



**References on the Administration of Vitamins
Using ALZET® Osmotic Pumps**

RO-23-7553

P3719: B. W. Light, *et al.* Potentiation of cisplatin antitumor activity using a vitamin D analogue in a murine squamous cell carcinoma model system. *Cancer Res* 1997;57(3759-3764

ALZET Comments: RO-23-7553; PBS; IP; mice; 1007D; 7 days; controls received sham mp; cancer.

Vitamin A

Q8858: C. Huang, *et al.* Chronic retinoic acid treatment induces affective disorders by impairing the synaptic plasticity of the hippocampus. *Journal of Affective Disorders* 2020;274(678-689

Agents: Retinoic acid **Vehicle:** Saline; DMSO; **Route:** CSF/CNS (lateral ventricle); **Species:** Rat; **Duration:** 21 days;

ALZET Comments: Dose (20 µg/day); Controls received mp w/ vehicle; animal info (Adult male Wistar rats, 220–240 g); behavioral testing (Sucrose Preference Test, Open Field Test, Elevated Plus Maze Test, Tail Suspension Test, Forced Swim Test); Retinoic acid aka RA; ALZET brain infusion kit used; Brain coordinates (AP: 0.8 mm, ML: 1.5 mm, DV: 4.0 mm);

Q7860: N. Y. Ru, *et al.* Glycosylated CD147 reduces myocardial collagen cross-linking in cardiac hypertrophy. *J Cell Biochem* 2018;119(10):8022-8034

Agents: retinoic acid **Vehicle:** Saline; **Route:** SC; **Species:** Rat; **Pump:** 2001; **Duration:** 7 days;

ALZET Comments: Dose (5 mg/kg/day); Controls received mp w/ vehicle; animal info (male, Sprague-Dawley, 160-180g); Retinoic acid is an agonist of N-acetylglucosamine transferase V; cardiovascular;

P7250: T. Liu, *et al.* The retinoid anticancer signal: mechanisms of target gene regulation. *British Journal of Cancer* 2005;93(3):310-318

Agents: Retinoic acid, 13-cis- **Vehicle:** Ethanol; **Route:** SC; **Species:** Mice (transgenic); **Pump:** 1007D; **Duration:** 5 weeks;

ALZET Comments: Controls received mp w/ vehicle; dose-response (fig. 1); no stress (see pg. 312-13); cancer (neuroblastoma)

P7232: S. M. Karam, *et al.* Retinoic acid stimulates the dynamics of mouse gastric epithelial progenitors. *Stem Cells* 2005;23(3):433-441

Agents: Retinoic acid; Uridine, bromodeoxy- **Vehicle:** Not Stated; **Route:** SC; **Species:** Mice; **Duration:** 1, 3, 6 days;

ALZET Comments: Controls received mp w/ vehicle; comparison of SC injections vs. mp; cancer (gastric); pumps per animal (2)

P4739: R. D. Kopke, *et al.* Growth factor treatment enhances vestibular hair cell renewal and results in improved vestibular function. *PNAS* 2001;98(10):5886-5891

Agents: Transforming growth factor; insulin-like growth factor I; retinoic acid; brain-derived neurotrophic factor; **Vehicle:** PBS; BSA; **Route:** Ear (vestibule); **Species:** Guinea pig; **Pump:** 2002; **Duration:** 4 weeks;

ALZET Comments: Controls received mp w/ vehicle; pumps replaced after 2 weeks; peptides; IntraEAR catheter used; GFI group pumps filled with TGF, IGF and Retinoic acid; GFII group pumps filled with TGF, IGF, BDNF and retinoic acid;

R0148: D. Al Musawi, *et al.* Adhesion prevention: state of the art. *GYNAECOLOGICAL ENDOSCOPY* 2001;10(123-130

Agents: Dipyridamole; Lazaroids; Retinoic acid **Vehicle:** Not Stated; **Route:** Not Stated; **Species:** Not Stated;

ALZET Comments: Review of adhesion formation and prevention; used mp to evaluate new agents to reduce experimental pelvic adhesions (p. 125).

P4026: K. E. Rodgers, *et al.* Reduction of adhesion formation by intraperitoneal administration of various anti-inflammatory agents. *J. Invest. Surgery* 1998;11(327-339

Agents: Retinoic acid; Quinacrine; Dipyridamole **Vehicle:** PBS; Ethanol; **Route:** Injury site; **Species:** Rabbit; **Pump:** 2ML1; **Duration:** 1, 2, 3, 7 days;

ALZET Comments: Controls received mp w/vehicle; tissue perfusion (surgical injury site); animals given morphine i.m. for post-operative pain; catheter stabilized in sidewall w/suture; in some studies, catheter tubing was disconnected to halt flow at specific times; immunology



P3491: M. Kaya, *et al.* Chemical induction of fenestrae in vessels of the blood-brain barrier. *Experimental Neurology* 1996;142(6-13)

Agents: Retinoic acid; Phorbol myristate acetate **Vehicle:** ETHANOL; Gibco BRL minimal essential medium; DMSO; Culture medium, serum-free; **Route:** CSF/CNS (cortex); **Species:** Rat; **Pump:** 2ML1; **Duration:** 21, 28 days;

ALZET Comments: controls received mp w/ vehicle; functionality of mp verified by residual volume; pumps replaced weekly

Vitamin B12

Q4348: E. Mutti, *et al.* 4-ethylphenyl-cobalamin impairs tissue uptake of vitamin B12 and causes vitamin B12 deficiency in mice. *PLoS One* 2013;8(9):e75312

ALZET Comments: Vitamin b12; Cobalamin, ethylphenyl-; saline; SC; mice; 2004; 4 weeks; controls received mp w saline; animal info: 7 wks old, female, strain 129.S6; mp used to infuse EtPhCbl in mice to see if it causes Cbl (cobalamin) deficiency; EtPhCbl (3.5 nmol/24 h), CNCbl.

Q2430: D. L. Lildballe, *et al.* Maximal Load of the Vitamin B12 Transport System: A Study on Mice Treated for Four Weeks with High-Dose Vitamin B12 or Cobinamide. *PLoS One* 2012;7(10):U386-U392

ALZET Comments: Cobinamide; vitamin B12; Saline; SC; Mice; 2004; 27 days; Control animals received mp w/ vehicle; animal info (129.S6, 8 wks old, female); "To avoid wound biting between mice, the mice were housed in individual cages for 3 days after surgery."; post op. care (buprenorphine in the water); cobinamide is a vitamin B12 analogue.

P3776: T. Kiuchi, *et al.* Effect of vitamin B12 on the sleep-wake rhythm following an 8-hour advance of the light-dark cycle in the rat. *Physiol. Behav* 1997;61(4):551-554

ALZET Comments: Vitamin B12; IP; Rat; 2002; 15 days; controls received mp w/saline.

P1825: E. P. Brass, *et al.* Effect of hydroxycobalamin[c-lactam] on propionate and carnitine metabolism in the rat. *Biochem. J* 1990;226(809-815)

ALZET Comments: Vitamin B12 analog; SC; Rat; 2002; controls received pumps with saline only; pumps replaced after 3 weeks;

Vitamin B12 analog

P1825: E. P. Brass, *et al.* Effect of hydroxycobalamin[c-lactam] on propionate and carnitine metabolism in the rat. *Biochem. J* 1990;226(809-815)

ALZET Comments: Vitamin B12 analog; SC; Rat; 2002; no duration posted; controls received pumps with saline only; pumps replaced after three weeks; cobalamin analog.

Vitamin D

Q8466: G. Fernandez Lahore, *et al.* Vitamin D3 receptor polymorphisms regulate T cells and T cell-dependent inflammatory diseases. *Proceedings of the National Academy of Sciences of the United States of America* 2020;117(40):24986-24997

Agents: Vitamin D3 **Vehicle:** Propylene, glycol; **Route:** SC; **Species:** Mice; **Pump:** Not stated; **Duration:** 1 day;

ALZET Comments: Dose (1000 IU/kg); Controls received mp w/ vehicle; animal info (QB Mice, 10 weeks old); immunology;

Q7891: I. Kaneko, *et al.* Eldecalcitol Causes FGF23 Resistance for Pi Reabsorption and Improves Rachitic Bone Phenotypes in the Male Hyp Mouse. *Endocrinology* 2018;159(7):2741-2758

Agents: 1 α ,25-dihydroxyvitamin D; **Vehicle:** Not Stated; **Route:** SC; **Species:** Mice; **Pump:** Not Stated; **Duration:** 3 weeks;

ALZET Comments: animal info (137 day old, C57BL/6J); 1 α ,25-dihydroxyvitamin D; aka 1, 25D; dependence;

Q5205: Stephanie R. Sisley, *et al.* Hypothalamic Vitamin D Improves Glucose Homeostasis and Reduces Weight. *Diabetes* 2016;1-35

Agents: Vitamin D3, 1,25-dyhydroxy **Vehicle:** Cyclodextrin; hydroxypropyl-B-; **Route:** CSF/CNS (third ventricle); **Species:** Rat; **Pump:** 1004; **Duration:** 28 days;

ALZET Comments: Controls received mp w/ vehicle; animal info (male, Long Evans, adult); dose-response (Supplementary Figure 3); obesity; Dose (-.264 ug/day); Brain coordinates (i3vt 2.2A/P, 7.8D/V);



Q5398: D. Ovejero, *et al.* 1,25-Dihydroxyvitamin D as Monotherapy for XLH: Back to the Future? *J Bone Miner Res* 2016;31(5):925-8

Agents: Vitamin D, 1,25-Dihydroxy- **Vehicle:** Not Stated; **Route:** Not Stated; **Species:** Mice; **Pump:** Not Stated; **Duration:** 4 weeks;

ALZET Comments: animal info (Hyp mice); "In contrast, Alzet minipump infusion of 1,25D into Hyp mice for 4 weeks after weaning, along with a diet rich in phosphate, normalizes the growth plate and dramatically improves osteoid thickness" pg 936; Oral vs. minipump (pg. 936);

Q3925: M. L. Hyde, *et al.* In vivo measurement of the absorption of strontium in the rumen and small intestine of sheep as an index of calcium absorption capacity. *British Journal of Oral and Maxillofacial Surgery* 2014;112(7):718-724

Agents: Hydroxyvitamin D3, 1 α - **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 1,25-dihydroxycholecalciferol levels;

Q3900: S. K. Halder, *et al.* Paricalcitol, a Vitamin D Receptor Activator, Inhibits Tumor Formation in a Murine Model of Uterine Fibroids. *REPRODUCTIVE SCIENCES* 2014;21(11):108-1119

Agents: Vitamin D3, 1,25-dihydroxy **Vehicle:** PEG; ethanol; **Route:** SC; **Species:** Mice (nude); **Pump:** Not Stated; **Duration:** 28 days;

ALZET Comments: Controls received mp w/ vehicle; animal info (female, athymic, nude, 5-6 weeks old); 95% PEG used; 5% ethanol used; cancer (uterine fibroid tumor);

Q4711: T. Chaichanasakul, *et al.* Diverse Osteoclastogenesis of Bone Marrow From Mandible Versus Long Bone 1116. *JOURNAL OF PERIODONTOLOGY* 2014;85(8):829-836

Agents: Parathyroid hormone (1-34), human; vitamin D3, 1,25-dihydroxy **Route:** SC; **Species:** Rat; **Duration:** 3 days;

ALZET Comments: Controls received mp w/ vehicle; animal info (male, Sprague Dawley, 3 months old);

Q2055: S. K. Halder, *et al.* 1,25-Dihydroxyvitamin D3 Treatment Shrinks Uterine Leiomyoma Tumors in the Eker Rat Model. *Biology of Reproduction* 2012;86(4):U41-U50

Agents: Vitamin D3, 1,25-dihydroxy **Vehicle:** Ethylene glycol; **Route:** SC; **Species:** Rat; **Pump:** Not Stated; **Duration:** 3 weeks;

ALZET Comments: Controls received mp w/ vehicle; animal info (female, Eker, 14-16 wks old); functionality of mp verified via serum drug levels; cancer (uterine leiomyomas)

Q0314: M. S. K. Wong, *et al.* Chronic treatment with vitamin D lowers arterial blood pressure and reduces endothelium-dependent contractions in the aorta of the spontaneously hypertensive rat. *American Journal of Physiology Heart and Circulatory Physiology* 2010;299(4):H1226-H1234

Agents: Vitamin D3, 1,25-dihydroxy- **Vehicle:** Not Stated; **Route:** SC; **Species:** Rat; **Pump:** 2006; **Duration:** 6 weeks;

ALZET Comments: Animal info (adult, SHR, WKY, 36 wk old); long-term study

Q1190: M. Lamblin, *et al.* Vitamin D receptor agonist/histone deacetylase inhibitor molecular hybrids. *Biometals* 2010;18(11):4119-4137

Agents: Vitamin D, 1 α 25-dihydroxy; Vitamin D hybrid, 1 α 25-dihydroxy **Vehicle:** Not Stated; **Route:** Not Stated;

Species: Mice; **Pump:** Not Stated; **Duration:** 6-7 days;

ALZET Comments: Animal info (female, virgin, FVB, 8 wks old); cancer; enzyme inhibitor (histone deacetylase, HDAC)

P8554: G. Mailhot, *et al.* Endocrine and bone consequences of cyclic nutritional changes in the calcium, phosphate and vitamin D status in the rat: An in vivo depletion-repletion-redepletion study. *Bone* 2007;41(3):422-436

Agents: Vitamin D3 **Vehicle:** Not Stated; **Route:** IP; **Species:** Rat; **Pump:** Not Stated; **Duration:** 14 days;

ALZET Comments: No stress (see pg. 425, 432); animal info (male, Sprague-Dawley, 7 weeks old)

P8289: W. Banach-Petrosky, *et al.* Vitamin D inhibits the formation of prostatic intraepithelial neoplasia in Nkx3.1; Pten mutant mice. *Clinical Cancer Research* 2006;12(19):5895-5901

Agents: Vitamin D3, 1,25-dihydroxy- **Vehicle:** Propylene glycol; **Route:** SC; **Species:** Mice; **Pump:** 2004; **Duration:** 1,4 months;

ALZET Comments: Controls received mp w/ vehicle; long-term study; pumps replaced every 4 weeks; stability verified by serum calcium levels; cancer (prostate); animal info (4-7 months old, male)



P7307: K. Nakagawa, *et al.* 22-oxa-1alpha,25-dihydroxyvitamin D₃ inhibits metastasis and angiogenesis in lung cancer. *Carcinogenesis: Integrative Cancer Research* 2005;26(6):1044-1054

Agents: Vitamin D3, 1, 25-dihydroxy-; vitamin D3, 22-oxa-1a, 25-dihydroxy- **Vehicle:** Tween 20; Ethanol; **Route:** SC; **Species:** Mice; **Pump:** 2ML4; **Duration:** 3 weeks; 10, 18 days;

ALZET Comments: Controls received mp w/ vehicle; dose-response; cancer (lung carcinoma); 10% ethanol;

P7170: G. Duque, *et al.* 1,25(OH)₂D₃ acts as a bone-forming agent in the hormone-independent senescence-accelerated mouse (SAM-P/6). *American Journal of Physiology Endocrinology and Metabolism* 2005;288(4):E723-E730

Agents: Vitamin D3, 1, 25-dihydroxy- **Vehicle:** Not Stated; **Route:** Not Stated; **Species:** Mice; **Duration:** 6 weeks;

ALZET Comments: Controls received mp w/ vehicle; pumps replaced after 3 weeks, no stress (see pg. E728)

P6832: R. Narayanan, *et al.* Differential skeletal responses of hindlimb unloaded rats on a vitamin D-deficient diet to 1,25-dihydroxyvitamin D₃ and its analog, seocalcitol (EB1089). *Bone* 2004;35(1):134-143

Agents: Vitamin D3, 1,25-dihydroxy; EB 1089 **Vehicle:** Polypropylene glycol; sodium phosphate; **Route:** SC; **Species:** Rat; **Duration:** 28 days;

ALZET Comments: Controls received mp w/ vehicle; functionality of mp verified by plasma 25(OH)-D and 1,25-D levels; stress/adverse reaction: (see pg. 137) 5 animals died due to anesthesia complications and to tail irritation and diarrhea

P6206: G. Duque, *et al.* Vitamin D treatment of senescence accelerated mice (SAM-P/6) induces several regulators of stromal cell plasticity. *Bioelectromagnetics* 2004;5(6):421-429

Agents: Vitamin D3, 1,25-dihydroxy- **Vehicle:** Not Stated; **Route:** Not Stated; **Species:** Mice; **Pump:** 2004; **Duration:** 6 weeks;

ALZET Comments: Controls received mp w/ vehicle; pumps replaced after 3 weeks

P5867: C. Theodoropoulos, *et al.* High sensitivity of rat hepatic vitamin D-3-25 hydroxylase CYP27A to 1,25-dihydroxyvitamin D-3 administration. *American Journal of Physiology Endocrinology and Metabolism* 2003;284(1):E138-E147

Agents: Vitamin D3, 1,25-dihydroxy-; vitamin D3, 25-dihydroxy- **Route:** IP; **Species:** Rat; **Duration:** 1,3,5,7 days;

ALZET Comments: Functionality of mp verified by serum levels (p. E140); dose-response (p. E140); pump model not stated

P5121: M. Thierry-Palmer, *et al.* Plasma 24,25-dihydroxyvitamin D concentration of Dahl salt-sensitive rats decreases during high salt intake. *Journal of Steroid Biochemistry and Molecular Biology* 2002;80(3):315-321

Agents: Vitamin D3, 24,25-dihydroxy-; Vitamin D3, 25-hydroxy- **Vehicle:** Propylene glycol; Ethanol; **Route:** SC; **Species:** Rat; **Pump:** Not Stated; **Duration:** Up to 28 days;

ALZET Comments: Controls received mp w/ vehicle; functionality of mp verified by plasma levels; vehicle was 95% PG with 5% ETOH

P6248: K. Rummens, *et al.* Vitamin D deficiency in guinea pigs: Exacerbation of bone phenotype during pregnancy and disturbed fetal mineralization, with recovery by 1, 25(OH)(2)D-3 infusion or dietary calcium-phosphate supplementation. *Calcified Tissue International* 2002;71(4):364-375

Agents: Vitamin D3, 1,25-dihydroxy- **Vehicle:** Not Stated; **Route:** SC; **Species:** Guinea pig; **Pump:** 2ML4; **Duration:** 4 weeks;

ALZET Comments:

P6660: D. C. Huang, *et al.* Targeted disruption of the 25-hydroxyvitamin D₃ 1 alpha-hydroxylase gene in *ras*-transformed keratinocytes demonstrates that locally produced 1 alpha,25-dihydroxyvitamin D₃ suppresses growth and induces differentiation in an autocrine fashion. *Molecular Cancer Research* 2002;1(1):56-67

Agents: Vitamin D3, 25-hydroxy- **Vehicle:** Not Stated; **Route:** SC; **Species:** Mice (SCID); **Duration:** 5.5 weeks;

ALZET Comments: Controls received mp w/ vehicle or agent with no tumor; functionality of mp verified by 25-OHD₃ plasma levels; no stress (see pg. 11 and fig.7); cancer (squamous carcinoma)

P5058: R. Gill, *et al.* Regulation of rat ileal NHE3 by 1,25(OH)(2)-vitamin D-3. *Digestive Diseases and Sciences* 2002;47(5):1169-1174

Agents: Vitamin D3, 1, 25-dihydroxy- **Vehicle:** Not Stated; **Route:** SC; **Species:** Rat; **Pump:** 2001; **Duration:** 7 days;

ALZET Comments: controls received mp w/ vehicle; functionality of mp verified by serum Vitamin D3 levels; streptozotocin induced diabetes, p. 1170



Q7708: V. Panichi, *et al.* Effects of 1,25(OH)2D3 in experimental mesangial proliferative nephritis in rats. *Kidney Int* 2001;60(1):87-95

Agents: 1,25-Dihydroxyvitamin D3 **Vehicle:** Saline; **Route:** SC; **Species:** Rat; **Pump:** Not Stated; **Duration:** 14 days;
ALZET Comments: Dose (25 ng/100g wt/day); Controls received mp w/ vehicle; animal info (Female, 8 week old, Wistar, 160-200 g); 1,25-Dihydroxyvitamin D3 aka 1,25(OH)2D3; enzyme inhibitor (Monocyte-derived cytokine inhibitor); dependence;

P4614: I. V. Silva, *et al.* PTH regulates expression of ClC-5 chloride channel in the kidney. *American Journal of Physiology Renal Physiology* 2000;278(F238-F245)

Agents: Vitamin D; Parathyroid hormone (1-34) **Vehicle:** Ringer's solution; **Route:** SC; **Species:** Rat (pregnant); **Pump:** 1003D;;
Duration: 3 days;

ALZET Comments: Controls received mp w/vehicle + sham operation; replacement therapy (thyroparathyroidectomy); peptides

P4691: G. Mailhot, *et al.* Influence of the *in vivo* calcium status on cellular calcium homeostasis and the level of the calcium-binding protein calreticulin in rat hepatocytes. *Endocrinology* 2000;141(3):891-900

Agents: Vitamin D **Vehicle:** Not Stated; **Route:** Not Stated; **Species:** Rat; **Pump:** Not Stated; **Duration:** 1 week;

ALZET Comments:

P4476: L. Xue, *et al.* Influence of dietary calcium and vitamin D on diet-induced epithelial cell hyperproliferation in mice. *J. Natl. Cancer Inst* 1999;91(176-181)

Agents: Vitamin D; uridine, bromodeoxy- **Vehicle:** Not Stated; **Route:** SC;; **Species:** Mice; **Pump:** 1003D; **Duration:** 3 days;

ALZET Comments: Cancer

P3992: A. W. Saxe, *et al.* Effect of chronic vitamin D infusion upon *in vivo* glucose disposal. *Calcified Tissue International* 1999;64(248-251)

Agents: Vitamin D **Vehicle:** Propylene glycol; Ethanol; **Route:** SC; **Species:** Rat; **Pump:** 2001; **Duration:** 5 days;

ALZET Comments: controls received mp w/vehicle

P3929: M. G. Tordoff, *et al.* Calcium intake by rats: influence of parathyroid hormone, calcitonin, and 1,25-dihydroxyvitamin D. *American Journal of Physiology Regulatory, Integrative, and Comparable Physiology* 1998;274(43):R214-R231

Agents: Parathyroid hormone; Calcitonin; Vitamin D, 1,25-dihydroxy- **Vehicle:** NaCl; HCl; Cysteine; Saline, isotonic; **Route:** SC; **Species:** Rat; **Pump:** 2002; **Duration:** 13 days;

ALZET Comments: controls received sham tubing; functionality of mp verified by hormone assays; replacement therapy (thyroidectomy, thyroparathyroidectomy); dose-response; stress/adverse reaction: high doses led to animal death; peptides; agents given singly and in combination

P3994: A. Sela-Brown, *et al.* Calreticulin inhibits vitamin D's action on the PTH gene *in vitro* and may prevent vitamin D's effect *in vivo* in hypocalcemic rats. *Molec. Endocrinol* 1998;12(8):1193-1200

Agents: Vitamin D3, 1,25-dihydroxy- **Vehicle:** Propylene glycol; **Route:** SC; **Species:** Rat; **Pump:** Not Stated; **Duration:** 7 days;

ALZET Comments: controls received mp w/vehicle

P3993: U. Schwarz, *et al.* Effect of 1,25 (OH)2 vitamin D3 on glomerulosclerosis in subtotaly nephrectomized rats. *Kidney Int* 1998;53(1696-1705)

Agents: Vitamin D3, 1,25-dihydroxy- **Vehicle:** Ethanol; **Route:** Not Stated; **Species:** Rat; **Pump:** 2ML4; **Duration:** Not Stated;

ALZET Comments: Controls received mp w/vehicle

P3606: H. Tsuji, *et al.* Abnormal modulation of serum osteocalcin by dietary phosphate and 1,25-dihydroxyvitamin D3 in the hypophosphatemic mouse. *J. Bone and Min. Res* 1996;11(9):1234-1240

Agents: Parathyroid hormone; Vitamin D3, 1,25-dihydroxy- **Vehicle:** Propylene glycol; Saline; Cysteine; **Route:** SC; **Species:** Mice; **Pump:** 2001; **Duration:** 3,14 days;

ALZET Comments: Controls received mp w/ vehicle; peptides



- P3621:** J. R. Stabel, *et al.* Low calcium diet and 1,25-dihydroxyvitamin D(3) infusion modulate immune responses during mycobacterium paratuberculosis infection in beige mice. *Vet. Immunology and Immunopathology* 1996;50(127-143)
Agents: Vitamin D3, 1,25-dihydroxy- **Vehicle:** Not Stated; **Route:** SC; **Species:** Mice; **Pump:** Not Stated; **Duration:** Not Stated;
ALZET Comments: Functionality of mp verified by plasma levels; immunology
- P3991:** J. R. Stabel, *et al.* Influence of vitamin D3 infusion and dietary calcium on secretion of interleukin 1, interleukin 6 and tumor necrosis factor in mice infected with Mycobacterium paratuberculosis. *American Journal of Veterinary Research* 1996;57(6):825-829
Agents: Vitamin D3, 1,25-dihydroxy- **Vehicle:** Not Stated; **Route:** SC; **Species:** Mice; **Pump:** Not Stated; **Duration:** 14 days;
ALZET Comments: Immunology
- P2853:** K. V. Rogers, *et al.* Calcium receptor messenger ribonucleic acid levels in the parathyroid glands and kidney of vitamin D-deficient rats are not regulated by plasma calcium or 1,25-dihydroxyvitamin D3. *Endocrinology* 1995;136(2):499-504
Agents: Calcium chloride; Vitamin D3, 1,25-dihydroxy- **Vehicle:** Propylene glycol; Ethanol; **Route:** SC; IV (inferior vena cava);
Species: Rat; **Pump:** 2002; 2ML1; **Duration:** 7 days;
ALZET Comments: no comment posted
- P3281:** R. A. Meyer, *et al.* Response of jejunal phosphate absorption to 1,25-dihydroxyvitamin D3 stimulation in vivo in young X-linked hypophosphatemic (Hyp) mice. *Endocrine* 1995;3(209-214)
Agents: Vitamin D3, 1,25-dihydroxy **Vehicle:** Propanediol, 1,2; **Route:** SC; **Species:** Mice; **Pump:** 2001; **Duration:** 4 days;
ALZET Comments: Normal and Hyp mice used
- P3541:** B. Ecarot, *et al.* Effect of 1,25-dihydroxyvitamin D3 treatment on bone formation by transplanted cells from normal and X-linked hypophosphatemic mice. *J. Bone and Min. Res* 1995;10(3):424-431
Agents: Vitamin D3, 1,25-dihydroxy-; Vitamin D3, 24,25-dihydroxy- **Vehicle:** Propylene glycol; **Route:** SC; **Species:** Mice;
Pump: 2001; 2002; **Duration:** 17 days;
ALZET Comments: Pumps replaced at day 6; vitamins given singly and together
- P3198:** D. C. Hatton, *et al.* 1,25(OH)₂ Vitamin D3-induced alterations in vascular reactivity in the spontaneously hypertensive rat. *Am. J. Med. Sci* 1994;307(Sup 1):S154-S158
Agents: Vitamin D3, 1,25-dihydroxy- **Vehicle:** Not Stated; **Route:** SC; **Species:** Rat; **Pump:** 2001; **Duration:** 7 days;
ALZET Comments: controls received mp with vehicle; comparison of daily sc injections vs. mp
- P3142:** A. Uhland-Smith, *et al.* The necessity for calcium for increased renal vitamin D receptor in response to 1,25-dihydroxyvitamin D. *Biochimica et Biophysica Acta (BBA) - Molecular Cell Research* 1993;1176(321-326)
Agents: Vitamin D3, 1,25-dihydroxy- **Vehicle:** Not Stated; **Route:** SC; **Species:** Rat; **Pump:** 2002; **Duration:** 4,8 weeks;
ALZET Comments: comparison of oral vitamin D-3 vs. mp; long-term study, pumps replaced after 2 weeks
- P3576:** M. G. Tordoff, *et al.* Independence of salt intake from the hormones regulating calcium homeostasis. *American Journal of Physiology Regulatory, Integrative, and Comparable Physiology* 1993;264(R500-R512)
Agents: Parathyroid hormone, bovine; Vitamin D3, 1,25-dihydroxy- **Vehicle:** Propylene glycol; **Route:** SC; **Species:** Rat; **Pump:** 2001; 2002; **Duration:** 1, 2 weeks;
ALZET Comments: replacement therapy (thyroparathyroidectomy)
- P2142:** T. Shimosawa, *et al.* Enhancement of vasoconstrictor response by a noncalcemic analogue of vitamin D3. *Hypertension* 1993;21(2):253-258
Agents: Oxacalcitriol, 22-; Vitamin D3, 24,25-dihydroxy-; Vitamin D3, 1,25-dihydroxy- **Vehicle:** Propylene glycol; **Route:** SC;
Species: Rat; **Pump:** 2002; **Duration:** 14 days;
ALZET Comments: no comment posted



P2886: H. Reichel, *et al.* Intermittent versus continuous administration of 1,25-dihydroxyvitamin D3 in experimental renal hyperparathyroidism. *Kidney Int* 1993;44(1259-1265

Agents: Vitamin D3, 1,25-dihydroxy- **Vehicle:** Propylene glycol; **Route:** SC; **Species:** Rat; **Pump:** 2001; **Duration:** 6 days; **ALZET Comments:** functionality of mp verified by residual volume, radioactive tracing and serum levels; comparison of i.p. injections vs. mp

P2664: A. J. Brown, *et al.* The mechanism for the disparate actions of calcitriol and 22-oxacalcitriol in the intestine. *Endocrinology* 1993;133(3):1158-1164

Agents: Oxacalcitriol, 22-; Vitamin D3, 1,25-dihydroxy- **Vehicle:** Propylene glycol; **Route:** SC; **Species:** Rat; **Pump:** 2002; **Duration:** 3 days;

ALZET Comments: controls received mp w/ vehicle; comparison of ip injections vs. mp; agent is 1,25-(OH)2D3

P2280: J. P. Goff, *et al.* Effect of dietary calcium or phosphorus restriction and 1,25-dihydroxyvitamin D administration on rat intestinal 24-hydroxylase. *Endocrinology* 1992;131(1):101-104

Agents: Vitamin D, 1,25-dihydroxy- **Vehicle:** Not Stated; **Route:** SC; **Species:** Rat; **Pump:** Not Stated; **Duration:** 3,7 days;

ALZET Comments: comparison of ip injections vs mp

P2073: J. Fox, *et al.* Normal plasma calcium, phosphate, and parathyroid hormone levels during 1,25(OH)2D3 infusions in rats. *American Journal of Physiology Endocrinology and Metabolism* 1992;262(E126-E129

Agents: Vitamin D3, 1,25-dihydroxy- **Vehicle:** Ethanol; Propylene glycol; **Route:** SC; **Species:** Rat; **Pump:** 2002; **Duration:** 10 days;

ALZET Comments: dose-response graphs (pp. E127-E128); infusion of D3 represents a better approach over injections for determining the physiology of tissue D3 responsiveness

P1759: B. Stein, *et al.* Cyclosporin-A increases synthesis of 1,25-dihydroxyvitamin D3 in the rat and mouse. *Endocrinology* 1991;128(3):1369-1373

Agents: Vitamin D3, 1,25-dihydroxy- **Vehicle:** Radio-isotopes; **Route:** SC; **Species:** Rat; **Pump:** 2002; **Duration:** Not Stated;

ALZET Comments: Not Stated

P1850: J. M. Lemire, *et al.* 1,25-dihydroxyvitamin D3 prevents the in vivo induction of murine experimental autoimmune encephalomyelitis. *J. Clin. Invest* 1991;87(1103-1107

Agents: Vitamin D3, 1,25-dihydroxy- **Vehicle:** Not Stated; **Route:** SC; **Species:** Mice; **Pump:** 2001; **Duration:** Not Stated;

ALZET Comments: no comment posted

P1761: G. A. Davidai, *et al.* Variable phosphate-mediated regulation of vitamin D metabolism in the murine hypophosphatemic rachitic/osteomalacic disorders. *Endocrinology* 1991;128(3):1270-1276

Agents: Vitamin D3, 1,25-dihydroxy- **Vehicle:** Propylene glycol; **Species:** Mice; **Pump:** 2001; **Duration:** 48 hours;

ALZET Comments: no comment posted

P1700: T. A. Reinhardt, *et al.* Parathyroid hormone down-regulates 1,25-dihydroxyvitamin D receptors (VDR) and VDR messenger ribonucleic acid in vitro and blocks homologous up-regulation of VDR in vivo. *Endocrinology* 1990;127(2):942-948

Agents: Parathyroid hormone; Vitamin D3, 1,25-dihydroxy- **Vehicle:** Cysteine; Ethanol; HCl; Propylene glycol; Saline; **Route:** Not Stated; **Species:** Rat; **Pump:** Not Stated; **Duration:** 5 days;

ALZET Comments: controls received pumps with saline only; peptides; PTH and vit. D infused separately and concurrently

P1393: H. Yamato, *et al.* Effect of 24,25-dihydroxyvitamin D3 on 1,25-dihydroxyvitamin D3 [1,25-(OH)2D3] metabolism in vitamin D-deficient rats infused with 1,25-(OH)2D3. *Endocrinology* 1989;124(1):511-517

Agents: Vitamin D3, 1,25-dihydroxy- **Vehicle:** Propylene glycol; **Route:** SC; **Species:** Rat; **Pump:** 2002; **Duration:** 7, 10 days;

ALZET Comments: dose-response (serum levels); half-life; functionality of mp verified by serum levels

P1540: A. Szabo, *et al.* 1,25(OH)2 vitamin D3 inhibits parathyroid cell proliferation in experimental uremia. *Kidney Int* 1989;35(1049-1056

Agents: Vitamin D3, 1,25-dihydroxy- **Vehicle:** Propanol; **Route:** IP; **Species:** Rat; **Pump:** Not Stated; **Duration:** Not Stated;

ALZET Comments: Comparison of IP injections vs. mp infusion



P1656: S. Patel, *et al.* Effect of vitamin D metabolites on calcitriol metabolism in experimental renal failure. *Kidney Int* 1989;36(234-239)

Agents: Calcitriol; Vitamin D3, 1,25-dihydroxy- **Vehicle:** Ethanol; Propylene glycol; **Route:** SC; **Species:** Rat; **Pump:** 2001; **Duration:** 1 week;

ALZET Comments: functionality of mp verified by measuring residual volume

P1576: Y. Naito, *et al.* Effects of continuous administration of 1,25-dihydroxyvitamin D3 on plasma minerals and unoccupied colon mucosal 1,25-dihydroxyvitamin D3 receptor concentrations. *J. Dairy Sci* 1989;72(2936-2941)

Agents: Vitamin D3, 1,25-dihydroxy- **Vehicle:** Propylene glycol; **Route:** SC; **Species:** Cattle; **Pump:** 2ML1; **Duration:** 7 days;

ALZET Comments: functionality of mp verified by measuring plasma vit. D levels; discusses comparison of IM injections vs. mp; states pump effectively maintained plasma conc. throughout (p. 2939), states conc. achieved via pump may improve vit. D3 therapy for preventing p

P1588: R. L. Horst, *et al.* Advancing age results in reduction of intestinal and bone 1,25-dihydroxyvitamin D receptor. *Endocrinology* 1989;126(2):1053-1057

Agents: Vitamin D3, 1,25-dihydroxy- **Vehicle:** Ethanol; Propylene glycol; **Route:** Not Stated; **Species:** Rat; **Pump:** 2001; **Duration:** 6 days;

ALZET Comments: no comment posted

P1515: M. H. Meyer, *et al.* Increased intestinal absorption of calcium in young and adult X-linked hypophosphatemic mice after the administration of 1,25-dihydroxyvitamin D3. *J. Bone and Min. Res* 1988;3(2):151-157

Agents: Vitamin D3, 1,25-dihydroxy- **Vehicle:** Propanediol, 1,2-; **Route:** SC; **Species:** Mice; **Pump:** 2001; **Duration:** 3 days;

ALZET Comments: No comment posted

P1401: R. A. Meyer, *et al.* Evidence that low plasma 1,25-dihydroxyvitamin D causes intestinal malabsorption of calcium and phosphate in juvenile X-linked hypophosphatemic mice. *J. Bone and Min. Res* 1987;2(1):67-82

Agents: Vitamin D3, 1,25-dihydroxy- **Vehicle:** Propanediol, 1,2-; **Route:** SC; **Species:** Mice; **Pump:** 2001; **Duration:** 3 days;

ALZET Comments: Dose-response; functionality of mp verified by plasma levels

P1089: P. Haddad, *et al.* Influence of the vitamin D hormonal status on the hepatic response to bromobenzene. *J. Pharmacol. Exp. Ther* 1987;242(1):354-363

Agents: Vitamin D3, 1,25-dihydroxy- **Vehicle:** Ethanol; Propylene glycol; Saline; **Route:** IP; **Species:** Rat; **Pump:** 2001; **Duration:** 8 days;

ALZET Comments: controls received mp w/vehicle

P8175: M. R. Clements, *et al.* A new mechanism for induced vitamin D deficiency in calcium deprivation. *Letters to Nature* 1987;325(6099):62-65

Agents: Vitamin D, 1,25-dihydroxy- **Vehicle:** Not Stated; **Route:** SC; **Species:** Rat; **Pump:** Not Stated; **Duration:** Not Stated;

ALZET Comments: Animal info (male, Norwegian hooded)

P1058: M. E. Bruns, *et al.* Vitamin D-dependent calcium binding proteins in the kidney and intestine of the X-linked hypophosphatemic mouse: Changes with age and responses to 1,25-dihydroxycholecalciferol. *Endocrine Society* 1987;121(1-6)

Agents: Vitamin D3, 1,25-dihydroxy- **Vehicle:** Propylene glycol; **Route:** SC; **Species:** Mice; **Pump:** 2001; **Duration:** 3 days;

ALZET Comments: Controls received mp w/vehicle; mice were hypophosphatemic

P0927: T. J. Wronski, *et al.* Chronic administration of 1,25-dihydroxyvitamin D3: Increased bone but impaired mineralization. *Endocrinology* 1986;119(6):2580-2585

Agents: Vitamin D3, 1,25-dihydroxy- **Vehicle:** Ethanol; Propylene glycol; **Route:** SC; **Species:** Rat; **Pump:** 2002; **Duration:** 13 days;

ALZET Comments: controls received mp w/vehicle



- P0779:** J. Sonnenberg, *et al.* 1,25-dihydroxyvitamin d3 treatment results in increased choline acetyltransferase activity in specific brain nuclei. *Endocrinology* 1986;118(4):1433-1439
Agents: Calcium chloride; Vitamin D3, 1,25-dihydroxy- **Vehicle:** Propylene glycol; Saline; **Route:** CSF/CNS; **Species:** Rat; **Pump:** 2001; **Duration:** 7 days;
ALZET Comments: mp connected to cannula in 3rd ventricle and implanted sc; vitamin d3 administered ip in combination w/mp infusion; controls received mp w/appropriate vehicle; agents administered separately
- P2521:** G. K. Potter, *et al.* Response to an active vitamin D3 metabolite of transplantable human myeloid leukemic cell lines in adult nude mice. In 'Experimental Hematology Today--1985,' S. J. Baum, D. H. Pluznick, and L. A. Rozenszajn (eds.), Springer-Verlag New York, Inc 1986;106-113
Agents: Vitamin D3 metabolites **Vehicle:** Propylene glycol; **Route:** SC; **Species:** Mice; **Pump:** 2002; **Duration:** Not Stated;
ALZET Comments: Not Stated
- P0781:** T. Nesbitt, *et al.* Abnormal parathyroid hormone stimulation of 25-hydroxyvitamin d-1a-hydroxylase activity in the hypophosphatemic mouse. *J. Clin. Invest* 1986;77(1):181-187
Agents: Parathyroid hormone, bovine; Vitamin D3, 1,25-dihydroxy- **Vehicle:** Cysteine HCl; Propylene glycol; Saline; **Route:** SC; **Species:** Mice; **Pump:** 2001; **Duration:** 48 hours;
ALZET Comments: mp primed in saline 24 hrs prior to implant; controls received sham pumps; dose-response (plasma levels & kidney conc.); agents infused separately; advantages of mp infusion (see pg. 185); peptides
- P0921:** J. R. Jobin, *et al.* Compensatory renal growth: Modulation by calcium PTH and 1,25-(OH)2D3. *Kidney Int* 1986;29(1124-1130)
Agents: Parathyroid hormone, bovine; Vitamin D3, 1,25-dihydroxy- **Vehicle:** Acetic acid; Albumin; Ethanol; Propylene glycol; Saline; **Route:** IP; **Species:** Rat; **Pump:** 2001; **Duration:** 3 days;
ALZET Comments: 4 doses of agents infused; replacement therapy (thyroparathyroidectomy); peptides
- P0777:** B. P. Halloran, *et al.* The role of 1,25-dihydroxyvitamin D in the inhibition of bone formation induced by skeletal unloading. *Endocrinology* 1986;118(3):948-954
Agents: Vitamin D3, 1,25-dihydroxy- **Vehicle:** Ethanol; Propylene glycol; **Route:** SC; **Species:** Rat; **Pump:** 2002; **Duration:** 2wks
ALZET Comments: dose-response (serum conc.)
- P0893:** B. P. Halloran, *et al.* Chronic 1,25-dihydroxyvitamin D3 administration in the rat reduces the serum concentration of 25-hydroxyvitamin D by increasing metabolic clearance rate. *J. Clin. Invest* 1986;78(622-628)
Agents: Radio-isotopes; Vitamin D3, 1,25-dihydroxy- **Vehicle:** 3H tracer; Ethanol; Propylene glycol; **Route:** SC; **Species:** Rat; **Pump:** 2002; **Duration:** 3, 7, 12 days;
ALZET Comments: metabolic clearance rate measured by mp infusion of labelled Vit. D3, see ref. 15 & 16
- P0734:** G. K. Potter, *et al.* Action of 1,25-(OH)2D3 in nude mice bearing transplantable human myelogenous leukemic cell lines. *Experimental Hematology* 1985;13(722-732)
Agents: Vitamin D3, 1,25-dihydroxy- **Vehicle:** Propylene glycol; **Route:** SC; **Species:** Mice (nude); **Pump:** 2001; **Duration:** 70 days;
ALZET Comments: mp replaced periodically; long-term study; comparison of various agents iv vs. mp infusion;
- P0646:** P. J. Marie, *et al.* Contrasting effects of 1,25-dihydroxyvitamin D3 on bone matrix and mineral appositional rates in the mouse. *Metabolism* 1985;34(8):777-783
Agents: Vitamin D3, 1,25-dihydroxy- **Vehicle:** Propylene glycol; **Route:** SC; **Species:** Mice; **Duration:** 1 week;
ALZET Comments: 3 doses of Vit D3 given; dose-response data
- P0434:** R. Brommage, *et al.* 1,25-Dihydroxyvitamin D3 normalizes maternal food consumption and pup growth in rats. *American Journal of Physiology Endocrinology and Metabolism* 1984;246(E227-E231)
Agents: Vitamin D3, 1,25-dihydroxy- **Vehicle:** Ethanol; Propylene glycol; **Route:** SC; **Species:** Rat; **Pump:** 2002; **Duration:** 17d
ALZET Comments: comparison of single ip injection vs. mp infusion; mp coated w/ Panalog ointment to reduce risk of infection



P0357: P. J. Marie, *et al.* Continuous infusion of 1,25-dihydroxyvitamin D3 stimulates bone turnover in the normal young mouse. *Calcified Tissue International* 1983;35(4):18-425

Agents: Vitamin D3, 1,25-dihydroxy- **Vehicle:** Propylene glycol; **Route:** SC; **Species:** Mice; **Duration:** 4 weeks;

ALZET Comments: 4 dose levels tested: 0.05, 0.10, 0.175, and 0.25 ug/kg/day

P0303: K. Jarnagin, *et al.* 1- But not 24-hydroxylation of vitamin D is required for growth and reproduction in rats. *American Journal of Physiology Endocrinology and Metabolism* 1983;244(E290-E297)

Agents: Vitamin D3, 1,25-dihydroxy-; Vitamin D3, 25-hydroxy- **Vehicle:** Propylene glycol; **Route:** SC; **Species:** Rat; **Pump:** 2002; **Duration:** 20 weeks;

ALZET Comments: comparison of oral vs. sc infusion; mp replaced every 2 weeks; pumps coated w/ Panalog ointment; animals washed w/surg. scrub & not shaved; long-term study; no stress - p. E296

P0309: E. Hefti, *et al.* Nature of calcemic effect of 1,25-dihydroxyvitamin D3 in experimental hypoparathyroidism. *American Journal of Physiology Endocrinology and Metabolism* 1983;244(E313-E316)

Agents: Vitamin D3, 1,25-dihydroxy- **Vehicle:** Propylene glycol; **Route:** IP; **Species:** Rat; **Pump:** 1701; **Duration:** 1 week;

ALZET Comments: no comment posted

P0304: R. Brommage, *et al.* 1- But not 24-hydroxylation of vitamin D is required for skeletal mineralization in rats. *American Journal of Physiology Endocrinology and Metabolism* 1983;244(E298-E304)

Agents: Vitamin D3, 1,25-dihydroxy-; Vitamin D3, 25-hydroxy- **Vehicle:** Propylene glycol; **Route:** SC; **Species:** Rat; **Pump:** 2002; **Duration:** Not Stated;

ALZET Comments: Comparison of oral vs. sc infusion

P0234: P. J. Marie, *et al.* Healing of bone lesions with 1,25-dihydroxyvitamin D3 in the young X-linked hypophosphatemic male mouse. *Endocrinology* 1982;111(3):904-911

Agents: Vitamin D3, 1,25-dihydroxy- **Vehicle:** Propylene glycol; **Route:** SC; **Species:** Mice; **Duration:** 4 weeks;

ALZET Comments: no comment posted

P0236: P. J. Marie, *et al.* Bone response to phosphate and vitamin D metabolites in the hypophosphatemic male mouse. *Calcified Tissue International* 1982;34(1):58-164

Agents: Vitamin D3, 24,25-dihydroxy-; Vitamin D3, 25-dihydroxy-; Vitamin D3, 1,25-dihydroxy- **Vehicle:** Propylene glycol; **Route:** SC; **Species:** Mice; **Pump:** Not Stated; **Duration:** 18 days;

ALZET Comments: Comparison of agents

P0149: H. S. Tenenhouse, *et al.* Effect of 1,25-dihydroxyvitamin D3 on phosphate homeostasis in the X-linked hypophosphatemic (Hyp) mouse. *Endocrinology* 1981;109(2):658-660

Agents: Vitamin D3, 1,25-dihydroxy- **Vehicle:** Propylene glycol; **Route:** SC; **Species:** Mice; **Pump:** 2001; **Duration:** 10 days;

ALZET Comments: Pumps replaced

Vitamin E

Q1590: C. Y. Hsieh, *et al.* Inhibition of vascular smooth muscle cell proliferation by the vitamin E derivative pentamethylhydroxychromane in an in vitro and in vivo study: pivotal role of hydroxyl radical-mediated PLC-gamma-1 and JAK2 phosphorylation. *Free Radical Biology and Medicine* 2010;49(5):881-893

Agents: PMC; tocopherol, alpha **Vehicle:** Not Stated; **Route:** SC; **Species:** Rat; **Pump:** Not Stated; **Duration:** 14 days;

ALZET Comments: Controls received mp w/ normal saline; animal info (Wistar, male, 350-400 g); PMC, also known as (2,2,5,7,8-pentamethyl-6-hydroxychromane, is a vitamin E derivative; tocopherol also known as vitamin E

P9636: D. C. Irwin, *et al.* A potential role for reactive oxygen species and the HIF-1-alpha-VEGF pathway in hypoxia-induced pulmonary vascular leak. *Free Radical Biology and Medicine* 2009;47(1):55-61

Agents: Ascorbate; glutathione; tocopherol, alpha- **Vehicle:** Not Stated; **Route:** SC; **Species:** Mice; **Pump:** 1007D;

ALZET Comments: Controls received mp w/saline; animal info (male, C57BL/6J, 25-30g, 10-12 weeks old); compounds were mixed and infused together as an antioxidant cocktail



P3759: T. Udaka, *et al.* The effect of combination therapy with EPC-K1 and low-dose cyclosporine to pulmonary allograft after rat lung transplantation. *J. Heart Lung Transplant* 1997;16(8):839-845

Agents: Vitamin E **Vehicle:** Not Stated; **Route:** IP; **Species:** Rat; **Pump:** 2001; **Duration:** 7 days;

ALZET Comments: functionality of mp verified by measuring EPC-K1 plasma levels; immunology; EPC-K1 is a diester of a-tocopherol and ascorbic acid; agent also called D-alpha-tocopherol

P2013: D. G. Stein, *et al.* Intracerebral administration of alpha-tocopherol-containing liposomes facilitates behavioral recovery in rats with bilateral lesions of the frontal cortex. *J. Neurotrauma* 1991;8(4):281-292

Agents: Phosphatidylcholine; vitamin E; Liposomes **Vehicle:** Not Stated; **Route:** CSF/CNS (cortex); **Species:** Rat; **Pump:** 2001; **Duration:** 7 days;

ALZET Comments: Multiple pumps per animal (2); agent also called D-alpha-tocopherol