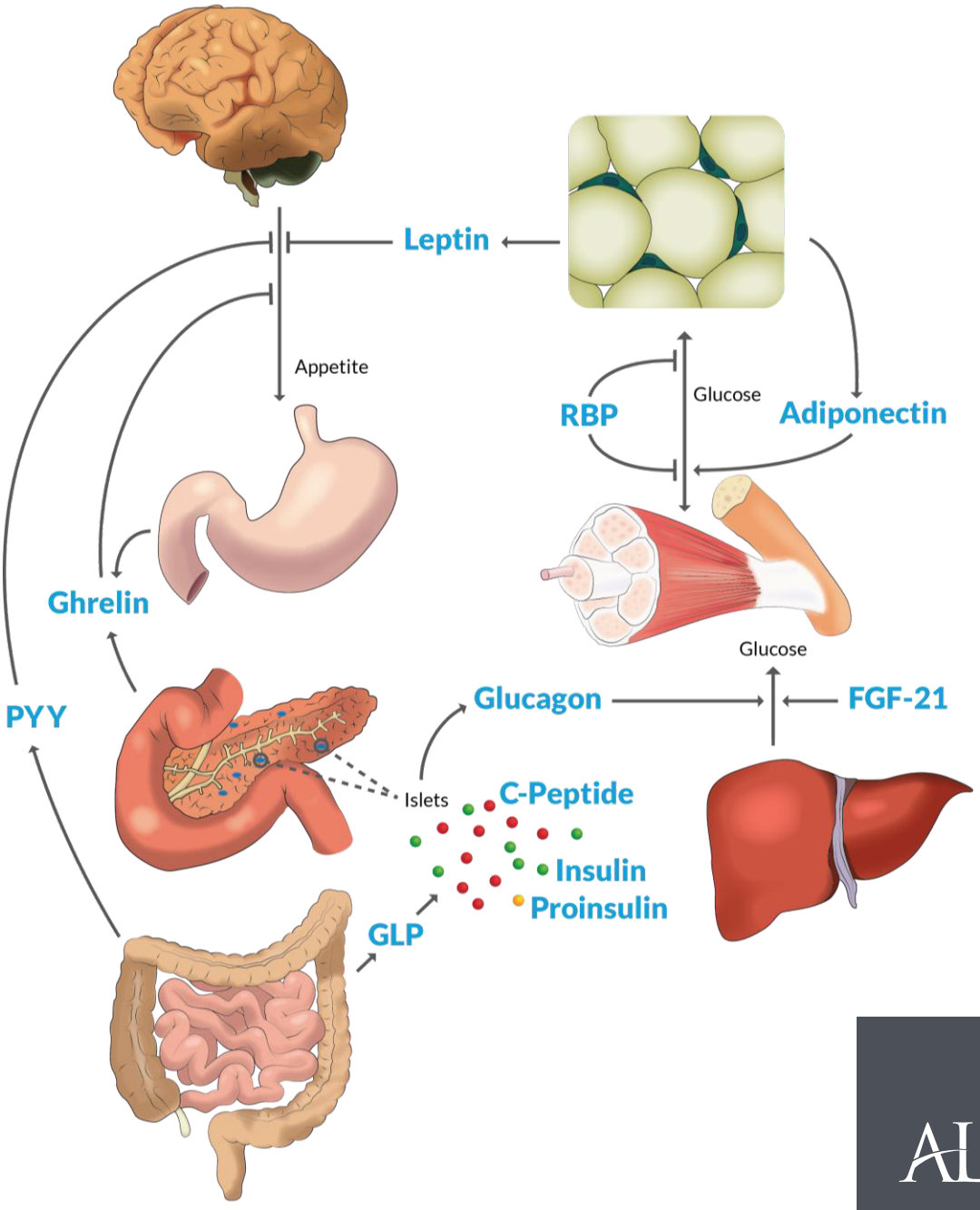
Diabetes & Obesity

Biomarkers of Energy Homeostasis

ALPCO offers several assays to assist both academic and industry researchers with quantification of analytes associated with energy homeostasis. It is now recognized that there are many central and peripheral factors involved in energy homeostasis; the study of these mechanisms could lead to effective treatments for the control of diabetes, obesity and other metabolic disorders.



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Energy Homeostasis

Energy homeostasis is a well-regulated process that depends on the coordination between feeding behavior and energy expenditure. The control of energy homeostasis in humans has received much attention in recent years due to alterations caused by the onset of conditions such as diabetes and obesity.

Adipose Tissue

Adipose tissue plays a much more active role in homeostasis than once thought. It has been found to be a source of lipid storage and mobilization, consisting of specialized tissue able to produce heat (brown adipose), and 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 put elegantly by Dr. Barry Levin, "the brain maintains a constant dialog with the external environment through inputs 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."[1] 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 have been well characterized and published. One relevant factor to be mentioned is glucagon-like peptide-1 (GLP-1). GLP-1 is secreted by epithelial intestinal L-cells in response to glucose and lipids and has been shown to enhance glucose-stimulated insulin secretion. In addition to its involvement with glucose homeostasis, GLP-1 reduces body weight and food intake, and slows gastric emptying. GLP-1 acts through a G-protein–coupled receptor that is widely distributed in the body including adipose tissue, stomach, brain, and others. PYY, a peptide also produced within the small intestine and rectum by L-cells has been shown to inhibit gut motility and is proposed to stimulate a significant central satiety response. This dynamic concert of events has significant control over systemic metabolism and overall energy homeostasis.

The Stomach

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

The Pancreas

Of the tissues mentioned thus far, 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 function of the liver as it is responsible for releasing glucagon when blood sugar (glucose) levels fall too low. Glucagon, the counterpart of insulin, causes 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*
5. *J. Nutr. November 2007 vol. 137 no. 11 2534S-2538S*

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Adiponectin	Species	Catalog #	Sample Types	Size	Incubation	Range	LOD
Adiponectin ELISA	Rat	22-ADPRT-E01	Plasma, Serum	5 µL	2hr 30min	0.25 - 10 ng/mL	0.08 ng/mL
Adiponectin HMW & Total ELISA	Mouse	47-ADPMS-E01	Plasma, Serum	5 µL	3hr	0.125 - 8.0 ng/mL	0.032 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	<0.1 ng/mL
C-peptide	**Species**	**Catalog #**	**Sample Types**	**Size**	**Incubation**	**Range**	**LOD**
C-peptide ELISA*+	Human	80-CPTHU-E01.1	Plasma, Serum	25 µL	2hr	20 - 3000 pmol/L	2.95 pmol/L
C-peptide ELISA	Mouse	80-CPTMS-E01	Serum	10 µL	2hr 15min	60 - 3000 pM	7.6 pM
C-peptide ELISA	Rat	80-CPTRT-E01	Serum	10 µL	2hr 15min	50 - 4500 pM	10.8 pM
C-peptide Chemi ELISA*	Human	80-CPTHU-CH01	Plasma, Serum, Cell Culture	50 µL	3hr	4.5 - 12,960 pg/mL	<4.32 pg/mL
Ghrelin	**Species**	**Catalog #**	**Sample Types**	**Size**	**Incubation**	**Range**	**LOD**
Acylated Ghrelin ELISA	Human	32-5106	Plasma	100 µL	3hr	1.95 - 250 pg/mL	0.8 pg/mL
Acylated Ghrelin ELISA	Mouse/Rat	32-5117	Plasma	100 µL	3hr	1.95 - 250 pg/mL	0.7 pg/mL
Non-Acylated Ghrelin ELISA	Human	32-5119	Plasma	10 µL	3hr	1.95 - 250 pg/mL	0.6 pg/mL
Non-Acylated Ghrelin ELISA	Mouse/Rat	32-5118	Plasma	10 µL	3hr	1.95 - 250 pg/mL	0.8 pg/mL
GLP	**Species**	**Catalog #**	**Sample Types**	**Size**	**Incubation**	**Range**	**LOD**
GLP-1 Active (7-36) ELISA	Human	43-GP1HU-E01	Plasma	100 µL	Overnight	0.64 -48 pmol/L	0.05 pmol/L
GLP-1 Total (7-36 and 9-36) ELISA	Human	43-GPTHU-E01	Plasma	100 µL	Overnight	2.1 - 54 pmol/L	0.6 pmol/L
GLP-2 ELISA	Human	48-GP2HU-E01.1	Plasma, Serum	25 µL	Overnight	0.412 - 100 ng/mL	0.412 ng/mL
GLP-2 ELISA	Mouse	48-GP2MS-E01	Plasma, Serum	25 µL	Overnight	0.412 - 100 ng/mL	0.412 ng/mL
GLP-2 ELISA	Rat	48-GP2RT-E01	Plasma, Serum	25 µL	Overnight	0.137 - 100 ng/mL	0.137 ng/mL
Glucagon	**Species**	**Catalog #**	**Sample Types**	**Size**	**Incubation**	**Range**	**LOD**
Glucagon ELISA	Human/Mouse/Rat	48-GLUHU-E01	Plasma	100 µL	Overnight	41 - 10000 pg/mL	41 pg/mL
Glucagon RIA*	Human	13-GLUHU-R100	Plasma	200 µL	Overnight	4.7 - 150 pmol/L	3 pmol/L
Insulin	**Species**	**Catalog #**	**Sample Types**	**Size**	**Incubation**	**Range**	**LOD**
Insulin Autoantibody ELISA	Human	21-IAAHU-E01	Serum	25 µL	Overnight	Cut-off	
Insulin ELISA*+	Human	80-INSHU-E01.1	Plasma, Serum	25 µL	2hr	3 - 200 µIU/mL	0.399 IU/mL
Insulin ELISA+	Mouse	80-INSMS-E01	Plasma, Serum	10 µL	2hr	0.188 - 6.9 ng/mL	0.06 ng/mL
Insulin ELISA+	Rat	80-INSRT-E01	Plasma, Serum	10 µL	2hr	0.15 - 5.5 ng/mL	0.124 ng/mL
Insulin ELISA	Ovine	80-INSOV-E01	Plasma, Serum	25 µL	2hr 15min	0.15 - 4 ng/mL	0.14 ng/mL
Insulin ELISA	Porcine/Canine	80-INSPO-E01	Plasma, Serum	25 µL	2hr 15min	0.05 - 2 ng/mL	0.007 ng/mL
Insulin High Range ELISA+	Mouse	80-INSMSH-E01	Plasma, Serum	5 µL	2hr 15min	3 - 150 ng/mL	1.99 ng/mL
Insulin High Range ELISA+	Rat	80-INSRTH-E01	Plasma, Serum	5 µL	2hr	3 - 150 ng/mL	0.52 ng/mL
Insulin Ultrasensitive ELISA*	Human	80-INSHUU-E01.1	Plasma, Serum	25 µL	2hr 30min	0.15 - 20 µIU/mL	0.135µIU/mL
Insulin Ultrasensitive ELISA+	Mouse	80-INSMSU-E01	Plasma, Serum	5 µL 25 µL	2hr 30min	0.025 - 6.9 ng/mL	0.115 ng/mL 0.019 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	0.107 ng/mL 0.002 ng/mL
Insulin Chemi ELISA*+	Human	80-INSHU-CH01	Heparin Plasma, Serum, Tissue Culture	25 µL	1hr 35min	5 - 30,000 pg/mL	2 pg/mL
Insulin Chemi ELISA+	Mouse/Rat	80-INSMR-CH01	Plasma, Serum	5 µL	2hr	0.1 - 150 ng/mL	0.089 ng/mL

Assays are for Research Use Only unless otherwise noted.
**FDA Class I Exempt Device. For In Vitro Diagnostic Use.*
+*Available in bulk packaging (10 plates/kit)*

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Leptin	Species	Catalog #	Sample Types	Size	Incubation	Range	LOD
Leptin ELISA	Human	11-LEPHU-E01	Serum	20 µL	1hr 45min	1 - 100 ng/mL	0.42 ng/mL
Leptin ELISA	Mouse/Rat	22-LEPMS-E01	Serum	5 µL	3hr	25 - 1600 pg/mL	10 pg/mL
Leptin Ultrasensitive ELISA	Human	22-LEPHUU-E01	Biological Fluids, Plasma, Serum	25 µL	1hr 45min	0.05 - 5 ng/mL	0.01 ng/mL
Bioactive Leptin ELISA	Human	22-BLEPHU-E01	EDTA Plasma, Heparin Plasma, Serum	15 µL	4hr	0.05 - 6 ng/mL	< 0.01 ng/mL
Proinsulin	**Species**	**Catalog #**	**Sample Types**	**Size**	**Incubation**	**Range**	**LOD**
Proinsulin ELISA	Mouse	80-PINMS-E01	Serum	10 µL	2hr 30min	4 - 300 pM	1.5 pM
Proinsulin (Intact) Chemi ELISA*	Human	80-PINHUI-CH01	Cell Culture, EDTA Plasma, Heparin Plasma, Serum, Tissue Culture	50 µL	2hr 31min	5 - 3000 pg/mL	<5.0 pg/mL
Proinsulin (Total) Chemi ELISA*	Human	80-PINHUT-CH01	EDTA Plasma, Serum, Tissue Culture	50 µL	2hr 31min	5 - 3000 pg/mL	0.455 pg/mL
PYY	**Species**	**Catalog #**	**Sample Types**	**Size**	**Incubation**	**Range**	**LOD**
PYY ELISA	Human	48-PYYHU-E01.1	Plasma, Serum	50 µL	Overnight	0.082 - 20 ng/mL	0.082 ng/mL
PYY ELISA	Mouse/Rat	48-PYYRT-E01.1	Plasma, Serum	25 µL	Overnight	0.15 - 12.5 ng/mL	0.31 ng/mL
RBP	**Species**	**Catalog #**	**Sample Types**	**Size**	**Incubation**	**Range**	**LOD**
RBP ELISA	Human	30-6110	Plasma, Serum, Urine	20 µL	2hr 20min	1.1 - 33 µg/L	0.2 µg/L
RBP 4 ELISA	Mouse	41-RBPMS-E01	Plasma, Serum	5 µL	1hr 10min	0.625 - 20 ng/ml	
RBP 4 ELISA	Rat	41-RBPRT-E01	Plasma, Serum, Urine	5 µL	1hr 10min	6.25 - 200 ng/ml	
Other	**Species**	**Catalog #**	**Sample Types**	**Size**	**Incubation**	**Range**	**LOD**
Adipocyte Fatty Acid Binding Protein ELISA	Human	32-5181	Cell Culture, Plasma, Serum	20 µL	2hr 30min	0.5 - 25 ng/mL	0.1 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	1.7 pg/mL
Obestatin ELISA	Human	48-OBEHU-E01	Plasma, Serum	20 µL	Overnight	0.231 - 25 ng/mL	0.231 ng/mL
Obestatin ELISA	Mouse/Rat	48-OBEMS-E01	Serum	25 µL	Overnight	0.082 - 20 ng/mL	0.082 ng/mL
Pancreatic Polypeptide RIA	Human	13-PPTHU-R100	Serum	100 µL	Overnight	6.25 - 200 pmol/L	3 pmol/L
Resistin ELISA	Rat	32-5179	Cell Culture	10 µL	2hr 30min	0.25 - 20 ng/mL	0.05 ng/mL
Resistin Ultrasensitive ELISA	Human	22-RESHUU-E01	Cell Culture, Plasma, Serum	20 µL	4hr	20 - 1000 pg/mL	6 pg/mL
Somatostatin RIA	Human	13-RB 306	Plasma	1 mL	Overnight	0 - 125 pmol/L	6 pmol/L

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