



## References on the Administration of Growth Hormones Using ALZET® Osmotic Pumps

### 1. Bovine

**Q1384:** M. Walser, *et al.* Peripheral administration of bovine GH regulates the expression of cerebrocortical beta-globin, GABAB receptor 1, and the Lissencephaly-1 protein (LIS-1) in adult hypophysectomized rats. *GROWTH HORMONE & IGF RESEARCH* 2011;21(1):16-24

**Agents:** Growth hormone, bovine recomb. **Vehicle:** Phosphate buffer; glycerol; sodium azide; **Route:** SC; **Species:** Rat; **Pump:** 2004; **Duration:** 6 days;

**ALZET Comments:** Animal info (female, Sprague Dawley, hx, normal); replacement therapy (hypophysectomized)

**P8049:** D. L. Kleinberg, *et al.* Insulin-like growth factor (IGF)-I controls prostate fibromuscular development: IGF-I inhibition prevents both fibromuscular and glandular development in eugonadal mice. *Endocrinology* 2007;148(3):1080-1088

**Agents:** Insulin-like growth factor I; growth hormone, bovine; insulin-like growth factor-1, binding protein **Vehicle:** Not Stated; **Route:** SC; **Species:** Mice; **Pump:** 1007D; **Duration:** 7 days;

**ALZET Comments:** Controls received mp w/ saline; peptides; animal info (ORX, 10 weeks old, male); drugs delivered alone or in combination

**P8552:** C. Gaelman, *et al.* Age-induced hypercholesterolemia in the rat relates to reduced elimination but not increased intestinal absorption of cholesterol. *American Journal of Physiology Endocrinology and Metabolism* 2007;293(3):E737-E742

**Agents:** Growth hormone, bovine **Vehicle:** Not Stated; **Route:** SC; **Species:** Rat; **Pump:** 2ML1; **Duration:** 1 week;

**ALZET Comments:** Controls received no treatment; peptides; animal info (male, Wistar-Hannover, 6, 18 months old); endocrinology

**P8424:** C. Gardmo, *et al.* In vivo transfection of rat liver discloses binding sites conveying GH-dependent and female-specific gene expression. *Journal of Molecular Endocrinology* 2006;37(3):433-441

**Agents:** Growth hormone, bovine **Vehicle:** Not Stated; **Route:** SC; **Species:** Rat; **Pump:** 2001; **Duration:** 6 days;

**ALZET Comments:** Peptides; animal info (Sprague-Dawley, 7 wks old, male)

**P6387:** M. Matasconi, *et al.* Pituitary control of lipoprotein and bile acid metabolism in male rats: growth hormone effects are not mediated by prolactin. *American Journal of Physiology Endocrinology and Metabolism* 2004;287(1):E114-E119

**Agents:** Growth hormone, human; growth hormone, bovine **Vehicle:** Not Stated; **Route:** SC; **Species:** Rat; **Pump:** 2001; **Duration:** 7 days;

**ALZET Comments:** Replacement therapy (hypophysectomy); dose-response (p. E115)

### 2. Chicken

**P4547:** C. G. Scanes, *et al.* Influence of continuous growth hormone or insulin-like growth factor I administration in adult female chickens. *General and Comparative Endocrinology* 1999;114(3):315-323

**ALZET Comments:** Growth hormone, chicken; Insulin-like growth factor I;; Saline; Albumin, bovine serum;; SC;; bird (chicken);; 2ML2;; 10 days;; controls received mp w/vehicle; functionality of mp verified by plasma levels; peptides; recomb. chicken growth hormone used;.

**P1528:** C. G. Scanes, *et al.* In vivo effects of biosynthetic chicken growth hormone in broiler-strain chickens. *Growth Dev. Aging* 1990;54(95):101

**ALZET Comments:** Growth hormone, chicken; Albumin, bovine serum; Saline; SC; bird (chicken); 2ML4; 3 weeks; pumps were siliconized (probably using Prosil) to decrease protein binding in pumps.



### 3. Human

**Q5334:** K. Wang, *et al.* Growth Hormone Mediates Its Protective Effect in Hepatic Apoptosis through Hnf6. PLoS One 2016;11(12):e0167085

**Agents:** Growth hormone, human recomb. **Vehicle:** Not Stated; **Route:** SC; **Species:** Mice; **Pump:** Not Stated; **Duration:** 7 days;

**ALZET Comments:** Controls received mp w/ PBS; animal info (male, Albumin-Cre); Therapeutic indication (Hepatic apoptosis); Dose (5 ug/h);

**Q6633:** H. Nishizawa, *et al.* IGF-I induces senescence of hepatic stellate cells and limits fibrosis in a p53-dependent manner. Sci Rep 2016;6(34605)

**Agents:** Insulin-like Growth Factor 1, recomb.; Growth Hormone, human **Vehicle:** Saline; **Route:** SC; **Species:** Rat; Mice; **Pump:** 2004; **Duration:** 4 weeks; 6 weeks;

**ALZET Comments:** Dose (10 mg/mL); Controls received mp w/ vehicle; animal info (Eight-week-old male ICR mice, Sprague-Dawley (SD) rats; db/db mice with a C57BL/6 background); Insulin-like Growth Factor aka IGF-I;

**Q0858:** C. Tateno, *et al.* Growth Hormone-Dependent Pathogenesis of Human Hepatic Steatosis in a Novel Mouse Model Bearing a Human Hepatocyte-Repopulated Liver. Endocrinology 2011;152(4):1479-1491

**Agents:** Growth hormone, human **Vehicle:** Not Stated; **Route:** SC; **Species:** Mice (transgenic/SCID); **Pump:** Not Stated; **Duration:** 2 weeks;

**ALZET Comments:** Animal info (uPA/SCID, 20-30 days old, chimeric)

**Q1174:** D. L. Kleinberg, *et al.* Pasireotide, an IGF-I action inhibitor, prevents growth hormone and estradiol-induced mammary hyperplasia. Pituitary 2011;14(1):44-52

**Agents:** Growth hormone, human **Vehicle:** Not Stated; **Route:** SC; **Species:** Rat; **Pump:** 1007D; **Duration:** Not Stated;

**ALZET Comments:** Animal info (CD-1, 42 days old); replacement therapy (hypophysectomy and oophorectomy)

**P9566:** E. F. Gevers, *et al.* Regulation of Rapid Signal Transducer and Activator of Transcription-5 Phosphorylation in the Resting Cells of the Growth Plate and in the Liver by Growth Hormone and Feeding. Endocrinology 2009;150(8):3627-3636

**Agents:** Growth hormone, human **Vehicle:** Saline; BSA; **Route:** SC; **Species:** Mice; **Pump:** 2001; **Duration:** 5 days;

**ALZET Comments:** Controls received sham surgery; animal info (dw/dw, 4-5 wks old)

### 4. Ovine

**P6300:** S. D. McCormick. Effects of Growth Hormone and Insulin-like Growth Factor I on Salinity Tolerance and Gill Na<sup>+</sup>, K<sup>+</sup>-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:**

**P3171:** A. L. Albiston, *et al.* Sex- and tissue- specific regulation of 11B-hydroxysteroid dehydrogenase mRNA. Molec. and Cell. Endocrinol 1995;109(183-188)

**Agents:** Growth hormone, ovine **Vehicle:** Not Stated; **Route:** Not Stated; **Species:** Rat; **Pump:** 2002; **Duration:** 4 days;

**ALZET Comments:** replacement therapy (hypophysectomy); peptides; infusion proved superior to injection; comparison of injections vs. mp

**R0097:** C. S. Nicoll, *et al.* Analysis of the role of hormones and growth factors in growth control and tissue differentiation using transplanted mammalian embryos and fetal structures. Growth Reg 1991;1(133-144)



**Agents:** Antibody, anti-fibroblast growth factor; Antibody, anti-IGF I; Insulin; Growth hormone, ovine; Fibroblast growth factor; Epidermal growth factor; Insulin-like growth factor II; Antibody, anti-epidermal growth factor **Vehicle:** Not Stated; **Route:** IV (suprarenal); **Species:** Not Stated; **Pump:** Not Stated; **Duration:** no duration posted; **ALZET Comments:** peptides

**P1589:** R. J. Madon, *et al.* Hypoinsulinaemia in the lactating rat is caused by a decreased glycaemic stimulus to the pancreas. *J. Endocrinol* 1990;125(81-88)

**Agents:** Growth hormone, ovine; Prolactin, ovine **Vehicle:** Not Stated; **Route:** Not Stated; **Species:** Rat; **Pump:** 2001; **Duration:** 5 days;

**ALZET Comments:** functionality of mp verified by serum levels; replacement therapy (oviarectomy) in some of the prolactin-treated animals

**P1177:** D. R. Smith, *et al.* Hepatic estrogen and androgen receptors and binding proteins in streptozotocin-diabetic male wistar rats. *Diabetologia* 1987;30(957-962)

**Agents:** Growth hormone, ovine **Vehicle:** Saline; **Route:** SC; **Species:** Rat; **Pump:** 2001; **Duration:** no duration posted;

**ALZET Comments:** streptozotocin induced diabetes; comparison of sc injections vs. mp infusion; peptides

## 5. Porcine

**Q4548:** H. Nishida, *et al.* Dexamethasone and BCAA Failed to Modulate Muscle Mass and mTOR Signaling in GH-Deficient Rats. *PLoS One* 2015;10(U459-U478)

**ALZET Comments:** Growth hormone, porcine; SC; Rat; 2002; 14 days; Animal info (Sprague Dawley, 6 weeks old);

**Q3456:** M. E. Diaz, *et al.* GH administration patterns differently regulate epidermal growth factor signaling. *Journal of Endocrinology* 2014;221(309-323)

**ALZET Comments:** Growth hormone, porcine; SC; Mice; 1007D; 5 days; Controls received mp w/ saline; animal info (Swiss-Webster, 3-4 months old, 26-30g); functionality of mp verified by plasma levels; comparison of SC injection BID vs mp; toxicology; "The results indicate that sustained delivery systems that allow continuous GH plasma patterns would be beneficial in terms of treatment safety with regard to the actions of GH on EGFR signaling and its promitogenic activity." pg 309.

**P5083:** P. J. D. Delhanty, *et al.* Growth hormone rapidly induces resistin gene expression in white adipose tissue of spontaneous dwarf (SDR) rats. *Endocrinology* 2002;143(6):2445-2448

**ALZET Comments:** Growth hormone, human; Growth hormone, porcine;; SC; Rat; 24-48 hours; comparison of IP injections vs. mp; peptides; porcine or recomb. human GH used.

**P4893:** M. A. Conlon, *et al.* Porcine growth hormone and LongR (3)IGF-I can improve recovery from surgery-induced weight loss in guinea pigs. *General and Comparative Endocrinology* 2001;123(332-336)

**ALZET Comments:** Growth hormone, porcine; Insulin-like growth factor I analog; Disodium hydrogen orthophosphate; Acetic acid; SC; Guinea pig; 2001; 7 days; controls received mp w/ vehicle; functionality of mp verified by serum drug levels; dose response (text, graph p. 334-5); peptides; LR3IGF-1 is an IGF-I analog; multiple pumps per animal (2), one containing each solution; pGH was dissolved in 0.1M disodium hydrogen orthophosphate; L3IGF-1 was dissolved in 0.1 M acetic acid.

## 6. Rat

**Q7825:** P. Hao, *et al.* Functional Roles of Sex-Biased, Growth Hormone-Regulated MicroRNAs miR-1948 and miR-802 in Young Adult Mouse Liver. *Endocrinology* 2018;159(3):1377-1392

**Agents:** growth hormone, recomb. rat **Vehicle:** Sodium bicarbonate; saline; albumin, buffered; **Route:** SC; **Species:** Mice; **Pump:** 1007D; **Duration:** 7 days;



**ALZET Comments:** Dose (20 ng/g body weight/hour); 30 mM NaHCO<sub>3</sub> (pH 8.3) buffer containing 0.15 M NaCl and 100 mg/mL rat albumin used; Controls received sham surgery; animal info (8-10 weeks, male, CD1); "exogenous GH infusion using an ALZET osmotic minipump overrides the normal male plasma GH pulses and leads to downregulation of a large fraction of male-biased genes and upregulation of female-biased genes" p.1382;

**Q1792:** Y. J. Zhang, *et al.* Dynamic, Sex-Differential STAT5 and BCL6 Binding to Sex-Biased, Growth Hormone-Regulated Genes in Adult Mouse Liver. *MOLECULAR AND CELLULAR BIOLOGY* 2012;32(4):880-896

**Agents:** Growth hormone, rat, recomb. **Vehicle:** Not Stated; **Route:** Not Stated; **Species:** Mice; **Pump:** 1007D; **Duration:** 7 days;

**ALZET Comments:** Animal info (male, female, CD-1, 7-8 wks old)

**P9969:** T. J. Zhao, *et al.* Ghrelin O-acyltransferase (GOAT) is essential for growth hormone-mediated survival of calorie-restricted mice. *PROCEEDINGS OF THE NATIONAL ACADEMY OF SCIENCES OF THE UNITED STATES OF AMERICA* 2010;107(16):7467-7472

**Agents:** Ghrelin, recomb. rat; growth hormone, recomb. **Vehicle:** Saline; sodium bicarbonate; albumin, rat; **Route:** SC; **Species:** Mice; **Pump:** 1002; 2004; **Duration:** 10, 11 days;

**ALZET Comments:** Controls received mp w/ vehicle; peptides; animal info (male, wt, Goat<sup>-/-</sup>, 8 weeks old)

**Q0258:** P. Pathipati, *et al.* Delayed and chronic treatment with growth hormone after endothelin-induced stroke in the adult rat. *Behavioural Brain Research* 2009;204(1):93-101

**Agents:** Growth hormone, rat **Vehicle:** NaCl; tween 20; NaHCO<sub>3</sub>; Na<sub>2</sub>CO<sub>3</sub>; **Route:** CSF/CNS; **Species:** Rat; **Pump:** 2002; **Duration:** 6 weeks;

**ALZET Comments:** Controls received mp w/ vehicle; animal info (adult, male, Sprague-Dawley, 280-350 g); pumps replaced every 2 weeks; stability verified by for 2 weeks in vitro

**Q0698:** R. D. Meyer, *et al.* Male-Specific Hepatic Bcl6: Growth Hormone-Induced Block of Transcription Elongation in Females and Binding to Target Genes Inversely Coordinated with STAT5. *MOLECULAR ENDOCRINOLOGY* 2009;23(11):1914-1926

**Agents:** Growth hormone, recomb. rat, human **Vehicle:** Not Stated; **Route:** Not Stated; **Species:** Rat; **Pump:** Not Stated; **Duration:** 7 days;

**ALZET Comments:** Controls were untreated; animal info (male, Fischer 344, 9-13 wks old); replacement therapy (hypophysectomy)

## 7. Rel Fact

**Q4888:** A. Veronique St-Onge, Alfonso Abizaid. Ghrelin enhances cue-induced bar pressing for high fat food. *Horm. Behav* 2016;78(141-149)

**Agents:** Ghrelin; growth hormone-releasing peptide 6, [D-Lys-3] **Vehicle:** Saline; **Route:** CSF/CNS (ventral tegmental area); **Species:** Rat; **Pump:** 2002; **Duration:** 14 days;

**ALZET Comments:** Controls received mp w/ vehicle; animal info (male, Long evans, 216-375g); post op. care (SC injection of meloxicam; feed of mashed food); behavioral testing (food operant responses); used Plastics One cannula; obesity;

**Q3886:** C. Garcia-Caceres, *et al.* The Opposing Effects of Ghrelin on Hypothalamic and Systemic Inflammatory Processes Are Modulated by Its Acylation Status and Food Intake in Male Rats. *Endocrinology* 2014;155(2868-2880)

**Agents:** Ghrelin, acylated; ghrelin, non-acylated; ghrelin mimetic growth hormone-releasing peptide-6 **Vehicle:** Saline; **Route:** CSF/CNS; **Species:** Rat; **Pump:** Not Stated; **Duration:** 14 days;

**ALZET Comments:** Controls received mp w/ vehicle; animal info (male, Wistar, 250g); immunology;

**Q0371:** S. Sheriff, *et al.* Ghrelin receptor agonist, GHRP-2, attenuates burn injury-induced MuRF-1 and MAFbx expression and muscle proteolysis in rats. *Peptides* 2009;30(10):1909-1913

**Agents:** Growth hormone-releasing peptide-2 **Vehicle:** Not Stated; **Route:** SC; **Species:** Rat; **Pump:** 2001D; **Duration:** 1 day;



**ALZET Comments:** Controls received mp w/ saline; animal info (male, Sprague Dawley, 50-70 g); peptides

**P8904:** M. L. Fiorotto, *et al.* Transplacental transfer of a growth hormone-releasing hormone peptide from mother to fetus in the rat. *DNA and Cell Biology* 2006;25(8):429-437

**Agents:** Growth hormone-releasing hormone; radio-isotopes  $^{125}$ I tracer **Vehicle:** BSA; **Route:** SC; **Species:** Rat (pregnant); **Pump:** 1003D; **Duration:** 52-58 hours;

**ALZET Comments:** Controls received sham operation; functionality of mp verified by residual volume, total activity; no stress (see pg. 433); half-life (p. 432) 8 hours; teratology; peptides; animal info (female, Sprague Dawley, gd18)

**P7613:** L. M. Frago, *et al.* Growth hormone-releasing peptide-6 increases insulin-like growth factor-I mRNA levels and activates Akt in RCA-6 cells as a model of neuropeptide Y neurones. *Journal of Neuroendocrinology* 2005;17(11):701-710

**Agents:** Growth hormone-releasing peptide-6 **Vehicle:** Saline; **Route:** IV (jugular); **Species:** Rat; **Pump:** 2001; **Duration:** 7 days;

**ALZET Comments:** Controls received mp w/ vehicle; animal info (male, wistar 200-250 g); ghrelin receptor agonist; peptides