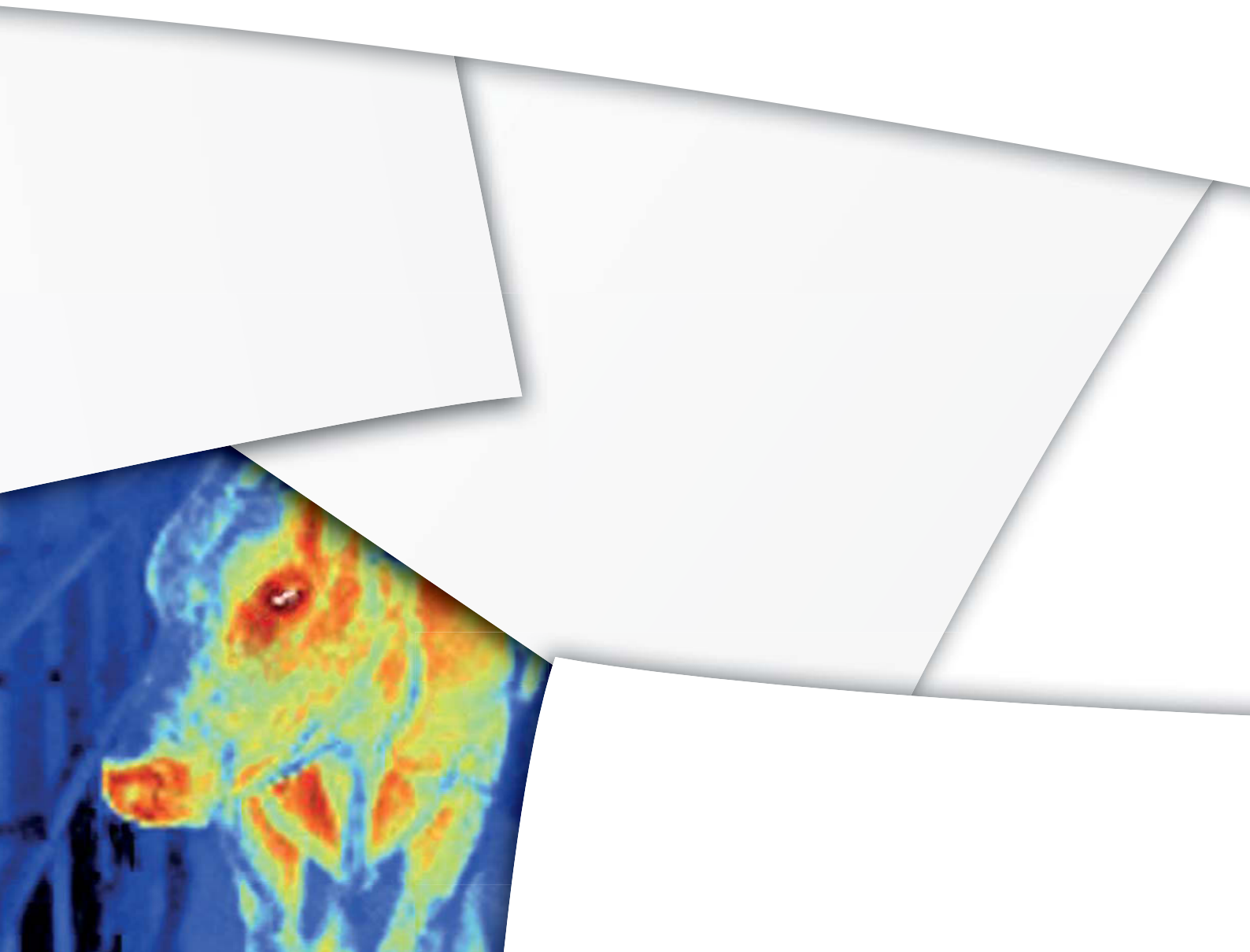


# VETERINARY PEPTIDES BACHEM

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# PEPTIDES IN VETERINARY MEDICINE

Bachem offers a choice of generic peptides for use as active ingredients in veterinary medicine, amongst them gonadorelin and gonadorelin agonists and antagonists. For a compilation of our peptide APIs please see page 20. Our offer is complemented by the corresponding peptides in research quality to be found on page 23-25.

Additionally, we provide the anesthetics etomidate and propofol as non-peptide generic APIs for the veterinary practice, please see page 21.

## Introduction

A considerable number of peptides applied as therapeutics or diagnostics in humans is also used for various indications in veterinary medicine.

Peptides are relatively expensive drugs which, in most cases, can't be applied orally, but these shortcomings are often outweighed by their advantages.

Peptide-based drugs are especially indicated for treating animals used in food production, as they are highly active compounds which require only very small doses. Additionally, they are metabolized more readily than organic compounds, which reduces the risk of contamination of the milk, eggs, or meat of the treated animal by the unmetabolized pharmaceutical and/or its degradation products.

There is also a vast market for peptide drugs in the treatment of companion animals and horses. Pets can suffer from most diseases of civilization that affect humans. Accordingly, diabetes has become a growing problem with dogs and cats in recent years due to their increasing life expectancy in combination with obesity and lack of exercise. At the same time, owners are more willing to pay for medication and therapies to increase the length and quality of life of their diseased pets. This also holds true for companion animals suffering from cancer and other life-threatening diseases. Synthetic peptides have also gained importance as diagnostics, especially in the case of small animals, which creates a further growing market for these compounds. Nevertheless, reproduction management

## PEPTIDE THERAPEUTICS

Administration of synthetic peptides as therapeutics or diagnostics is well-established in human medicine. A few of them have also found use for comparable indications in veterinary medicine.

is the most important and best established area of usage for peptide drugs in veterinary medicine and animal husbandry. Synthetic peptide hormones and analogs are employed to stimulate and facilitate breeding as well as to prevent unwanted offspring. Livestock as well as companion animals are treated with LHRH (GnRH, gonadorelin) and its agonists and antagonists to regulate fertility and reproduction as well as to treat disorders of the reproductive tract. A number of LHRH analogs have been applied in the regulation of reproduction in animals:

|                         |
|-------------------------|
| <b>Alarelin</b>         |
| <b>Azagly-Nafarelin</b> |
| <b>Buserelin</b>        |
| <b>Deslorelin</b>       |
| <b>Fertirelin</b>       |
| <b>Goserelin</b>        |
| <b>Lecirelin</b>        |
| <b>Leuprolide</b>       |
| <b>Lutrelin</b>         |
| <b>Nafarelin</b>        |
| <b>Peforelin</b>        |
| <b>Triptorelin</b>      |

**Gonadotropin-Releasing Hormone (GnRH, LHRH) and Analogs**

Besides GnRH, deslorelin, leuprolide, and buserelin are probably the most often commonly prescribed synthetic peptides in veterinary medicine and livestock breeding. GnRH agonists are metabolized more slowly than the native hormone which allows

for the use of much lower doses and thus reduces treatment costs. For example, the activity of buserelin was shown to be 100 to 200 times higher than the activity of GnRH, and fertirelin was 2.5 to 10 times more active than the natural peptide. In female dogs, a single dose of buserelin during heat will induce ovulation. In cows, a postinseminal application will assist the corpus luteum, and administration coinciding with insemination will delay ovulation, which alternatively can be induced by an injection of fertirelin 10 to 17 days postpartum. Repetitive injections of buserelin in mares will effect the onset of heat or ovulation, whereas in rabbits, a single injection of a GnRH analog induces ovulation and increases the conception rate. Buserelin and fertirelin have also been used in ewes. Overdosage of these highly active peptides can have a detrimental effect on ovarian response. Deslorelin is administered as an injection or implant to induce a reversible infertility in pets, especially in males. These implants can postpone the estrus of bitches for more than 2 years and have found use in the reproduction management of extensive cattle farming. Long-term release formulations of leuprolide have been shown to postpone puberty and reversibly suppressed reproductive function in male and female dogs for periods exceeding 1 year. Peforelin, which is used in the reproduction management of swine, is a naturally occurring peptide and corresponds to lamprey LHRH III. Peforelin is applied to induce the estrus of the sow after weaning. Depot formulations of triptorelin have been tested in heifers and gilts.

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**THERE IS A VAST MARKET FOR PEPTIDE DRUGS IN THE TREATMENT OF COMPANION ANIMALS AND HORSES**

GnRH agonists such as deslorelin and leuprolide are applied as implants for long-term reproduction management not only in domestic animals. Implants facilitate long-term administration and allow non-surgical sterilization of stray dogs and cats, population control in wildlife, and reproduction management in zoos.

In dairy cattle and camelids, GnRH and GnRH analogs such as buserelin or fertirelin are indicated for the treatment of ovarian cysts. Deslorelin is commonly applied as an implant for treating hyperadrenocorticism in domestic ferrets. Gonadorelin can also be used as a diagnostic in disorders of the reproductive system, e.g. in dogs with hypogonadotropic hypogonadism to differentiate between pituitary and hypothalamic defects.

#### **Anti-GnRH vaccines**

As an additional tool for non-surgical spaying, anti-GnRH vaccines were recently developed. The C-terminally elongated peptide hormone is linked to a carrier protein, and the resulting conjugate is applied in combination with an adjuvant to achieve immunization against endogenous LHRH. A GnRH-keyhole limpet hemocyanin conjugate vaccine has been developed as a contraceptive to control wildlife. Effective after a single vaccination, it has been applied to bison, deer, feral pigs, and others. In male pigs, the anti-LHRH-vaccine is injected in two doses several weeks before slaughtering to control boar taint. Another anti-LHRH-vaccine has been registered for the treatment of benign prostatic hyperplasia in dogs.

#### **Ovsynch**

The synchronization of ovulation in dairy cattle is the most important application of GnRH and analogs in animal husbandry. The Ovsynch protocol using gonadorelin for the controlled induction of ovulation was developed in 1995 by R. Pursley and N. Bello at Michigan State University. The program consists of an initial injection of GnRH followed 7 days later by an injection of prostaglandin  $F_{2\alpha}$  ( $PGF_{2\alpha}$ ). It can be started at any stage of the estrous cycle. Two days following the  $PGF_{2\alpha}$  injection, cows receive a second GnRH injection followed

by timed artificial insemination in the next 8 to 24 hours. The efficiency of the synchronization in lactating dairy cows can be further improved by pretreatment with an additional dose of  $PGF_{2\alpha}$  (8 days before starting Ovsynch) and GnRH (6 days before starting Ovsynch) ("G6G", Bello et al., 2006). Unfortunately, heifers respond only poorly to Ovsynch and artificial insemination, but suitable modifications of the protocol could be developed.

Buserelin, fertirelin and other GnRH agonists have also been administered in synchronization schemes. For example, in the recently described Doublesynch scheme, lecorelin has been shown to be especially suitable for primiparous cows.

#### **GnRH in aquaculture**

Not all fish species can be bred efficiently by stimulating reproduction with GnRH agonists. Hence, the development of combination products composed of GnRH agonists as (Des-Gly<sup>10</sup>, D-Arg<sup>6</sup>, Pro-NHEt<sup>9</sup>)-salmon GnRH (sGnRH-A), or alarelin (LHRH-A), and dopamine D2 receptor antagonists as pimozine or domperidone meant a breakthrough for fish farming, as they allowed reliable induction and synchronization of ovulation and spawning („Linpe method“). The synthetic stimulators yield spawn of much higher quality than the pituitary extracts used in controlled fish reproduction. The dopamine antagonist inhibits the synthesis of gonadotropin. The mixture of the ingredients is applied as single dose injection or in pelleted form. The pellets serve as short-term controlled release implants. Injectable drugs containing a combination of sGnRH-A and domperidone are employed in the controlled hatching of salmon, trout and many other cultured marine and freshwater fish species, as well as in the breeding of ornamental fish. The combination of the dopamine antagonist metoclopramide and LHRH-A in pelleted form assists e.g. in the culturing of freshwater fish as carp, chub and catfish species.

#### **GnRH antagonists**

Whereas the veterinarian can choose from a number of proven, highly active and efficient GnRH agonists, the situation on the antagonist side is not yet satisfactory.

Third-generation antagonists such as acyl-ine, antarelix, antide (itirelix), and cetorelix have been used in studies with domestic animals, e.g. to prevent ovulation during proestrus or terminate pregnancy.

## Oxytocin and Carbetocin

Oxytocin and its more stable carba analog carbetocin are administered to induce normal labor and facilitate parturition in livestock (cows, ewes, sows, goats) as well as in pets. In captive birds such as budgerigars or cockatiels, oxytocin and its avian analog vasotocin help to induce oviposition in case of egg binding.

Oxytocin, which is produced in the hypothalamus, and synthetic carbetocin act on the smooth musculature of the female reproductive system. Both peptides induce strong contractions of the estrogen-stimulated uterus, but distinctly prolonged and more frequent contractions will result during administration of the analog. Simultaneously, these hormones stimulate the lactating glands to produce milk and deblock the teats for ejection.

Oxytocin and carbetocin are also applied in case of agalactia or reduced milk flow after birth. In cows, carbetocin is administered to prevent a retarded involution of the uterus or in case of abnormal milk ejection. A single injection of carbetocin in dysgalactic sows induces milk flow post partum. If drug overdosage may cause problems oxytocin is preferred over carbetocin due to its shorter half-life.

In large animals, oxytocin is administered to stimulate the expulsion of placenta after parturition in case of prolonged retention. Oxytocin is also applied therapeutically: in mares, it is indicated for the treatment of endometritis following insemination. In cows and swine, it is used to treat mastitis.

## Vasopressin and Desmopressin

Vasopressin (Antidiuretic Hormone, ADH), a peptide hormone secreted by the hypothalamus, acts on the renal tubulus cells. Most mammals produce (Arg<sup>8</sup>)-Vasopressin (Arg-Vasopressin, AVP), whereas the Lys<sup>8</sup>-

analog is secreted in pigs. The porcine analog shows only half of the antidiuretic activity of AVP. In higher dosage, vasopressin additionally induces vasoconstriction and stimulates the production of factor VIII and von Willebrand factor.

Vasopressin is administered intravenously or subcutaneously as a diagnostic to differentiate between renal and central diabetes insipidus in dogs, cats, horses, and cattle. AVP can also be used as a therapeutic in the treatment of the central form of the disease. However, due to its short half-life, its stable synthetic analog desmopressin (DDAVP) is the preferred medication in the treatment of dogs and cats suffering from polyurea caused by diabetes insipidus centralis. Compared to vasopressin, desmopressin shows an improved antidiuretic and a reduced vasoconstrictive activity, it more effectively stimulates factor VIII and von Willebrand factor production. DDAVP is often applied conjunctively or nasally in dogs and cats, and has even been administered orally in humans. It is applied intravenously or subcutaneously in dogs for treating moderate cases of von Willebrand's disease before surgery to avoid hemorrhagia. In animals with von Willebrand's disease, desmopressin transiently elevates von Willebrand's factor and shortens bleeding time. It may be useful in dogs with von Willebrand's disease permitting surgical procedures or controlling capillary bleeding. The hemostatic effect in cats has not yet been evaluated.

Vasopressin is gaining attention in veterinary emergency medicine as a cardiovascular resuscitation drug in small animal patients and newborn foals.

## Glucagon, Peptides in Pancreatic Disorders

### Glucagon

Glucagon, as its antagonist insulin, is secreted by the pancreas. The peptide hormone is used as emergency medication in cases of severe hypoglycemia, as it upregulates plasma glucose.

Management of bovine fatty liver disease (FLD, Steatosis hepatis) is an important application of this hormone in veterinary

**Peptide-based drugs are especially indicated for treating animals used in food production, though regulation of fertility is their most important application. Only very small doses of these rather expensive, but highly active compounds are required. Peptides are metabolized more readily than many small molecules, which reduces the risk of contamination of the milk, eggs, or meat of the treated animal.**

medicine. FLD is an accumulation of fat (especially triglycerides) in the liver occurring in cows after calving. The disease can be treated efficiently by longterm intravenous infusion of glucagon. Besides stimulating glycogenolysis, gluconeogenesis, and insulin production, the peptide hormone reduces liver triglycerides. Glucagon is also used as a diagnostic in veterinary medicine, especially in dogs (Glucagon stimulation test).

Intravenously injected glucagon causes a short rise in the plasma concentration of insulin in healthy dogs. This will not happen when administering glucagon to diabetic canines due to their inability to produce the hormone. But instead of measuring the secreted insulin, determination of the amount of the concomitantly formed C-peptide is preferred, as it is not affected by insulin treatment. The measurement is performed 10 minutes after the glucagon injection.

#### **C-Peptide**

Canine C-peptide is applied as a diagnostic tool for monitoring diabetes in dogs. This peptide is released together with insulin from a precursor peptide, so its plasma concentration indicates how much insulin is being produced by the pancreas. The extent of  $\beta$ -cell loss can be deduced from the result. Determining the amount of C-peptide in diabetic animals allows for therapeutic monitoring as one can differentiate between endogenous (produced by the body) and exogenous (injected into the body) insulin. Inappropriate dosage of insulin in dogs with low blood sugar levels results in a low C-peptide level.

Whereas type 1 diabetes is quite common in dogs, type 2 diabetes has not been observed yet.

In case of insulin resistance, the increased concentration of C-peptide results from a high activity level of the pancreas  $\beta$ -cells. Abnormally high amounts of C-peptide can indicate the formation of an insulinoma which secretes insulin.

#### **Octreotide and analogs**

Octreotide, a synthetic somatostatin analog showing higher activity and increased

half-life, was evaluated in the management of insulinomas in dogs.

Octreotide is a long-acting inhibitor of pancreatic secretion, which helps to prevent complications after pancreatic surgery. Single photon emission computed tomography (SPECT) applying  $^{111}\text{In}$ -pentetreotide allows the detection and localization of canine insulinomas.

#### **Diagnostics**

##### **TRH**

As in humans, protirelin (TRH) is injected or infused in pet dogs for diagnosing thyroid disorders as hypothyroidism. TRH acts on the anterior pituitary gland. In the case of a healthy pituitary, application of the hormone stimulates the secretion of TSH, which promotes the secretion of triiodothyronine (T3) and thyroxin (T4) from the thyroid gland. T3 and T4 can be measured in plasma later on.

In horses, a TRH test alone or in combination with the dexamethasone suppression test (DST) is performed to diagnose pituitary gland hyperplasia (pituitary pars intermedia dysfunction (PPID) or equine Cushing's disease (ECD)).

##### **ACTH and cosyntropin (tetracosactide)**

Corticotropin (ACTH) and cosyntropin (tetracosactide) are used diagnostically to detect adrenal disorders, especially in dogs, cats, and horses. Both peptides stimulate the adrenal cortex (zona fasciculata) and induce the production of glucocorticoids. The use of cosyntropin is indicated in case of allergic reactions to the natural hormone. In dogs, blood samples have to be taken preceding the intravenous or intramuscular injection of the peptide to obtain the basal cortisol value, and one hour after the administration.

Canine Cushing's disease (hyperadrenocorticism, rather common in dogs but occurs rarely in cats) and Addison's disease (hypoadrenocorticism, in cats and dogs) can both be diagnosed. In case of spontaneous hyperadrenocorticism, the ACTH test is also performed to monitor the effects of medication.

In neonatal foals, cosyntropin stimulation

is a reliable test for dysfunctions of the hypothalamic-pituitary-adrenal axis.

### **Ceruletide**

Ceruletide (caerulein) has been proposed as a diagnostic of hepatic dysfunctions in dogs. The cholecystokinin (CCK) analog stimulates postprandial serum bile acid, and is a more efficient secretagogue than CCK. As hepatopathy can occur in dogs suffering from severe respiratory diseases, administration of ceruletide as a liver function test should be performed routinely with such patients.

### **Prospective Peptide Drugs**

#### **Peptide drugs**

Peptide drugs such as exenatide or teriparatide, which have been successfully established in human medicine, can likely also be applied to treat similar medical conditions of companion animals and horses.

The somatostatin analogs lanreotide and the recently approved pasireotide also show potential in veterinary medicine, e.g. in the treatment of canine Cushing's disease or feline hypersomatotropism.

In the management of cancer and development of new (peptide) therapeutics, human patients can profit from the experience gained with afflicted pet dogs and vice versa, as naturally occurring cancers in these species share many features including biological behavior and the response to conventional therapies.

#### **Peptide vaccines**

Peptide-based vaccines could be a safer alternative to immunization using the inactivated virus. Peptide vaccines present a number of advantages, as they are easily available (also on large scale), relatively cheap, shelf-stable, chemically well-defined compounds. A number of studies evaluating synthetic peptides (immunogenic sequences from viral proteins, used in combination with a suitable adjuvant for inoculation) as vaccines against viral diseases affecting livestock such as foot-and-mouth disease or swine fever have been published.

### **Antimicrobial peptides**

An alternative to the antibiotics used in animals involved in food production may come from antimicrobial peptides, which have been described in many organisms. These peptides have a wide spectrum of action. They can kill gram negative and gram positive bacteria, enveloped viruses, yeasts, and moulds. Several peptides were recently discovered in shrimp and oysters, where they are essential elements of innate defense, in the absence of acquired immunity.

These molecules could advantageously replace antibiotics, since they are less susceptible to cause resistance in the target microorganisms, due to their direct action on membranes, and to their fast degradability, which avoid the accumulation of residues.

Application of antibacterial peptides is an attractive option for intensive animal husbandry such as poultry farming and, especially, aquaculture.

**In the management of cancer and development of new (peptide) therapeutics, human patients can profit from the experience gained with afflicted pet dogs and vice versa, as naturally occurring cancers in these species share many features including biological behavior and the response to conventional therapies.**

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#### **Peptide drugs**

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# PEPTIDES FOR VETERINARY MEDICINE

Peptide-based drugs are especially indicated for treating animals used in food production, as they are highly active compounds which require only very small doses. Additionally, they are metabolized more readily than organic compounds, which reduces the risk of contamination of the milk, eggs, or meat of the treated animal by the unmetabolized pharmaceutical and/or its degradation products.

## LHRH GENERIC APIs

**Gonadorelin Acetate**  
CEP, DMF  
[H-4005-GMP, 4008614](#)

**Buserelin**  
DMF  
[H-4224-GMP, 4038785](#)

**Goserelin Acetate**  
CEP, DMF  
[H-6395-GMP, 4036062](#)

**Leuprolide Acetate**  
CEP, DMF  
[H-4060-GMP, 4008634](#)

**Triptorelin Acetate**  
DMF  
[H-4075-GMP, 4008442](#)

**Triptorelin Pamoate**  
DMF  
[H-6150-GMP, 4010246](#)

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**Desmopressin Acetate**  
CEP, DMF  
[H-7675-GMP, 4033038](#)

**Exenatide**  
DMF  
[4044219](#)

**Glucagon**  
DMF  
[H-6790-GMP, 4015466](#)

**Lanreotide**  
[H-9055-GMP, 4071138](#)

**Octreotide Acetate**  
DMF  
[H-5972-GMP, 4034264](#)

**Pasireotide Acetate\***  
[4047875](#)

**pTH (1-34) (human) Acetate**  
DMF  
[H-4835-GMP, 4033364](#)

**Tetracosactide**  
DMF  
(Cosyntropin)  
[H-1150-GMP, 4042686](#)

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## NON-PEPTIDE GENERIC APIs

Etomidate  
CEP, DMF  
2990-GMP, 4049295

Propofol  
CEP, DMF  
2270-GMP, 40378086

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# LHRH ANALOGS (RESEARCH GRADE)

## LHRH

(GnRH; Gonadorelin Acetate salt)

**H-4005**

<EHWSYGLRPG-NH<sub>2</sub>

## LHRH

(Gonadorelin Hydrochloride salt)

**H-6728**

<EHWSYGLRPG-NH<sub>2</sub>

## (Des-Gly<sup>10</sup>,D-Ala<sup>6</sup>,Pro-NHEt<sup>9</sup>)-LHRH

(Alarelin)

**H-4070**

<EHWSYaLRP-NHEt

## (Des-Gly<sup>10</sup>,D-Ser(tBu)<sup>6</sup>,Pro-NHEt<sup>9</sup>)-LHRH

(Buserelin)

**H-4224**

<EHWSYs(tBu)LRP-NHEt

## (Des-Gly<sup>10</sup>,D-Trp<sup>6</sup>,Pro-NHEt<sup>9</sup>)-LHRH (High acetate salt)

(Deslorelin)

**H-4116**

<EHWSYwLRP-NHEt

## (Des-Gly<sup>10</sup>,Pro-NHEt<sup>9</sup>)-LHRH

(Fertirelin)

**H-4055**

<EHWSYGLRP-NHEt

## (D-Ser(tBu)<sup>6</sup>,Azagly<sup>10</sup>)-LHRH

(Goserelin)

**H-6395**

<EHWSYs(tBu)LRP-Azagly-NH<sub>2</sub>

## (D-Ser(tBu)<sup>6</sup>,Azagly<sup>10</sup>)-LHRH (free base)

(Goserelin (free base))

**H-7296**

<EHWSYs(tBu)LRP-Azagly-NH<sub>2</sub>

## (Des-Gly<sup>10</sup>,tBu-D-Gly<sup>6</sup>,Pro-NHEt<sup>9</sup>)-LHRH

(Lecirelin Trifluoroacetate salt)

**H-5936**

<EHWSY-D-Tle-LRP-NHEt

## (Des-Gly<sup>10</sup>,D-Leu<sup>6</sup>,Pro-NHEt<sup>9</sup>)-LHRH

(Leuprolide)

**H-4060**

<EHWSYILRP-NHEt

## (Des-Gly<sup>10</sup>,D-Leu<sup>6</sup>,[<sup>13</sup>C<sub>6</sub>]Leu<sup>7</sup>,Pro-NHEt<sup>9</sup>)-LHRH

(([<sup>13</sup>C<sub>6</sub>]Leu<sup>7</sup>)-Leuprolide)

**H-6258**

<EHWSYI[<sup>13</sup>C<sub>6</sub>]LRP-NHEt

## (D-2-Nal<sup>6</sup>)-LHRH

(Nafarelin)

**H-6095**

<EHWSY-D-2Nal-LRPG-NH<sub>2</sub>

## LHRH (lamprey III)

(Peforelin)

**H-4258**

<EHWSHDWKPG-NH<sub>2</sub>

## LHRH (salmon)

**H-6845**

<EHWSYGWLP-G-NH<sub>2</sub>

## (Des-Gly<sup>10</sup>,D-Arg<sup>6</sup>,Pro-NHEt<sup>9</sup>)-LHRH (salmon)

(sGnRH-A)

**H-9205**

<EHWSYrWLP-NHEt

## (D-Trp<sup>6</sup>)-LHRH

(Triptorelin Acetate salt)

**H-4075**

<EHWSYwLRPG-NH<sub>2</sub>

## (D-Trp<sup>6</sup>)-LHRH

(Triptorelin Pamoate salt)

**H-6150**

<EHWSYwLRPG-NH<sub>2</sub>

## Antide

(Iturelix)

**H-9215**

Ac-D-2Nal-D-4Cpa-D-3Pal-SK(nicotinoyl)k(nicotinoyl)IK(isopropyl)Pa-NH<sub>2</sub>

## Cetrorelix\*

**H-6682**

Ac-D-2Nal-D-4Cpa-D-3Pal-SY-D-Cit-LRPa-NH<sub>2</sub>

## Degarelix\*

**H-7428**

Ac-D-2Nal-D-4Cpa-D-3Pal-SF(4-amino(L-4,5-dihydroorotyl)f(4-ureido)LK(isopropyl)Pa-NH<sub>2</sub>

\*Offered under Bolar Exemption:

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## OXYTOCIN, CARBETOCIN (RESEARCH GRADE)

**Carbetocin**  
**H-5832**  
Butyryl-YMe)IQNCPLG-NH<sub>2</sub>

**Oxytocin**  
**H-2510**  
CYIQNCPLG-NH<sub>2</sub>  
(Disulfide bond)

**(Ile<sup>8</sup>)-Oxytocin**  
(Mesotocin)  
**H-2505**  
CYIQNCPIG-NH<sub>2</sub>  
(Disulfide bond)

**(Arg<sup>8</sup>)-Vasotocin**  
(Argiprestocin)  
**H-1785**  
CYIQNCPRG-NH<sub>2</sub>  
(Disulfide bond)

## DESMOPRESSIN, VASOPRESSIN (RESEARCH GRADE)

**(Arg<sup>8</sup>)-Vasopressin**  
(Argipressin; AVP)  
**H-1780**  
CYFQNCPRG-NH<sub>2</sub>  
(Disulfide bond)

**(Lys<sup>8</sup>)-Vasopressin**  
(Lypressin; LVP)  
**H-2530**  
CYFQNCPKG-NH<sub>2</sub>  
(Disulfide bond)

**Deamino-Cys<sup>1</sup>, D-Arg<sup>8</sup>-Vasopressin**  
(Desmopressin; DDAVP)  
**H-7675**  
3-Mercaptopropionyl-YFQNCPrG-NH<sub>2</sub>  
(Disulfide bond)

## PEPTIDES IN PANCREATIC DISORDERS (RESEARCH GRADE)

**Glucagon (1-29) (human, rat, porcine)**  
**H-6790**  
HSQGTFTSDYSKYLDSRRAQD-  
FVQWLMNT

**Glucagon (1-29) (human, rat, porcine)  
Acetate salt**  
**H-7754**  
HSQGTFTSDYSKYLDSRRAQD-  
FVQWLMNT

**([<sup>13</sup>C<sub>6</sub>]Leu<sup>14</sup>)-Glucagon (1-29)  
(human, rat, porcine)**  
**H-7236**  
HSQGTFTSDYSKY[<sup>13</sup>C<sub>6</sub>]LDSRRAQD-  
FVQWLMNT

**Biotinyl-Glucagon (1-29) (human, rat,  
porcine)**  
**H-5676**  
Biotinyl-HSQGTFTSDYSKYLDSRRAQD-  
FVQWLMNT

**Oxyntomodulin (human, mouse, rat)**  
**H-6058**  
HSQGTFTSDYSKYLDSRRAQD-  
FVQWLMNTKRNRNNTIA

**Oxyntomodulin (bovine, dog, porcine)**  
**H-6880**  
HSQGTFTSDYSKYLDSRRAQD-  
FVQWLMNTKRKNNTIA

**(Tyr<sup>0</sup>)-C-Peptide (dog)**  
**H-2914**  
YEVEDLQVRDVELAGAPGEGGLQPLALE-  
GALQ

**Octreotide**  
**H-5972**  
fCFwKTC-L-threoninol  
(Disulfide bond)

**([ring-D<sub>5</sub>]Phe<sup>3</sup>)-Octreotide**  
**H-7238**  
fC[ring-D<sub>5</sub>]FwKTC-L-threoninol  
(Disulfide bond)



## DIAGNOSTICS (RESEARCH GRADE)

**TRH**  
(Protirelin)  
**H-4915**  
<EHP-NH<sub>2</sub>

**ACTH (1-39) (human)**  
(Corticotropin)  
**H-1160**  
SYSMEHFRWGKPVGK-  
KRRPVKVYPNGAEDESAEAFPLEF

**ACTH (1-24) (human)**  
(Cosyntropin; Tetracosactide)  
**H-1150**  
SYSMEHFRWGKPVGKKRRPVKVYP

**Caerulein**  
(Ceruletide)  
**H-3220**  
<EQDY(SO<sub>3</sub>H)TGWMDF-NH<sub>2</sub>

**Aprotinin**  
(BPTI)  
**H-5834**  
RPDFCLEPPYTGPCKARIIRYFYNAKAGL-  
CQTFVYGGCRAKRNNFKSAEDCMRTC-  
GGA  
(Disulfide bonds between Cys<sup>5</sup> and  
Cys<sup>55</sup>/Cys<sup>14</sup> and Cys<sup>38</sup>/Cys<sup>30</sup> and Cys<sup>51</sup>)

## PROSPECTIVE DRUGS (RESEARCH GRADE)

**Exenatide**  
(Exendin-4)  
**H-8730**  
HGEFTFTSDLKQMEEEAVRL-  
FIEWLKNGGPSSGAPPPS-NH<sub>2</sub>

**Lanreotide**  
**H-9055**  
D-2NaI-CYwKVCT-NH<sub>2</sub>

**Pasireotide**  
**H-7542**  
C(Hyp(2-aminoethylcarbamoyl)-Phg-  
wKY(Bzl)F)

**pTH (1-34) (human)**  
(Teriparatide)  
**H-4835**  
SVSEIQLMHNLGKHLNSMERVEWLRK-  
KLQDVHNF

**([<sup>13</sup>C<sub>6</sub>]Leu<sup>15</sup>)-pTH (1-34) (human)**  
**H-7234**  
SVSEIQLMHNLGKH [<sup>13</sup>C<sub>6</sub>] LNSMERVEW-  
LRKKLQDVHNF

**pTH (1-84) (dog)**  
**H-6438**  
SVSEIQFMHNLGKHLSSMERVEWLRK-  
KLQDVHNFVALGAPIAHRDGSSQR-  
PLKKEDNVLVESYQKSLGEADKADVVDLT-  
KAKSQ

**Ac-muramyl-Ala-D-Glu-NH<sub>2</sub>**  
(MDP)  
**G-1055**  
MurNAc-Ae-NH<sub>2</sub>

**Palmitoyl-Cys((RS)-2,3-  
di(palmitoyloxy)-propyl)-Ser-Lys-Lys-  
Lys-Lys-OH**  
**H-5656**  
Pam<sub>3</sub>CSKSKK

## NON-PEPTIDE DRUGS (RESEARCH- GRADE)

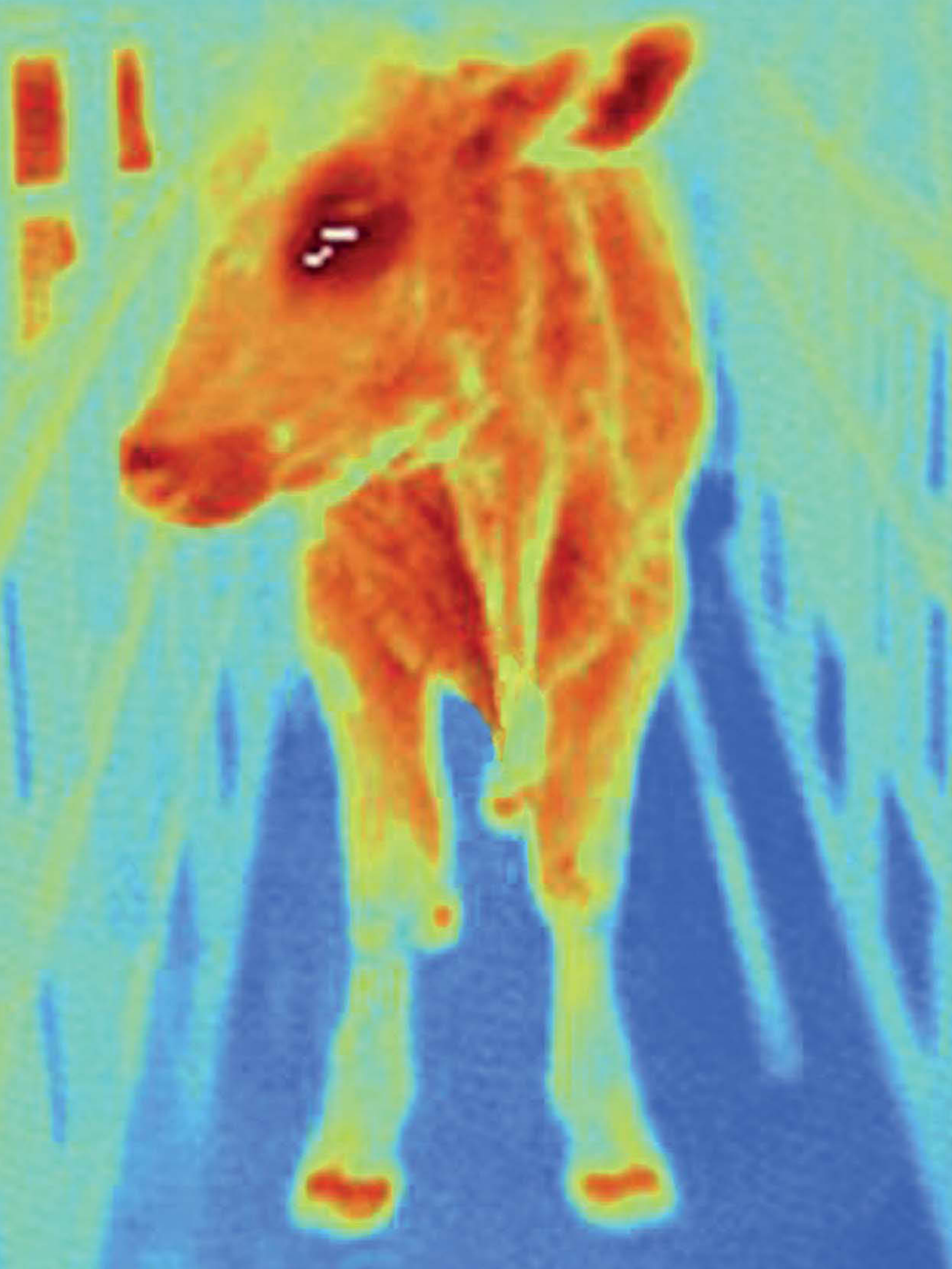
**DL-Aminoglutethimide**  
**Q-1020**

**Phenserine**  
**Q-1860**

**Vincamine base**  
**Q-1435**

**Xylazine (free base)**  
**Q-1445**

**Xylazine · HCl**  
**Q-1440**





## HEALTHY AND INFECTED COWS, THERMOGRAMS

### **Healthy and infected cows.**

Thermogram (infrared) images of a cow infected with the foot-and-mouth-disease virus (left) and a healthy cow (right). The effects of the disease cause the hooves to be hotter than usual, showing up on the thermogram as a red colour at left. For the uninfected cow at right, no heat or red colour is seen in the hooves. Foot-and-mouth disease is caused by viruses in the picornavirus group. It is highly contagious, spreading by direct contact with infected animals. Infected farm animals are slaughtered and burnt to remove contamination.

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CRAIG PACKER/US DEPARTMENT OF  
AGRICULTURE

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