



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

Carp

Q7487: P. Sorensen, *et al.* A Blend of F Prostaglandins Functions as an Attractive Sex Pheromone in Silver Carp. *Fishes* 2019;4(2):

Agents: Prostaglandin F₂-alpha **Vehicle:** Not Stated; **Route:** IP; **Species:** Fish (Carp); **Pump:** 2ML1; **Duration:** 8 days;
ALZET Comments: Dose (1ug/g body weight for 8 days); animal info (9 juvenile Silver, Bighead, and Common Carp (all approximately 50 g +/- 10 g);

Q1919: H. Lim, *et al.* Common Carp Implanted with Prostaglandin F₂-alpha Release a Sex Pheromone Complex that Attracts Conspecific Males in Both the Laboratory and Field. *JOURNAL OF CHEMICAL ECOLOGY* 2012;38(2):127-134

Agents: Prostaglandin F₂-alpha **Vehicle:** Water, deionized, sterile; **Route:** IP; **Species:** Fish (carp); **Pump:** 2ML1; **Duration:** 2 weeks;

ALZET Comments: Animal info (juvenile, male, female, carp); "We suggest that the implant technique may be useful in future studies of how PGF pheromones function and could be further developed to attract invasive fish for use in control." pg 127

P6093: J. R. Metz, *et al.* Regulation of branchial Na⁺/K⁺-ATPase in common carp *Cyptinus carpio* L . acclimated to different temperatures. *Journal of Experimental Biology* 2003;206(13):2273-2280

Agents: Cortisol **Vehicle:** Cyclodextrin, beta; **Route:** IP; **Species:** Fish (carp); **Pump:** 1007D; **Duration:** Not Stated;
ALZET Comments: Controls received mp w/ vehicle; functionality of mp verified by cortisol plasma levels taken; "this approach was used instead of cortisol injection, which evokes stress responses due to repetitive handling..." (p. 2275); 30% cyclodextrin used

Catfish

Q8646: S. K. Mamta, *et al.* Controlled release of sex steroids through osmotic pump alters brain GnRH1 and catecholaminergic system dimorphically in the catfish, *Clarias gariepinus*. *Brain Research Bulletin* 2020;164(325-333

Agents: Estradiol, 17B-; Testosterone, 17a-methyl **Vehicle:** Ethanol; Saline; **Route:** IP; **Species:** Fish (catfish); **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);

Q7077: C. Laldinsangi, *et al.* Expression profiling of c-kit and its impact after esiRNA silencing during gonadal development in catfish. *Gen Comp Endocrinol* 2018;266(38-51

Agents: Chorionic gonadotropin hormone, human **Vehicle:** Saline; **Route:** IP; **Species:** Fish (catfish); **Pump:** Not Stated;
ALZET Comments: Dose (5000 IU/100 ul); Controls received mp w/ vehicle;

Q5617: R. Muruganankumar, *et al.* In vivo induction of human chorionic gonadotropin by osmotic pump advances sexual maturation during pre-spawning phase in adult catfish. *Gen Comp Endocrinol* 2017;251(74-84

Agents: Gonadotrophin, human chorionic **Vehicle:** Saline; **Route:** IP; **Species:** Fish (catfish); **Pump:** 1002; **Duration:** 21 days;
ALZET Comments: Dose (5000 IU); Controls received mp w/ vehicle; animal info (21 month old); "...the sustained-release of hCG through osmotic pump has been shown to be a reliable method to induce vitellogenesis and ovulation in females" pg. 75;

P4012: D. G. Kelly, *et al.* Enhanced disease resistance to enteric septicemia in channel catfish, *Ictalurus punctatus*, administered lytic peptide. *J. Applied Aquaculture* 1993;3(1/2):25-34

Agents: LSB-37; E. ictaluri; Bacteria **Vehicle:** Saline; **Route:** Not Stated; **Species:** Fish (catfish); **Pump:** Not Stated; **Duration:** 14 days;

ALZET Comments: Comparison of injections vs. mp; LSB-37 is a synthetic lytic peptide derived from the native cecropin B peptide; immunology; fish received mp w/saline, bacteria alone, or peptide and bacteria



Cod

Q2977: L. Kleppe, *et al.* Cortisol treatment of prespawning female cod affects cytogenesis related factors in eggs and embryos. *General and Comparative Endocrinology* 2013;189(1):84-95

Agents: Cortisol; propranolol **Vehicle:** Hydrocortisone; **Route:** IP; **Species:** Fish (cod); **Pump:** Not Stated; **Duration:** 27.3 days; **ALZET Comments:** Controls received mp w/ 80% 1.2-propranolol; animal info (cod, 1.8kg, female); 2ML pump used

P5951: L. A. Comeau, *et al.* Modifying thyroidal status in Atlantic cod by osmotic pump delivery of thyroid and antithyroid agents. *TRANSACTIONS OF THE AMERICAN FISHERIES SOCIETY* 2003;132(5):1021-1026

Agents: Triiodothyronine; iodide, potassium; methimazole; Estradiol, 17 β -; testosterone; thiourea **Vehicle:** Saline; **Route:** IP; **Species:** Fish (cod); **Pump:** 2ML1; **Duration:** 17 days;

ALZET Comments: Controls received mp w/ vehicle; functionality of mp verified by residual volume; drug plasma levels taken; potassium iodide, methimazole and thiourea are thyroid inhibitors; sex hormones were in a separate study where the ALZET pump model was not listed; "this study demonstrates the value of osmotic pumps as effective delivery vehicles for drugs in wild demersal fish." p. 1024

Eel

Q10498: M. Blanes-Garcia, *et al.* Using Osmotic Pumps to Induce the Production of Gametes in Male and Female European Eels. *Animals (Basel)* 2022;12(3):

Agents: Chorionic gonadotropin hormone, recombinant human; Pituitary extract, carp **Vehicle:** Saline **Route:** IP; **Species:** Fish (eel); **Pump:** 1004; 2006; 2ML4; **Duration:** 5 weeks; 10 weeks;

ALZET Comments: Dose: HCG (13 IU/uL); CPE (1.05 uL); 90% saline vehicle used; animal info: European eels Male eels (mean body weight = 126.7 \pm 17.9 g), Female eels (mean body weight = 771 \pm 123.8 g) Multiple pumps per animal (3); HCG aka (Human chorionic gonadotropin); CPE aka (Carp pituitary extract); hormone replacement therapy

Q5608: A. Miura, *et al.* Administration of 17 α -hydroxyprogesterone into mature male Japanese eel reduces sperm motility by decreasing potassium ion concentrations in the seminal plasma. *Aquaculture* 2013;414-415(217-223

Agents: Gonadotrophin, human chorionic **Vehicle:** Not Stated; **Route:** Not Stated; **Species:** Fish (Eel); **Pump:** 1002; **Duration:** 6 weeks;

ALZET Comments: animal info (male, 303g, freshwater) ; ""The osmotic pump releases 5 μ l of solution per day for approximately 45–50 days when the fish are maintained at a water temperature of 20 $^{\circ}$ C"" (pg 218); Therapeutic indication (sperm motility); Dose (330 IU/week);

Q2599: H. Kagawa, *et al.* Mechanism of oocyte maturation and ovulation and its application to seed production in the Japanese eel. *FISH PHYSIOLOGY AND BIOCHEMISTRY* 2013;39(1):13-17

Agents: Salmon pituitary extract **Vehicle:** Not Stated; **Route:** IP; **Species:** Fish (eel); **Pump:** 2002; **Duration:** Not Stated;

ALZET Comments: Animal info (full grown, female); Model 2002 "can release 5 ul of solution per day for approximately 45-50 days when the fish are maintained at a water temperature of 20C"; image of pump inside eel abdomen, fig 1, page 15

Q2691: H. Kagawa, *et al.* Using osmotic pumps to deliver hormones to induce sexual maturation of female Japanese eels, *Anguilla japonica*. *Aquaculture* 2013;388(1):30-34

Agents: Salmon pituitary extract; gonadotrophin, human chorionic; gonadotropin-releasing hormone analogue **Vehicle:** Sodium chloride; **Route:** IP; **Species:** Fish (eel); **Pump:** 2002; **Duration:** Not Stated;

ALZET Comments: Control animals received mp w/ saline, vehicle; animal info (female, cultured); functionality of mp verified via residual volume; "osmotic pump was implanted into the peritoneal cavity of each eel after cutting an approximately 8-mm opening in the abdomen with a fine scalpel. The wound was not sutured, but healed naturally within 2 weeks." pg 31; "This study confirms the effectiveness of using osmotic pumps to induce the maturation of captive female eels..." pg 33; comparison of mp vs injections



R0333: H. Kagawa. Oogenesis in Teleost Fish. *Aquaculture* 2013;6(4):99-127

Agents: Gonadotropin releasing hormone **Vehicle:** BSA; Sodium chloride; **Route:** IP; **Species:** Fish (eel); **Pump:** 2002;
Duration: Not Stated;

ALZET Comments: Controls received mp w/ vehicle; animal info (freshwater eels, *Anguilla* spp.); 0.1% BSA used; dose-response (pg 118); "implantation of these osmotic pumps loaded with protein hormones, instead of repeated injections of hormones, is a reliable sustained-release delivery system for inducing sexual maturation in fish." pg 119; picture of pump implantation pg 118; Dose (GnRH α 0.9, 1.8 or 3.6 ug/day; hCG 50 IU/day; salmon pituitary extract 2.24 mg/day);

Q0835: Y. Kasuga, *et al.* Induction of sexual maturation of male Japanese eel (*Anguilla japonica*) by continuous administration of various hormones using osmotic pump. *Cybiurn* 2008;32(2):171-171

Agents: Chorionic gonadotropin hormone, human; salmon pituitary extract; gonadotropin-releasing hormone agonist **Vehicle:** Not Stated; **Route:** IP; **Species:** Fish (eel); **Pump:** 2006; **Duration:** 42 days;

ALZET Comments: Animal info (male, Japanese); long-term study; comparison of IP injections vs IP mp; incorrectly listed Model 2002; "HCG administration of 50 IU day⁻¹ by using OS was an efficient and reliable method for the artificial maturation of male Japanese eel, instead of the weekly injections method." pg 171

Q5637: C. P. Cutler, *et al.* Cortisol regulates eel (*Anguilla anguilla*) aquaporin 3 (AQP3) mRNA expression levels in gill. *Gen Comp Endocrinol* 2007;152(2-3):310-3

Agents: Cortisol **Vehicle:** Cyclodextrin, 2-hydroxypropyl-b-; **Route:** Not Stated; **Species:** Fish (Eel); **Pump:** 1003D; **Duration:** 8 days;

ALZET Comments: Controls received mp w/ vehicle; functionality of mp verified by plasma levels; 30% 2-hydroxypropyl-b-cyclodextrin used; "The infusion of cortisol into FW eels using osmotic mini-pumps led to a 2.8-fold increase in the level of plasma cortisol as measured 8-days after the onset of the experiment (Fig. 1)" pg 311; Dose (15 ug/hr);

P7143: A. S. Martinez, *et al.* Cloning and expression of three aquaporin homologues from the European eel (*Anguilla anguilla*): effects of seawater acclimation and cortisol treatment on renal expression. *Biology of Sex Differences* 2005;97(8):615-627

Agents: Cortisol **Vehicle:** Cyclodextrin, beta; **Route:** IP; **Species:** Fish (eel); **Pump:** 1003D; **Duration:** 8 days;

ALZET Comments: Controls received mp w/ vehicle; functionality of mp verified by cortisol plasma levels; pumps implanted IP per contact with author; 30% cyclodextrin used

P7146: A. S. Martinez, *et al.* Regulation of expression of two aquaporin homologs in the intestine of the European eel: effects of seawater acclimation and cortisol treatment. *American Journal of Physiology Regulatory, Integrative, and Comparable Physiology* 2005;288(6):R1733-R1743

Agents: Cortisol **Vehicle:** Cyclodextrin, beta; **Route:** IP; **Species:** Fish (eel); **Pump:** 1003D; **Duration:** 8 days;

ALZET Comments: Controls received mp w/ vehicle; cortisol plasma levels; yellow/silver eels with an ambient temp. of 5-14 degrees celsius, 30 degrees celsius Cyclodextrin used; pumps implanted IP; per contact with author; 30% cyclodextrin used

Goldfish

P4001: J. T. Schmidt, *et al.* Role for cell adhesion and glycosyl (HNK-1 and oligomannoside) recognition in the sharpening of the regenerating retinotectal projection in goldfish. *J. Neurobiol* 1998;37(659-671

Agents: Antibody, anti-HNK-1; Antibody, C183 monoclonal; Oligomannoside glycopeptide **Vehicle:** Ringer's solution; **Route:** CSF/CNS (tectal ventricle); **Species:** Fish (goldfish); **Pump:** 2002; 1003D; **Duration:** 7,21 days;

ALZET Comments: Controls received mp w/vehicle; peptides; external pump

P3448: J. T. Schmidt. The modulatory cholinergic system in goldfish tectum may be necessary for retinotopic sharpening. *Visual Neuroscience* 1995;12(1093-1103

Agents: Bungarotoxin, a-; Bungarotoxin, n-; Pancuronium **Vehicle:** Not Stated; **Route:** CSF/CNS; **Species:** Fish (goldfish);

Pump: 2002; **Duration:** 2 weeks;

ALZET Comments: Controls received mp w/ ringer's; comparison of intracranial injections vs. mp



P1611: J. T. Schmidt. Long-term potentiation and activity-dependent retinotopic sharpening in the regenerating retinotectal projection of goldfish: common sensitive period and sensitivity to NMDA blockers. *Journal of Neuroscience* 1990;10(1):233-246
Agents: AP6; AP7; AP5 **Vehicle:** Not Stated; **Route:** CSF/CNS (tectal ventricle); **Species:** Fish (goldfish); **Pump:** 2002; **Duration:** 12, 24 days;

ALZET Comments: Functionality of mp verified by recovery of remaining drug soltn. at end of study; good methods for infusion to tectal ventricle; pumping in 20 degrees celsius environment, discusses dilution of drug in fluids of fish's brain; NMDA antagonists

P1777: J. T. Schmidt, *et al.* Antibodies to ependymin block the sharpening of the regenerating retinotectal projection in goldfish. *Brain Research* 1988;446(269-284

Agents: Antibody, antiependymin IgG **Vehicle:** Not Stated; **Route:** CSF/CNS; **Species:** Fish (goldfish); **Pump:** 2002; **Duration:** 14, 20 days;

ALZET Comments: Functionality of mp verified by measuring residual volume; schematic p. 271; external pump

Icefish

Q1687: K. A. Borley, *et al.* Phenylhydrazine-induced anemia causes nitric-oxide-mediated upregulation of the angiogenic pathway in *Notothenia coriiceps*. *Journal of Experimental Biology* 2010;213(16):2865-2872

Agents: Hydrazine, phenyl **Vehicle:** Ringer's solution, notothenoid; **Route:** IP; **Species:** Fish (icefish); **Pump:** 2ML1; **Duration:** 10 days;

ALZET Comments: Animal info (39-43 cm, 1000-1400g); "The fish responded remarkably well to the treatment with PHZ." pg 2869

Mackerel

R0379: H. Ohga, *et al.* The Roles of Kisspeptin System in the Reproductive Physiology of Fish With Special Reference to Chub Mackerel Studies as Main Axis. *Front Endocrinol (Lausanne)* 2018;9(147

Agents: Kiss1-15, Kiss2-12 peptides **Route:** SC; **Species:** Fish (Chub mackerel); **Pump:** 2006; **Duration:** 6 weeks;

ALZET Comments: Controls received mp w/ vehicle; animal info (adult fish); peptides;

Q2920: S. Selvaraj, *et al.* Peripheral Administration of Kiss1 Pentadecapeptide Induces Gonadal Development in Sexually Immature Adult Scombroid Fish. *Zoological Science* 2013;30(6):446-454

Agents: Kiss1-15; Kiss2-12, kisspeptin; kiss pentadecapeptide; **Vehicle:** DMSO; NaCl; **Route:** SC; **Species:** Fish (Mackerel); **Pump:** 2006; **Duration:** Not Stated;

ALZET Comments: Controls received mp w/ DMSO, and 0.75% NaCl; peptides; animal info (sexually immature adult chub mackerel); 50% DMSO used

Milkfish

P1141: C. L. Marte, *et al.* Induced spawning of maturing milkfish (*chanos forsskal*) with gonadotropin-releasing hormone (GnRH) analogues administered in various ways. *Applied Radiation and Isotopes* 1987;60(3/4):303-310

Agents: Luteinizing HRH **Vehicle:** HCl; **Route:** IP; **Species:** Fish (milkfish); **Pump:** 2002; **Duration:** Not Stated;

ALZET Comments: mp primed 12 hrs. at 4 degrees C; concomitant infusion; comparison of im inject. vs. LHRH pellet vs. mp infusion; functionality of mp verified; stress/adverse reaction (tissue necrosis); peptides; salmon & mammal LHRH used

Salmon

Q1247: K. Murashita, *et al.* Leptin reduces Atlantic salmon growth through the central pro-opiomelanocortin pathway. *Comparative Biochemistry and Physiology Part A: Molecular & Integrative Physiology* 2011;158(1):79-86

Agents: Leptin, recomb. saline **Vehicle:** Saline, teleost; **Route:** IP; **Species:** Fish (salmon); **Pump:** 1007D; **Duration:** 20 days;

ALZET Comments: Animal info (Atlantic salmon); dose-response



Q1524: H. J. McQuillan, *et al.* Effects of chronic manipulation of adrenocorticotrophic hormone levels in Chinook salmon on expression of interrenal steroidogenic acute regulatory protein and steroidogenic enzymes. *General and Comparative Endocrinology* 2011;174(2):156-165

Agents: Adrenocorticotrophic hormone **Vehicle:** NaCl, sterile; **Route:** IP; **Species:** Fish (salmon); **Pump:** 1003D; **Duration:** 10 days;

ALZET Comments: Controls received mp w/ vehicle; animal info (juvenile, Chinook); functionality of mp verified by plasma drug levels or visual inspection

Q0247: X. Jia, *et al.* Antimicrobial Peptides Protect Coho Salmon from *Vibrio anguillarum* Infections. *Appetite* 2000;66(5):1928-1932

Agents: Peptide, cecropin-melittin; pleurocidin **Vehicle:** Citric acid; saline; **Route:** IP; **Species:** Fish (salmon); **Pump:** 1007D; **Duration:** Not Stated;

ALZET Comments: Controls received mp w/ vehicle; peptides; animal info (Coho Salmon, juvenile, 20g); comparison of IP injections vs. IP mp; dose response (Fig. 2); agent also known as CEME; "a single injection of CEME did not have any effect, but constant delivery of the peptide via an implanted miniosmotic pump significantly delayed and reduced mortality" (p1932); immunology

P6300: S. D. McCormick. Effects of Growth Hormone and Insulin-like Growth Factor I on Salinity Tolerance and Gill Na⁺, K⁺-ATPase in Atlantic Salmon (*Salmo salar*): Interaction with Cortisol. *General and Comparative Endocrinology* 1996;101(3-11)

Agents: Growth hormone, ovine; insulin-like growth factor I, recomb. ovine **Vehicle:** Ringer's solution; **Route:** Not Stated; **Species:** Fish (atlantic salmon); **Pump:** 1003D; **Duration:** 4,14 days;

ALZET Comments: no comment posted

P2997: J. M. Shrimpton, *et al.* Downregulation of corticosteroid receptors in gills of coho salmon due to stress and cortisol treatment. *American Journal of Physiology Regulatory, Integrative, and Comparable Physiology* 1994;267(36):R432-R438

Agents: Cortisol, 21-hemisuccinate **Vehicle:** Saline; Cyclodextrin; **Route:** IP; **Species:** Fish (salmon); **Pump:** Not Stated; **Duration:** 18 days;

ALZET Comments: Controls received mp w/ vehicle or no surgery; functionality of mp verified by plasma levels; comparison of ip injections and daily handling vs. mp; no stress (see pg. R433); stability verified for 18 days at 7.5 degrees C; only chronic infusion resulted in reduction of corticosteroid receptor number and affinity; cyclodextrin was Molecusol HBP

P2153: S. D. McCormick, *et al.* Stimulation of coho salmon growth by insulin-like growth factor I1. *Gen. Comp. Endocrinol* 1992;86(398-406)

Agents: Insulin-like growth factor I **Vehicle:** Saline; **Route:** IP; **Species:** Fish (salmon); **Pump:** Not Stated; **Duration:** Not Stated;

ALZET Comments: Controls received mp with saline; peptides; temperatures were 15 degrees and 8 degrees; recomb. bovine IGF-1 used

P1772: N. E. Down, *et al.* Growth acceleration of seawater-adapted female chinook salmon *Oncorhynchus tshawytscha* by constant infusion of recombinant bovine growth-hormone under ambient summer conditions. *Journal of World Aquaculture Society* 1989;20(4):181-187

Agents: Growth hormone, recomb. bovine **Vehicle:** Water, distilled; **Route:** IP; **Species:** Fish (salmon); **Pump:** 2001; **Duration:** 5 weeks;

ALZET Comments: functionality of mp verified by measuring residual volume; 3 doses of rbGH infused, 'exogenous GH administered in a continuous fashion by osmotic pumps can markedly accelerate growth in chinook salmon.' (p. 184)

P1221: N. E. Down, *et al.* Recombinant bovine somatotropin more than doubles the growth rate of coho salmon (*Oncorhynchus kisutch*) acclimated to seawater and ambient winter conditions. *Aquaculture* 1988;68(141-155)

Agents: Growth hormone, bovine **Vehicle:** Lactose; Mannitol; Sodium bicarbonate; Water; **Route:** IP; **Species:** Fish (salmon); **Pump:** 2001; **Duration:** 8 weeks;

ALZET Comments: Comparison of ip injections vs. pellets vs. mp infusion; long-term study; peptides



Sea Bream

P8578: J. Fuentes, *et al.* A PTH/PTHrP receptor antagonist blocks the hypercalcemic response to estradiol-17 beta. *American Journal of Physiology Regulatory, Integrative, and Comparable Physiology* 2007;293(R956-R960)

Agents: Parathyroid hormone-related protein (7-34) **Vehicle:** Not Stated; **Route:** IP; **Species:** Fish (sea bream); **Pump:** Not Stated; **Duration:** Not Stated;

ALZET Comments: Controls received mp w/ vehicle; peptides; animal info (Sparus auratus, juvenile)

Tilapia

P7303: L. G. Riley, *et al.* Long-term treatment of ghrelin stimulates feeding, fat deposition, and alters the GH/IGF-I axis in the tilapia, *Oreochromis mossambicus*. *General and Comparative Endocrinology* 2005;142(1-2):234-240

Agents: Ghrelin-C8, tilapia; Ghrelin-C10, tilapia **Vehicle:** Saline, sterile; **Route:** IP; **Species:** Fish (tilapia); **Pump:** 1002; **Duration:** 21 days;

ALZET Comments: Controls received mp w/ vehicle; no stress (see pg. 235); peptides; post op. care (maracyn); fish temperature of 25 degrees celsius gives a 28 day predicted duration for mp 1002; endocrinology

P0282: G. J. J. M. van Eys, *et al.* Structural changes in the pars intermedia of the cichlid teleost *Sarotherodon mossambicus* as a result of background adaptation and illumination. *Cell and Tissue Research* 1981;220(561-571)

Agents: Melatonin **Vehicle:** Water; **Route:** IP; **Species:** Fish (Mozambique tilapia); **Pump:** 1701; **Duration:** 10 days;

ALZET Comments: no comment posted

P0151: G. J. J. M. van Eys, *et al.* Evidence for a direct role of α -MSH in morphological background adaptation of the skin in *Sarotherodon mossambicus*. *Cell and Tissue Research* 1981;217(361-372)

Agents: Melanocyte-stimulating hormone, α - **Vehicle:** Water; **Route:** IP; **Species:** Fish (Mozambique tilapia); **Pump:** 1701; **Duration:** 10 days;

ALZET Comments: Peptides

Trout

Q3289: M. A. Caruso, *et al.* Differential regulation of the multiple insulin and insulin receptor mRNAs by somatostatin. *MOLECULAR AND CELLULAR ENDOCRINOLOGY* 2014;384(1-2):126-133

Agents: Somatostatin, bovine **Vehicle:** Saline; **Route:** IP; **Species:** Fish (trout); **Pump:** Not Stated; **Duration:** 29 days;

ALZET Comments: Controls received mp w/ vehicle; animal info (rainbow trout, juvenile, 120g); 0.75% saline used; no stress (see pg. 128); post op. care (Neosporin); behavioral testing (food intake); diabetes;

Q1284: S. Polakof, *et al.* Glucose homeostasis in rainbow trout fed a high-carbohydrate diet: metformin and insulin interact in a tissue-dependent manner. *American Journal of Physiology Regulatory, Integrative, and Comparable Physiology* 2011;300(1):R166-R174

Agents: Insulin, Bovine; Metformin **Vehicle:** Not Stated; **Route:** IP; **Species:** Fish (rainbow trout); **Pump:** 1003D; **Duration:** 11 days;

ALZET Comments: Controls received mp w/ saline; animal info (200 g); multiple pumps per animal (2); no stress (see pg. R167); post op. care (antibiotic gel); "No symptoms of stress, including alterations in feeding behavior, were observed as a consequence of pump implantation."

Q0655: S. Polakof, *et al.* Insulin Stimulates Lipogenesis and Attenuates Beta-Oxidation in White Adipose Tissue of Fed Rainbow Trout. *Lipids* 2011;46(2):189-199

Agents: Insulin, bovine **Vehicle:** Not Stated; **Route:** IP; **Species:** Fish (Rainbow trout); **Pump:** Not Stated; **Duration:** 5, 11 days;

ALZET Comments: Controls received mp w/ saline; animal info (rainbow trout, 200 g); post op. care (antibiotic gel)



Q0182: S. Polakof, *et al.* Insulin-induced hypoglycaemia is co-ordinately regulated by liver and muscle during acute and chronic insulin stimulation in rainbow trout (*Oncorhynchus mykiss*). *Journal of Experimental Biology* 2010;213(9):1443-1452

Agents: Insulin, bovine **Vehicle:** Saline; **Route:** IP; **Species:** Fish (trout); **Pump:** 1003D; **Duration:** 4 days;

ALZET Comments: Controls received mp w/ vehicle; peptides; animal info (rainbow trout, 170 g); post op. care (antibiotic ointment); comparison of IP injections vs. mp; 17 degrees C; endocrinology

Q1649: S. Polakof, *et al.* Effects of insulin infusion on glucose homeostasis and glucose metabolism in rainbow trout fed a high-carbohydrate diet. *Journal of Experimental Biology* 2010;213(24):4151-4157

Agents: Insulin, bovine **Vehicle:** Not Stated; **Route:** IP; **Species:** Fish (rainbow trout); **Pump:** 1003D; **Duration:** 5 days;

ALZET Comments: Controls received mp w/ saline; animal info (immature); post op. care (antibiotic gel)

P9941: S. Polakof, *et al.* Glucose homeostasis is impaired by a paradoxical interaction between metformin and insulin in carnivorous rainbow trout. *American Journal of Physiology Regulatory, Integrative, and Comparable Physiology* 2009;297(6):R1769-R1776

Agents: Metformin; insulin, bovine **Vehicle:** Not Stated; **Route:** SC; **Species:** Fish (rainbow trout); **Pump:** 1007D; **Duration:** Not Stated;

ALZET Comments: Controls received mp w/ saline; post op. care (antibiotic gel); animal info (rainbow trout); one group contained metformin and insulin

P9927: B. M. Cleveland, *et al.* Insulin-like growth factor-I and genetic effects on indexes of protein degradation in response to feed deprivation in rainbow trout (*Oncorhynchus mykiss*). *American Journal of Physiology Regulatory, Integrative, and Comparable Physiology* 2009;297(5):R1332-R1342

Agents: Insulin-like growth factor-1, recomb. human **Vehicle:** Not Stated; **Route:** IP; **Species:** Fish (rainbow trout); **Pump:** 1003D; **Duration:** Not Stated;

ALZET Comments: Post op.care (triple antibiotic ointment); animal info (rainbow trout.1 year old); wound clips used

P8608: N. M. Very, *et al.* Somatostatin regulates hepatic growth hormone sensitivity by internalizing growth hormone receptors and by decreasing transcription of growth hormone receptor mRNAs. *American Journal of Physiology Regulatory, Integrative, and Comparable Physiology* 2007;292(5):R1956-R1962

Agents: Somatostatin-14-I **Vehicle:** Saline; **Route:** IP; **Species:** Fish (trout); **Pump:** Not Stated; **Duration:** 15 days;

ALZET Comments: Controls received mp w/ vehicle; functionality of mp verified by plasma levels; peptides; animal info (male, female, juvenile, rainbow trout, 58 grams)

P7350: B. J. Slagter, *et al.* Expression of somatostatin receptor mRNAs is regulated in vivo by growth hormone, insulin, and insulin-like growth factor-I in rainbow trout (*Oncorhynchus mykiss*). *Regulatory Peptides* 2005;128(1):27-32

Agents: Growth hormone, recomb. bovine; insulin, recomb. bovine; insulin-like growth factor. recomb. human **Vehicle:** NaCl; **Route:** IP; **Species:** Fish (rainbow trout); **Pump:** 1007D; **Duration:** 21 days;

ALZET Comments: Controls received mp w/ vehicle; peptides; post op. care (topical antibiotic ointment); at 14 degrees celsius, the 1007D infuses at 0.14 ul/hr for approximately 21 days

P7604: N. J. Bernier, *et al.* CRF-related peptides contribute to stress response and regulation of appetite in hypoxic rainbow trout. *American Journal of Physiology Regulatory, Integrative, and Comparable Physiology* 2005;289(4):R982-R990

Agents: Corticotropin-releasing factor, a helical (9-41) **Vehicle:** Saline, physiological; NaOH; **Route:** CSF/CNS; **Species:** Fish (rainbow trout); **Pump:** 1003D; **Duration:** 8 days;

ALZET Comments: Controls received mp w/ vehicle; no stress (see pg. R984); peptides; animal info (male, female, hypoxia); CRF receptor antagonist; x-ray radiography; mp encased in a layer of dialysis tubing; cannula placement confirm; mp at 14C



Q7382: N. Very. Somatostatin inhibits growth of rainbow trout. *Journal of Fish Biology* 2001;59(1):157-165

Agents: somatostatin-14 **Vehicle:** Saline; **Route:** IP; **Species:** Fish (Rainbow trout); **Pump:** pump model not stated; **Duration:** 20 days;

ALZET Comments: Dose ($5 \cdot 8 \cdot 10^{-11}$ mol/h); 0.75% (w/v) NaCl used; Controls received mp w/ vehicle; animal info (juvenile, male and female, 58.3+/-1.3 g); post op. care (return to 100L tank containing 250 mg erythromycin, fasting for 5 days); Resultant plasma level ((4.4+/-0.2 and 4.2+/-0.3 ng/mL in saline-injected fish), (6.4+/-0.4 and 5.8+/-0.3 ng/mL in SS-14 injected fish, 3h and 6h post-injection)); enzyme inhibitor (GH release from teleost pituitary); good methods (pre- and post-surgery information, location of implantation site, p.158-159); trout received i.p. injection of SS-14 on day 20 of experiment to measure plasma concentration at 3h and 6h post-injection.

P3682: A. Levy, *et al.* Penetration of phosphorothioate oligodeoxynucleotides into rainbow trout brain in vivo. A technique for chronic infusion of substances into the brain of free-living adult fish. *J. Fish Bio* 1997;50(691-702

Agents: Oligodeoxynucleotide, phosphorothioate; Melanin-concentrating hormone; Lipofectin; Dye, xylene cyanole **Vehicle:** Saline; BSA; Radio-isotopes; **Route:** CSF/CNS; **Species:** Fish (rainbow trout); **Pump:** 2001; **Duration:** Not Stated;

ALZET Comments: Controls received mp w/ saline & BSA; good methods; "No problems with pump patency were encountered, and the contents of the pump diffused consistently throughout the brain ventricular system...", p. 691; pump encased in dialysis tubing bag

P2594: D. E. Andersen, *et al.* Metabolic effects associated with chronically elevated cortisol in rainbow trout (*Oncorhynchus mykiss*). *Canadian Journal of Fisheries and Aquatic Sciences* 1991;48(9):1811-1817

Agents: Cortisol **Vehicle:** Cyclodextrin, B-; **Route:** IA (dorsal aorta); **Species:** Fish (rainbow trout); **Pump:** 2001; **Duration:** 10,14 days;

ALZET Comments: controls received mp w/ vehicle or sham operation; functionality of mp verified by RIA of plasma levels; stress from surgery caused hyperglycemia (p.816) for 22 hours; "Mini-osmotic pumps. . .were an effective method for chronically elevating cortisol titers in trout."; Molecusol HBP is a beta-cyclodextrin

P0985: B. I. Baker, *et al.* Effects of chronic administration of melanin-concentrating hormone on corticotrophin, melanotrophin, and pigmentation in the trout. *General and Comparative Endocrinology* 1986;63(62-69

Agents: Melanin-concentrating hormone **Vehicle:** Albumin, bovine serum; Saline; **Route:** IP; **Species:** Fish (trout); **Pump:** 2001; **Duration:** Not Stated;

ALZET Comments: 2001, controls received mp w/vehicle or sham operated; mps primed in saline prior to implant; stability of MCH verified

P0519: K. T. Rodrigues, *et al.* Effects of background adaptation on the pituitary and plasma concentrations of some pro-opiomelanocortin-related peptides in the rainbow trout (*Salmo gairdneri*). *Journal of Endocrinology* 1984;101(277-284

Agents: Melanocyte-stimulating hormone, b-; Melanocyte-stimulating hormone, a- **Vehicle:** Saline; **Route:** IP; **Species:** Fish (rainbow trout); **Pump:** 2002; **Duration:** 4 weeks;

ALZET Comments: Comparison of agents effects; plasma assayed by RIA at 28 days to verify mp delivery; delivery rate 0.17 ul/hr at 21C; peptides