

## EDI™ Osteocalcin (1-43/49) Specific ELISA Kit Enzyme Linked ImmunoSorbent Assay (ELISA) for the Measurement the Level of Human Osteocalcin (1-43) and Osteocalcin (1-49)



KT 809

EU:



### INTENDED USE

This ELISA (enzyme-linked immunosorbent assay) kit is intended for the quantitative determination of both human osteocalcin (1-49) and osteocalcin (1-43) (also referred as N-terminal & mid-regional osteocalcin) levels in test samples. This test is useful for assessing the bone formation activity or osteoblast activity in patients associated with changes in the rate of bone turnover in metabolic bone disease, such as osteoporosis, primary hyperparathyroidism, hyperthyroidism, Paget's disease, and renal osteodystrophy.

### INTRODUCTION

Osteocalcin [also as bone Gla protein (BGP)] is a major noncollagenous protein found in bone and dentin. The synthesis of osteocalcin involves vitamin K and vitamin D3. Freshly synthesized osteocalcin is partly released into the bloodstream and partly incorporated into the bone matrix. Both osteocalcin (1-49) and its fragments including osteocalcin (1-43) are released into the blood stream. Serum osteocalcin (1-43) is also generated by catabolic breakdown of osteocalcin (1-49) in the circulation, liver and kidney, as well as by in vitro degradation during storage of samples, because of a labile six-amino acid C-terminal sequence that, in vitro at room temperature, is easily cleaved off. There are several studies that have confirmed the measurement of the much more stable N-terminal and mid-regional osteocalcin [osteocalcin (1-43/49)] as being clinically useful, which may contribute to a more accurate assessment of the bone turnover rate.

As osteocalcin is manufactured by osteoblasts, it is often used as a biochemical marker, or biomarker, for the bone formation process. It has been routinely observed that higher serum-osteocalcin levels are relatively well correlated with increases in bone mineral density (BMD) during treatment with anabolic bone formation drugs for osteoporosis, such as Forteo. In many studies, osteocalcin is used as a preliminary biomarker on the effectiveness of a given drug on bone formation.

### ASSAY PRINCIPLE

This ELISA is designed, developed and produced for the quantitative measurement of human osteocalcin (1-49) and (1-43) in serum or plasma sample. The assay utilizes the two-site "sandwich" technique with two selected antibodies that bind to different epitopes of human osteocalcin.

Assay standards, controls and patient samples are added directly to wells of a microtiter plate that is coated with streptavidin. Subsequently, a mixture of biotinylated human osteocalcin N-terminal region specific polyclonal antibody and a peroxidase-labeled human osteocalcin 20 – 43 region specific monoclonal antibody is added to each well. After the first incubation period, a "sandwich" of "biotinylated antibody – human osteocalcin – HRP-monoclonal antibody" is formed and this immunocomplex is also captured to the wall of microtiter plate via a streptavidin-biotin affinity binding. The unbound monoclonal antibodies and buffer matrix are removed in the subsequent washing step. A substrate solution in a timed reaction is

then measured in a spectrophotometric microplate reader. The enzymatic activity of the immunocomplex bound to the wall of each microtiter well is directly proportional to the amount of human osteocalcin in a test sample. A standard curve is generated by plotting the absorbance versus the respective human osteocalcin concentration for each standard on point-to-point or 4 parameter curve fit. The concentration of human osteocalcin in test samples is determined directly from this standard curve.

### REAGENTS: Preparation and Storage

This test kit must be stored at 2 – 8°C upon receipt. For the expiration date of the kit refer to the label on the kit box. All components are stable until this expiration date.

### Prior to use allow all reagents to come to room temperature.

Reagents from different kit lot numbers should not be combined or interchanged.

#### 1. Streptavidin Coated Microplate (Cat. No. 10040B)

One microplate with 12 x eight strips (96 wells total) coated with streptavidin. The plate is framed and sealed in a foil zipper bag with a desiccant. This reagent should be stored at 2 – 8°C and is stable until the expiration date on the kit box.

#### 2. HRP-Conjugated Osteocalcin Antibody (Cat. No. 30288)

One vial contains 1.2 mL HRP-conjugated monoclonal anti-human osteocalcin (20- 43) antibody in a stabilized protein matrix. This reagent must be diluted with biotinylated antibody before use. This reagent should be stored at 2 – 8°C and is stable until the expiration date on the kit box.

#### 3. Biotinylated Osteocalcin Antibody (Cat. No. 30289)

**Two bottles** each contains 12 mL biotinylated anti-human osteocalcin N-terminal region specific antibody in a stabilized protein matrix. This reagent is ready to be used for dilution of HRP-conjugated osteocalcin antibody. This reagent should be stored at 2 – 8°C and is stable until the expiration date on the kit box.

#### 4. ELISA Wash Concentrate (Cat. No. 10010)

One bottle contains 30 mL of 30-fold concentrate. Before use the contents must be diluted with 870 mL of distilled water and mixed well. Upon dilution this yields a working wash solution containing a surfactant in phosphate-buffered saline with a non-azide, non-mercury preservative. The diluted wash solution may be stored at room temperature and is stable until the expiration date on the kit box.

#### 5. ELISA HRP Substrate (Cat. No. 10020)

One bottle contains 22 mL of tetramethylbenzidine (TMB) with hydrogen peroxide. This reagent should be stored at 2 – 8°C and is stable until the expiration date on the kit box.

### 6. ELISA Stop Solution (Cat. No. 30357)

One bottle contains 12 mL of sulfuric acid. This reagent may be stored at 2 – 8°C or room temperature and is stable until the expiration date on the kit box.

### 7. Human Osteocalcin Standards (Cat. No. 30291 – 30296)

Six vials each contain human osteocalcin in a lyophilized bovine serum-based matrix with a non-azide, non-mercury preservative. **Refer to vials for exact concentration for each standard.** These reagents should be stored at 2 – 8°C and are stable until the expiration date on the kit box.

### 8. Human Osteocalcin Controls (Cat. No. 30297 – 30298)

Two vials each contain human osteocalcin in a lyophilized bovine serum-based matrix with a non-azide, non-mercury preservative. **Refer to vials for exact concentration range for each control.** Both controls should be stored at 2 – 8°C and are stable until the expiration date on the kit box.

## SAFETY PRECAUTIONS

The reagents must be used in professional laboratory. Source material for reagents containing bovine serum was derived in the contiguous 48 United States. It was obtained only from healthy donor animals maintained under veterinary supervision and found free of contagious diseases. Wear gloves while performing this assay and handle these reagents as if they are potentially infectious. Avoid contact with reagents containing TMB, hydrogen peroxide, or sulfuric acid. TMB may cause irritation to skin and mucous membranes and cause an allergic skin reaction. TMB is a suspected carcinogen. Sulfuric acid may cause severe irritation on contact with skin. Do not get in eyes, on skin, or on clothing. Do not ingest or inhale fumes. On contact, flush with copious amounts of water for at least 15 minutes. Use Good Laboratory Practices.

## MATERIALS REQUIRED BUT NOT PROVIDED

1. Serum or plasma sample collection tube.
2. Precision single channel pipettes capable of delivering 25 µL, 100 µL, 200 µL, and 1000 µL etc.
3. Repeating dispenser suitable for delivering 100 µL and 200 µL.
4. Disposable pipette tips suitable for above volume dispensing.
5. Disposable 12 x 75 mm or 13 x 100 plastic test tubes.
6. Disposable plastic 1000 mL bottle with cap.
7. Aluminum foil.
8. Deionized or distilled water.
9. Plastic microtiter well cover or polyethylene film.
10. ELISA multichannel wash bottle or automatic (semi-automatic) washing system.
11. Spectrophotometric microplate reader capable of reading absorbance at 450 nm.
12. ELISA plate shaker.

## SPECIMEN COLLECTION

Only 50 µL of human serum or plasma sample is required for human osteocalcin measurement in duplicate. No special preparation of individual is necessary prior to specimen collection. Whole blood should be collected and must be allowed to clot for minimum 30 minutes at room temperature before the serum is separated by centrifugation (850 – 1500xg for 10 minutes). The serum should be separated from the clot within three hours of blood collection and transferred to a clean test tube. Serum sample is allowed to be stored at 2-8°C or room temperature for 6 days until measurement. Sample should be stored in frozen condition (< -20°C) for longer storage. Avoid more than three freeze-thaw cycles of specimen. It is necessary to take care in the sample collection procedure to avoid haemolysis.

## ASSAY PROCEDURE

### 1. Reagent Preparation

- (1) Prior to use allow all reagents to come to room temperature. Reagents from different kit lot numbers should not be combined or interchanged.
- (2) ELISA Wash Concentrate (Cat. 10010) must be diluted to working solution prior use. Please see REAGENTS section for details.
- (3) Reconstitute all assay standards (Cat. 30291-30296) and controls (Cat. 30297-30298) by adding **0.5 mL** of distilled or demineralized water to each vial. Allow the standards and controls to sit undisturbed for 5 minutes, and then mix well by inversions or gentle vortexing. Make sure that all solid is dissolved completely prior to use. These reconstituted standards and controls must be stored at -18°C or below. Do not exceed 3 freeze-thaw cycles.

### 2. Assay Procedure

- (1) Place a sufficient number of streptavidin-coated microwell strips (Cat. 10040B) in a holder to run human osteocalcin standards, controls and unknown samples in duplicate. The unused strips should be resealed in the bag with a desiccant and stored at 2-8°C.
- (2) Test Configuration

ROW	STRIP 1	STRIP 2	STRIP 3
A	STD 1	STD 5	SAMPLE 1
B	STD 1	STD 5	SAMPLE 1
C	STD 2	STD 6	SAMPLE 2
D	STD 2	STD 6	SAMPLE 2
E	STD 3	C 1	SAMPLE 3
F	STD 3	C 1	SAMPLE 3
G	STD 4	C 2	
H	STD 4	C 2	

- (3) Prepare working HRP conjugated Osteocalcin Antibody (Cat. 30288) and Biotinylated Osteocalcin Antibody (Cat. 30289) by 1:21 fold dilution of the conjugation antibody with the biotinylated antibody solution. Following is a table that outlines the relationship of strips used and antibody mix prepared.

Strip no.	Biotinylated Antibody Solution	HRP-Conjugated Antibody
1	2 mL	100 µL
2	4 mL	200 µL
3	6 mL	300 µL
4	8 mL	400 µL
5	10 mL	500 µL
6	12 mL	600 µL
7	14 mL	700 µL
8	16 mL	800 µL
9	18 mL	900 µL
10	20 mL	1000 µL
11	22 mL	1100 µL
12	24 mL	1200 µL

**Note:** this antibody mixture should be freshly prepared.

- (4) Add **25 µL** of standards, controls and patient serum/plasma samples into the designated microwell.
- (5) Add **200 µL** of above antibody mixture to each well
- (6) Cover the plate with one plate sealer and also with aluminum foil to avoid exposure to light.
- (7) Incubate the plate at room temperature, shaking 350 rpm ± 100 rpm for **1 hour**.
- (8) Remove the aluminum foil and plate sealer. Aspirate the contents of each well. Wash each well 5 times by dispensing 350 µL - 400 µL of working wash solution into

each well and then completely aspirating the contents. Alternatively, an automated microplate washer can be used.

- (9) Add **200 µL** of ELISA HRP Substrate (Cat. 10020) into each of the wells.
- (10) Cover the plate with one new plate sealer and also with aluminum foil to avoid exposure to light.
- (11) Incubate plate at room temperature static for **20 minutes**. (*This incubation period may be reduced to 8 – 15 min if a lower OD reading is demanded to fit to the plate readers specification.*)
- (12) Remove the aluminum foil and plate sealer. Add **50 µL** of ELISA Stop Solution (Cat. 30357) into each of the wells. Mix gently.
- (13) Read the absorbance at **450 nm** within 10 minutes in a microplate reader.

*NOTE: in case extremely low background is required, one can set the instrument to dual wavelength measurement at 450 nm with background wavelength correction set at 595 nm, 620 nm or 630 nm.*

### PROCEDURAL NOTES

1. It is recommended that all standards, controls and unknown samples be assayed in duplicate. The average absorbance reading of each duplicate should be used for data reduction and the calculation of results.
2. Keep light-sensitive reagents in the original amber bottles.
3. Store any unused streptavidin-coated strips in the foil zipper bag with desiccant to protect from moisture.
4. Careful technique and use of properly calibrated pipetting devices are necessary to ensure reproducibility of the test.
5. Incubation times or temperatures other than those stated in this insert may affect the results.
6. Avoid air bubbles in the microwell as this could result in lower binding efficiency and higher CV% of duplicate reading.
7. All reagents should be mixed gently and thoroughly prior to use. Avoid foaming.
8. Prepare a calibration curve for each run. Do not use data from previous runs.
9. To avoid cross-contamination, use a clean disposable pipette tip for the addition of each reagent and sample.

### INTERPRETATION OF RESULTS

1. Calculate the average absorbance for each pair of duplicate test results.
2. Subtract the average absorbance of the zero standard from the average absorbance of all other readings to obtain corrected absorbance.
3. The standard curve is generated by the corrected absorbance of all standard levels on the ordinate against the standard concentration on the abscissa using point-to-point or log-log paper. Appropriate computer assisted data reduction programs (e.g. Point-to-Point, 4-Parameter) may also be used for the calculation of results.

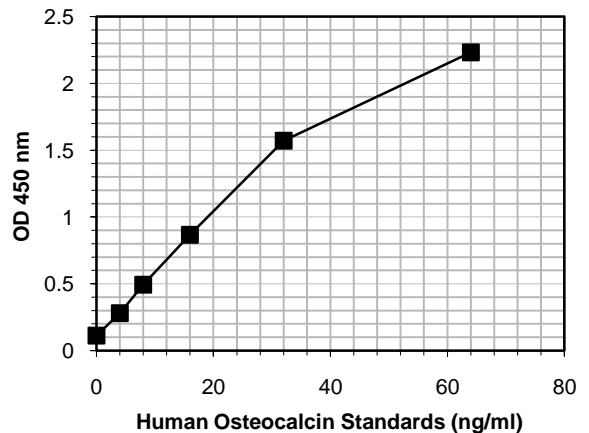
The sample human osteocalcin concentrations for the controls and the patient samples are read directly from the standard curve using their respective corrected absorbance.

### EXAMPLE DATA AND STANDARD CURVE

A typical absorbance data and the resulting standard curve from this human osteocalcin ELISA are represented. **This curve should not be used in lieu of standard curve run with each assay.**

Well I.D.	Results		
	Average	Corrected	
0 ng/mL	0.112	0.000	
4 ng/mL	0.279	0.167	
8 ng/mL	0.494	0.382	
16 ng/mL	0.866	0.754	
32 ng/mL	1.570	1.458	
64 ng/mL	2.232	2.120	
Control 1	0.363	0.251	5.26 ng/mL
Control 2	0.663	0.551	11.69 ng/mL

### Human Osteocalcin (1-43/49) ELISA



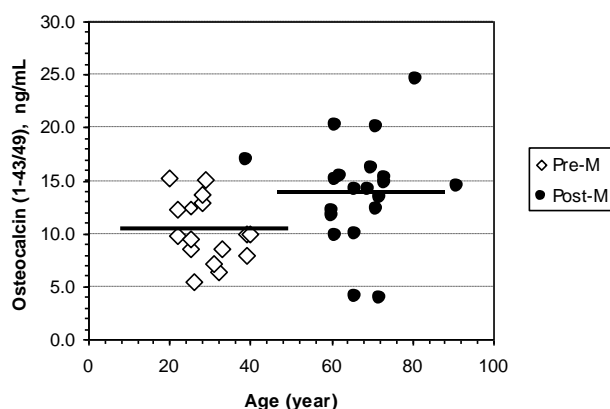
### EXPECTED VALUES

Forty serum samples from normal healthy adults with age of 26 – 58 were collected and measured with this ELISA. The normal osteocalcin range was found to be 3.8 – 25.3 ng/mL and the mean osteocalcin level of this group was 11.7 ng/mL (median: 11.4 ng/mL) and a Standard Deviation of 3.8 ng/mL. The ninety-five percentile normal high cut-off is 17 ng/mL based on this study group.

A validation study of pre- and post-menopausal women, as well as a group of male subjects, indicated a well-differentiated serum osteocalcin level of post-menopausal women from other two groups with this ELISA. The data is summarized in the following table and figure.

	Premenopausal Women (n = 16)	Postmenopausal Women (n = 19)	Male (n = 15)
<b>Age</b>			
<b>Mean</b>	29.0	68.7	50.3
<b>SD</b>	6.3	7.9	9.9
<b>Range</b>	21 – 40	60 – 91	37 – 76
<b>Osteocalcin (1-43/49), ng/mL</b>			
<b>Mean</b>	10.3	13.8	10.8
<b>SD</b>	3.0	5.0	3.6
<b>Range</b>	5.4 – 15.2	3.9 – 21.6	5.4 – 15.1

Pre- and Post menopausal Female



Forty serum samples from patients with end-stage renal diseases on hemodialysis were also measured with this ELISA. Except for one patient, all other 39 patients showed their osteocalcin values above the normal high cut-off ranging from 21 ng/mL to 119 ng/mL with a mean value of 60.6 ng/mL (median: 59.6 ng/mL, SD: 26.2 ng/mL).

#### LIMITATION OF THE PROCEDURE

1. An abnormally high osteocalcin value is likely to indicate a more significant bone turnover condition of a patient. For sample values reading greater than the highest standard, it is recommend to re-assay sample with dilution.
2. Different age group and gender may show a different normal range of osteocalcin.
3. Water deionized with polyester resins may inactivate the horseradish peroxidase enzyme.

#### QUALITY CONTROL

To assure the validity of the results each assay should include adequate controls.

#### PERFORMANCE CHARACTERISTICS

##### Sensitivity

The sensitivity of this human osteocalcin ELISA as determined by the 95% confidence limit on 8 replicate determinations of both zero and level 2 standards is approximately 0.31 ng/mL.

##### High Dose “hook” effect

This assay has showed that it did not have any high dose “hook” for sample osteocalcin level up to 1,250 ng/mL.

#### Precision

The intra-assay precision is validated by measuring two patient samples in a single assay with 16 replicate determinations.

Mean Osteocalcin Value (ng/mL)	CV (%)
11.9	4.7
40.2	5.0

The inter-assay precision is validated by measuring two control samples in duplicate in 6 individual assays.

Mean Osteocalcin Value (ng/mL)	CV (%)
5.6	8.3
11.9	5.7

#### Linearity

Two serum samples from dialysis patients were diluted with a BSA based 0.01M phosphate, 0.15M sodium chloride buffer matrix and assayed. The results in the value of ng/mL are as follows:

#	DILUTION	OBSERVED VALUE	EXPECTED VALUE	RECOVERY
1	Neat	69.6	-	-
	1:2	34.5	34.8	99%
	1:4	15.1	17.4	87%
2	Neat	42.1	-	-
	1:2	21.4	21.1	101%
	1:4	10.4	10.5	99%

#### Recovery

Two serum samples are spiked with three assay standards in equal volume (1 vol. + 1 vol. mixture) and assayed. The results in the value of ng/mL are as follows:

#	Orig. Value	Spiked Sample Value	Observed Value	Expected Value	Recovery %
<b>Sample 1</b>					
1	33.4	8	18.5	20.7	89
2	33.4	16	23.8	24.7	96
3	33.4	32	30.4	32.7	93
<b>Sample 2</b>					
4	15.7	8	11.4	11.9	96
5	15.7	16	15.3	15.9	96
6	15.7	32	24.4	23.9	102

**WARRANTY**

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**REFERENCES**


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**Short Assay Procedure:**

- Add 25 µL of standards, controls and patient samples into the designated microwell.
- Add 200 µL of antibody mixture to each well.
- Incubate 60 minutes at RT, shaking 350 rpm.
- Wash each well 5 times.
- Add 200 µL of ELISA HRP Substrate into each of the wells.
- Cover and incubate plate at room temperature static for 20 minutes.
- Add 50 µL of ELISA Stop Solution into each of the wells.
- Read the absorbance at 450 nm.

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