



UNACYLATED GHRELIN (pig)

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European patent # 89 139 552

U.S. patent # 50 47 330

**UnAcylated Ghrelin (pig)
Enzyme Immunoassay kit
#A05402.96 wells**

For research laboratory use only
Not for human diagnostic use

This assay has been developed & validated
by Bertin Pharma



Fabriqué en France
Made in France

Version: 0117
Ref. #A11402

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96 wells
Storage: -20°C
Expiry date: stated on the package

This kit contains:

	Colour of cap	Item #	Quantity per kit	Form
Strip 96 well Microtiter plate, pre-coated with anti-Ghrelin monoclonal antibody (pig)	Blister with zip	A08402.1 ea	1	-
Unacylyated Ghrelin (pig) Tracer	Green	A04402.100 dtn	1	Lyophilised
Unacylyated Ghrelin (pig) Standard	Blue with red septum	A06402.1 ea	2	Lyophilised
Unacylyated Ghrelin (pig) Quality Control	Green with red septum	A10402.1 ea	2	Lyophilised
EIA Buffer	Blue	A07100.1 ea	1	Lyophilised
Wash Buffer concentrated 400x	Silver	A17000.1 ea	1	Liquid
Tween 20	Transparent	A12000.1 ea	1	Liquid
Ellman's reagent 49+1	Black with red septum	A09000_49+1.100 dtn	2	Lyophilised
Technical booklet	-	A11402	1	-
Well cover sheet	-	-	1	-

Each kit contains sufficient reagents for 96 wells. This allows for the construction of one standard curve in duplicate and the assay of 36 samples in duplicate.

If you want to use the kit in two times, we provide one additional vial of Standard, one of Quality Control and one of Ellman's Reagent.

▶ **Precaution for use**

Users are recommended to read all instructions for use before starting work.

Each time a new pipette tip is used, aspirate a sample or reagent and expel it back into the same vessel. Repeat this operation two or three times before distribution in order to equilibrate the pipette tip.

- ▶ For research laboratory use only
- ▶ Not for human diagnostic use
- ▶ Do not pipet liquids by mouth
- ▶ Do not use kit components beyond the expiration date
- ▶ Do not eat, drink or smoke in area in which kit reagents are handled
- ▶ Avoid splashing

Wearing gloves, laboratory coat and glasses is recommended when assaying kit materials and samples.

▶ **Temperature**

Unless otherwise specified, all the experiments are done at room temperature (RT), that is around +20°C. Working at +25°C or more affects the assay and decreases its efficiency.

▶ **Background**

▷ **Acetylcholinesterase AChE® Technology**

Acetylcholinesterase (AChE®), the enzymatic label for EIA, has the fastest turnover rate of any enzymatic label. This specific AChE is extracted from the electric organ of the electric eel, *Electrophorus electricus*, and is capable of massive catalytic turnover during the generation of the electrochemical discharges. The use of AChE as enzymatic label for EIA has been patented by the French academic research Institute CEA [1, 2, 3], and Bertin Pharma, formerly known as SPI-Bio, has expertise to develop and produce EIA kits using this technology.

AChE® assays are revealed with Ellman's Reagent, which contains acetylthiocholine as a substrate. The final product of the enzymatic reaction (5-thio-2-nitrobenzoic acid) is bright yellow and can be read at 405-414 nm. AChE® offers several advantages compared to enzymes conventionally used in EIAs:

- > **Kinetic superiority and high sensitivity:** AChE® shows true first-order kinetics with a turnover of 64,000 sec⁻¹. That is nearly 3 times faster than Horseradish Peroxidase (HRP) or alkaline phosphatase. AChE® allows a greater sensitivity than other labeling enzymes.
- > **Low background:** non-enzymatic hydrolysis of acetylthiocholine in buffer is essentially absent. So, AChE® allows a very low background and an increased signal/noise ratio compared to other substrate of enzymes which is inherently unstable.

- > **Wide dynamic range:** AChE[®] is a stable enzyme and its activity remains constant for many hours as, unlike other enzymes, its substrate is not suicidal. This permits simultaneous assays of high diluted and very concentrated samples.
- > **Versatility:** AChE[®] is a completely stable enzyme, unlike peroxidase which is suicidal. Thus, if a plate is accidentally dropped after dispatch of the AChE[®] substrate (Ellman's Reagent) or if it needs to be revealed again, one only needs to wash the plate, add fresh Ellman's Reagent and proceed with a new development. Otherwise, the plate can be stored at +4°C with Wash Buffer in wells while waiting for technical advice from the Bioreagent Department.

▷ Ghrelin

Ghrelin discovered in 1999, is fast becoming an endocrinology target of the millennium. Ghrelin, identified in rat stomach as an endogenous ligand for the GH secretagogue receptor, is mainly produced in stomach, but has been demonstrated in many other organs **[4, 5]**.

In addition to GH-releasing properties and its orexant action, Ghrelin could act as an hormone having effects on gastric motility (similarity with the peptide hormone motilin), acidic secretion, cardiovascular action, antiproliferative effects, pancreatic and glucose metabolism function, sleep **[6, 7, 8]**...

Ghrelin gene raises to mRNA prepro-ghrelin of 117 amino acids. This precursor is processed into Ghrelin, 28 amino acids (human).

Before being secreted, this peptide is octanoylated at Ser 3 by GOAT (Ghrelin Octanoyl Acyl Transferase). This step is essential for biological activity making GOAT a perfect target for drugs in feeding behaviour. Interestingly, the potential therapeutic importance of this hormone is not restricted to regulation of food intake **[9]** but also in cachexia (related to cancer treatment, anorexia nervosa or ischemia) **[10]** gastric motility and may be involved in osteoporosis, somatopause, infertility and ovulation induction, neurological disorders (Alcoholism, Post Traumatic Stress disorders...) **[11]** and cardiovascular diseases.

▶ Principle of the assay

This Enzyme Immunometric Assay (EIA) is based on a double-antibody sandwich technique. The wells of the plate supplied are coated with a monoclonal antibody specific to the C-terminal part of Ghrelin.

This antibody will bind to any Ghrelin introduced into the wells (standard or sample). The acetylcholinesterase (AChE) - Fab' conjugate (Tracer) which recognises the N-terminal part of Unacylyated Ghrelin is also added to the wells.

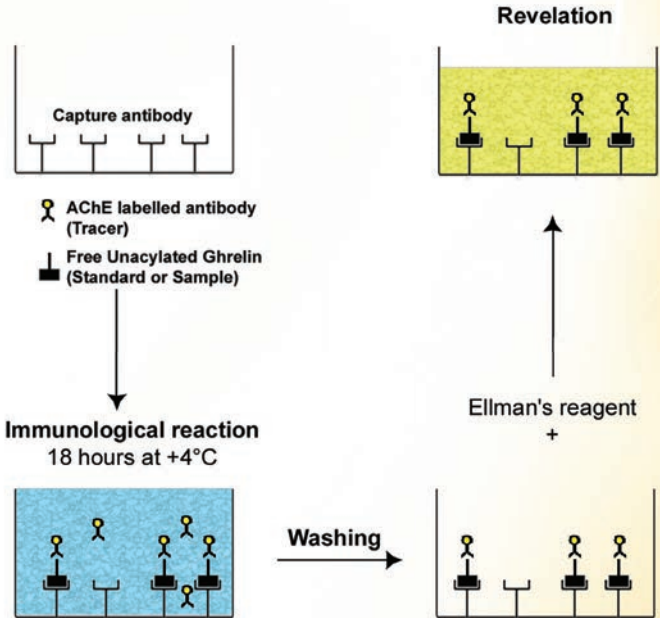
The two antibodies then form a sandwich by binding on different parts of the Unacylyated Ghrelin (pig).

The sandwich is immobilised on the plate so reagents in excess may be washed away.

The concentration of Unacylyated Ghrelin (pig) is determined by measuring the enzymatic activity of immobilized Tracer using Ellman's Reagent. AChE Tracer acts on Ellman's Reagent to form a yellow compound that strongly absorbs at 414 nm.

The intensity of the colour, which is determined by spectrophotometry, is proportional to the amount of Unacylyated Ghrelin (pig) present in the well during the immunological incubation.

The principle of the assay is summarised below:



▶ **Materials and equipment required**

In addition to standard laboratory equipment, the following material is required.

▷ **For the sample preparation**

- > K2-EDTA tubes for blood collection
- > 35 sampling tubes with PHMB #D31009
or reagents for PHMB inhibitor solution:
 - Potassium Phosphate buffer 0.1 M pH 7.4
 - NaOH 10N
 - p-Hydroxymercuribenzoic acid (PHMB)
 - UltraPure water #A07001
- or Aprotinin (up to 0,6 TIU per mL blood)
or PMSF

▷ **For the assay**

- > Precision micropipettes (20 to 1000 μ L)
- > Spectrophotometer plate reader (405 or 414 nm filter)
- > Microplate washer (or washbottles)
- > Orbital microplate shaker able to perform at 600 rpm
- > Multichannel pipette and disposable tips 30-300 μ L
- > UltraPure water (Ref. #A07001)
- > Polypropylene tubes



Water used to prepare all EIA reagents and buffers must be UltraPure (deionized & free from organic contaminant traces).

Otherwise, organic contamination can significantly affect the enzymatic activity of the tracer Acetylcholinesterase (AChE).

Do not use distilled water, HPLC-grade water or sterile water.

UltraPure water may be purchased from Bertin Pharma :
item #A07001.1L

▶ **Sample collection and preparation**

This assay has been validated to measure Unacylyated Ghrelin in buffer and in pig plasma samples (see validation data at the end of this booklet).

▷ **General precautions**

- ▶ All samples must be free of organic solvents prior to assay.
- ▶ Samples should be assayed immediately after collection or should be stored at -20°C .

▷ **Blood collection**

- ▶ Blood samples are collected in tubes containing K2-EDTA and a protease inhibitor to prevent the degradation of Aclyated Ghrelin.

▶ **Choice of protease inhibitor**

We suggest adding p-hydroxymercuribenzoic acid (PHMB) 1 mM in the final sample volume during the blood collection.

We suggest preparing a 100 times concentrated solution of protease inhibitor and then adding 10 μL of this solution per mL of blood. For example, for PHMB 100mM concentrated solution, prepare a potassium phosphate buffer 0.1 M pH 7.4 in which 1.2% NaOH 10N volume/volume is added. Then dissolve PHMB to get a 100 times concentrated solution (100 mM) in this buffer.

Add 10 μL of this PHMB 100x solution per mL of blood. The PHMB 100x solution may be stored one month at -20°C .

We suggest using aliquots for PHMB 100x solution in order to avoid freezing/thawing cycles.

To avoid the preparation of PHMB protease inhibitor solution, Bertin Pharma provides sampling tubes for 1 mL of blood containing PHMB (item #D31009).

Other protease inhibitors could be used with the assay like Aprotinin (up to 0,6 TIU/mL blood) or PMSF (around 0.1 mg/mL blood according to literature) as indicated in the section "Protease inhibitor compatibility table" at the end of this booklet. For the use of these different products, please refer to the vendor's instructions.

- > Collection tubes are mixed by inversion 5 folds.



Samples should be kept on ice between collection and centrifugation (15 minutes max).

- > Blood samples are centrifuged at 3,500 rpm for 10 minutes at +4°C and then, supernatants are transferred in separate tubes.
Samples should be quickly assayed or stored at -20°C for later use.
- > The best way is to assay the samples within 3 weeks after the collection date. Moreover, we suggest using aliquots for plasma samples (we suggest 250 µl per aliquot) in order to avoid freezing/thawing cycles.



Plasma samples prepared as above-mentioned can be assayed for Acylated Ghrelin (pig) with Acylated Ghrelin (pig) EIA kit or for Unacylyated Ghrelin (pig) with Unacylyated Ghrelin (pig) EIA kit.

▷ **Sample preparation**

Plasma samples may be assayed directly without any extraction procedure after being diluted at **least to 1:5 in EIA Buffer** in order to avoid matrix effect.

▶ Reagent preparation

Each kit contains sufficient reagents for 96 wells. This allows for the construction of one standard curve in duplicate and the assay of 36 samples in duplicate.

If you want to use the kit in two times, we provide one additional vial of Standard, one of Quality Control and one of Ellman's Reagent.

All reagents need to be brought to room temperature, around +20°C, prior to the assay.

▶ EIA Buffer

Reconstitute the vial #A07100 with 50 mL of UltraPure water. Allow it to stand 5 minutes until completely dissolved and then mix thoroughly by gentle inversion.

Stability at 4°C: 1 month

▶ Unacylated Ghrelin (pig) Standard

Reconstitute the Standard vial #A06402 with 1 mL of UltraPure water. Allow it to stand 5 minutes until completely dissolved and then mix thoroughly by gentle inversion.

The concentration of the first standard S1 is 500 pg/mL.

Prepare seven propylene tubes for the other standards and add 500 µL of EIA Buffer into each tube. Then prepare the standards by serial dilutions as follows:

Standard	Volume of Standard	Volume of EIA Buffer	Standard concentration pg/mL
S1	-	-	500
S2	500 μ L of S1	500 μ L	250
S3	500 μ L of S2	500 μ L	125
S4	500 μ L of S3	500 μ L	62.5
S5	500 μ L of S4	500 μ L	31.3
S6	500 μ L of S5	500 μ L	15.6
S7	500 μ L of S6	500 μ L	7.8
S8	500 μ L of S7	500 μ L	3.9

Stability at 4°C: 1 week

▶ **Unacylated Ghrelin (pig) Quality Control**

The Quality Control provided in this kit has been prepared by spiking Unacylated Ghrelin (pig) peptide in EIA Buffer.

Reconstitute the Quality Control vial #A10402 with 1 mL of UltraPure water. Allow it to stand 5 minutes until completely dissolved and then mix thoroughly by gentle inversion.

Stability at -20°C: 1 week

▶ **Unacylated Ghrelin (pig) Tracer**

Reconstitute the vial #A04402 with 10 mL of EIA Buffer. Allow it to stand 5 minutes until completely dissolved and then mix thoroughly by gentle inversion.

Stability at +4°C: 1 week

▷ **Wash Buffer**

Dilute 2 mL of concentrated Wash Buffer #A17000 with 800 mL of UltraPure water. Add 400 μ L of Tween20 #A12000. Use a magnetic stirring bar to mix the content.

Stability at +4°C: 1 week

▷ **Ellman's Reagent**

5 minutes before use (development of the plate), reconstitute one vial of Ellman's Reagent #A09000_49+1 with 49 mL of UltraPure water and 1 mL of concentrated Wash Buffer. The tube content should be thoroughly mixed.

Stability at 4°C and in the dark: 24 hours

▶ **Assay procedure**

It is recommended to perform the assays in duplicate and to follow the instructions hereafter.

▶ **Plate preparation**

Prepare the Wash Buffer as indicated in the reagent preparation section.

Open the plate packet and select the sufficient strips for your assay and place the unused strips back in the packet.

Stability at +4°C: 1 month.

Rinse each well 3 times with the Wash Buffer 300 µL/well.

Just before distributing reagents and samples, remove the buffer from the wells by inverting the plate and shaking out the last drops on a paper towel.

▶ **Plate set-up**

A plate set-up is suggested hereafter.

The contents of each well may be recorded on the template sheet provided at the end of this technical booklet.

	1	2	3	4	5	6	7	8	9	10	11	12
A	Bk	S7	S3	*	*	*	*	*	*	*	*	*
B	Bk	S7	S3	*	*	*	*	*	*	*	*	*
C	Bk	S6	S2	*	*	*	*	*	*	*	*	*
D	NSB	S6	S2	*	*	*	*	*	*	*	*	*
E	NSB	S5	S1	*	*	*	*	*	*	*	*	*
F	NSB	S5	S1	*	*	*	*	*	*	*	*	*
G	S8	S4	QC	*	*	*	-	-	-	-	-	-
H	S8	S4	QC	*	*	*	*	*	*	*	*	*

Bk : Blank

S1-S8 : Standards 1-8

NSB : Non Specific Binding

QC : Quality Control

* : Samples

▷ Pipetting the reagents

All samples and reagents must reach room temperature prior to performing the assay.

Use different tips to pipette the buffer, standard, sample, tracer, antiserum and other reagents.

Before pipetting, equilibrate the pipette tips in each reagent. Do not touch the liquid already in the well when expelling with the pipette tip.

> **EIA Buffer**

Dispense 100 μ L to Non Specific Binding NSB wells.

> **Unacylated Ghrelin (pig) Standards**

Dispense 100 μ L of each of the eight standards S1 to S8 in duplicate to appropriate wells.

Start with the lowest concentration standard S8 and equilibrate the tip in the next higher standard before pipetting.

> **Quality Control and samples**

Dispense 100 μ L in duplicate to appropriate wells. Highly concentrated samples may be diluted in EIA Buffer.

> **Unacylated Ghrelin (pig) Tracer**

Dispense 100 μ L to each well, **except** Blank (Bk) wells.

▷ **Incubating the plate**

Cover the plate with the cover sheet and incubate for 18 to 20 hours (overnight) at +4°C.

▷ Developing and reading the plate

- > Reconstitute Ellman's reagent as mentioned in the Reagent preparation section.
- > Empty the plate by turning over. Rinse each well five times with 300 μ L Wash Buffer. The 5th time, slightly shake the plate for 5 minutes on an orbital shaker. Then rewash five times with 300 μ L Wash Buffer. At the end of the last washing step, empty the plate and blot the plate on a paper towel to discard any trace of liquid.
- > Add 200 μ L of Ellman's reagent to each 96 well. Cover the plate with aluminium sheet and incubate in the dark at room temperature. Optimal development is obtained using an orbital shaker.
- > Wipe the bottom of the plate with a paper towel, and make sure that no liquid has splashed outside the wells.
- > Read the plate at a wavelength between 405 and 414nm (yellow colour).

After addition of Ellman's reagent, the absorbance has to be checked periodically (every 30 minutes) until the maximum absorbance has reached a minimum of 0.5 A.U. blank subtracted.

Enzyme Immunoassay Protocole (volumes are in μL)					
Volume	Wells	Blank	NSB	Standard	Sample or QC
EIA Buffer		-	100	-	-
Standard		-	-	100	-
Sample or QC		-	-	-	100
Tracer				100	
Cover plate, incubate 16-20 hours at +4°C					
Wash plate 5 times, shake 5 min, wash 5 times & discard liquid from the wells					
Ellman's reagent			200		
Incubate with an orbital shaker in the dark at RT					
Read the plate between 405 and 414 nm					

► Data analysis

Make sure that your plate reader has subtracted the absorbance readings of the blank well (absorbance of Ellman's reagent alone) from the absorbance readings of the rest of the plate. If not, do it now.

- Subtract the NSB mean absorbance from each standard, QC and sample.
- Calculate the average absorbance for each QC, standard and sample.
- For each standard, plot the absorbance on y axis versus the concentration on x axis. Draw a best-fit line through the points.
- To determine the concentration of your samples, find the absorbance value of each sample on the y axis.
- Read the corresponding value on the x axis which is the concentration of your unknown sample. Do not forget to integrate the dilution factor of your own samples (due notably to the minimal dilution for the assay 1:5).
- Samples with a concentration greater than 500 pg/mL should be re-assayed after dilution in EIA Buffer.
- Most plate readers are supplied with curve-fitting software capable of graphing these data (logit/log or 4-parameter logistic fit 4PL or 5 parameter logistic fitting with ponderation $1/Y^2$). If you have this type of software, we recommend using it. Refer to it for further information.



Two vials of Quality Control are provided with this kit.

Your standard curve is validated only if the calculated concentration of the Quality Control obtained with the assay is +/- 25% of the expected concentration (written on the label of the QC vial)

▶ **Acceptable range**

- > Non Specific Binding < 200 mA.U.
- > Limit of detection in sample before dilution <25 pg/mL
- > QC sample: $\pm 25\%$ of the expected concentration (see the label of QC vial)

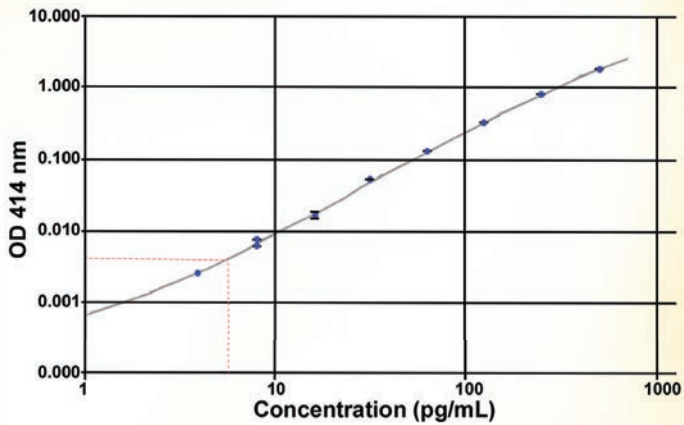
► Typical results

The following data are for demonstration purpose only. Your data may be different and still correct.

These data were obtained using all reagents as supplied in this kit under the following conditions: 30 minutes developing, reading at 414 nm. A 5-parameter logistic fitting with ponderation $1/Y^2$ was used to determine the concentrations.

	Unacylyated Ghrelin (pig) pg/mL	Absorbance (mAU)
Standard S1	500	1 941
Standard S2	250	870
Standard S3	125	344
Standard S4	62.5	133
Standard S5	31.3	54
Standard S6	15.6	16
Standard S7	7.8	7
Standard S8	3.9	3

Typical Unacylated Ghrelin (pig) standard curve



► Assay validation and characteristics

The Enzyme Immunometric assay of Unacylated Ghrelin (pig) has been validated for its use in buffer and in plasma (without extraction but diluted at least 1:5). A 5-parameter logistic fitting with ponderation 1/Y² was used to determine the concentrations.

For additional information regarding the validation of immunoassay for protein biomarkers in biological samples, please refer to bibliography [12, 13].

- The **limit of detection**, calculated as the concentration of Unacylated Ghrelin corresponding to the NSB average (n = 8) plus three standard deviations is 5 pg/mL. Due to the minimal plasma dilution (1:5), the limit of detection in the samples is 25 pg/mL.
- **Cross-reactivity**

Acyated Ghrelin (pig)	<1%
Ghrelin (1-14) (human)	<0.001 %
Ghrelin (1-11) (rat)	<0.001 %
Ghrelin (17-28) (human, rat)	<0.001 %
GHRF (human)	<0.001 %
Insulin (human)	<0.001 %
Motiline	<0.001 %
Leptin (human)	<0.001 %
Somatostatine	<0.001 %
CRF (human, rat)	<0.001 %
Glucagon (human, rat)	<0.001 %

> Protease Inhibitor compatibility table

	AEBSF	PMSF	Pefabloc	P800	Aprotinin	PHMB
A05402.96 wells	NO	YES	NO	NO	YES	YES

Plasma samples were collected on different protease inhibitors according to vendors instruction and measured with the appropriate kit. Recovery is different from one inhibitor to the other and it belongs to the end user to define according to its needs which inhibitor to be used.

> Related products

Item Reference	Designation	Application
A05106.96 wells	Acylyated Ghrelin (human) Express EIA kit	PHMB, PMSF, Aprotinin samples
A05106.384 wells	Acylyated Ghrelin (human) 384w EIA kit	GOAT inhibitor screening
A05117.96 wells	Acylyated Ghrelin (mouse, rat) Express EIA kit	PHMB, PMSF, Aprotinin samples
A05118.96 wells	UnAcylyated Ghrelin (mouse, rat) Express EIA kit	PHMB, PMSF, Aprotinin samples
A05119.96 wells	UnAcylyated Ghrelin (human) Express EIA kit	PHMB, PMSF, Aprotinin samples
A05306.96 wells	Acylyated Ghrelin (human) Easy Sampling EIA kit	Any kind of sample
A05317.96 wells	Acylyated Ghrelin (mouse, rat) Easy Sampling EIA kit	
A05318.96 wells	UnAcylyated Ghrelin (mouse, rat) Easy sampling EIA kit	
A05319.96 wells	UnAcylyated Ghrelin (human) Easy Sampling EIA kit	
A05320.96 wells	UnAcylyated Ghrelin (dog) Easy Sampling EIA kit	
A05321.96 wells	Acylyated Ghrelin (dog) Easy Sampling EIA Kit	
A05401.96 wells	Acylyated Ghrelin (pig) EIA kit	
A05402.96 wells	UnAcylyated Ghrelin (pig) EIA kit	PHMB, PMSF, Aprotinin samples
D31009	Sampling Tubes with PHMB	Sample preparation

► Troubleshooting

- > **Absorbance values are too low:**
 - organic contamination of water,
 - one reagent has not been dispensed,
 - incorrect preparation/dilution,
 - assay performed before reagents reached room temperature,
 - reading time not long enough.

- > **High signal and background in all wells:**
 - inefficient washing,
 - overdeveloping (incubation time should be reduced),
 - high ambient temperature.

- > **High dispersion of duplicates:**
 - poor pipetting technique,
 - irregular plate washing.

- > **If a plate is accidentally dropped after dispatch of the AChE[®] substrate (Ellman's Reagent) or if it needs to be revealed again:**
 - one only needs to wash the plate, add fresh Ellman's Reagent and proceed with a new development.
 - otherwise, the plate can be stored at +4°C with Wash Buffer in wells while waiting for technical advice from the Bioreagent Department.

These are a few examples of trouble shooting that may occur.

If you need further explanation, Bertin Pharma will be happy to assist you. Feel free to contact our technical support staff by phone (+33 (0)139 306 036), fax (+33 (0)139 306 299) or E-mail (bioreagent@bertinpharma.com), and be sure to indicate the batch number of the kit (see outside the box).

Bertin Pharma proposes EIA Training kit #B05005 and EIA workshop upon request. For further information, please contact our Marketing Department by phone (+33 (0)139 306 260) or E-mail (marketing@bertinpharma.com).

► Bibliography

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Compounds labelled by the acetylcholinesterase of *Electrophorus Electricus*. Its preparation process and its use as a tracer or marquer in enzyme-immunological determinations.
United States patent, N° 1,047,330. September 10, 1991
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The use of Acetylcholinesterase as a Universal marker in Enzyme-Immunoassays
Proceedings of the Third International Meeting on Cholinesterases, American Chemical Society (1991)
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Med Sci (Paris), August 1, 2005, 21 (8-9): 715-21
6. de Faria Barros A. *et al.*
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J Bras Nefrol. (2013) 35(2): 120-126.

- 7.** Grousselle D. *et al.*
Variations des peptides dérivés de la préprogréline au cours du repas dans l'anorexie mentale restrictive
Poster GIR-AFDAS-TCA2014
- 8.** Delhanty P. *et al.*
Des-acyl ghrelin analogs prevent high-fat-diet-induced dysregulation of glucose homeostasis
FASEB J. (2013) 27(4):1690-1700.
- 9.** Costantini V. *et al.*
GSK1614343, a Novel Ghrelin Receptor Antagonist, Produces an Unexpected Increase of Food Intake and Body Weight in Rodents and Dogs
Neuroendocrinology (2011); 94: 158–168
- 10.** Porporato E., Filigheddu N. *et al.*
Acyated and unAcyated Ghrelin impair skeletal muscle atrophy in mice.
J. Clinical Invest (2013) 123(2): 611-622
- 11.** Sentissi O., Epelbaum J., Olié J-P. *et al.*
Leptin and Ghrelin Levels in Patients With Schizophrenia During Different Antipsychotics Treatment: A Review
Schizophrenia Bulletin (2008) 34(6), 1189–1199
- 12.** Valentin M-A., Ma S., Zhao A. *et al.*
Validation of immunoassay for protein biomarkers: Bioanalytical study plan implementation to support pre-clinical and clinical studies.
J Pharm Biomed Anal. (2011) 55(5) : 869-877

13. European Medicines Agency

Guideline on bioanalytical method validation, 21 July 2011

Additional readings

List of publications quoting the use of SPI-Bio Ghrelin kits

14. Batorek N., Vogrin Bracic M., Skorjanc D.

Serum Concentrations of Leptin, Ghrelin and Cortisol are not Direct Related to the Loss of Backfat Thickness, Body Weight, Protein and Fat at Weaning of Second Parity of Crossbreed Sows (Landrace x Large white)

Journal of Animal and Veterinary Advances (2013) 12(6): 766-774

Bertin Pharma, over the last decades, has been developing and marketing over 100 biomarker assays, pre-analytical products, kits, antibodies and biochemicals thanks to its innovative work in research and development. Our core areas are orientated to inflammation, oxidative injury, endocrinology, diabetes, obesity, hypertension, neurodegenerative diseases, HIV, prion diseases, pharmacokinetics and metabolism.

Bertin Pharma is active worldwide either with direct sales or through our qualified and trained international distribution network from the United States to Japan.

We are able to provide you with local technical support to use at ease our products.

For further information, please send your request to
bioreagent@bertinpharma.com



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