

ALPCO offers several assays for academic and industry researchers to measure biomarkers associated with energy homeostasis. Studying the many central and peripheral mechanisms involved in energy homeostasis could lead to effective treatments for the control of diabetes, obesity, and other metabolic disorders.

### Adipose Tissue

Adipose tissue is a source of lipid storage and mobilization, consisting of specialized tissue able to produce heat (brown adipose). Adipose tissue has the intrinsic ability to produce and secrete an extensive number of adipocytokines. These adipocytokines consist of polypeptides, but also non-protein factors which are metabolically active. These factors span different functional categories including immunity (complement factors, haptoglobin), endocrine function (leptin, sex steroids, various growth factors), metabolic function (fatty acids, adiponectin, resistin), and cardiovascular function (angiotensinogen, PAI-1).

### The Brain

As stated by Dr. Barry Levin, "the brain maintains a constant dialog with the external environment through in-puts from somatic sensation, taste, smell, sight, and sound and the body by inputs from the viscera. These signals are relayed to a variety of brain areas through hard-wired neural connections and are complemented by metabolic and hormonal inputs that reflect the metabolic status of the body. These metabolic sensing neurons are clustered in sites scattered throughout the brainstem and forebrain and are integrated into a distributed network that links them to afferent and efferent pathways involved in the control of energy homeostasis."<sup>1</sup> These signals can be augmented and influenced by adipocytokines (e.g. leptin) and factors released from the gut and stomach.

### The Intestine

The effects of gut-derived hormones on metabolic function and energy homeostasis are becoming increasingly well-characterized. Glucose-dependent insulinotropic polypeptide (GIP), an incretin hormone produced in the intestines, is an inhibitor of gastric acid secretion and a releaser of insulin during hyperglycemia. GIP also promotes energy storage in adipose tissue and plays a key role in high-fat diet (HFD)-induced obesity and insulin resistance. Glucagon-like peptide-1 (GLP-1) is a second incretin hormone produced in the intestines that stimulates insulin release from beta cells in the pancreas. In addition to its involvement with glucose homeostasis, GLP-1 reduces body weight and food intake and slows gastric emptying. PYY, a peptide also produced within the small intestine and rectum by L-cells, inhibits gut motility and is proposed to stimulate a significant central satiety response.

### The Stomach

The stomach is responsible for producing ghrelin, the only known circulating orexigenic hormone. Ghrelin is acylated with a medium-chain fatty acid by the enzyme ghrelin O-acyltransferase (GOAT) and displays a range of activity from central control of food intake to peripheral functions such as gastric emptying and insulin secretion.

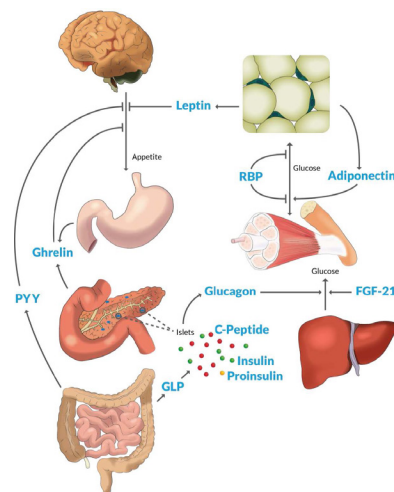
### The Pancreas

The pancreas may have the most obvious involvement in energy homeostasis. The pancreas is responsible for secretion of insulin and glucagon, two counteregulatory hormones that control systemic concentration of glucose, a metabolic intermediate used by cells as the primary source of energy. The pancreas releases insulin and glucagon directly based on concentration of glucose in the blood. Not only is insulin secretion regulated in this direct fashion, it is also controlled by the previously mentioned incretins (GIP and GLP-1), a group of gastrointestinal hormones that cause an increase in the amount of insulin released from beta cells after eating, even before blood glucose

levels become elevated.

### The Liver

Pancreatic function is tightly coordinated with liver function as it is responsible for releasing glucagon when blood sugar (glucose) levels fall too low. Glucagon, the counterpart of insulin, prompts the liver to convert stored glycogen into glucose, causing release into the bloodstream.



#### References

1. *Central Regulation of Energy Homeostasis Intelligent Design: How to Build the Perfect Survivor* Barry E. Levin\*
2. *Sensory and Metabolic Control of Energy Balance. Results and Problems in Cell Differentiation*, 2010, Volume 52/2010, 183-188, DOI: 10.1007/978-3-642-14426-4\_15
3. *Curr Drug Targets*. 2004 Apr;5(3):241-50. Adipose tissue as a regulator of energy balance. Klaus S.
4. *AJP - Endo* May 1, 2010 vol. 298 no. 5 E909-E919
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6. Seino Y, et al (2010). GIP and GLP-1, the two incretin hormones: Similarities and differences. *Journal of Diabetes Investigation*. 1:1/2:8-23. PMID: 24843404.
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## Testing Solutions to Measure Energy Homeostasis Biomarkers



Energy homeostasis is a well-regulated process dependent upon the coordination between feeding behavior and energy expenditure. Research around energy homeostasis, including the impact that conditions such as diabetes and obesity have on this complex process, has grown significantly in recent years.

Adiponectin	Species	Catalog #	Sample Types	Size	Incubation	Range
Adiponectin ELISA	Rat	22-ADPRT-E01	Plasma, Serum	5 µL	2hr 30min	0.25 - 10 ng/mL
Adiponectin Total ELISA	Mouse	22-ADPMS-E01	Plasma, Serum, Cell Culture	<5 uL	2hr 30min	0.025 - 1 ng/mL
Adiponectin HMW & Total ELISA	Human	80-ADPHU-E01	Citrate Plasma, EDTA Plasma, Heparin Plasma, Serum	50 µL	2hr 30min- 3hr	0.078 - 5 ng/mL
C-peptide	Species	Catalog #	Sample Types	Size	Incubation	Range
C-peptide ELISA**	Human	80-CPTHU-E01.1	Plasma, Serum	25 µL	2hr	60 - 9,000 pg/mL
C-peptide ELISA	Mouse	80-CPTMS-E01	Serum	10 µL	2hr 15min	187 - 9,366 pg/mL
C-peptide ELISA	Rat	80-CPTRT-E01	Serum	10 µL	2hr 15min	150 - 13,500 pg/mL
C-peptide Chemiluminescence ELISA*	Human	80-CPTHU-CH01	Plasma, Serum, Cell Culture	50 µL	3hr	4.5 - 12,960 pg/mL
Ghrelin	Species	Catalog #	Sample Types	Size	Incubation	Range
Acylated Ghrelin ELISA	Human	32-5106	Plasma	100 µL	3hr	1.95 - 250 pg/mL
Acylated Ghrelin ELISA	Mouse/Rat	32-5117	Plasma	100 µL	3hr	1.95 - 250 pg/mL
Non-Acylated Ghrelin ELISA	Human	32-5119	Plasma	10 µL	3hr	1.95 - 250 pg/mL
Non-Acylated Ghrelin ELISA	Mouse/Rat	32-5118	Plasma	10 µL	3hr	1.95 - 250 pg/mL
GIP	Species	Catalog #	Sample Types	Size	Incubation	Range
Active GIP ELISA	Human	48-AGIPHU-E01	Cell Culture, Plasma	50 µL	3 hr 30 min	3.9 - 250 pg/mL
Active GIP ELISA	Mouse	48-AGIPMS-E01	Cell Culture, Plasma	25 µL	3 hr 30 min	7.8 - 500 pg/mL
Active GIP ELISA	Rat	48-AGIPRT-E01	Cell Culture, Plasma	50 µL	3 hr 30 min	3.9 - 250 pg/mL
Total GIP ELISA	Human	48-GIPHU-E01	Cell Culture, EDTA Plasma	50 µL	3 hr 30 min	3.1 - 200 pM
Total GIP ELISA	Mouse	48-GIPMS-E01	Cell Culture, EDTA Plasma	10 µL	Overnight	2.5 - 600 pM
Total GIP ELISA	Rat	48-GIPRT-E01	Cell Culture, EDTA Plasma	50 µL	3 hr 30 min	3.1 - 200 pM
GLP	Species	Catalog #	Sample Types	Size	Incubation	Range
GLP-1 Active (7-36)	Human/ Mouse/Rat	80-GLP1A-CH01	EDTA Plasma	25 ul	<3hr	0.45 - 151.6 pmol/L
GLP-1 Active (7-36) ELISA	Human	43-GP1HU-E01	Plasma	100 µL	Overnight	0.64 - 48 pmol/L
GLP-1 Total (7-36 and 9-36) ELISA	Human	43-GPTHU-E01	Plasma	100 µL	Overnight	2.1 - 54 pmol/L

Assays are for Research Use Only unless otherwise noted.

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GLP-2 ELISA	Human	48-GP2HU-E01.1	Plasma, Serum	25 µL	Overnight	0.412 - 100 ng/mL
GLP-2 ELISA	Mouse	48-GP2MS-E01	Plasma, Serum	25 µL	Overnight	0.412 - 100 ng/mL
GLP-2 ELISA	Rat	48-GP2RT-E01	Plasma, Serum	25 µL	Overnight	0.137 - 100 ng/mL
<b>Glucagon</b>	<b>Species</b>	<b>Catalog #</b>	<b>Sample Types</b>	<b>Size</b>	<b>Incubation</b>	<b>Range</b>
Glucagon ELISA	Human/ Mouse/Rat	48-GLUHU-E01	Plasma	100 µL	Overnight	41 - 10000 pg/mL
Glucagon Ultrasensitive ELISA	Human/ Mouse/Rat	48-GLUHUU-E01	Plasma, Serum	10 µL	Overnight	7.8 - 500 pg/mL
Glucagon RIA*	Human	38-GLUHU-R100	Plasma	200 µL	Overnight	4.7 - 150 pmol/L
<b>Insulin</b>	<b>Species</b>	<b>Catalog #</b>	<b>Sample Types</b>	<b>Size</b>	<b>Incubation</b>	<b>Range</b>
Anti-Insulin-IgG ELISA	Human	35-INAHU-E01	Serum	10 µL	1hr	3-300 U/mL
Insulin Autoantibody ELISA	Human	21-IAAHU-E01	Serum	25 µL	Overnight	Cut-off
Insulin ELISA	Bovine	80-INSBO-E01	Plasma, Serum	25 µL	2hr 15 min	0.25 - 6.0 ng/mL
Insulin ELISA*+	Human	80-INSHU-E01.1	Plasma, Serum	25 µL	2hr	3 - 200 µIU/mL
Insulin ELISA+	Mouse	80-INSMS-E01	Plasma, Serum	10 µL	2hr	0.188 - 6.9 ng/mL
Insulin ELISA*	Rat	80-INSRT-E01	Plasma, Serum	10 µL	2hr	0.15 - 5.5 ng/mL
Insulin High Range ELISA+	Mouse	80-INSMSH-E01	Plasma, Serum	5 µL	2hr 15min	3 - 150 ng/mL
Insulin High Range ELISA+	Rat	80-INSRTH-E01	Plasma, Serum	5 µL	2hr	3 - 150 ng/mL
Insulin Ultrasensitive ELISA*	Human	80-INSHUU-E01.1	Plasma, Serum	25 µL	2hr 30min	0.15 - 20 µIU/mL
Insulin Ultrasensitive ELISA+	Mouse	80-INSMSU-E01	Plasma, Serum	5 µL 25 µL	2hr 30min	0.19 - 6.9 OR 0.025 - 1.25 ng/mL
Insulin Ultrasensitive ELISA+	Rat	80-INSRTU-E01	Plasma, Serum	5 µL 25 µL	2hr 30min	0.15 - 5.5 OR 0.02 - 1.0 ng/mL
Insulin Chemiluminescence ELISA*+	Human	80-INSHU-CH01	Heparin Plasma, Serum, Tissue Culture	25 µL	1hr 35min	5 - 30,000 pg/mL
Insulin Chemiluminescence ELISA+	Mouse/Rat	80-INSMR-CH01	Plasma, Serum	5 µL	2hr	0.1 - 150 ng/mL
<b>Leptin</b>	<b>Species</b>	<b>Catalog #</b>	<b>Sample Types</b>	<b>Size</b>	<b>Incubation</b>	<b>Range</b>
Leptin ELISA	Human	11-LEPHU-E01	Serum	20 µL	1hr 45min	1 - 100 ng/mL
Leptin ELISA	Mouse/Rat	22-LEPMS-E01	Serum	5 µL	3hr	25 - 1600 pg/mL

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Leptin Ultrasensitive ELISA	Human	22-LEPHUU-E01	Biological Fluids, Plasma, Serum	25 µL	1hr 45min	0.05 - 5 ng/mL
Bioactive Leptin ELISA	Human	22-BLEPHU-E01	EDTA Plasma, Heparin Plasma, Serum	15 µL	4hr	0.05 - 6 ng/mL
Proinsulin	Species	Catalog #	Sample Types	Size	Incubation	Range
Proinsulin (Intact) ELISA*	Human	82-PINHUI-E01	Plasma, Serum	50 µL	3h 30 min	0.3 - 100 pM
Proinsulin (Total) ELISA	Human	82-PINHUT-E01	Plasma, Serum	50 µL	3h 15 min	0.5 - 250 pM
Proinsulin (Total) Chemiluminescence ELISA*	Human	80-PINHUT-CH01	EDTA Plasma, Serum, Tissue Culture	50 µL	2hr 31min	5 - 3000 pg/mL
PYY	Species	Catalog #	Sample Types	Size	Incubation	Range
PYY ELISA	Human	48-PYYHU-E01.1	Plasma, Serum	50 µL	Overnight	0.082 - 20 ng/mL
PYY ELISA	Mouse/Rat	48-PYYRT-E01.1	Plasma, Serum	25 µL	Overnight	0.15 - 12.5 ng/mL
RBP	Species	Catalog #	Sample Types	Size	Incubation	Range
RBP ELISA	Human	30-6110	Plasma, Serum, Urine	20 µL	2hr 20min	1.1 - 33 µg/L
RBP 4 ELISA	Mouse	41-RBPM5-E01	Plasma, Serum	5 µL	1hr 10min	0.625 - 20 ng/ml
Other	Species	Catalog #	Sample Types	Size	Incubation	Range
Adipocyte Fatty Acid Binding Protein ELISA	Human	32-5181	Cell Culture, Plasma, Serum	20 µL	2hr 30min	0.5 - 25 ng/mL
Islet Cell Antibody ELISA	Human	21-ICAHU-E01	Serum	25 µL	2hr 30min	Cut-off
Intact FGF-21 ELISA	Human	43-FGFHU-E01	Cell Culture, Plasma, Serum	100 µL	2hr 35min	32.5 - 2000 pg/mL
L-Arginine ELISA	Human	30-7733	EDTA Plasma	25 µL	Overnight	12.5-300 µmol/L
Obestatin ELISA	Human	48-OBEHU-E01	Plasma, Serum	20 µL	Overnight	0.231 - 25 ng/mL
Obestatin ELISA	Mouse/Rat	48-OBEMS-E01	Serum	25 µL	Overnight	0.082 - 20 ng/mL
Pancreatic Polypeptide RIA	Human	38-PPTHU-R100	Serum	100 µL	Overnight	6.25 - 200 pmol/L
Resistin ELISA	Rat	32-5179	Cell Culture	10 µL	2hr 30min	0.25 - 20 ng/mL
Resistin Ultrasensitive ELISA	Human	22-RESHUU-E01	Cell Culture, Plasma, Serum	20 µL	4hr	20 - 1000 pg/mL
Somatostatin RIA	Human	38-RB 306RUO	Plasma	1 mL	Overnight	0 - 125 pmol/L
Total 25-OH Vitamin D ELISA*	Human	38-25DHU-E01	Serum	50 µL	2 hr 45 min	10-180 ng/mL
25-OH Vitamin D ELISA	Rat	38-25DRT-E01	Serum	50 µL	2 hr 45 min	5.3-133.0 ng/mL

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14SEPT2022