NEUROPEPTIDE Y
BACHEM
PIONEERING PARTNER FOR PEPTIDES
Neuropeptide Y (NPY) is one of the most abundant neuropeptides in the brain. Together with the two gut hormones, pancreatic polypeptide (PP) and peptide YY (PYY) it belongs to the pancreatic polypeptide hormone family, also known as the neuropeptide Y family. All three peptide hormones consist of 36 amino acid residues and are C-terminally amidated. This post-translational modification is essential for their biological activity. In addition to a distinct sequence homology they share a common hairpin-like three-dimensional structure, known as the pancreatic polypeptide fold (PP-fold).

Neuropeptide Y exhibits a large number of physiological activities in the central and peripheral nervous system. These effects are mediated through the activation of Y receptors, which belong to the large superfamily of G-protein-coupled receptors (GPCRs). There is evidence that neuropeptide Y is implicated in the pathophysiology of a number of diseases such as feeding disorders and metabolic diseases as well as anxiety, seizures, intestinal dysfunction, cardiovascular and respiratory diseases. Its various effects make neuropeptide Y an attractive target for the potential treatment of several of these diseases.

In this brochure we present a selection of catalog products in the field of neuropeptide Y (NPY) research.
Introduction
Neuropeptide Y (NPY) is one of the most abundant neuropeptides in the central and peripheral nervous system. It is present in high concentrations in the brain, especially in the cortical areas, hippocampus and hypothalamus. Since its discovery about 30 years ago, NPY has been implicated in many physiological processes and in the pathophysiology of a number of diseases such as feeding disorders and metabolic diseases as well as anxiety, seizures, intestinal dysfunction, cardiovascular diseases, and respiratory diseases.

Biosynthesis and Structure of NPY
NPY was first isolated from extracts of porcine brain in 1982 by Tatemoto and coworkers. It belongs to the pancreatic polypeptide hormone family (PP family), also known as NPY family, which further includes the two gut hormones peptide YY (PYY) and pancreatic polypeptide (PP). All three peptides consist of 36 amino acid residues, are C-terminally amidated and show a distinct sequence homology which is 70% between NPY and PYY and 50% between NPY and PP.

Meanwhile, the amino acid sequences of NPY from a variety of species from lamprey to mammals are known (Fig. 1). NPY displays a remarkable degree of sequence conservation. 22 Positions out of 36 amino acids are identical in all of the investigated species. This circumstance makes NPY to one of the most evolutionarily conserved peptides known.

<table>
<thead>
<tr>
<th>NPY Human</th>
<th>Y P S K P</th>
<th>D N P G E</th>
<th>D A P A E</th>
<th>D M A R Y</th>
<th>Y S A L R</th>
<th>H Y I N L</th>
<th>I T R Q R</th>
<th>Y − N H 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>NPY Monkey</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Y − N H 2</td>
</tr>
<tr>
<td>NPY Porcine</td>
<td></td>
<td></td>
<td>L</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Y − N H 2</td>
</tr>
<tr>
<td>NPY Cow</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Y − N H 2</td>
</tr>
<tr>
<td>NPY Guinea Pig</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Y − N H 2</td>
</tr>
<tr>
<td>NPY Rabbit</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Y − N H 2</td>
</tr>
<tr>
<td>NPY Rat</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Y − N H 2</td>
</tr>
<tr>
<td>NPY Sheep</td>
<td></td>
<td></td>
<td>D</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Y − N H 2</td>
</tr>
<tr>
<td>NPY Chicken</td>
<td></td>
<td></td>
<td></td>
<td>S</td>
<td></td>
<td></td>
<td></td>
<td>Y − N H 2</td>
</tr>
<tr>
<td>NPY Alligator</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Y − N H 2</td>
</tr>
<tr>
<td>NPY Desert tortoise</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Y − N H 2</td>
</tr>
<tr>
<td>NPY Frog (R. ridibunda)</td>
<td></td>
<td></td>
<td></td>
<td>K</td>
<td></td>
<td></td>
<td></td>
<td>Y − N H 2</td>
</tr>
<tr>
<td>NPY Frog (R. temporaria)</td>
<td></td>
<td></td>
<td></td>
<td>K</td>
<td></td>
<td></td>
<td></td>
<td>Y − N H 2</td>
</tr>
<tr>
<td>NPY Toad (X. laevis)</td>
<td></td>
<td></td>
<td></td>
<td>K</td>
<td></td>
<td></td>
<td></td>
<td>Y − N H 2</td>
</tr>
<tr>
<td>NPY Toad (X. laevis)</td>
<td></td>
<td></td>
<td>D</td>
<td>K</td>
<td></td>
<td></td>
<td></td>
<td>Y − N H 2</td>
</tr>
<tr>
<td>NPY Caecilian</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Y − N H 2</td>
</tr>
<tr>
<td>NPY Sea bass</td>
<td>V</td>
<td>E</td>
<td>D</td>
<td>E</td>
<td>L</td>
<td>K</td>
<td></td>
<td>Y − N H 2</td>
</tr>
<tr>
<td>NPY Cod</td>
<td>I</td>
<td>E</td>
<td>G</td>
<td>E</td>
<td>L</td>
<td>K</td>
<td></td>
<td>Y − N H 2</td>
</tr>
<tr>
<td>NPY Goldfish</td>
<td>T</td>
<td>E</td>
<td>G</td>
<td>E</td>
<td>L</td>
<td>K</td>
<td></td>
<td>Y − N H 2</td>
</tr>
<tr>
<td>NPY Zebrafish</td>
<td>T</td>
<td>E</td>
<td>T</td>
<td>E</td>
<td>L</td>
<td>K</td>
<td></td>
<td>Y − N H 2</td>
</tr>
<tr>
<td>NPY Rainbow trout</td>
<td>V</td>
<td>E</td>
<td>E</td>
<td>T</td>
<td>L</td>
<td>K</td>
<td></td>
<td>Y − N H 2</td>
</tr>
<tr>
<td>NPY Torpedo</td>
<td></td>
<td></td>
<td>G</td>
<td>L</td>
<td>L</td>
<td>K</td>
<td></td>
<td>Y − N H 2</td>
</tr>
<tr>
<td>NPY Dogfish</td>
<td></td>
<td></td>
<td>G</td>
<td>L</td>
<td>L</td>
<td>V</td>
<td></td>
<td>Y − N H 2</td>
</tr>
<tr>
<td>NPY River lamprey</td>
<td>F</td>
<td>N</td>
<td>S</td>
<td>L</td>
<td>L</td>
<td>V</td>
<td></td>
<td>Y − N H 2</td>
</tr>
</tbody>
</table>

Fig. 1. Alignment of mature NPY sequences from different origins. Only positions that differ from the top sequence (human) are shown. Dashes indicate identical amino acids to the top sequence. Two distinct Xenopus laevis NPY sequences have been determined that presumably correspond to separate loci (Xenopus laevis is tetraploid). Modified after J.M. Cerdá-Reverter and D. Larhammar, Biochem. Cell Biol. 78, 371 - 392 (2000).
The NPY gene is located on human chromosome 7 at 7p15.1 and is composed of 4 exons which are separated by 3 introns. A remarkable similarity in the exon-intron organization of the known DNA sequences encoding for the various members of the NPY family can be observed. The first exon encodes for the 5’ untranslated region (5’-UTR). The second exon encodes for the signal peptide and the main part of the mature NPY sequence. The third exon contains the sequences which encode for the tyrosine<sup>36</sup> of the mature peptide, the glycine<sup>37</sup> amide donor site, the dibasic lysine<sup>38</sup> - arginine<sup>39</sup> (K<sup>38</sup> - R<sup>39</sup>) site for the cleavage by prohormone convertases, and the main portion of CPON (C-terminal peptide of NPY). Finally, the fourth exon encodes for the terminal sequence of CPON and the 3’-UTR (Fig. 2).

Biologically active NPY is derived from a 97-amino acid precursor, prepro-neuropeptide Y (prepro-NPY). After translation it is directed into the endoplasmic reticulum where the signal peptide is removed. The following processing step is the cleavage of the 69-residue pro-NPY at the dibasic K<sup>38</sup> - R<sup>39</sup> site by prohormone convertases, releasing NPY<sub>1-39</sub> and the 30-amino acid carboxy-terminal peptide CPON. NPY<sub>1-39</sub> is further processed by two sequential truncations at the C-terminal end by the actions of a carboxypeptidase and a peptidylglycine α-amidating monooxygenase, which finally leads to the biologically active amidated NPY. The amide moiety is essential for its biological activity and protects NPY against degradation by carboxypeptidases. Mature NPY can be further processed by two enzymes, the dipeptidyl peptidase IV and aminopeptidase P, which results in the formation of NPY<sub>3-36</sub> and NPY<sub>2-36</sub>.

The three-dimensional solution structure of NPY has been investigated by two-dimensional NMR and circular dichroism spectroscopy (CD). NPY exhibits a hairpin-like 

---

**Fig. 2.** Synthesis and processing of NPY. The figure shows a schematic outline of the human NPY gene, mRNA and protein precursor. In the gene, filled boxes show the coding parts and open boxes show non-coding parts. GKR constitutes the proteolytic processing site in the peptide precursor. Please, note that the gene and mRNA are not drawn to scale (bp: base pairs; mRNA: messenger ribonucleic acid; nt: nucleotides; UTR: untranslated regions; CPON: C-flanking peptide of NPY). Modified after J.M. Cerda-Reverter and D. Larhammar, Biochem. Cell Biol. 78, 371-392 (2000)
three-dimensional structure called pancreatic polypeptide-fold (PP-fold) as suggested by computer modeling studies based on the crystal structure of avian PP. This tertiary structure consists of an extended type II polyproline helix (residues 1-8), followed by a type II β-turn and an amphipathic α-helix (residues 15-32). The C-terminal residues are existent in a flexible turn conformation. Subsequent studies have shown that the PP-fold is a structural feature of all members of the NPY family.

Distribution of NPY

NPY is primarily found in the peripheral and central nervous system. In the brain, substantial NPY concentrations are found in numerous brain regions including the hypothalamus, amygdala, hippocampus, nucleus of the solitary tract, locus coeruleus, nucleus accumbens and the cerebral cortex. Brain NPY is found colocalized with norepinephrine (NE), GABA, somatostatin in agouti-related protein containing neurons. In the periphery, NPY is abundantly expressed in the sympathetic nervous system, where it is stored and released along with NE. It is also present in a subpopulation of parasympathetic neurons. Apart from its expression in the nervous system NPY can also be detected in the adrenal medulla, which represents the primary source of circulating NPY, and in liver, heart, spleen, and in endothelial cells of blood vessels.

Physiological Functions

Based on several pharmacological studies over the past years a great number of physiological functions for NPY have been revealed. Some of the best studied functions of NPY include the control of appetite, body weight and obesity. It became evident that NPY is one of the most potent orexigenic peptides known. Apart from its role in feeding control, NPY is involved in the regulation of luteinizing hormone, adrenocorticotropic hormone and insulin secretion, reduction of growth hormone release, anxiolysis, and thermoregulation. NPY causes long-lasting vasoconstriction in skeletal muscle, heart, kidney, and brain. Presynaptically, NPY inhibits its own release as well as the release of noradrenaline and ATP, and suppressing synaptic inhibition mediated by GABA receptors. Additionally, NPY enhances memory retention, and is also involved in the modulation of ethanol consumption and resistance. Several disorders and pathological conditions are associated with altered NPY functions.

NPY Receptors

NPY induces its biological effects through several subtypes of Y-receptors. These receptors belong to the large superfamily of G-protein-coupled receptors (GPCRs) which are characterized by seven transmembrane α-helices that interact with a family of heterotrimeric GTP-binding proteins, referred to as G-proteins. GPCRs are found in a wide range of organisms, and many kinds of chemical messengers act through them.

Up to now five NPY receptors have been cloned (Y1-, Y2-, Y4-, Y5-, and Y6-receptor) from mammals. Several additional receptors such as the Y3-receptor could be postulated based on their pharmacological characteristics using various tissue preparations. The Y6-receptor is designated by lower case since the receptor protein is truncated in most mammals including man. Interestingly, the Y6-receptor has been found functional in mice and rabbits.

In order to investigate each NPY receptor subtype individually on the structural as well as on the biological level, highly potent and selective compounds which recognize only one receptor in a specific manner are required. Therefore, a combination of different approaches has been applied, leading to the identification of the structural and functional features which are responsible for the pharmacological profile of the native ligand. To gain insight into the function of each part of the ligand, systematic alanine scanning (systematic exchange of each residue of NPY against L-alanine or the corresponding D-isomer) and N-, C-terminal or central truncations of NPY were performed.
Neuropeptide Y

Binding of NPY to the Y₁-receptor is largely impaired when the N-terminal part of the peptide is removed. Truncations of NPY leading to NPY[2-36] [H-3316, H-2216], NPY[3-36] [H-3326, H-8570] or NPY[13-36] [H-3324, H-9300] result in a marked loss of their affinity and biological activity, which strongly suggests that the Y₁-receptor interacts with the N-terminal part of the ligand. Peptides with structural modifications at the C-terminal end, such as (Pro³⁴)-NPY [H-8580] and (Leu³¹,Pro³⁴)-NPY [H-3306] retain full activity for the Y₁-receptor, and lose their affinity for the Y₂-receptor. This further indicates that the N-terminal part of the peptide determines its binding to and activity at the Y₁-receptor in the periphery. The Y₁-receptor is mainly localized in blood vessels and in the central nervous system. It is mainly detected in the anterior thalamus, cerebral cortex, and medial geniculate. The main effect of NPY mediated by the Y₁-receptor is vasoconstriction, but this receptor subtype seems also to be involved in the control of food intake.

The Y₂-receptor seems to be mostly a presynaptic receptor. It is expressed in the central and peripheral nervous system, intestine and certain blood vessels and is involved in the inhibition of neurotransmitter release. In contrast to the Y₁-receptor it does not require the N-terminal part of the peptide, since it binds well to N-terminal truncated analogs such as NPY[2-36] [H-3316, H-2216], NPY[3-36] [H-3326, H-8570], NPY[13-36] [H-3324, H-9300], NPY[18-36] [H-3296], and NPY[22-36] [H-9305]. The C-terminal part of NPY seems to be important for the Y₂-receptor. This is suggested by the facts, that (Pro³⁴)-NPY [H-8580] has a much lower affinity to the Y₂-receptor than for the Y₁-receptor and that N-terminally truncated fragments like NPY[13-36] [H-3316, H-2216] are fully active.

The Y₃-receptor is characterized by an at least 10-fold lower affinity for PYY than for NPY in contrast to the Y₁- and Y₂-receptors. This receptor subtype is localized in the adrenal medulla where it mediates the NPY-induced secretion of catecholamines but could also be detected in the posterior brain (i.e. nucleus tractus solitarius), cardiac membranes and chromaffin cells.

The Y₄-receptor, also known as pancreatic polypeptide preferring receptor, binds to a variable extent to all three members of the NPY family (NPY, PYY, PP) in mammals. However, the relative binding affinities differ between species. The binding affinities for the human Y₄-receptor decrease from PP over PYY to NPY. In contrast, the rodent Y₄-receptor is more selective. The affinity to PP is higher than the one to both NPY and PYY. Histochemical studies indicate that the Y₄-receptor is widely distributed in the whole body including the brain. It is expressed in hypothalamus, hippocampus, skeletal muscle, heart, adrenal medulla and cortex, thyroid gland, prostate, small intestine, colon and pancreas. In the CNS, low expression levels can also be detected in the cerebellum, medulla, and spinal cord. PP inhibits exocrine pancreatic secretion, induces gall bladder relaxation, and stimulates LH secretion. Considering its tissue distribution and its high affinity for PP the Y₄-receptor might be the endogenous PP receptor.

The Y₅-receptor, also referred to as feeding receptor, binds the Y₁-receptor agonist (Leu³¹,Pro³⁴)-NPY [H-3306], but it also has affinity to Y₂-receptor agonists such as NPY[2-36], NPY[13-36], and PP. The modified variant (D-Trp³²)-NPY [H-3312, H-3308] appears to act as a partial agonist of the Y₅-receptor. The NPY analog (Ala³¹,Aib³²)-NPY [H-5084] was described as a selective agonist of the Y₅-receptor. This substituted peptide was even more potent than NPY in its capacity to stimulate food intake. A strong expression of the Y₅-receptor has been detected in the hypothalamus, where it stimulates appetite. In the periphery, it seems mainly expressed in the testis.

The study of the various NPY receptors has largely been facilitated by the synthesis of selective agonists and antagonists, but so far the correlation of a certain Y-receptor subtype to a distinct physiological effect is not fully understood.

Prospects

NPY is widely distributed in the central and peripheral nervous system. During the past years NPY has received great attention,
because it is involved in a variety of important neurobiological functions, including control of food intake, cardiovascular regulation, anxiety, and memory retention. It will not be surprising if novel roles for NPY will be discovered in the next decade. The discovery of the various NPY receptor subtypes and the design of selective agonists and antagonists has contributed to a better understanding of its physiological and pathophysiological roles. This might enable the establishment of therapeutic approaches for the treatment of certain human diseases, such as obesity, metabolic disorders, hypertension, and heart failure.

REFERENCES

K. Tatemoto et al.
Neuropeptide Y - a novel brain peptide with structural similarities to peptide YY and pancreatic polypeptide. 

H. Darbon et al.
Solution conformation of human neuropeptide Y by 1H nuclear magnetic resonance and restrained molecular dynamics. 

S.A. Monks et al.
Solution structure of human neuropeptide Y. 
J. Biomol. NMR 8, 379-390 (1996)

M.C. Michel et al.
XVI. International Union of Pharmacology recommendations for the nomenclature of neuropeptide Y, peptide YY, and pancreatic polypeptide receptors. 

D.R. Gehlert
Role of hypothalamic neuropeptide Y in feeding and obesity. 

A. Nordmann et al.
Aspects of the molecular structure and dynamics of neuropeptide Y. 

C. Cabrele and A.G. Beck-Sickinger
Molecular characterization of the ligand-receptor interaction of the neuropeptide Y family. 

C. Cabrele et al.
The first selective agonist for the neuropeptide YY5 receptor increases food intake in rats. 
J. Biol. Chem. 275, 36043-36048 (2000)

J.M. Cerdá-Reverter and D. Larhamnar
Neuropeptide Y family of peptides: structure, anatomical expression, function, and molecular evolution. 

D. Poyner et al.
Neuropeptides in drug research. 
Prog. Drug Res. 54, 121-149 (2000) Review

A.P. Silva et al.
Neuropeptide Y and its receptors as potential therapeutic drug targets. 

A. Balasubramaniam
Neuropeptide Y (NPY) family of hormones: progress in the development of receptor selective agonists and antagonists. 

M.M. Berglund et al.
Recent developments in our understanding of the physiological role of PP-fold peptide receptor subtypes. 

T. Pedrazzini et al.
Neuropeptide Y: the universal soldier. 

B.M. Chronwall and Z. Zukowska
Neuropeptide Y, ubiquitous and elusive. 
NEUROPEPTIDE Y (NPY)

Please feel free to download our related brochure “Peptide YY” available on our website: www.bachem.com
NPY, ANALOGS AND FRAGMENTS

BIBP3226
E-3620
Diphenylacetyl-D-Arg-4-hydroxybenzylamide

Neuropeptide Y (human, rat)
H-6375
YPSKPDPNPGEDAPAEDMARYYSAL-RHYINLITRQRY-NH$_2$

Biotinyl-Neuropeptide Y (human, rat)
H-5674
Biotinyl-YPSKPDPNPGEDAPAEDMARYYSALRHYINLITRQRY-NH$_2$

Neuropeptide Y (free acid) (human, rat)
H-3322
YPSKPDPNPGEDAPAEDMARYYSAL-RHYINLITRQRY

(Leu$^{31}$,Pro$^{34}$)-Neuropeptide Y (human, rat)
H-3306
YPSKPDPNPGEDAPAEDMARYYSAL-RHYINLITRPRY-NH$_2$

(D-Trp$^{32}$)-Neuropeptide Y (human, rat)
H-3312
YPSKPDPNPGEDAPAEDMARYYSAL-RHYINLwRQRY-NH$_2$

(Tyr(Me)$^{21}$)-Neuropeptide Y (human, rat)
H-3302
YPSKPDPNPGEDAPAEDMARYYSALRHYINLITRQRY-NH$_2$

Neuropeptide Y (porcine)
H-4430
YPSKPDPNPGEDAPAEDMARYYSAL-RHYINLITRQRY-NH$_2$

(Ala$^{31}$,Aib$^{32}$)-Neuropeptide Y (porcine)
H-5084
YPSKPDPNPGEDAPAEDRARYYSALRHYINLA-Aib-RQRY-NH$_2$

(Leu$^{31}$,Pro$^{34}$)-Neuropeptide Y (porcine)
H-8575
YPSKPDPNPGEDAPAEDRARYYSAL-RHYINLITRPRY-NH$_2$

(Pro$^{34}$)-Neuropeptide Y (porcine)
H-8580
YPSKPDPNPGEDAPAEDRARYYSAL-RHYINLITRPRY-NH$_2$

(D-Trp$^{32}$)-Neuropeptide Y (porcine)
H-3308
YPSKPDPNPGEDAPAEDMARYYSALRHYINLwRQRY-NH$_2$

Neuropeptide Y (1-24) amide (human, rat)
H-3304
YPSKPDPNPGEDAPAEDMARYYSAL-NH$_2$

(Cys$^4$)-Neuropeptide Y (1-4)-8-aminoctanoyl-(D-Cys$^{27}$)-Neuropeptide Y (25-36)
H-3298
YCSK-8-aminoctanoyl-RHcINLITRQRY-NH$_2$
(Disulfide bond)

Neuropeptide Y (2-36) (human, rat)
H-3316
PSKPDPNPGEDAPAEDMARYYSAL-RHYINLITRQRY-NH$_2$

Neuropeptide Y (2-36) (porcine)
H-2216
PSKPDPNPGEDAPAEDMARYYSAL-RHYINLITRQRY-NH$_2$

Neuropeptide Y (3-36) (human, rat)
H-3326
SKPDNPEDAPAEDMARYYSAL-RHYINLITRQRY-NH$_2$

Neuropeptide Y (3-36) (porcine)
H-8570
SKPDNPEDAPAEDMARYYSAL-RHYINLITRQRY-NH$_2$

Neuropeptide Y (13-36) (human, rat)
H-3324
PAEDMARYYSAL-RHYINLITRQRY-NH$_2$

(Leu$^{31}$,Pro$^{34}$)-Neuropeptide Y (13-36) (human, rat)
H-3318
PAEDMARYYSAL-RHYINLITRPRY-NH$_2$

Neuropeptide Y (13-36) (porcine)
H-9300
PAEDRARYYSAL-RHYINLITRQRY-NH$_2$
Neuropeptide Y (18-36)
H-3296
ARYYSALRHYINLITRQRY-NH₂

Pancreatic Polypeptide
(1-17)-(Ala³¹,Aib³²)-Neuropeptide Y (18-36) (human)
H-5086
APLEPVYPGDATPEQMARYYSAL-
RHYINLA-Aib-RQRY-NH₂

Neuropeptide Y (22-36)
H-9305
SALRHYINLITRQRY-NH₂

Acetyl-(Leu²⁸-³¹)-Neuropeptide Y (24-36)
H-6182
Ac-LRHYLNLLTRQRY-NH₂

Tyr-Lys-Gly-(Cyclo(Glu²⁶-
Lys²⁹),Pro³⁴)-Neuropeptide Y (25-36)
H-3972
YKGR-c(EYIK)-LITRPRY-NH₂

(D-Tyr¹⁷-³⁴,D-Thr²³²)-Neuropeptide Y (27-36)
H-3328
YINLTITRQRY-NH₂

((Cys³¹,Nva³⁴)-Neuropeptide Y (27-36))₂
H-3704
(YINLCTR-Nva-RY-NH₂)₂
(Disulfide bond)

(Pro³⁰,Tyr³²,Leu³⁵)-Neuropeptide Y (28-36)
H-3546
INPIYRLRY-NH₂

(His³²,Leu³⁴)-Neuropeptide Y (32-36)
H-3544
HRLRY-NH₂

DL-2,7-Diaminosuberoyl-
((Tyr³²,Leu³⁴)-Neuropeptide Y (32-
36))₂
H-6522
DL-2,7-Diaminosuberoyl-(YRLRY-NH₂)₂

(D-Glu¹, Ser²-²²,Gln³-³⁴, Thr³, Arg¹⁹,Tyr²¹,
Ala²³-³¹, Aib³³)-Pancreatic Polypeptide
(human)
H-5088
GPSOQYPGDATPEQMARYYSALR-
YNMA-Aib-RQRY-NH₂

PYX-1
H-5786
Ac-Y(3-(2,6-dichloro-Bzl))INLITRQRY-
Nh₂
NERVE CELLS

Nerve cells, artwork.
Computer artwork of nerve cells, also called neurons. Neurons are responsible for passing information around the central nervous system (CNS) and from the CNS to the rest of the body. The nerve cell comprises a nerve cell body surrounded by numerous extensions called dendrites, which collect information from other nerve cells or from sensory cells. Each neuron has one process called an axon through which information passes to other cells, including other nerve cells and muscle fibres.

KEYSTONE/SCIENCE PHOTO LIBRARY/PASIEKA