel.
5. Pipette each 1 ml Wash Buffer into all wells and incubate for 5 minutes at room temperature on an orbital shaker (slow shaking).
6. Decant the plate and remove residual liquid by tapping the inverted plate on a paper towel.
7. Pipette each 150  $\mu$ l Acylation Buffer into all wells.
8. Pipette each 50  $\mu$ l Acylation Reagent into all wells and continue with step 9. immediately.  
(please note that solvent reacts with many plastic materials including plastic trays; it does not react with normal pipette tips and with glass devices)
9. Incubate the plate for 20 minutes at room temperature on an orbital shaker (400 - 600 r/min).
10. Decant the plate and remove residual liquid by tapping the inverted plate on a paper towel.

11. Pipette each 1 ml Wash Buffer into all wells and incubate for 5 minutes at room temperature on an orbital shaker (slow shaking).
12. Decant the plate and remove residual liquid by tapping the inverted plate on a paper towel.
13. Repeat the wash steps 11. and 12.
14. Pipette each 200  $\mu$ l HCl (0.025 M) into all wells.
15. Incubate the plate with adhesive foil for 20 minutes at room temperature on an orbital shaker (400 - 600 r/min).

**Caution: Do not decant the supernatant thereafter.**

Take each 100  $\mu$ l of the supernatant for the adrenaline assay and 15  $\mu$ l for the noradrenaline assay.

## 7. Test Procedure ELISA

Allow reagents to reach room temperature. Duplicates are recommended.

### 7.1. Adrenaline ELISA

1. Pipette each 20  $\mu$ l of freshly prepared Enzyme Mix into all wells (colour coded blue).
2. Pipette each 100  $\mu$ l prepared Standards, Controls and Patient Samples into the respective wells (colour coded blue).
3. Incubate the plate with adhesive foil for 30 minutes at room temperature (20 – 25 °C) on an orbital shaker (400 - 600 r/min).
4. Pipette each 20  $\mu$ l Adrenaline-Antiserum (colour coded blue) into all wells.
5. Cover the plate with adhesive foil, shake for 10 seconds and incubate for 12 – 20 hours (overnight) at 2-8 °C.
6. Discard or aspirate the contents of the wells and wash thoroughly with each 250  $\mu$ l Wash Buffer. Remove residual liquid by tapping the inverted plate on clean absorbent paper. Repeat the washing procedure 4 times.
7. Pipette each 100  $\mu$ l POD-Conjugate into all wells.
8. Incubate for 30 minutes at room temperature on an orbital shaker (400 - 600 r/min).
9. Washing: Repeat wash step 6.
10. Pipette each 100  $\mu$ l Substrate into all wells.
11. Incubate 25 to 35 minutes at room temperature (20 – 25 °C) on an orbital shaker (400 - 600 r/min).
12. Pipette 100  $\mu$ l Stop Solution into all wells.
13. Read the optical density at 450 nm (reference wavelength between 570 and 650 nm) in a microplate photometer within 15 minutes.

## 7.2. Noradrenaline ELISA

1. Pipette each 20  $\mu$ l of freshly prepared Enzyme Mix into all wells (colour coded yellow).
2. Pipette each 15  $\mu$ l prepared Standards, Controls and Patient Samples into the respective wells (colour coded yellow).
3. Incubate the plate with foil for 30 minutes at room temperature (20 – 25 °C) on an orbital shaker (400 - 600 r/min).
4. Pipette each 100  $\mu$ l Noradrenaline-Antiserum (colour coded yellow) into all wells.
5. Cover the plate with adhesive foil, shake for 10 seconds and incubate for 12 – 20 hours (overnight) at 2-8 °C.
6. Discard or aspirate the contents of the wells and wash thoroughly with each 250  $\mu$ l Wash Buffer. Remove residual liquid by tapping the inverted plate on clean absorbent paper. Repeat the washing procedure 4 times.
7. Pipette each 100  $\mu$ l POD-Conjugate into all wells.
8. Incubate for 30 minutes at room temperature on an orbital shaker (400 - 600 r/min).
9. Washing: Repeat wash step 6.
10. Pipette each 100  $\mu$ l Substrate into all wells.
11. Incubate 25 to 35 minutes at room temperature (20 – 25 °C) on an orbital shaker (400 - 600 r/min).
12. Pipette 100  $\mu$ l Stop Solution into all wells.
13. Read the optical density at 450 nm (reference wavelength between 570 and 650 nm) in a microplate photometer within 15 minutes.

## 8. Calculation of Results

On a semilogarithmic graph paper the concentration of the standards (x-axis, logarithmic) are plotted against their corresponding optical density (y-axis, linear). Alternatively, the optical density of each standard and sample can be related to the optical density of the zero standard, expressed as the ratio OD/OD<sub>max</sub>, and then plotted on the y-axis.

A good fit is provided with 4 Parameter Logistic (alternatively Log-Logit or Cubic Spline).

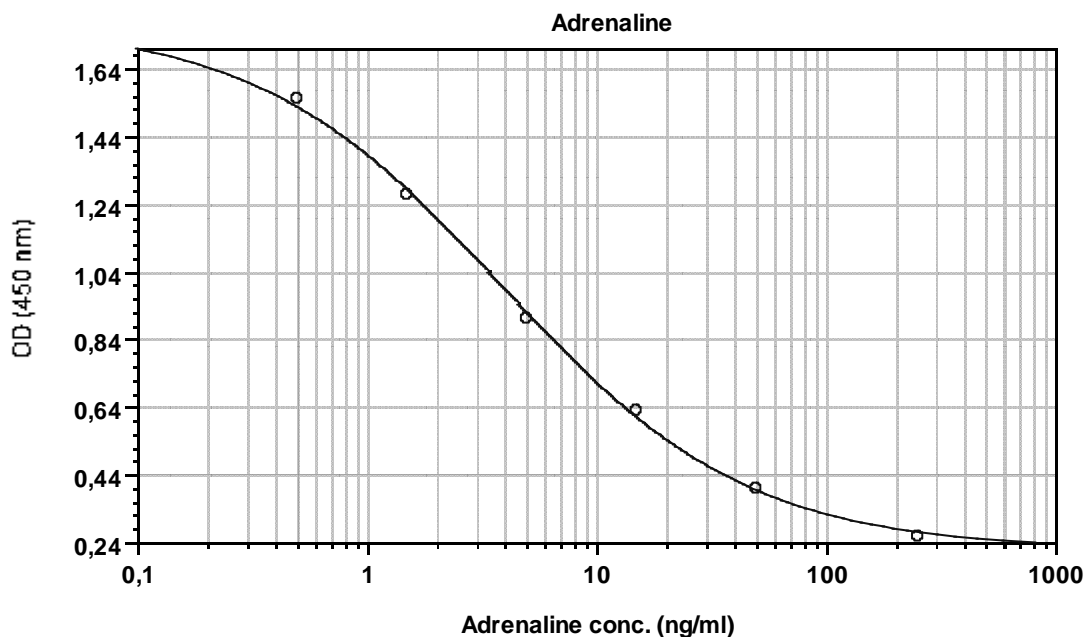
The concentration of the controls and urine samples can be read off the standard curve directly without any further conversion.

The read concentrations of adrenaline and noradrenaline in **plasma samples** have to be **divided by 15** due to the use of 300 µl plasma sample in relation to 20 µl standard.

## Typical Examples

Below are listed typical examples of standard curves with the Adrenaline ELISA and Noradrenaline ELISA:

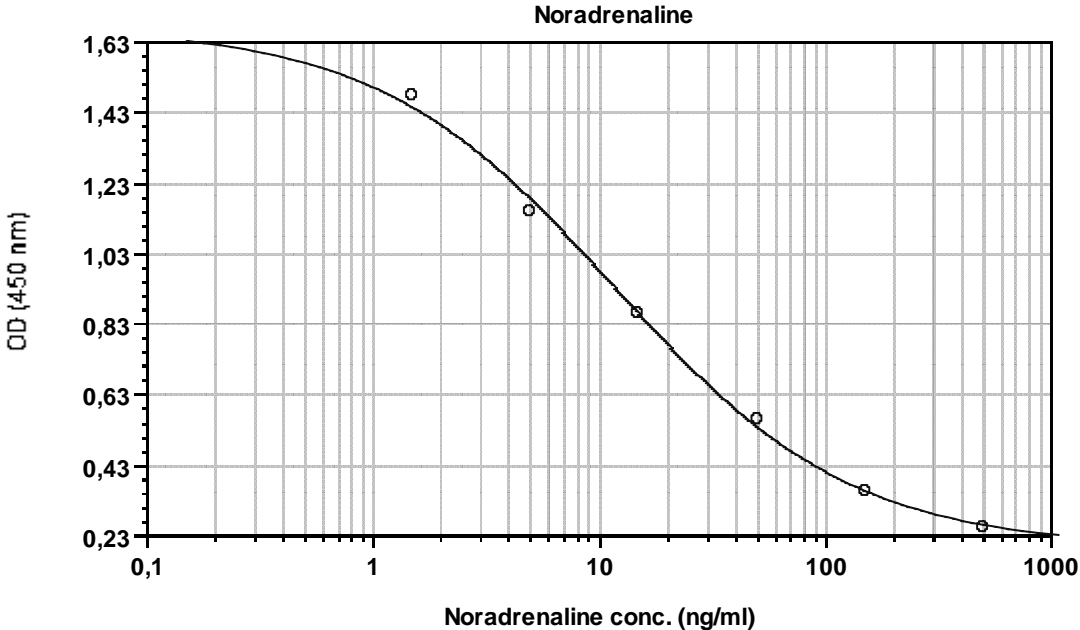
### Adrenaline ELISA



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

○ Std (Standards: Concentration vs MeanValue)      A      B      C      D      R<sup>2</sup>  
 1,774      0,811      3,897      0,22      0,999

# Noradrenaline ELISA



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

<u>A</u>	<u>B</u>	<u>C</u>	<u>D</u>	<u>R<sup>2</sup></u>
1,67	0,826	11,787	0,195	0,998

○ Std (Standards: Concentration vs MeanValue)

## 9. Assay Characteristics

### 9.1. Reference Ranges

The reference ranges given below should only be taken as a guideline. It is recommended that each laboratory should establish its own normal values.

	<b>Adrenaline</b>	<b>Noradrenaline</b>
Urine	< 20 µg/day	< 90 µg/day
Plasma	< 100 pg/ml	< 600 pg/ml

### 9.2. Sensitivity

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

	<b>Adrenaline</b>	<b>Noradrenaline</b>
Sensitivity (Urine):	0.08 ng/ml	0.24 ng/ml
Sensitivity (Plasma):	5 pg/ml	16 pg/ml

### 9.3. Specificity (Cross Reactivity)

Structural related components were tested for possible interference with the antisera against adrenaline and noradrenaline used in the ELISA method.

Components	Cross Reactivity (%)	Cross Reactivity (%)
	Adrenaline-Ab	Noradrenaline-Ab
Adrenaline	100	< 0.012
Noradrenaline	0.030	100
Dopamine	< 0.01	0.092
Metanephrine	0.48	< 0.012
Normetanephrine	< 0.01	0.16
3-Methoxytyramine	< 0.01	< 0.012
L-Dopa	< 0.002	< 0.005
Tyramine	< 0.002	< 0.005
Tyrosine	< 0.002	< 0.005
Homovanillic acid	< 0.002	< 0.005
Vanillic mandelic acid	< 0.002	< 0.005

## 9.4. Recovery

Increasing amounts of adrenaline and noradrenaline were added to an urine and to a plasma sample. Each spiked sample was assayed. The analytical recovery was estimated at different concentrations by using the theoretically expected and the actually measured values.

Concentrations in ng/ml

### Adrenaline

Urine				Plasma			
added	measured	expected	% recovery	added	measured	expected	% recovery
0.00	0.71			0.00	0.03		
1.46	2.6	2.2	<b>120</b>	0.07	0.09	0.10	<b>92</b>
2.38	3.9	3.1	<b>126</b>	0.12	0.13	0.15	<b>90</b>
3.70	4.7	4.4	<b>105</b>	0.19	0.18	0.22	<b>82</b>
5.36	7.2	6.1	<b>118</b>	0.29	0.33	0.32	<b>104</b>
9.80	12.7	10.5	<b>120</b>	0.48	0.54	0.51	<b>107</b>
19.2	19.4	19.9	<b>97</b>	0.71	0.69	0.74	<b>94</b>
32.7	40.2	33.4	<b>120</b>	1.22	1.25	1.24	<b>100</b>
61.4	59.5	62.1	<b>96</b>	1.92	2.13	1.95	<b>109</b>
		mean recovery:	<b>113</b>			mean recovery:	<b>97</b>

### Noradrenaline

Urine				Plasma			
added	measured	expected	% recovery	added	measured	expected	% recovery
0.00	8.6			0.00	0.12		
2.83	10.0	11.4	<b>88</b>	0.16	0.25	0.28	<b>88</b>
4.84	13.5	13.4	<b>101</b>	0.29	0.42	0.42	<b>102</b>
7.59	17.0	16.2	<b>105</b>	0.44	0.59	0.56	<b>106</b>
12.0	25.2	20.5	<b>123</b>	0.58	0.70	0.70	<b>101</b>
19.2	22.3	27.8	<b>80</b>	0.71	0.77	0.84	<b>92</b>
32.7	40.4	41.3	<b>98</b>	1.14	1.27	1.26	<b>101</b>
76.3	71.1	84.8	<b>84</b>	2.08	1.94	2.20	<b>88</b>
144.6	165.3	153.1	<b>108</b>	4.37	3.31	4.49	<b>74</b>
		mean recovery:	<b>98</b>			mean recovery:	<b>94</b>



## 9.5. Linearity

The linearity of the ELISA method was investigated using different dilutions of an urine and a plasma sample.

Concentrations in ng/ml

### Adrenaline

Urine				Plasma			
dilution	measured	recalculated value	% Re-cov-ery	dilution	measured	recalculated value	% Re-cov-ery
Orig.	39.2			Orig.	2.11		
1+1	20.9	19.6	<b>107</b>	1+1	1.13	1.05	<b>107</b>
1+2	12.4	13.1	<b>95</b>	1+2	0.63	0.70	<b>90</b>
1+4	7.4	7.8	<b>94</b>	1+4	0.43	0.42	<b>101</b>
1+9	4.1	3.9	<b>104</b>	1+9	0.20	0.21	<b>97</b>
1+14	2.7	2.6	<b>102</b>	1+14	0.13	0.14	<b>95</b>
		mean linearity:	100			mean linearity:	98

### Noradrenaline

Urine				Plasma			
dilution	measured	recalculated value	% Re-cov-ery	dilution	measured	recalculated value	% Re-cov-ery
Orig.	97.5			Orig.	3.06		
1+1	46.0	48.7	<b>94</b>	1+1	1.42	1.53	<b>93</b>
1+2	27.1	32.5	<b>83</b>	1+2	0.82	1.02	<b>80</b>
1+4	19.5	19.5	<b>100</b>	1+4	0.68	0.61	<b>112</b>
1+9	9.8	9.7	<b>100</b>	1+9	0.34	0.31	<b>110</b>
1+14	6.7	6.5	<b>103</b>	1+14	0.24	0.20	<b>116</b>
		mean linearity:	<b>96</b>			mean linearity:	<b>102</b>

## 9.6. Reproducibility

### Intra-Assay

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

Concentrations in ng/ml

### Adrenaline

<b>sample</b>	<b>n</b>	<b>mean value</b>	<b>sd</b>	<b>cv (%)</b>
1	40	9.7	0.88	<b>9.0</b>
2	40	14.3	1.11	<b>7.7</b>

### Noradrenaline

<b>sample</b>	<b>n</b>	<b>mean value</b>	<b>sd</b>	<b>cv (%)</b>
1	40	12.1	1.15	<b>9.5</b>
2	40	32.4	3.20	<b>9.9</b>

## Pipetting Scheme Sample Preparation (Adrenaline, Noradrenaline)

		Standards	Controls	Urine	Plasma
Standard 1 - 7	µl	20			
Control 1&2	µl		20		
Patient Urine	µl			20	
Patient Plasma	µl				300
Dist. Water	µl	250	250	250	
Extraction Buffer	µl	50	50	50	50

Incubate 60 minutes at RT (shake: 400 - 600 r/min)

Decant plate and remove residual liquid

Wash Buffer	ml	1	1	1	1
-------------	----	---	---	---	---

Incubate 5 minutes at RT (slow shaking)

Decant plate and remove residual liquid

Acylation Buffer	µl	150	150	150	150
Acyl. Reagent	µl	50	50	50	50

**Immediately** shake 20 minutes at RT (shake: 400 - 600 r/min)

Decant plate and remove residual liquid

Wash Buffer	ml	1	1	1	1
-------------	----	---	---	---	---

Incubate 5 minutes at RT (slow shaking)

Decant plate and remove residual liquid

Wash Buffer	ml	1	1	1	1
-------------	----	---	---	---	---

Incubate 5 minutes at RT (slow shaking)

Decant plate and remove residual liquid

HCl	µl	200	200	200	200
-----	----	-----	-----	-----	-----

Incubate 20 minutes with adhesive foil at RT (shake: 400 - 600 r/min)

**Caution: Do not decant the supernatant thereafter**

For the ELISA take each

100 µl for Adrenaline  
15 µl for Noradrenaline

## Pipetting Scheme - ELISA

Standards	Controls	Samples
-----------	----------	---------

<b>Adrenaline (blue)</b>				
Enzyme Mix (Fresh)	μl	20	20	20
Standard 1 - 7	μl	100		
Controls 1&2	μl		100	
Samples	μl			100
Cover with adhesive foil; shake 30 min at room temperature				
Adrenaline Antiserum	μl	20	20	20

<b>Noradrenaline (yellow)</b>				
Enzyme Mix (Fresh)	μl	20	20	20
Standard 1 - 7	μl	15		
Controls 1&2	μl		15	
Samples	μl			15
Cover with adhesive foil; shake 30 min at room temperature				
Noradrenaline Antiserum	μl	100	100	100

Cover plates with adhesive foil  
Shake for 10 seconds  
Incubate for 12 – 20 hours (overnight) at 2-8°C

4 x washing

POD-Conjugate	μl	100	100	100
---------------	----	-----	-----	-----

Incubate for 30 minutes at room temperature on an orbital shaker

4 x washing

Substrate	μl	100	100	100
-----------	----	-----	-----	-----

Incubate 25 to 35 minutes at room temperature on an orbital shaker

Stop Solution	μl	100	100	100
---------------	----	-----	-----	-----

Reading of absorbance at 450 nm