



BMA BIOMEDICALS

Glucagon

Glucagon is a 29-residue peptide hormone produced by alpha cells, endocrine cells in the pancreatic islets of the pancreas. It plays a significant role in glucose homeostasis by controlling plasma glucose levels through hepatic glucose output. Glucagon is considered a main catabolic hormone of the body. Glucagon and insulin are part of a feedback system that keeps blood glucose levels stable.

Additionally, glucagon reduces body weight and adiposity by suppression of appetite and by modulation of lipid metabolism. Moreover, this hormone promotes weight loss by activation of energy expenditure and thermogenesis.

In standard histological sections of the pancreas, islets are seen as relatively pale-staining groups of cells embedded in a sea of darker-staining exocrine tissue.

Immunohistochemistry with anti-Glucagon antibody is used for the assessment of endocrine cell distribution within the pancreas, and for the evaluation of islet composition and islet morphology.

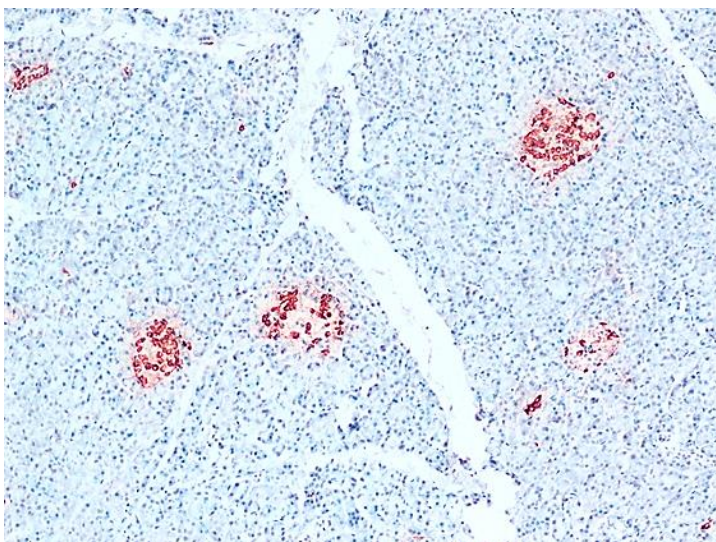


Figure 1: Immunohistochemical analysis of formalin-fixed, paraffin-embedded human pancreatic tissue using rabbit anti-Glucagon (**product # T-4358**, 1 : 800 dilution, Hematoxylin counterstaining) yields strong cytoplasmic staining. The section was

treated with Proteinase K for antigen retrieval and blocked with goat serum. Incubation with primary antibody was done for 1 hour at room temperature with PBS instead of primary antibody as negative control. A horseradish peroxidase-conjugated goat anti-rabbit antibody was used as secondary antibody and developed with AEC as substrate. Copyright BMA Biomedicals / S. Accossato.

Pancreatic islets house different **cell** types which produce endocrine products of major importance:

Alpha cells (A cells) make up to 20% of the human islet cells synthesizing and secreting glucagon. Glucagon is found in characteristic electron-dense granules visible by electron microscopy. Alpha cells also generate Glucagon-like Peptide-1 and may have protective and regenerative effect on beta cells. Glucagon is also produced by alpha cells in the stomach. Production of glucagon, which is otherwise freerunning, is modulated by Amylin, a peptide hormone co-secreted with insulin.

Beta cells (B cells) produce **insulin** and are the most abundant of the islet cells, making up 50-70% in humans.

Delta cells (D cells) synthesize and secrete the hormone somatostatin, which is also produced by a number of other endocrine cells in the body. They create a neuron-like network for intra-islet communication.

Pancreatic Polypeptide (PP) cells are the most infrequent islet cell type. PP has anorexic effects on gastro-intestinal function and alters insulin and glucagon secretion.

Glucagon exerts pleiotropic effects on energy balance and has emerged as an attractive target for the treatment of diabetes and obesity in the last few years. Beyond its effects on metabolism, glucagon reduces food intake by modulation of satiety, and increases energy expenditure.

The main source of glucagon is the pancreatic α -cell, while intestinal L-cells and neurons in the nucleus of the solitary tract are the principal producers of GLP-1

Physiologically, glucagon's main action is related to glucose homeostasis. It elevates the blood glucose level by binding to a G-protein coupled receptor mainly found on hepatocytes, and to lesser levels on brain, heart, kidney, gastrointestinal tract, white fat, and brown adipose tissue. This activates the intracellular enzyme glycogen phosphorylase (EC 2.4.1.1.) to hydrolyse glycogen to glucose.

Simultaneously, glycogen synthesis is inhibited, thereby restoring glucose levels in hypoglycemic states.

glucagon decreases food intake [16,17,18,19]. The underlying mechanism is based on an increase in satiety inducing a decrease in meal size without affecting the meal frequency [20,21]. Although this effect on eating behavior influences energy balance, it is also known that glucagon modulates energy expenditure, leading to weight loss not accompanied by a concomitant decrease in food intake.

Several lines of evidence support the idea that the mechanism through which glucagon increases energy expenditure involves fibroblast growth factor 21 (FGF21) a 22.3kDa polypeptide produced and secreted by the liver, which has been shown to induce weight loss by increasing energy expenditure through the activation of brown adipose tissue thermogenesis and white adipose tissue browning.

GLP-1 analogues have been developed for their therapeutic effects on obesity and diabetes, and GLP-1 receptor agonists (e.g. liraglutide, semaglutide, exenatide) are now in use for the treatment of type 2 diabetes.

Literature: Al-Massadi O. et al: Glucagon Control on Food Intake and Energy Balance. *Int. J. Mol. Sci.* 2019, 20, 3905; doi:10.3390/ijms20163905. Review.

Aside from insulin, glucagon and somatostatin, a number of other hormones have been identified as products of pancreatic islet cells. Please check the list below for our products related to research in this field.

Glucagon **ELISA** kit **S-1211** is used for detecting and quantifying the presence of glucagon from various samples. It is a competitive immunoassay. The antiserum is captured by antibodies coated on a 96-well plate. A constant concentration of biotinylated tracer and varying concentrations of unlabeled standard or sample peptide compete for binding specifically to the antiserum. Captured biotinylated tracer is subsequently bound by streptavidin-conjugated horseradish peroxidase (SA-HRP), which produces a soluble colored product after the TMB-substrate is added. The yellow coloration is measured at 450nm with reference wavelength set at 630nm.

S-1211 is a highly sensitive and easy handling kit. Assay time is 5 hours.

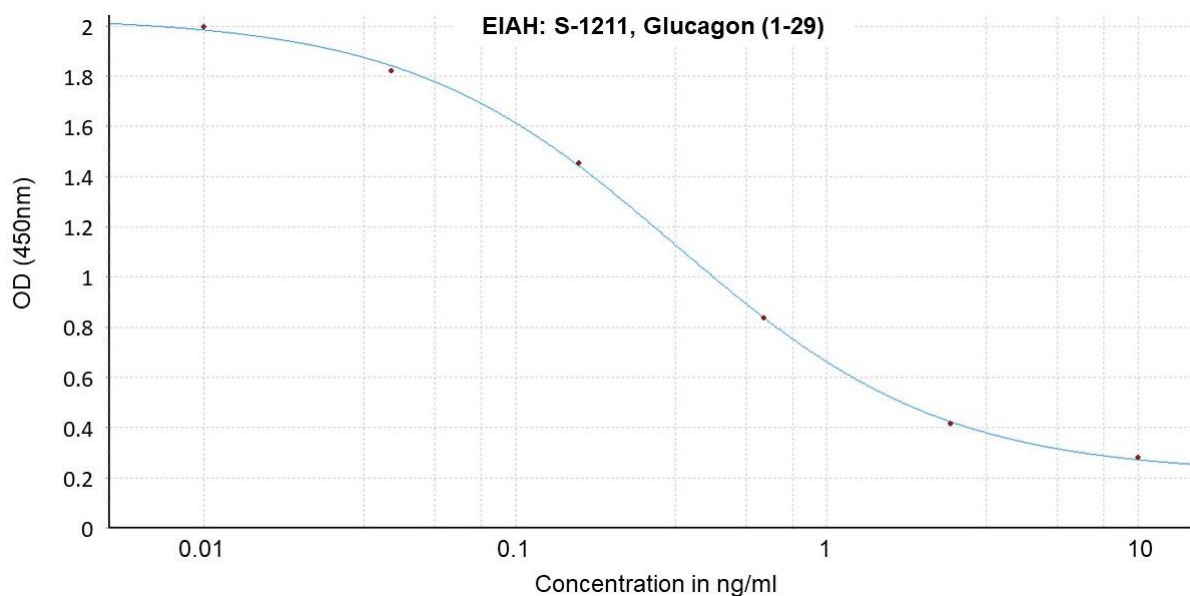


Figure 2: Glucagon ELISA using **product # S-1211**. Standard curve (four-parameter fit) from six different antigen concentrations in the range 0.01 to 10ng/ml. Optimal measuring range: 0.05 to 5ng/ml. Copyright BMA Biomedicals / H. Bui.

List of related products:

Amylin <http://www.bma.ch/en/search?q=amylin>

S-1186: ELISA, high sensitivity for extracted samples (ms, rt)

S-1187: ELISA, high sensitivity for extracted samples (hu)

T-4141: Rabbit anti Amylin (ct), purified IgG

T-4144: Rabbit anti Amylin (ms, rt), diluted antiserum

T-4140: Rabbit anti Amylin (ct), diluted antiserum

T-4145: Rabbit anti Amylin (ms, rt, ct), purified IgG

T-4150: Rabbit anti-Amylin (hu), neat serum

T-4149: Rabbit anti-Amylin (hu), purified IgG

T-4142: Rabbit anti-Amylin (ct), neat antiserum

T-4146: Rabbit anti-Amylin (ms, rt) neat antiserum

T-4148: Rabbit anti Amylin (hu), diluted antiserum

T-4154: Rabbit anti-Amylin (1-13) (hu), neat antiserum

T-4153: Rabbit anti-Amylin (1-13) (hu), purified IgG
T-4157: Rabbit anti-Amylin (25-37) (hu), purified IgG
T-4158: Rabbit anti-Amylin (25-37) (hu), neat antiserum

Exendin-4 <http://www.bma.ch/en/search?q=exendin-4>

S-1297: ELISA, high sensitivity for extracted samples
S-1311: ELISA, extraction-free for rat serum and plasma samples
S-1310: ELISA, extraction-free for human serum and plasma samples
T-4844: Rabbit anti Exendin-4, purified IgG

Glucagon <http://www.bma.ch/en/search?q=glucagon>

S-1211: ELISA, high sensitivity for extracted samples (hu, rt, po)
S-1349: ELISA, extraction-free for human serum and plasma samples
T-4358: Rabbit anti-Glucagon (1-29), (hu, po, rt), purified IgG
T-4357: Rabbit anti-Glucagon (1-29) (hu, rt, po), diluted antiserum
T-4359: Rabbit anti-Glucagon (1-29) (hu, rt, po), neat antiserum
T-5037: Guinea pig anti-Glucagon (1-29) (hu, rt, po), neat antiserum

Glucagon-like-Peptide-1 <http://www.bma.ch/en/search-product?product-search-product-searchStr=GLP-1&product-search-exec-search=search>

T-4363: Rabbit anti-GLP-1 (7-37), (hu, bo, gp, ms, rt), neat antiserum
T-4362: Rabbit anti-GLP-1 (7-37), (hu, bo, gp, ms, rt), purified IgG
T-4111: Rabbit anti-GLP-1 (7-36) amide, (hu, bo, gp, ms, rt), purified IgG
T-4057: Rabbit anti-GLP-1 (7-36) amide, (hu, bo, gp, ms, rt), neat antiserum

Insulin <http://www.bma.ch/en/search?q=Insulin>

T-1321: Mouse anti-Insulin (hu, po, bo), purified monoclonal IgG1
T-5013: Guinea pig anti-Insulin (hu), diluted antiserum
T-5015: Guinea pig anti-Insulin (hu), neat antiserum
T-5014: Guinea pig anti-Insulin (hu), purified IgG

Liraglutide <http://www.bma.ch/en/search?q=liraglutide>

S-1502: ELISA, high sensitivity for extracted samples
T-4880: Rabbit anti Liraglutide, purified IgG

Oxyntomodulin (glucagon-37) <http://www.bma.ch/en/search?q=Oxyntomodulin>

S-1392: ELISA, high sensitivity for extracted samples (hu, ms, rt)
T-4799: Rabbit anti-Oxyntomodulin, (hu, ms, rt), diluted antiserum
T-4801: Rabbit anti-Oxyntomodulin, (hu, ms, rt), neat antiserum
T-4800: Rabbit anti-Oxyntomodulin, (hu, ms, rt), purified IgG

Pancreatic Polypeptide <http://www.bma.ch/en/search?q=Pancreatic+Polypeptide>

S-1373: ELISA, extraction-free for human serum and plasma samples
T-4087: Rabbit anti-Pancreatic polypeptide, (hu), purified IgG
T-4489: Rabbit anti-Pancreatic polypeptide, (avian), neat antiserum
T-4086: Rabbit anti-Pancreatic polypeptide, (hu), diluted antiserum
T-4488: Rabbit anti Pancreatic polypeptide, (avian), purified IgG
T-4088: Rabbit anti-Pancreatic polypeptide, (hu), neat antiserum

Semaglutide <http://www.bma.ch/en/search?q=semaglutide>

S-1530: ELISA, high sensitivity for extracted samples

Somatostatin <http://www.bma.ch/en/search?q=Somatostatin>

S-1152: ELISA, extraction-free for human serum and plasma samples, Somatostatin-14
S-1179: ELISA, high sensitivity for extracted samples, Somatostatin-14

S-1406: ELISA, high sensitivity for extracted samples, Somatostatin-28
T-4101: Rabbit anti-Somatostatin-14, diluted antiserum
T-4102: Rabbit anti-Somatostatin-14, purified IgG
T-4103: Rabbit anti-Somatostatin-14, neat antiserum
T-4547: Rabbit anti-Somatostatin-28, neat antiserum
T-4546: Rabbit anti-Somatostatin-28, purified IgG

Xenin <http://www.bma.ch/en/search?q=xenin>

T-4922: Rabbit anti-Xenopsin-Related peptide 1 (XP-1, Xenin-8), Lyophilized antiserum
T-4936: Rabbit anti-Xenin 25, Lyophilized antiserum for ELISA

In the next Newsletter, we will take a close look at the guinea pig human polyclonal antibody Oxytocin, a neuropeptide produced by the hypothalamus and known for its important role in the childbirth process.

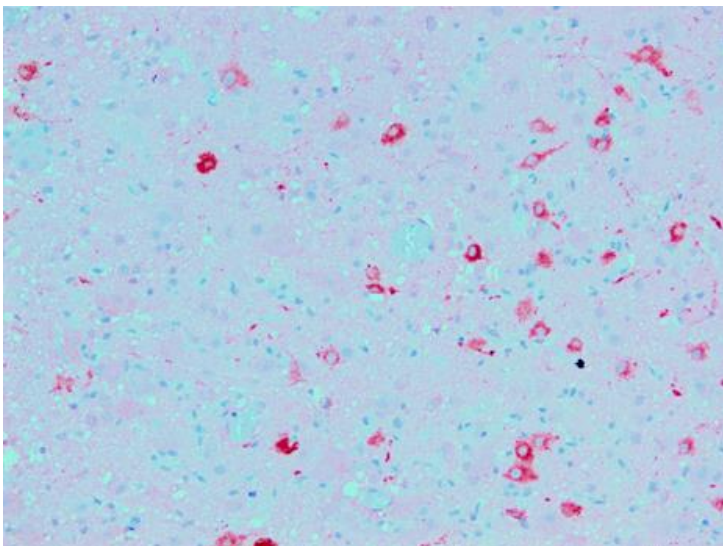


Figure 3: Immunohistochemical analysis of formalin-fixed, paraffin-embedded human hypothalamic tissue using guinea pig anti-Oxytocin (**product # T-5021**, 1 : 200 dilution, Hematoxylin counterstaining). Copyright BMA Biomedicals / S. Accossato.