Recent References on the Administration of Agents to Livestock Using ALZET® Osmotic Pumps

Cattle (1995-Present)


Agents: Prolactin Vehicle: Saline; Route: SC; Species: Cattle (pregnant); Pump: Not Stated; Duration: 28 days;
ALZET Comments: Controls received no mp; animal info (female, Holstein, multiparous); functionality of mp verified by blood samples; pumps removed after 28 days;


Agents: Ciprofloxacin Vehicle: Not Stated; Route: Eye; Species: Cattle (bull); Pump: Not Stated; Duration: 4 weeks;
ALZET Comments: Animal info (male, Hanwoo bull calf, 6 months old); functionality of mp verified by drug levels in aqueous humor and residual volume; good methods (pg. 284); “As the owner could not apply topical medications regularly, a drug-filled osmotic pump (Alzet; Alza, Palo Alto, CA) was implanted subconjunctivally under the upper eyelid and connected to a catheter at the lateral limbus.” pg 282; “... it is clear that the osmotic infusion pump maintained the aqueous concentration of ciprofloxacin at a reasonable steady state until its removal four weeks after implantation. The amount of drug remaining in the pump was about 17 μg/ml after four weeks. This also demonstrates the reliability of the pump. ” pg. 286; picture of pump pg 283; pumps primed for 40 hours in 37C saline; pumps removed after 4 weeks;


Agents: Tumor necrosis factor alpha Vehicle: Saline; Route: SC; Species: Cattle (lactating); Pump: 2ML1; Duration: 7 days;
ALZET Comments: Controls received mp w/ vehicle; animal info (female, Holstein, late lactation); Multiple pumps per animal (2); immunology;


Agents: Buserelin acetate Vehicle: NaCl; Route: SC; Species: Cattle (bull); Pump: 2ML4; Duration: 9 weeks;
ALZET Comments: Animal info (Belgian, blue, beef, 5 years old); pumps replaced every 28 days; long-term study; buserelin acetate is a gonadotrophin releasing hormone analog


Agents: Ghrelin, Dap3; obestatin Vehicle: DMSO; Route: SC; Species: Cattle (cow); Pump: 2ML4; Duration: 8 weeks;
ALZET Comments: Controls were untreated; functionality of mp verified by residual volume; long-term study; pumps replaced after 28 days; animal info (multipart); 50% DMSO used; wound clips used; peptides


Agents: Buserelin Vehicle: Not Stated; Route: SC; Species: Cattle; Pump: 2ML4; Duration: 2 months;
ALZET Comments: Long-term study


Agents: Prolactin, recomb. bovine Vehicle: Saline; Route: SC; Species: Cattle; Pump: 2ML2; Duration: 10 days;
ALZET Comments: Comparison of IV injections vs mp; no stress ( see pg. 1914); immunology; peptides; post op. care (prodine, excenel); each animal received 4 rounds of 10 day prolactin treatment (2 w/ mp, 2 IV injection) with 11 days of non treatment between each round; wound clips used

**Agents:** Azagly-Nafarelin; Gonadotrophin-releasing hormone agonist  
**Vehicle:** Mannitol; water, distilled  
**Route:** SC  
**Species:** Cattle (bull)  
**Pump:** 2ML4  
**Duration:** 50 weeks  
**ALZET Comments:** Controls received mp w/ vehicle; functionality of mp verified by blood samples taken; dose-response (p.227); Azagly-Nafarelin (GnRH agonist) was dissolved in 5% mannitol in water


**Agents:** Azagly-Nafarelin  
**Vehicle:** Sodium Chloride  
**Route:** SC  
**Species:** Cattle  
**Pump:** 2ML2; 2ML4  
**Duration:** 9, 18 days  
**ALZET Comments:** Controls received no treatment; replacement therapy (ovariectomy); agent is a gonadotrophin-releasing hormone agonist

P5097: H. A. Garverick, et al. Regulation of expression of ovarian mRNA encoding steroidogenic enzymes and gonadotrophin receptors by FSH and GH in hypogonadotrophic cattle. REPRODUCTION 2002;123(651-661

**Agents:** Buserelin  
**Vehicle:** Not Stated  
**Route:** SC  
**Species:** cattle  
**Pump:** 2ML4  
**Duration:** 7.5 weeks  
**ALZET Comments:** long-term study, pmps replaced after 28 days; buserelin is a gonadotrophin-releasing hormone agonist


**Agents:** Buserelin  
**Vehicle:** Not Stated  
**Route:** SC  
**Species:** cattle (lactating)  
**Pump:** 2ML2  
**Duration:** 30 days  
**ALZET Comments:** Functionality of mp verified by residual volume; pumps replaced at Day 16; multiple pumps per animal (2)


**Agents:** Zeranol  
**Vehicle:** Water  
**Route:** Not Stated  
**Species:** cattle (steer)  
**Pump:** Not Stated  
**Duration:** 56 days  
**ALZET Comments:** comparison of pellets vs. mp; long-term study, pumps replaced after 28 days


**Agents:** Growth hormone-rel. factor-2  
**Vehicle:** DMSO; PEG 400; Tween 80; Saline  
**Route:** SC  
**Species:** cattle  
**Pump:** 2ML2  
**Duration:** 14 days  
**ALZET Comments:** controls received mp w/ vehicle; peptides; agent also called KP102; multiple pumps per animal (3 or 4); comparison between injections vs. mp


**Agents:** Buserelin  
**Vehicle:** Not Stated  
**Route:** SC  
**Species:** cattle  
**Pump:** 2ML4  
**Duration:** 48 days  
**ALZET Comments:** controls received no treatment; long-term study, pumps replaced after 28 days; agent is a GnRH agonist; pumps replaced in opposite shoulder than original placement; researchers compare mp w/ injections from previous study (p. 72)


**Agents:** Zeranol  
**Vehicle:** Not Stated  
**Route:** Not Stated  
**Species:** cattle  
**Pump:** Not Stated  
**Duration:** 1,2,4,8 days  
**ALZET Comments:** no comment posted
Horse

Agents: Gonadotropin-releasing Hormone Vehicle: Saline; Route: SC; Species: Horse; Pump: 2ML2; Duration: 14 days;
ALZET Comments: Dose (20 mg/mL); 0.9% Saline used; animal info (Female, ); Gonadotropin-releasing Hormone aka GnRH; dependence;

Agents: Gonadotropin-releasing hormone Vehicle: Not Stated; Route: Not Stated; Species: Horse; Pump: Not Stated; Duration: 7 days; 12-18 days;
ALZET Comments: Animal info (female, Quarter horse and mixed breed, 5-10 years old);

Agents: Gonadotropin-releasing hormone Vehicle: Saline; Route: SC; Species: Horse (mare); Pump: 2ML2; 2ML4; Duration: 8 weeks;
ALZET Comments: Controls received mp w/ vehicle; animal info (female, Quarter Horse grade); pumps replaced every 14 days (2ML2) or 28 days (2ML4); Multiple pumps per animal (4 2ML2 or 2 2ML4); used contralateral side for next pump implantation; pumps removed at end of study;

Agents: Gonadotropin-releasing hormone Vehicle: Saline, sterile; Route: SC; Species: Horse (mare); Pump: 2ML2; Duration: 28 days;
ALZET Comments: Controls received sham pumps (silastic tubing); animal info (female, American Quarter Horses, 409-522 kg); pumps replaced every 14 days; post op. care (wound cleaned, disinfected with povidone iodine, antibacterial ointment - PO); pumps primed for 16 hours in 37C saline; used contralateral location for next pump implantation;

Agents: Gonadotrophin-releasing hormone Vehicle: Saline, physiological; Route: SC; Species: Horse; Pump: 2004; Duration: 120 days;
ALZET Comments: Controls received sham pumps; long-term study; pumps replaced every 30 days; animal info (mare, 18 mo to 24 years); pumps were disinfected using chlorhexidine gluconate, sham pumps were made from silicon tubing filled with medical grade silicone adhesive to approximate the size of the ALZET pumps, then cold-sterilized (similar to pumps) before surgical insertion

Agents: Gonadotrophin-releasing hormone Vehicle: Not Stated; Route: Not Stated; Species: Cat; horse; Pump: Not Stated; Duration: Not Stated;
ALZET Comments:

Agents: Melatonin Vehicle: Saline; DMSO; Route: SC; Species: horse; Pump: Not Stated; Duration: 12 weeks;
ALZET Comments: controls received mp w/vehicle; functionality of mp verified by serum assays on days 5, 26 and 59; long-term study, pumps replaced every 28 days
P3029: D. K. Vanderwall, et al. Corpus luteal function in nonpregnant mares following intrauterine administration of prostaglandin E2 or estradiol-17B. Theriogenology 1994;42(1069-1083

**Agents:** Prostaglandin E2; Estradiol, 17B-  
**Vehicle:** Ethanol; PBS;  
**Route:** intrauterine;  
**Species:** horse;  
**Pump:** 2001;  
**Duration:** 7 days;

**ALZET Comments:** controls received no treatment or mp with vehicle; tissue perfusion (uterine horn lumen); no stress (see pg. 1078); benzathine penicillin-G given prophylactically


**Agents:** Luteinizing HRH  
**Vehicle:** Not Stated;  
**Route:** SC;  
**Species:** horse;  
**Pump:** 2ML2; 2ML4;  
**Duration:** 14 or 28 days;

**ALZET Comments:** comprehensive review of other GnRH induced estrous studies (pp. 198-199)


**Agents:** Luteinizing HRH  
**Vehicle:** Not Stated;  
**Route:** IV (jugular);  
**Species:** horse;  
**Pump:** 2ML1;  
**Duration:** 7-16 days;

**ALZET Comments:** controls received no treatment; functionality of mp verified by LH plasma levels; comparison of iv pulsatile infusion vs. mp; peptides


**Agents:** Luteinizing HRH  
**Vehicle:** Saline;  
**Route:** SC;  
**Species:** horse;  
**Pump:** Not Stated;  
**Duration:** 28 days;

**ALZET Comments:** peptides


**Agents:** Wy-40972  
**Vehicle:** Saline;  
**Route:** SC;  
**Species:** horse;  
**Pump:** Not Stated;  
**Duration:** 14 days;

**ALZET Comments:** controls received saline injections; functionality of mp verified by LH RIA; comparison of i.m. injections vs mp; pumps inserted via trochar; Wy-40972 is lutrelin


**Agents:** Buserelin  
**Vehicle:** Not Stated;  
**Route:** SC;  
**Species:** horse;  
**Pump:** Not Stated;  
**Duration:** 28 days;

**ALZET Comments:** peptides


**Agents:** Luteinizing HRH  
**Vehicle:** Saline;  
**Route:** SC;  
**Species:** horse;  
**Pump:** 2ML4;  
**Duration:** 28 days;

**ALZET Comments:** peptides


**Agents:** Luteinizing HRH  
**Vehicle:** Not Stated;  
**Route:** SC;  
**Species:** horse;  
**Pump:** 2001;  
**Duration:** 6 days;

**ALZET Comments:** functionality of mp verified in vitro; peptides


**Agents:** Luteinizing HRH  
**Vehicle:** Saline;  
**Route:** SC;  
**Species:** horse;  
**Pump:** 2ML4;  
**Duration:** 28 days;

**ALZET Comments:** peptides

Agents: Luteinizing HRH Vehicle: Potassium phosphate; Route: SC; Species: horse; Pump: 2001; Duration: 7 days; ALZET Comments: controls receive mp w/ vehicle; dose-response; mp primed 4 hours before implant; 2 experiments using mp; progestrin silastic implants used concomitantly with GnRH; peptides


Agents: Luteinizing HRH Vehicle: Saline; Route: SC; Species: horse; Pump: 2ML4; Duration: 28 days; ALZET Comments: controls remained untreated; dose-response; infusion of GnRH via mp did not produce linear plasma increase, possibly because of stability of GnRH in solution or pooling at implant site; peptides

Pig (2011-Present)


Agents: Serelaxin Vehicle: Saline; Route: IV; Species: Pig; Pump: Not Stated; Duration: 48 hours; ALZET Comments: Dose: (30 μg/kg/day); Controls received mp w/ vehicle; animal info: 17 male Sus scrofa domesticus pig weighing 34 ± 4 kg; post op. care: Analgesia was performed with butorphanol; Cardiovascular *

Q9971: S. Thavapalachandran, et al. Platelet-derived growth factor-AB improves scar mechanics and vascularity after myocardial infarction. Cardiology 2020;

Agents: Recombinant human platelet-derived growth factor-AB Vehicle: Not Stated; Route: Not Stated; Species: Pig; Pump: Not Stated; Duration: 7 days; ALZET Comments: Dose (65 ug/kg); animal info (Landrace, 2-4 months old, 25-30 kg); Recombinant human platelet-derived growth factor-AB aka rhPDGF-AB ; ischemia (Myocardial);


Agents: Interferon, gamma; Albumin, porcine serum Vehicle: Not stated; Route: Intrauterine (uterine horn); Species: Pig; Pump: 2ML1; Duration: 5 days; ALZET Comments: Dose (240 uL/day); animal info (Sexually mature gilts); Interferon, gamma aka IFNG; Porcine serum albumin aka PSA; dependence;


Agents: POL5551; POL6326 Vehicle: Saline; Route: SC; Species: Mice; Pigs; Pump: 1007D; Duration: 7 days; ALZET Comments: Dose (8mg/kg/dose); Controls received mp w/ vehicle; animal info (female pigs; 8- to 10-week-old male mice); enzyme inhibitor (peptidic macrocycle CXCR4 antagonist); cardiovascular; Therapeutic indication (Acute myocardial infarction);

Q6526: A. Vivekanandarajah, et al. Intermittent hypercapnic hypoxia effects on the nicotinic acetylcholine receptors in the developing piglet hippocampus and brainstem. Neurotoxicology 2017;60(23-33

Agents: Nicotine Hydrogen Tartrate Salt Vehicle: Water (sterile); Route: IP; Species: Pig (neonate); Pump: 2ML2; Duration: 14 days; ALZET Comments: Dose (2.0 mg/kg/day); animal info (mixed-breed miniature piglets); comparison of patch vs mp; Resultant plasma level (serum cotinine: 23.1 + 17.3 ng/mL) "The use of an osmotic minipump as opposed to a skin patch was chosen as the method of nicotine delivery given it provides a steady state, same dose, infusion over our 14 day study whereas patches result in sudden spikes in plasma levels and require replacement of patches every 1–2 days dependent on chosen patch " pg. 2
Q6137: J. Huang, et al. Hypoxia and nicotine effects on Pituitary adenylate cyclase activating polypeptide (PACAP) and its receptor 1 (PAC1) in the developing piglet brainstem. Neurotoxicology 2017;62(3):30-38

Agents: Nicotine Vehicle: Water; Route: IP; Species: Pig; Pump: 2ML2; Duration: 14 days;
ALZET Comments: Dose (2 mg/kg/day); Controls received mp w/ vehicle; “The delivery of nicotine via the minipump provides a steady state infusion over our 14 day study whereas other methods result in sudden spikes in plasma levels (reviewed by Shiffman et al., 2005) and require more animal handling and stress.” pg. 31;


Agents: Placental growth factor-2, recombinant human Vehicle: PBS; Route: IV; Species: Pig; Pump: 2ML2; Duration: 14 days;
ALZET Comments: Controls received mp w/ vehicle; animal info (Sus Scrofa, 20-25kg); functionality of mp verified by plasma levels; ischemia (myocardial); cardiovascular; Dose (15 ug/kg/day);


Agents: Nicotine hydrogen tartrate salt Vehicle: Water; Route: SC; Species: Pig (mini); Pump: 2ML2; Duration: 14 days;
ALZET Comments: Controls received mp w/ vehicle; animal info (male mixed breed miniature piglets, postnatal day 2, 1.27 kg); functionality of mp verified by brain analysis; toxicology; Chronic postnatal nicotine and intermittent hypercapnic hypoxia (IHH); Dose (2 mg/kg/day);


Agents: BRL37344 Vehicle: Saline; Route: IV (right jugular vein); Species: Pigs; Pump: 2ML2; Duration: 14 days;
ALZET Comments: Controls received mp w/ vehicle; animal info (pig, 4 months old, 45 kg); functionality of mp verified by plasma levels; cardiovascular; antihypertensive; PE-60 catheter used for IV application; BRL37344 is a B3AR agonist; Dose (10 ug/kg/day BRL37344);


Agents: Nicotine Hydrogen Tartrate Vehicle: water; Route: SC; Species: Piglets; Pump: 2ML2; Duration: 14 days;
ALZET Comments: Controls received mp w/ vehicle; animal info (piglets); functionality of mp verified by blood and urine samples; toxicology; Dose (2 mg/kg/d); Resultant plasma level (20.3 ± 2.5 ng/mL);


Agents: Fulvestrant Vehicle: DMSO; PBS; Route: Not Stated; Species: Pig; Pump: 2ML2; 2ML4; Duration: 4 weeks;
ALZET Comments: Controls received mp w/ vehicle; animal info (boar, 6-6.5 weeks old); 50% DMSO used; Fulvestrant is a nuclear estrogen receptor antagonist and G protein-coupled receptor agonist;


Agents: Captopril; losartan; CGP42112A Vehicle: Not Stated; Route: SC; Species: Guinea pig; Pump: 2ML4; Duration: 4 weeks; 6 weeks;
ALZET Comments: Animal info (male, Hartley, 9 weeks old, 500-650g); pumps replaced every 3 weeks; cardiovascular; long-term study;


Agents: Vascular endothelial growth factor, recombinant human Vehicle: Heparin; Saline; Route: Intrapericardial; Species: Pig; Pump: 2ML4; Duration: 4 weeks;
ALZET Comments: Animal info (male, Yorkshire miniswine, 13-22kg); ischemia (cardiac, chronic); stress/adverse reaction: (see pg. 746); post op. care (Enrofloxacin 68mg PO daily for 5 days; aspirin 325 mg/day for 5 days; buprenorphine HCL 0.3 mg/kg, transdermal fentanyl patch 4mcg/kg for 72h); cardiovascular;
   **Agents:** Nicotine  **Vehicle:** Water, sterile;  **Route:** IP;  **Species:** Pig;  **Pump:** 2ML2;  **Duration:** 14 days;
   **ALZET Comments:** Control animals received mp w/ vehicle; animal info (piglet, mixed breed)

   **Agents:** ICI 182,780  **Vehicle:** Saline;  **Route:** SC;  **Species:** Pig;  **Pump:** 2ML4, 2ML2;  **Duration:** Not Stated;
   **ALZET Comments:** Control animals received mp w/ vehicle; animal info (1 wk old, Sygen); 50% DMSO used; pumps replaced after 4 weeks

   **Agents:** ICI 182,780  **Vehicle:** Saline;  **Route:** SC;  **Species:** Pig;  **Pump:** 2ML2; 2ML4;  **Duration:** Not Stated;
   **ALZET Comments:** Control animals received mp w/ vehicle; animal info (1-5 weeks old, Sygen); gene therapy;

   **Agents:** Amikacin; gentamicin  **Vehicle:** Not Stated;  **Route:** SC;  **Species:** Pig (mini);  **Pump:** Not Stated;  **Duration:** Not Stated;
   **ALZET Comments:** Animal info (female, 3.5-4.5 mo old, 12-27 kg); 2ML sized pumps used; pump implanted in the back of the neck

   **Agents:** CSF, artificial (agent)  **Vehicle:** Not Stated;  **Route:** CSF/CNS (patumen);  **Species:** Pig;  **Pump:** 2ML4;  **Duration:** 1 month;
   **ALZET Comments:** Animal info (Large White/Landrace); “due to concerns regarding the risk of blockage, catheters were modified to be connected to Alzet osmotic minipumps” pg 288

   **Agents:** Vascular endothelial growth factor, recomb. human  **Vehicle:** Not Stated;  **Route:** Intrapericardial;  **Species:** Pig;  **Pump:** Not Stated;  **Duration:** Not Stated;
   **ALZET Comments:** Animal info (intact, male, Yorkshire); stress/adverse effects “sudden cardiac death”, pg 393

Sheep (2014-Present)

   **Agents:** AMD3100  **Vehicle:** PBS; Saline;  **Route:** Intrauterine;  **Species:** Sheep;  **Pump:** 2ML1;  **Duration:** 7 days;
   **ALZET Comments:** Dose (2060 ng); Controls received mp w/ vehicle; dependence;

   **Agents:** Recombinant Ovine IFNT  **Vehicle:** Saline;  **Route:** SC;  **Species:** Sheep;  **Pump:** 2ML1;  **Duration:** 7 days;
   **ALZET Comments:** Dose (10 ul/hr); Controls received mp w/ vehicle; dependence;

   **Agents:** AMD3100  **Vehicle:** Saline;  **Route:** SC;  **Species:** Sheep;  **Pump:** 2ML1;  **Duration:** 7 days;
   **ALZET Comments:** Dose (2060 ng); Controls received mp w/ vehicle; animal info (Female, ); CXCR4 antagonist aka AMD3100; dependence;
**Agents:** AMD3100  **Vehicle:** PBS;  **Route:** Intrauterine;  **Species:** Sheep (Pregnant);  **Pump:** 2ML1;  **Duration:** 8 days;
**ALZET Comments:** Dose (2060 ng at 10 μl/h); Controls received mp w/ vehicle; animal info (female, western white face);
AMD3100 is a CXCR4 antagonist; cyanoacrylate adhesive; teratology;

**Agents:** CXCR4 inhibitor  **Vehicle:** PBS;  **Route:** Intrauterine;  **Species:** Sheep;  **Pump:** 2ML2;  **Duration:** 14 days;
**ALZET Comments:** Dose (4120 ng); Controls received mp w/ vehicle; animal info (Rambouillet-cross ewes);
CXCR4 inhibitor aka AMD3100; toxicology;

**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;

**Agents:** calpeptin  **Vehicle:** DMSO;  **Route:** intramuscular (infraspinatus);  **Species:** Sheep;
**Pump:** 2ML4;  **Duration:** 6 weeks;
**ALZET Comments:** Dose (0.75 mg/day); animal info (26.7+/−1.4 months, female, Swiss Alpine); pumps replaced at 2 weeks;
calpeptin is a synthetic calpain inhibitor; enzyme inhibitor (calpain); tissue perfusion (m. infraspinatus); good methods (detailed pump implantation procedure on page 3.); Therapeutic indication (calpain inhibition prevented the early unloading adaptations, but not the subsequent initiation of rotator cuff disease); 75% DMSO used;

**Agents:** Melatonin  **Vehicle:** Not Stated;  **Route:** Intrauterine;  **Species:** Sheep (pregnant);
**ALZET Comments:**

**Agents:** Ara-C  **Vehicle:** Serum, Physiological;  **Route:** CSF/CNS (lateral ventricle);  **Species:** Sheep;  **Pump:** 2ML4;  **Duration:** 4 weeks;
**ALZET Comments:** 4% Physiological Serum used; Controls received mp w/ vehicle; animal info (primiparous parturient Ile de France ewes (2–3 years old)); post op. care (amoxicillin, diurizone, finadyne, morphine); functionality of mp verified; Brain coordinates (rostrocaudal plane, 36 mm; mediolateral plane, 4.3 ± 0.7mm from the middle of the third ventricle; and depth,16.6 ± 1mm from the cortex surface); bilateral cannula used;

**Agents:** Ara-C  **Vehicle:** Serum, Physiological;  **Route:** CSF/CNS (lateral ventricle);  **Species:** Sheep;  **Pump:** 2ML4;  **Duration:** 4 weeks;
**ALZET Comments:** 4% Physiological Serum used; Controls received mp w/ vehicle; animal info (primiparous parturient Ile de France ewes (2–3 years old)); post op. care (amoxicillin, diurizone, finadyne, morphine); functionality of mp verified; Brain coordinates (rostrocaudal plane, 36 mm; mediolateral plane, 4.3 ± 0.7mm from the middle of the third ventricle; and depth,16.6 ± 1mm from the cortex surface); bilateral cannula used;

**Agents:** Dexamethasone 21-phosphate disodium salt  **Vehicle:** Not Stated;  **Route:** IV (lateral saphenous vein);  **Species:** Sheep (pregnant);  **Pump:** 2ML1;  **Duration:** 48 hours;
**ALZET Comments:** Dose (0.48 mg/h);

**Agents:** Rosiglitazone Maleate  
**Vehicle:** Water, Ethanol  
**Route:** SC  
**Species:** Sheep (pregnant)  
**Pump:** 2ML1  
**Duration:** 16 days;

**ALZET Comments:** animal info (Singleton pregnant sheep); functionality of mp verified by plasma level, amniotic fluid samples; 15% ethanol used; Multiple pumps per animal (4); stability verified by regular plasma level measurements (reached after day 5, tested through day 16; half life of 24-48 hours in sheep); Catheters flushed with heparinized saline; Dose (2.7 mg/fetus/d);


**Agents:** oligonucleotides, antisense morpholino  
**Vehicle:** PBS  
**Route:** Intrauterine  
**Species:** Sheep (ewe, pregnant)  
**Pump:** 2ML1  
**Duration:** 7 days;

**ALZET Comments:** Controls received mp w/ control oligonucleotides; animal info (female, Columbia Rambouillet); teratology; cyanoacrylate adhesive; used vinyl catheter tubing (0007760) to cannulate uterine lumen; pump affixed to mesosalpinx using cyanoacrylate glue;


**Agents:** Endotoxin, LPS  
**Vehicle:** Not Stated  
**Route:** Oral cavity  
**Species:** Sheep (ewe)  
**Pump:** Not Stated  
**Duration:** 1 day; 6 days;

**ALZET Comments:** Controls received mp w/ saline; animal info (Merino); teratology; immunology;


**Agents:** Melatonin; luzindole  
**Vehicle:** DMSO; water  
**Route:** Intrauterine  
**Species:** Sheep (ewe, pregnant)  
**Pump:** 2ML4  
**Duration:** 28 days;

**ALZET Comments:** Controls received mp w/ vehicle; animal info (female, Western white face, GD62); functionality of mp verified by serum levels; 45% DMSO used; good methods (pg 15); no stress (see pg. 15); post op. care (BID IM injection flunixin meglumine; QD IP injection Penicillin G Procaine); teratology; cardiovascular; used 20 cm of PE 60 tubing; pumps primed overnight 37C saline with catheters;


**Agents:** Oligonucleotide, antisense morpholino PPARD; oligonucleotide, antisense morpholino PPARG  
**Vehicle:** PBS  
**Route:** Intrauterine (uterine horn)  
**Species:** Sheep (ewe)  
**Pump:** 2ML1  
**Duration:** 7 days;

**ALZET Comments:** Controls received mp w/ control morpholino; animal info (Ovis aries, 7 days after mating); cyanoacrylate adhesive; used vinyl catheter tubing; pump glued to mesosalpinx and sutures; pumps primed in 37C sterile PBS for 24 hours;


**Agents:** Endotoxin, LPS  
**Vehicle:** Not Stated  
**Route:** Intra-amniotic  
**Species:** Sheep (fetus)  
**Pump:** Not Stated  
**Duration:** 24 hours;

**ALZET Comments:** Controls received mp w/ saline; animal info (124 gestation day); immunology;


**Agents:** Endotoxin, LPS  
**Vehicle:** Not Stated  
**Route:** Amniotic sac  
**Species:** Sheep (fetus)  
**Pump:** 2ML4  
**Duration:** 4 weeks;

**ALZET Comments:** Controls received mp w/ saline; animal info (female, pregnant, GD80); post op. care (benacillin); teratology; immunology; E.coli LPS 055:B5, 18 mg/ml;
**Agents:** Medetomidine **Vehicle:** Saline; **Route:** IP; **Species:** Sheep (pregnant); **Pump:** 2ML1; **Duration:** 7 days;
**ALZET Comments:** Animal info (female, Merino singleton, pregnant at GD118-121); functionality of mp verified by plasma levels; comparison of transdermal patch vs mp; behavioral testing (mechanical nociceptive threshold; thermal nociceptive threshold); pumps primed at 37°C overnight;

**Agents:** Rosiglitazone **Vehicle:** Ethanol; **Route:** SC; **Species:** Sheep (fetus); **Pump:** 2ML4; **Duration:** 14 days;
**ALZET Comments:** Controls received mp w/ vehicle; animal info (fetus, 123-126 days gestation); 15% ethanol used; cardiovascular;

**Agents:** U0126; serum protein, ovine; interferon tau, recombinant ovine **Vehicle:** DMSO; **Route:** Intrauterine (uterine horn); **Species:** Sheep (ewe); **Pump:** 2ML1; **Duration:** 6 days;
**ALZET Comments:** Controls received mp w/ vehicle; animal info (female, Suffolk Ovis aries); 3% DMSO used; tissue perfusion (uterine horn); cyanoacrylate adhesive; used cyanoacrylate glue to anchor pump; interferon tau aka IFNT;

**Agents:** Hydroxyvitamin D3, 1α- **Vehicle:** Not Stated; **Route:** SC; **Species:** Sheep (ewe); **Pump:** 2002; **Duration:** 6 days;
**ALZET Comments:** Animal info (merino, mature); functionality of mp verified by plasma 1,125-dihydroxycholecalciferol levels;

**Agents:** Oxytocin **Vehicle:** Not Stated; **Route:** Not Stated; **Species:** Sheep; **Pump:** Not Stated; **Duration:** 90 days;
**ALZET Comments:** Pumps replaced every 30 days; long-term study;