This collection of references illustrates techniques by which the physiological effects of a controlled hormone infusion are determined in the absence of endogenous hormone production. In this manner, the effects that hormones have at different concentrations can be determined independent of temporal fluctuations in hormone levels. The technical notes following each reference detail the substance(s) infused, the route of administration, the animal model studied, the vehicle for infusion, the model of pump used, the duration of infusion, and notable technical achievements or results obtained.

This list does not contain references in this category from before 2016. To obtain a complete list of citations since 1975, please contact ALZET Technical Support at (800) 692-2990 or alzet@durect.com.

The inverse of this technique, or the study of the differential effects of varying regimens of pulsatile hormone administration, can be accessed through the sub-bibliography entitled "References on Pulsed Administration of Agents by ALZET Osmotic Pumps". To obtain a copy of this sub-bibliography contact ALZET Technical Support.

For a more complete discussion of the capabilities of these techniques consult the following reference:

Recent References (2017-Present): The Rate-Controlled Modulation of Hormone Levels Using ALZET® Osmotic Pumps


**Agents:** Antibody, anti-Mullerian hormone  
**Vehicle:** Not Stated;  
**Route:** IP;  
**Species:** Mice;  
**Pump:** Not Stated;  
**Duration:** 7 days;  
**ALZET Comments:** Dose (1.23 mcg/day); Controls received mp w/ vehicle; animal info (ovariectomized NU/J mice or nude mice); anti-Mullerian hormone Antibody aka rAMH; replacement therapy (anti-mullerian hormone);


**Agents:** 17 B-Estradiol  
**Vehicle:** DMSO; Propylene Glycol;  
**Route:** SC;  
**Species:** Mice;  
**Pump:** 1004;  
**Duration:** 4 weeks;  
**ALZET Comments:** Dose (0.5 ug/day); 50% DMSO used; Controls received mp w/ vehicle; animal info (C57BL/6 mice, 2-3 months old); 17 B-Estradiol aka E2; replacement therapy (estradiol);


**Agents:** Growth hormone  
**Vehicle:** Saline;  
**Route:** SC;  
**Species:** Rat;  
**Pump:** 1002;  
**Duration:** Not Stated;  
**ALZET Comments:** Dose (1 ug/g); Controls received mp w/ vehicle; animal info (Male Sprague-Dawley rats); Growth hormone aka GH; replacement therapy (growth hormone);


**Agents:** Fibroblast growth factor 23  
**Vehicle:** Saline;  
**Route:** Not Stated;  
**Species:** Mice;  
**Pump:** Not Stated;  
**Duration:** 4 days;  
**ALZET Comments:** Dose (200 ng/g/day); Controls received mp w/ vehicle; animal info (9 week old Hyp mice; 6 week old Fgf23−/− mice); Fibroblast growth factor 23 aka FGF23; replacement therapy (Fibroblast growth factor);


**Agents:** Ouabain  
**Vehicle:** PBS, Sterile;  
**Route:** Not Stated;  
**Species:** Rat;  
**Pump:** 2004;  
**Duration:** 4 weeks;  
**ALZET Comments:** Dose (10 ug/kg/day); animal info (female Sprague-Dawley rats); Blood pressure measured via tail-cuff method; replacement therapy (Ouabain);


**Agents:** Alosetron  
**Vehicle:** Water;  
**Route:** Not Stated;  
**Species:** Rat;  
**Pump:** Not Stated;  
**Duration:** 14 days;  
**ALZET Comments:** Animal info (Pregnant Sprague Dawley rats and female adult offspring, 5 weeks old); replacement therapy (estradiol);

Q9879: J. Yuan, et al. The effects of oxytocin to rectify metabolic dysfunction in obese mice are associated with increased thermogenesis. Molecular and Cellular Endocrinology 2020;514(110903

**Agents:** Oxytocin, synthetic  
**Vehicle:** Not stated;  
**Route:** SC;  
**Species:** Mice;  
**Pump:** 1004;  
**Duration:** 4 weeks;  
**ALZET Comments:** Dose (100 nmol/d); animal info (4 week old male C57BL6/J mice); replacement therapy (oxytocin);


**Agents:** Human parathyroid hormone-(1-34)  
**Vehicle:** Not Stated;  
**Route:** SC;  
**Species:** Mice;  
**Pump:** 1002;  
**Duration:** 2 weeks;  
**ALZET Comments:** Dose (80 μg/kg/day); Controls received mp w/ vehicle; animal info (16-weeks-old female mice); Human parathyroid hormone-(1-34); aka hPTH1-34; replacement therapy (parathyroid hormone);
Bibliography

Q9037: J. A. West, et al. Proximal and Distal Gut Mucosa Adapt Differently to Westernized Diet, Promoting an Insulin-Resistant Dysmetabolic State. BioRxiv 2020; Agents: Glucose-dependent insulinotropic polypeptide(3-30)-NH2; GIPR antagonist Vehicle: Saline; Route: SC; Species: Mice; Pump: Not Stated; Duration: 28 days; ALZET Comments: Dose (30 mg/mL); 0.9% Saline used; Controls received mp w/ vehicle; animal info (C57BL/6Jrj mice, 23-week-old males); Glucose-dependent Insulinotropic Polypeptide(3-30)-NH2 aka GIP(3-30)NH2; replacement therapy (Gut Hormones);

Q9508: B. Tuku, et al. Testosterone Protects Against Severe Influenza by Reducing the Pro-Inflammatory Cytokine Response in the Murine Lung. Frontiers in Immunology 2020;11(697) Agents: Testosterone Vehicle: “Cyclodextrin, 2-ß-Hydroxypropl-”; Route: SC; Species: Mice; Pump: 2004; Duration: 2 weeks; ALZET Comments: Dose (5 mg/ml); 45%% “Cyclodextrin, 2-ß-Hydroxypropl-” used; Controls received mp w/ vehicle; animal info (Six weeks old female mice); replacement therapy (testosterone);

Q9496: Q. Tang, et al. Sirt6 in pro-opiomelanocortin neurons controls energy metabolism by modulating leptin signaling. Molecular Metabolism 2020;37(100994) Agents: Leptin Vehicle: Saline; Route: SC; Species: Mice; Pump: 1007D; Duration: 2 days; ALZET Comments: Dose (500 ng/h); Controls received mp w/ vehicle; animal info (Male mice, 6 weeks old); replacement therapy (Leptin);

Q9492: T. Takeda, et al. Gestational dioxin exposure suppresses prolactin-stimulated nursing in lactating dam rats to impair development of postnatal offspring. Biochemical Pharmacology 2020;178(114106) Agents: Prolactin Vehicle: Saline, sterile; Route: CSF/CNS (lateral ventricle); Species: Rat; Pump: 2002; Duration: 28 days; ALZET Comments: Dose (400 ng/day); Controls received mp w/ vehicle; animal info (Male (10 week-old, body weight: around 280 ~ 320 g) and female (6~7 week-old, body weight: around 160 ~ 220 g) Wistar rats); behavioral testing (Maternal Capacity Tests, Y-maze Test); ALZET brain infusion kit 2 used; Brain coordinates (antero-posterior, −1.0 mm and lateral, 1.0 mm from the bregma, and depth of 4 mm.); replacement therapy (Prolactin);

Q9012: J. G. Soares de Carvalho, et al. Administration of PGF2alpha during the periovulatory period increased fertilization rate in superovulated buffaloes. Theriogenology 2020;145(138-143) Agents: Prostaglandin F2α Vehicle: Not stated; Route: SC; Species: Buffalo; Pump: 1003D; Duration: 2 days; ALZET Comments: Dose (0.833 mg/h); animal info (Crossbred Murrah x Mediterranean buffalo, 8.5 ± 2.2 old); Prostaglandin F2α aka PGF2α; replacement therapy (Prostaglandin F2α Infusion);

Q9443: S. Sanchez-Bezanilla, et al. Growth Hormone Treatment Promotes Remote Hippocampal Plasticity after Experimental Cortical Stroke. International Journal of Molecular Sciences 2020;21(12): Agents: Growth hormone, recomb. human Vehicle: Saline, sterile; Route: SC; Species: Mice; Pump: 2004; Duration: 28 days; ALZET Comments: Dose ((0.04 mg r-hGH per day); Controls received mp w/ vehicle; animal info (C57BL/6 mice, male, 10 weeks old); recombinant human growth hormone aka r-hGH; replacement therapy (human recombinant growth hormone);

Q9442: S. Sanchez-Bezanilla, et al. Growth Hormone Promotes Motor Function after Experimental Stroke and Enhances Recovery-Promoting Mechanisms within the Peri-Infarct Area. International Journal of Molecular Sciences 2020;21(2): Agents: Growth hormone, human recombinant Vehicle: Saline; Route: SC; Species: Mice; Pump: 2004; Duration: 28 days; ALZET Comments: Dose (0.04 mg rhGH per day); Controls received mp w/ vehicle; animal info (Male C57BL/6 mice, 10 weeks old); behavioral testing (Motor test); Recombinant human growth hormone aka rhGH; replacement therapy (growth hormone);

Q9441: W. Sakuma, et al. Antidepressant effect of BE360, a new selective estrogen receptor modulator, activated via CREB/BDNF, Bcl-2 signaling pathways in ovariectomized mice. Behavioural Brain Research 2020;393(112764) Agents: Estradiol, 17B-; Tamoxifen; Raloxifene; BE360 Vehicle: PEG 300; Route: SC; Species: Mice; Pump: 2002; Duration: 2 weeks; ALZET Comments: Dose (0.1 μg/day 17B-Estradiol; 1000 μg/day Tamoxifen; 1000 μg/day Raloxifene; 30 and 100 μg/day BE360); animal info (Female ddY mice (8 weeks old)); behavioral testing (Forced swimming test); 17B-Estradiol aka E2, Tamoxifen aka TAM, Raloxifene aka RAL;replacement therapy (estradiol);
Q9414: V. G. Piazza, et al. Exposure to growth hormone is associated with hepatic up-regulation of cPLA2alpha and COX.
Molecular and Cellular Endocrinology 2020;509(110802

**Agents:** Growth hormone, porcine **Vehicle:** Saline; **Route:** SC; **Species:** Mice; **Pump:** 1007D; **Duration:** 5 days;

**ALZET Comments:** Dose (1 mg/kg of body weight per day); Controls received mp w/ vehicle; animal info (Adult (3–4 months old) Swiss-Webster female and male mice); Growth hormone, porcine aka GH; replacement therapy (Growth Hormone, Porcine);


**Agents:** Estradiol, 17B-; Testosterone, 17a-methyl **Vehicle:** Ethanol; Saline; **Route:** IP; **Species:** Fish; **Pump:** 1007D; **Duration:** 21 days;

**ALZET Comments:** Dose (0.48 ug/day); Controls received mp w/ vehicle; animal info (male and female catfish); functionality of mp verified by residual volume; 17B-estradiol aka E2, 17a-methyltestosterone aka MT; replacement therapy (testosterone; estradiol);


**Agents:** Prolactin ovine **Vehicle:** Saline; **Route:** SC; **Species:** Bird; **Pump:** 1007D; **Duration:** 7 days;

**ALZET Comments:** Dose (80 μg/day); 0.87% NaCl used; Controls received mp w/ vehicle; animal info (Female brown-headed and bronzed cowbirds); Ovine Prolactin aka Prolactin; replacement therapy (Prolactin);

Q8591: S. V. Koebele, et al. Characterizing the effects of tonic 17beta-estradiol administration on spatial learning and memory in the follicle-deplete middle-aged female rat. Hormones and Behavior 2020;126(104854

**Agents:** Estradiol, 17-beta- **Vehicle:** PEG; **Route:** SC; **Species:** Rat; **Pump:** 2002; **Duration:** 30 days;

**ALZET Comments:** Dose (3 ug/day 17 B-Estradiol; 5 ug/day other agonists); 10% DMSO, 20% Hydroxypropl-ß-Cyclodextrin used; Controls received mp w/ vehicle; animal info (Female Sprague–Dawley rats, 11 weeks of age); 17 B-Estradiol aka E2; 4,4′,4′′-(4-Propyl-[1H]-pyrazole-1,3,5-triyl) trisphenol aka PPT; Diarylpropiolnitrile aka DPN; G-1 aka GPER1 agonist; replacement therapy (estradiol);


**Agents:** 17 B-Estradiol; 4,4′,4′′-(4-Propyl-[1H]-pyrazole-1,3,5-triyl) trisphenol; Diarylpropiolnitrile; G-1 **Vehicle:** DMSO; Hydroxypropl-b-cyclodextrin; **Route:** SC; **Species:** Rat; **Pump:** 2002; **Duration:** 30 days;

**ALZET Comments:** Dose (3 ug/day 17 B-Estradiol; 5 ug/day other agonists); 10% DMSO, 20% Hydroxypropl-b-Cyclodextrin used; Controls received mp w/ vehicle; animal info (Female Sprague–Dawley rats, 11 weeks of age); 17 B-Estradiol aka E2; 4,4′,4′′-(4-Propyl-[1H]-pyrazole-1,3,5-triyl) trisphenol aka PPT; Diarylpropiolnitrile aka DPN; G-1 aka GPER1 agonist; replacement therapy (estradiol);


**Agents:** Oxytocin **Vehicle:** Saline; **Route:** SC; **Species:** Rat; **Pump:** 2002; **Duration:** 14 days;

**ALZET Comments:** Dose (380 ug/day); Controls received mp w/ vehicle; animal info (Female Wistar rats); replacement therapy (effects of the chronic administration of oxytocin);


**Agents:** Ghrelin; JMV2959 **Vehicle:** Saline; **Route:** CSF/CNS (dorsomedial hypothalamus); **Species:** Mice; **Pump:** 1004; **Duration:** 28 days;

**ALZET Comments:** Controls received mp w/ vehicle; animal info (adult male C57BL/J6 mice); JMV2959 aka growth hormone secretagogue receptor antagonist; peptides; ALZET brain infusion kit used; Brain coordinates (AP 1.6 mm, ML 0.4 mm, and DV 5.25 mm); replacement therapy (Ghrelin infusion);
Agents: Estradiol benzoate, 17-beta - Vehicle: PEG; Route: SC; Species: Rat; Pump: Not stated; Duration: 28 days;
ALZET Comments: Dose (750 ng/6 ul/day); animal info (Transgenic male (300 g) and female Long Evans rats (260 g)); replacement therapy (estradiol);

Agents: Oxytocin Vehicle: Buffered Saline; Route: SC; Species: Mice; Pump: 1003D; Duration: Not stated;
ALZET Comments: Dose (0.6, 6, 18 or 240 μg/day); Controls received mp w/ vehicle; animal info (Wild-type C57BL6/J mice and DBA/2 mice); replacement therapy (associations between oxytocin induced labor and mental disorders in offspring);

Agents: G1 Vehicle: DMSO; Route: SC; Species: Rat; Pump: 2ML4; Duration: 14 days;
ALZET Comments: Dose (400 ug/kg/day); 75% DMSO used; Controls received mp w/ vehicle; animal info (Male and female (16–20 weeks of age) Sprague Dawley rats); Blood pressure measured via HD- S10 transmitters;G1 aka GPER agonist; replacement therapy (estradiol);

Agents: G1 Vehicle: DMSO; Route: SC; Species: Rat; Pump: Q8491; Duration: Q8491;
ALZET Comments: Dose (400 ug/kg/day); 75% DMSO used; Controls received mp w/ vehicle; animal info (Male and female (16–20 weeks of age) Sprague Dawley rats); Blood pressure measured via HD- S10 transmitters;G1 aka GPER agonist; replacement therapy (estradiol);

Agents: Nicotine Vehicle: Not Stated; Route: Not Stated; Species: Rat; Pump: 2ML2; Duration: 14 days;
ALZET Comments: Dose (3.2 mg/kg/day); animal info (Male and female Wistar rats); behavioral testing (physical signs test, Anxiety-like behavior assessments); replacement therapy (Estradiol, progesterone);

Agents: Insulin; Humulin Vehicle: Saline; Route: SC; Species: Mice; Pump: Not Stated; Duration: 2 weeks;
ALZET Comments: Dose (0.45 IU/day); Controls received mp w/ vehicle; animal info (C57BL/6CRL mice); replacement therapy (Insulin);

Q8445: Q. N. Dinh, et al. Aldosterone-Induced Hypertension is Sex-Dependent, Mediated by T Cells and Sensitive to GPER Activation. Cardiovascular Research 2020;
Agents: Aldosterone; G-1; G-15; Angiotensin II Vehicle: Propylene Glycol; DMSO; Saline; Route: SC; Species: Mice; Pump: 2002; Duration: 14 days;
ALZET Comments: Dose (0.72 mg/kg/d; 0.03 mg/kg/d; 0.3 mg/kg/d; 0.7 mg/kg/d); 87% propylene glycol used; Controls received mp w/ vehicle; animal info (C57BL/6 (WT) mice; RAG1-deficient mice; GPER- deficient mice); Blood pressure measured via tail cuff plethysmography;G-1 aka G protein-coupled estrogen receptor 1 agonist; G-15 aka G protein-coupled estrogen receptor 1 antagonistreplacement therapy (estrone receptor);
Q8440: S. Dey, et al. Sex-specific brain erythropoietin regulation of mouse metabolism and hypothalamic inflammation. JCI Insight 2020;5(5);
Agents: Erythropoietin, recombinant human Vehicle: Saline; Route: CSF/CNS (lateral cerebral ventricle); Species: Mice; Pump: 2006; Duration: 14 days;
ALZET Comments: Dose (3000 U/kg); Controls received mp w/ vehicle; animal info (Tg21 mice); recombinant human Erythropoietin aka recombinant human EPO; ALZET brain infusion kit 3 used; Brain coordinates (midline, 1.00 mm; antero-posterior, 0.34 mm; dorsoventral, 2.30 mm); dental cement used; replacement therapy (Erythropoietin);

Agents: Ouabain Vehicle: PBS, Sterile; Route: Not stated; Species: Rat; Pump: 2004; Duration: 4 weeks;
ALZET Comments: Dose (10 ug/kg/day); animal info (female Sprague-Dawley rats); Blood pressure measured via tail-cuff method; replacement therapy (Ouabain);

Agents: Estradiol, 17β Vehicle: Not stated; Route: Intraovarian; Species: Mice; Pump: Not stated; Duration: 8 weeks;
ALZET Comments: Dose (20 ug/kg/day); animal info (Six-month-old WT C57BL6 mice); 17β-Estradiol aka E2; replacement therapy (estradiol);

Agents: dihydroxyestra-1,4-dien-3-one, 10β,17β Vehicle: propylene glycol; Route: SC; Species: Mice; Pump: 2004; Duration: 8 weeks;
ALZET Comments: Dose (2 μg/day); Controls received sham surgery and mp w/ vehicle; animal info (6 months, female, Tg2576); behavioral testing (Morris Water Maze); pumps replaced every 4 weeks; 17β-dihydroxyestra-1,4-diene-3-one (DHED) is a brain-selective prodrug of 17β-estradiol; neurodegenerative (Alzheimer’s); replacement therapy (estradiol); treatment groups received bilateral ovariectomies; Therapeutic indication (hinder the progression of AD and improving cognitive functions through inhibiting klf5-NF-κB pathway and restraining oxidative and inflammatory stress in the hippocampus);

Agents: Follicle stimulating hormone, recomb. human Vehicle: Not Stated; Route: SC; Species: Mice; Pump: 2002; Duration: 2 weeks;
ALZET Comments: Dose (5 IU/day); Controls received sham surgery; animal info (7-9 weeks, male, C57BL/6Law and nude); replacement therapy (FSH);

Agents: Parathyroid Hormone, 1-34 Vehicle: Vehicle not stated; Route: SC; Species: Rat; Pump: 2002; Duration: Duration not stated;
ALZET Comments: “Dose (0.1 mg/kg/h); animal info (13-week-old male Sprague Dawley rats weighing 350 g); replacement therapy (parathyroidectomy); ”

Agents: Estrogen, conjugated; Bazedoxifene Vehicle: Cyclodextrin, hydroxypropyl-beta; HEPES buffer; Route: SC; Species: Mice; Pump: Not Stated; Duration: 3 weeks;
ALZET Comments: Dose (BZA (10 mg/kg/day), CE (3 mg/kg/day)); animal info (Female C57BL/6J mice 4 weeks old); replacement therapy (ovariectomized);
Agents: 4-pyridyl analog Vehicle: Not Stated; Route: SC; Species: Rat; Pump: Not Stated; Duration: 6 days;
ALZET Comments: Dose (5, 10, or 20 nmol/hr); Controls received mp w/ vehicle; animal info (9 week old, Male); replacement therapy (Testosterone);

Agents: Pituitary Growth Hormone 1-34, Human Vehicle: aminocaproic acid, 6-; Route: SC; Species: Mice; Pump: 2004; Duration: 21 days;
ALZET Comments: Dose (25 ug/kg/day); Controls received mp w/ vehicle; animal info (C57BL/6J, FVB/N, 75-96 weeks old); replacement therapy (parathyroidectomy); dependence;

Agents: ASB20123 Vehicle: Not Stated; Route: SC; Species: Rat; Pump: Not Stated; Duration: 1 week, 12 weeks;
ALZET Comments: Dose (0.05, 0.15 mg/kg/day); dose-response (fig 5); Controls received mp w/ vehicle; animal info (Seven-week-old male SD rats); comparison of injections vs mp “We also analyzed whether continuous sc infusion of ASB20123 to rats could accelerate skeletal growth, compared to the effects of multiple sc bolus injections”; long-term study; ASB20123 is a CNP/ghrelin chimeric peptide, composed of CNP(1-22) and human ghrelin (12-28, E17D); peptides; replacement therapy (dwarf);

Q9360: J. Mao, et al. Interleukin-1alpha leads to growth hormone deficiency in adamantinomatous craniopharyngioma by targeting pericytes: implication in pituitary fibrosis. Metabolism Clinical and Experimental 2019;101(153998
Agents: Recomb. IL-1R1a Vehicle: PBS; Route: CSF/CNS (cranium); Species: Rat; Pump: Not Stated; Duration: 28 days;
ALZET Comments: Dose (10 mg/kg/day); Controls received mp w/ vehicle; animal info (Male Sprague–Dawley rats (weight, 135 ± 5 g)); Recombinant IL-1R1a aka rrIL-1α; Brain coordinates (4 mm posterior to the bregma and 1.4 mm lateral to the midline); dental cement used;replacement therapy (antifibrotic drugs and anti-inflammatory drugs for growth hormone function);

Agents: Estradiol, 17 beta- Vehicle: Not Stated; Route: SC; Species: Mice; Pump: 1007D; Duration: 7 days;
ALZET Comments: Dose (0.0167mg); Controls received mp w/ placebo; animal info (Chimera male); replacement therapy (ovariectomy);

Q7537: J. Y. Li, et al. IL-17 Receptor Signaling in Osteoblasts/Osteocytes Mediates PTH-Induced Bone Loss and Enhances Osteocytic RANKL Production. J Bone Miner Res 2019;34(2):349-360
Agents: Parathyroid Hormone 1-34, human Vehicle: Not Stated; Route: Not Stated; Species: Mice; Pump: 1002; Duration: 2 weeks;
ALZET Comments: Dose (80 ug/kg/day); Controls received mp w/ vehicle; animal info (16-week-old female IL-17RADOCY mice); replacement therapy (hyperparathyroidism);

Q7354: D. Lau-Corona, et al. Sex-biased genetic programs in liver metabolism and liver fibrosis are controlled by EZH1 and EZH2. bioRxiv 2019;
Agents: Growth Hormone Vehicle: Not Stated; Route: Not Stated; Species: Mice; Pump: Not Stated; Duration: 14 Days;
ALZET Comments: animal info (male E1/E2-KO mice); replacement therapy (hypophysectomy); “pituitary secretion of growth hormone”;

Agents: Leptin Vehicle: PBS; Route: SC; Species: Mice; Pump: Not stated; Duration: 14 days;
ALZET Comments: Dose (0.5 μg/h); Controls received mp w/ vehicle; animal info (12 weeks, female, C57BL/J6 Lep(ob)/Lep(ob)); replacement therapy (leptin);

Agents: Irisin  Vehicle: Saline; Route: IV; Species: Rat; Pump: 2ML2; Duration: 2 weeks;
ALZET Comments: Dose (50 nmol/day); Controls received mp w/ vehicle; animal info (adult male, 330-390 g, Sprague Dawley rats); Blood pressure measured via tail cuff method; replacement therapy (Irisin);


Agents: dihydrotestosterone, 5alpha-; ethyltrimethylammonium iodide, 2-(alpha-naphthoyl)-  Vehicle: Not stated; Route: SC; Species: Mice; Pump: 1004; Duration: 28 days;
ALZET Comments: Dose ((DHT 83.3 μg/day), (alpha-NETA 33 μg/day)); Controls received empty mp; animal info (8 or 10 weeks, male, C57BL/6 or CMKLR1−/−); DHT is a nonaromatizable androgen. Alpha-NETA is a small molecule reported to function as a CMKLR1 antagonist; replacement therapy (testosterone);


Agents: Parathyroid hormone 1-34  Vehicle: Saline; Route: SC; Species: Mice; Pump: 2002; Duration: 2 weeks;
ALZET Comments: Dose (40 μg/kg/day); Controls received mp w/ vehicle; animal info (8 week old, male, C57BL/6J); replacement therapy (parathyroid hormone);

Q8979: R. Yang, et al. A glucose-responsive insulin therapy protects animals against hypoglycemia. JCI Insight 2018;3(1):13715

 Agents: Insulin, glucose-responsive; Insulin, recomb. human  Vehicle: Not Stated; Route: SC; Species: Mice; Pump: 2001; Duration: 7 days;
ALZET Comments: Dose ((GRI1 340 nmol/kg/day), (RHI 60 nmol/kg/day)); Controls received mp w/ vehicle; animal info (male, C57BL/6); comparison of SC injection vs mp; glucose-responsive insulin aka GRI is glycosylated insulin that has been conjugated to maltose and polymerized with concanavalin A; replacement therapy (insulin); diabetes; vehicle used, but identity not stated;


Agents: Aldosterone  Vehicle: Water, Distilled, DMSO buffered; Route: SC; Species: Rat; Pump: Not Stated; Duration: 6 weeks;
ALZET Comments: Dose (); Controls received sham surgery and mp w/ vehicle; animal info (8 weeks, male, Sprague-Dawley, 290-320g); replacement therapy (aldosterone); aldosterone dosage and pump model not stated in article;


Agents: Leptin  Vehicle: Saline; Route: CSF/CNS (lateral ventricle); Species: Mice; Pump: 1007D; Duration: 7 days;
ALZET Comments: Dose (454 ng/μl); Controls received mp w/ vehicle; animal info (4-8 weeks, Agrp-IRES-cre and Agrp-IRES-cre::LSL-Cas9-GFP); Brain coordinates (AP: −0.50mm, ML±1.3mm, DV: −2.3mm); replacement therapy (leptin);
Agents: ghrelin, acyl Vehicle: Saline; Route: SC; Species: Mice; Pump: 1002; Duration: 2 weeks;
ALZET Comments: Dose (11 nmol/kg/d); Controls received mp w/ vehicle; animal info (16 weeks, male, C57BL/6J); replacement therapy (ghrelin); Therapeutic indication (ghrelin is able to restore the derangement of the circadian clock in steatotic liver by increasing the expression amplitude and shifting the expression peak of clock genes);

Agents: Estradiol Vehicle: CSF, artificial; Route: SC; CSF/CNS (lateral ventricle); Species: Mice; Pump: 1004; Duration: 3 weeks;
ALZET Comments: Dose ((SC 50 μg/kg/day), (ICV 1 μg/kg/day)); Controls received mp w/ agent; animal info (16 weeks, female, C57BL/6); behavioral testing (Open field, Light-dark box, Tail suspension, Forced swim); Multiple pumps per animal (2 for SC group); comparison of SC mp vs ICV mp; ALZET brain infusion kit 3 used; Brain coordinates (0.3 mm posterior to the bregma, 0.9 mm lateral to the central sulcus, 2.5 mm below the skull); replacement therapy (estradiol); Therapeutic indication (mouse model of postmenopausal obesity that exhibited anxiety disorder and depression phenotypes were improved by E2 replacement.);

Agents: Buserelin acetate Vehicle: Saline; Route: SC; Species: Sheep; Pump: Not stated; Duration: 18 days;
ALZET Comments: Dose (1mg/ml at 2.5 μl/hr); Controls received mp w/ agent; animal info (female, Welsh mountain); Buserelin acetate is a gonadotrophin agonist; replacement therapy (oestradiol); Buserelin used to remove the effect of endogenous gonadotrophins, luteinizing hormone and follicle stimulating hormone;

Q7302: R. Scott, et al. Oxyntomodulin analogue increases energy expenditure via the glucagon receptor. Peptides 2018;104(70-77
Agents: Exendin (9-39), Oxyntomodulin analogue Vehicle: Saline; Route: SC; Species: Rat; Pump: 1003D; Duration: 3 days;
ALZET Comments: Dose (100 nmol/kg/hr Ex9-39); (40 nmol/kg OX-SR) ; Controls received mp w/ vehicle; animal info (Male, Wistar, 222g mean); replacement therapy (Oxyntomodulin);

Agents: leptin, recomb. mouse Vehicle: Saline, buffered; Route: SC; Species: Mice; Pump: 2006; Duration: 33 days;
ALZET Comments: Dose (150 ng/hr); saline (pH 8) used; Controls were WT and received mp w/ agent; animal info (4 weeks, male, C57BL/6J(Lepob/ob)); Resultant plasma level (1.8 ± 1.4 ng/mL); replacement therapy (leptin); good methods (detailed pump placement on page e3);

Agents: Estradiol; Estrogen-dendrimer conjugate Vehicle: Not Stated; Route: Not Stated; Species: Not Stated; Pump: Not Stated; Duration: 2 weeks;
ALZET Comments: ischemia (placental); replacement therapy (ovarectomy);

Agents: aldosterone Vehicle: CSF, artificial; Route: CSF/CNS (lateral ventricle); Species: Mice; Pump: 2004; Duration: 4 weeks;
ALZET Comments: Dose (25 ng/h); Controls received mp w/ vehicle; animal info (10-12 weeks, 129SvEv or ASKO); ALZET brain infusion kit 2 used; Brain coordinates (anterior-posterior –0.220, medial-lateral +1.000, dorsal-ventral –3.000); Cannula placement verified via stereotaxic frame and at sacrifice; cyanoacrylate adhesive; replacement therapy (aldosterone); Therapeutic indication (aldosterone attenuated high fat diet-induced hyperinsulinemia through increased body energetic efficiency.);

**Agents:** ghrelin, unacylated  
**Vehicle:** saline, sterile, heparinized, BSA buffered  
**Route:** IV (jugular)  
**Species:** Mice  
**Pump:** 1007D  
**Duration:** 7 days  
**ALZET Comments:** Dose (48μg/day); sterile isotonic saline containing BSA (1mg/ml) and heparin (SU/ml) used; Controls received mp w/ vehicle; animal info (6 months, C57BL/6 and GOAT-null); UAG is considered an inactive precursor to acyl-ghrelin; neurodegenerative (Parkinson's); replacement therapy (ghrelin);


**Agents:** Angiotensin II; LGND2, beta  
**Vehicle:** Saline  
**Route:** SC  
**Species:** Mice (ovariectomized)  
**Pump:** Not Stated  
**Duration:** Not Stated  
**ALZET Comments:** Dose ((AngII 0.7 mg/kg/day), (beta-LGND2 0.5mg in 100 μl)); Controls received mp w/ vehicle; animal info (10 weeks, female, C57/BJ6); beta-LGND2 is a highly specific ERbeta agonist; replacement therapy (estradiol); cardiovascular; "In some mice, an E2 pellet (0.1 mg, 21-day release pellets, Innovative Research of America, Sarasota, Florida) was inserted under the skin and these mice did not receive beta-LGND2." p.241;


**Agents:** Angiotensin II; Aldosterone; Dexamethasone  
**Vehicle:** Not Stated  
**Route:** SC  
**Species:** Mice  
**Pump:** 2002  
**Duration:** 7 days  
**ALZET Comments:** Dose ((AngII 400 μg/kg/day), (aldosterone 0.1 μg/day), (dexamethasone 12 μg/kg/day)); Controls received mp w/ vehicle; animal info (8-14 weeks, male, C57BL/6J or PDS-/-); replacement therapy (aldosterone, dexamethasone; adrenalectomy); Vehicle used but identity not stated. All minipumps contained dexamethasone for glucocorticoid replacement;


**Agents:** myriocin; tauroursodeoxycholic acid  
**Vehicle:** Saline; DMSO, buffered; PBS  
**Route:** CSF/CNS (lateral ventricle)  
**Species:** Rat  
**Pump:** 2001  
**Duration:** 6 days  
**ALZET Comments:** "Dose ((myriocin 4 μg/day), (TUDCA 10 μg/day)); saline containing 1/3 of DMSO, or PBS alone was used; Controls received sham surgery and mp w/ vehicle; animal info (female, Sprague-Dawley, 250-300g); myriocin is a serine palmitoyltransferase inhibitor. TUDCA is a chemical chaperone; Brain coordinates (1.6 mm lateral to bregma, 0.6 mm posterior, 4.5 mm deep); Cannula placement verified via stereotaxic frame; replacement therapy (estradiol); Therapeutic indication (both TUDCA and myriocin induced (in OVX rats) feeding-independent weight loss, decreased hypothalamic ER stress, a trend to increase body temperature, elevated BAT temperature and UCP1 protein levels in BAT.); "


**Agents:** angiotensin (1-9)  
**Vehicle:** Not stated  
**Route:** IV (jugular)  
**Species:** Rat  
**Pump:** 2002  
**Duration:** 14 days  
**ALZET Comments:** Dose ((Ang(1-9) 600 ng/kg/min), (PD123319 28 ng/kg/min), (A779 100 ng/kg/min)); Controls received sham surgery and mp w/ vehicle; animal info (male, Sprague-Dawley, 150+-10g); PD123319 is an AT2R blocker. A779 is a Mas receptor blocker; replacement therapy (Uninephrectomized); cardiovascular; vehicle used but identity not stated.; Therapeutic indication (Ang-(1-9) protects against hypertensive cardiovascular and kidney damage induced by volume overload by decreasing inflammation in the heart, aortic wall, and kidney; these effects are not mediated by the Mas or AT2 receptor.);


**Agents:** Ghrelin, recombinant rat  
**Vehicle:** PBS; SC  
**Species:** Mice  
**Pump:** 1002  
**Duration:** 17 days  
**ALZET Comments:** Dose (0.5 μg/hr); Controls received standard diet and mp w/ vehicle; animal info (2-3 months, male, C57BL/6); replacement therapy (); pumps implanted 3 days prior to caloric restriction. “mice implanted with vehicle pumps failed to maintain viable glucose levels, and the entire group had to be euthanized on day 12.” (p.467);
Agents: insulin Vehicle: Saline; Route: SC; Species: Mice; Pump: 1002; Duration: 14 days;
ALZET Comments: Dose (50 U/kg/d); Controls received mp w/ vehicle; animal info (4-7 months, male, TALLYHO/Jng); replacement therapy (insulin); “Systolic BP was significantly higher in the insulin-infused mice during the early time period of infusion; however this arose primarily due to the fact that systolic BP levels tended to fall in vehicle-infused mice. We do not fully understand this response, but it may reflect recovery from the surgeries to implant the radiotelemetry transmitter and osmotic pumps.” p.8;

Agents: prolactin, ovine Vehicle: Not Stated; Route: SC; Species: Rat (lactating); Pump: Not Stated; Duration: 17 days;
ALZET Comments: Dose (0.16 mg/kg/d); Controls received sham surgery; animal info (female, Sprague-Dawley, 300-350g); comparison of oral administration of PRL in pups vs mp; replacement therapy (prolactin); pump model not stated although listed as a 28-day rate. pumps implanted from d4 to d21 of lactation.

Q7779: M. Buscato, et al. The antagonist properties of Bazedoxifene after acute treatment are shifted to stimulatory action after chronic exposure in the liver but not in the uterus. Mol Cell Endocrinol 2018;472(87-96
Agents: Estrogen, Conjugated Equine; Bazedoxifene Vehicle: Hydroxypropyl-beta-cyclodextrin; HEPES buffer; Route: SC; Species: Mice; Pump: Not Stated; Duration: 14 days;
ALZET Comments: Dose (CE- 3 mg/kg/day, BZA- 10 mg/kg/day); animal info (Female, C57BL/6J); Conjugated Equine Estrogen aka CE, Bazedoxifene aka BE; replacement therapy (Estrogen);

Q7086: J. C. Brague, et al. BDNF infusion into the MPN mag is sufficient to restore copulatory behavior in the castrated Syrian hamster. Horm Behav 2018;102(69-75
Agents: Brain-derived neurotrophic factor, human recom. Vehicle: Albumin, bovine serum; Route: CSF/CNS (magnocellular medial preoptic nucleus); Species: Hamster; Pump: 2004; Duration: 9 days;
ALZET Comments: Dose (6.25 ug/ml/day); Controls received mp w/ vehicle; animal info (Male, Mesocricetus auratus, 5–6 months old); behavioral testing (Sex behavior test); Brain coordinates (ML=+0.85mm, DV=−7.4); replacement therapy (testosterone);

Agents: Estradiol, 17b- Vehicle: Not Stated; Route: SC; Species: Rat; Pump: 2006; Duration: Not Stated;
ALZET Comments: Controls received mp w/ vehicle; animal info (male, Sprague Dawley, 250-300g, adult); functionality of mp verified by serum levels; behavioral testing (Morris water maze); replacement therapy (estradiol infusion); long-term study; cardiovascular; Dose (0.05 ug/h); “exogenous E2 replacement produced E2 levels of 25-33pg/ml” (pg 2);

Q5925: C. Xu, et al. (Pro)Renin receptor regulates potassium homeostasis through a local mechanism. American Journal of Physiology Renal Physiology 2017;313(3):F641-F656
Agents: PRO020 Vehicle: Saline; Route: Intrarenal (cortex); Species: Rat; Pump: 1007D; Duration: 7 days;
ALZET Comments: Controls received mp w/ vehicle; animal info (male, Sprague Dawley, 250-300g); replacement therapy (uniphrectomy, bilateral adrenalectomy); cardiovascular; peptides; Used PE-10 catheter, inserted 2mm into cortex; vet bond; Dose (700 ug/kg/day); PRO20 is a decoy peptide antagonist of (Pro)renin receptor (PRR)

Agents: Testosterone Vehicle: Ethanol, PEG-400; Route: SC; Species: mice (transgenic); Pump: Not Stated; Duration: 4 weeks;
ALZET Comments: animal info (CK18-CreERT2 transgenic, Nkx3.1, C57BL/6N); cancer (prostate); replacement therapy (testosterone infusion); Dose (1.875 ug/h);

**Agents:** Angiotensin II; sodium butyrate  
**Route:** SC; Intrarenal (medulla)  
**Species:** Rat  
**Pump:** 2002  
**Duration:** 14 days  

**ALZET Comments:** Controls received mp w/ vehicle; animal info (male, Sprague Dawley, 250-300g); Multiple pumps per animal (2); replacement therapy (uniphrectomy); tissue perfusion (renal medulla); cardiovascular; antihypertensive; peptides; Bp measured using radio telemetry (DSI); Dose (Ang II 200 ng/kg/min; NaBu 1 ug/kg/min); good bp comparison curve (pg4);  


**Agents:** Estradiol  
**Vehicle:** Not Stated  
**Route:** Not Stated  
**Species:** Mice  
**Pump:** 2006  
**Duration:** 6 weeks  

**ALZET Comments:** Dose (6 μg/d); animal info (5-month-old C57BL/6 male mice); replacement therapy (orchiectomy);  


**Agents:** ICI 182,780  
**Vehicle:** DMSO; Saline  
**Route:** CSF/CNS (fourth ventricle)  
**Species:** Rat  
**Pump:** 1002  

**ALZET Comments:** animal info (female, Wistar, 250-300g, OVX); 1% DMSO used; post op. care (enrofloxacin IV 2.5-5 mg/kg, ibuprofen PO 15 mg/kg); replacement therapy (estradiol infusion); Cannula placement verified via injection of Evans Blue dye; Used PlasticsOne cannula;  


**Agents:** Estradiol, 17b-; Progesterone sulfate  
**Vehicle:** Cyclodextrin, 2-hydroxypropyl-β-; water  
**Route:** SC  
**Species:** Rat  
**Pump:** 2002  
**Duration:** 14 days  

**ALZET Comments:** Dose (0.25 mg/kg body weight); 27% hydroxypropyl-β-cyclodextrin used; animal info (ovariectomized (OVX) female Sprague Dawley rats, weighing between 200–225 g.); replacement therapy (estradiol);  


**Agents:** Progesterone; Prolactin  
**Vehicle:** Cyclodextrin, 2-hydroxypropyl-b;  
**Route:** SC  
**Species:** Mice  
**Pump:** 2ML4  
**Duration:** 28 days  

**ALZET Comments:** Dose (progesterone 250 μg/day; prolactin 7 μg/day); 20% (w/v) 2-hydroxypropyl-beta-cyclodextrin used; Controls received mp w/ vehicle; animal info (7–8 week old female mice with bilateral oophorectomy); replacement therapy (oophorectomy);  


**Agents:** Corticosterone  
**Vehicle:** DMSO; Propylene glycol  
**Route:** Not Stated  
**Species:** Mice  

**ALZET Comments:** Dose (100 ug/day); 50% DMSO, 50% Propylene glycol used; animal info (Female 3-4 month old 5αR1-KO and wild-type mice); replacement therapy (glucocorticoid);  


**Agents:** Estradiol  
**Vehicle:** Not Stated  
**Route:** SC  
**Species:** Rat  
**Pump:** 2ML4  
**Duration:** 28 days  

**ALZET Comments:** Dose (0.5 mg/kg/d); Controls received mp w/ vehicle; animal info (Sprague-Dawley female rats weighing 230–250 g); post op. care (3.5 mg/kg bupivacaine and 7 mg/kg lidocaine SC injections for 48 hours after); functionality of mp verified by measuring residual volume at the end of the study; replacement therapy (estradiol);

**Agents:** Aldosterone  **Vehicle:** Not Stated;  **Route:** SC;  **Species:** Mice (knockout);  **Pump:** 2004;  **Duration:** Not Stated;  
**ALZET Comments:** Dose (0.2 µg/kg body weight per minute); Controls received mp w/ vehicle; animal info (Male systemic GC-A KO mice and wild-type); replacement therapy (left uninephrectomy);


**Agents:** Sulfasalazine  **Vehicle:** Not Stated;  **Route:** SC;  **Species:** Mice;  **Pump:** 2004;  **Duration:** 4 weeks;  
**ALZET Comments:** Dose (80 mg); animal info (3 month old Female BALB/C mice weighing 25-30g); replacement therapy (ovariectomy);


**Agents:** Insulin-like growth factor 1  **Vehicle:** Acetic acid;  **Species:** Mice (knockout);  **Pump:** 1003D;  **Duration:** 24 hours;  
**ALZET Comments:** Dose (0.5 mg IGF1/mL); 0.1N acetic acid used; animal info (Eight weeks or older female Ex3aERKO or ERaUtcKO mice); replacement therapy (ooverectomy);


**Agents:** RFRP-3, Syrian hamster  **Vehicle:** CSF, artificial;  **Route:** CSF/CNS;  **Species:** Hamster;  **Pump:** 2006;  **Duration:** 5.5 weeks;  
**ALZET Comments:** Dose (12 ug/d); Controls received mp w/ vehicle; animal info (Adult sexually mature female Syrian hamsters); ALZET brain infusion kit 1 used; replacement therapy (ovariectomy);


**Agents:** Estradiol  **Vehicle:** DMSO, PBS, Ethanol;  **Route:** IP;  **Species:** mice;  **Pump:** 1004;  **Duration:** 3.5 weeks;  
**ALZET Comments:** Controls received mp w/ vehicle; animal info (5 months old) (15% EtOH, 43% DMSO, 42% PBS) replacement therapy (Estradiol); Therapeutic indication (Estrogen); Dose (6 ug/day);


**Agents:** NETA, progestin  **Vehicle:** Propylene glycol;  **Route:** Not Stated;  **Species:** Rat;  **Pump:** 2006;  **Duration:** Not Stated;  
**ALZET Comments:** Dose (20 µg/day); Controls received mp w/ vehicle; animal info (twelve month old Fisher-344 female rats); post op. care (Rimadyl (5 mg/mL/kg) for pain and saline (2 mL) to prevent dehydration); replacement therapy (oophorectomy);

Q6419: J. P. Ball, et al. Role and Regulation of MicroRNAs in Aldosterone-Mediated Cardiac Injury and Dysfunction in Male Rats. Endocrinology 2017;158(6):1859-1874

**Agents:** Aldosterone  **Vehicle:** PEG 300;  **Route:** SC;  **Species:** Rat;  **Pump:** 2004;  **Duration:** 8 weeks;  
**ALZET Comments:** Dose (0.75 mg/h); Controls received mp w/ vehicle; animal info (Eight-week old male Sprague–Dawley rats); replacement therapy (uninephrectomy); cardiovascular;


**Agents:** Angiotensin (1-7);  **Vehicle:** Not Stated;  **Route:** SC;  **Species:** Rat;  **Pump:** 2006;  **Duration:** 6 weeks;  
**ALZET Comments:** Dose (Ang 1-7: 200 ng/kg/min; A-779: 400 ng/kg/min); animal info (female Wistar rats weighting approximately 220–250 g); replacement therapy (ovariectomy);