Recent References (2019-Present) on the Intracerebroventricular Administration of Agents to Rats Using ALZET® Osmotic Pumps

Q9557: Y. Z. Wu, et al. Cordyceps cicadae NTTU 868 Mycelium with The Addition of Bioavailable Forms of Magnesium from Deep Ocean Water Prevents the Aβ40 and Streptozotocin-Induced Memory Deficit via Suppressing Alzheimer’s Disease Risk Factors and Increasing Magnesium Uptake of Brain. Fermentation 2021;7(1):

Agents: Amyloid protein, beta (40) Vehicle: Acetonitrile; Trifluoroacetic acid; Route: CSF/CNS (left ventricle); Species: Rat; Pump: 2004; Duration: 28 days;

ALZET Comments: Dose (24.299 µg); 35% Acetonitrile, 0.1% Trifluoroacetic Acid used; Controls received mp w/ vehicle; animal info (Male Sprague Dawley rats, 6-8 weeks old); behavioral testing (Morris Water Maze); Amyloid protein, beta (40) aka Aβ40; Brain coordinates (relative to the bregma; 0.8 mm posterior, 1.4 mm latera); dental cement used; neurodegenerative (Alzheimer’s);

Q9516: T. C. Uzuneser, et al. Presynaptic vesicular accumulation is required for antipsychotic efficacy in psychotic-like rats. Journal of Psychopharmacology 2021;35(1):65-77

Agents: Amphetamine sulfate, d Vehicle: Saline; Route: CSF/CNS (lateral ventricle); Species: Rat; Pump: 2001; Duration: 7 days;

ALZET Comments: Dose (); 0.9% Saline used; Controls received mp w/ vehicle; animal info (Male Sprague-Dawley rats, 300-350 g); behavioral testing (locomotion test); d-amphetamine sulfate aka AMPH; ALZET brain infusion kit 2 used; Brain coordinates (0.8 mm posterior, 1.4 mm lateral, 4.5 mm ventral from the bregma); cyanoacrylate adhesive;

Q9513: M. M. Uddin, et al. Neuroestradiol regulation of ventromedial hypothalamic nucleus 5’-AMP-activated protein kinase activity and counterregulatory hormone secretion in hypoglycemic male versus female rats. Neuroscience 2021;8(1):133-147

Agents: Letrozole Vehicle: CSF, artificial; DMSO; Route: CSF/CNS (left ventricle); Species: Rat; Pump: 1007D; Duration: 5 days;

ALZET Comments: Dose (1.678 ug/ul); 30% Artificial CSF, 70% DMSO used; Controls received mp w/ vehicle; animal info (Adult male and female Sprague Dawley rats, 3–4 months old); Letrozole aka Lz; ALZET brain infusion kit 1 used; Brain coordinates (0.0 mm posterior to bregma; 1.5 mm lateral to bregma; 3.5 mm ventral to brain surface); dependence;

Q10066: R. A. Smith, et al. Development of a molecular therapy for the SOD1 familial variant of ALS. Neurotherapeutics in the Era of Translational Medicine 2021;1-18

Agents: Oligonucleotides; Methylene blue Vehicle: Not Stated; Route: CSF/CNS (right lateral ventricle); Species: Rat; Pump: Not Stated; Duration: 14 days;

ALZET Comments: Animal info (G93A SOD1 transgenic rats, 2-3 months of age); functionality of mp verified by pump weight; neurodegenerative (ALS);

Q8744: S. K. Mun, et al. MicroRNAs Related to Cognitive Impairment After Hearing Loss. Clinical and Experimental Otorhinolaryngology 2021;14(1):76-81

Agents: Amyloid protein, beta (1-42) Vehicle: Acetonitrile; Trifluoroacetic Acid; Route: CSF/CNS (right lateral ventricle);
Species: Rat; Pump: 2002; Duration: 2 weeks;

ALZET Comments: Dose (160 pmol/day); 35% Acetonitrile, 0.1% Trifluoroacetic Acid used; animal info (Wistar rats, 200-250 g, 7 weeks old); behavioral testing (Y-maze test, object-in-place task (OPT), novel object recognition task (NOR), object location task); peptides; ALZET brain infusion kit 2 used; Brain coordinates (anteroposterior, −0.3; lateral, 1.2; vertical, 4.5); neurodegenerative (Hearing loss);

Q9337: D. S. Lee, et al. Regional specific activations of ERK1/2 and CDK5 differently regulate astroglial responses to ER stress in the rat hippocampus following status epilepticus. Brain Research 2021;1753(147262

Agents: Tunicamycin; U0126; Roscovitine Vehicle: Saline; Route: CSF/CNS (right lateral ventricle); Species: Rat; Pump: 1007D; Duration: 7 days;

ALZET Comments: Controls received mp w/ vehicle; animal info (Adult male Sprague-Dawley rats, weight 250–280 g); ALZET brain infusion kit 1 used; Brain coordinates (1 mm posterior; 1.5 mm lateral; − 3.5 mm depth; flat skull position with bregma as reference); neurodegenerative (status epilepticus);
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Bibliography

Q10103: V. Barrios, et al. Cerebral Insulin Bolus Revokes the Changes in Hepatic Lipid Metabolism Induced by Chronic Central Leptin Infusion. Cells 2021;10(3);
Agents: Leptin, Saline Vehicle: Not Stated; Route: CSF/CNS (cerebral ventricle); Species: Rat; Pump: Not Stated; Duration: 14 days;
ALZET Comments: Dose: (0.2 mg/kg/day); Controls received mp w/ vehicle; Animal info: Adult male Wistar rats (250 +/− 10 g)

Q9564: W. Xu, et al. Blockade of Nogo-A/Nogo-66 receptor 1 (NgR1) Inhibits Autophagic Activation and Prevents Secondary Neuronal Damage in the Thalamus after Focal Cerebral Infarction in Hypertensive Rats. Neuroscience 2020;431(103-114
Agents: NEP1-40 Vehicle: PBS; Route: CSF/CNS (right lateral ventricle); Species: Rat; Pump: Duration: 3 days;
ALZET Comments: Dose (270 ug/kg); Controls received mp w/ vehicle; animal info (male Sprague–Dawley rats, weighing 60–90 g); behavioral testing (adhesive removal test); NEP1-40 aka Nogo-66 receptor antagonist peptide; peptides; Brain coordinates (relative to bregma: −1.0 mm anteroposterior, 1.4 mm lateral and -4.0 mm dorsoventral); ischemia (cerebral);

Q9565: M. L. Xu, et al. Calcitriol ameliorated autonomic dysfunction and hypertension by down-regulating inflammation and oxidative stress in the paraventricular nucleus of SHR. Toxicology and Applied Pharmacology 2020;394(114950
Agents: Calcitriol Vehicle: Propylene glycol; Ethanol; Route: CSF/CNS (hypothalamic paraventricular nucleus); Species: Rat; Pump: 1004; Duration: 4 weeks;
ALZET Comments: Dose (40 ng/day); 50% Ethanol, 50% Propylene Glycol used; Controls received mp w/ vehicle; animal info (Twelve-week-old male spontaneously hypertensive rats and Wistar Kyoto rats); Blood pressure measured via radiotelemetry transmitters;140 mmHg - 180 mmHg;Resultant plasma level (700 pg/ml norepinephrine); cardiovascular;

Q10072: M. M. Uddin, et al. Sex-dimorphic neuroestradiol regulation of ventromedial hypothalamic nucleus glucoregulatory transmitter and glycogen metabolism enzyme protein expression in the rat. BMC Neuroscience 2020;21(1):51
Agents: Letrozole Vehicle: CSF, artificial; DMSO; Route: CSF/CNS (left lateral ventricle); Species: Rat; Pump: 1007D; Duration: 6 days;
ALZET Comments: Dose (1.67 ug/uL); 30% Artificial CSF, 70% DMSO used; Controls received mp w/ vehicle; animal info (Adult male Sprague Dawley rats, 3 months old, 362-426 g, Adult female Sprague Dawley rats, 3.5 months old, 234-296 g); Letrozole aka Lz; ALZET brain infusion kit 1 used; Brain coordinates (0.0 mm posterior to bregma; 1.5 mm lateral to bregma; 3.5 mm ventral to brain surface); dependence;

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

Q9009: N. M. Sharma, et al. Central angiotensin II-Protein inhibitor of neuronal nitric oxide synthase (PIN) axis contribute to neurogenic hypertension. Nitric Oxide 2020;94(54-62
Agents: Angiotensin II Vehicle: Saline; Route: CSF/CNS (lateral ventricle); Species: Rat; Pump: 2002; Duration: 14 days;
ALZET Comments: Dose (20 ng/min, 0.5 ul/h); Controls received mp w/ vehicle; animal info (Sprague-Dawley rats (250~300 g)); Blood pressure measured via pressure transducer;84 mmHg - 126 mmHg;Angiotensin II aka Ang II; Brain coordinates (0.8mm caudal to bregma, 1.5mm lateral to the midline and 4.0 mm ventral to the dorsal surface of the skull); cardiovascular;

Q10058: F. Portillo, et al. Nitric oxide controls excitatory/inhibitory balance in the hypoglossal nucleus during early postnatal development. Brain Structure and Function 2020;225(9):2871-2884
Agents: L-NAME; D-NAME Vehicle: Saline, sterile; Route: CSF/CNS (fourth ventricle); Species: Rat; Pump: 1002; Duration: 2 weeks;
ALZET Comments: Dose (180 mg/kg/day); Controls received mp w/ vehicle; animal info (Wistar rat); post op. care (penicillin); functionality of mp verified by pump weight; ALZET brain infusion kit 3 used; dependence;
Q8934: R. J. Perry, et al. Leptin mediates postprandial increases in body temperature through hypothalamus-adrenal medulla-adipose tissue crosstalk. Journal of Clinical Investigation 2020;130(4):2001-2016

**Agents:** Corticosterone  
**Vehicle:** Not Stated;  
**Route:** CSF/CNS (third ventricle);  
**Species:** Rat;  
**ALZET Comments:** Dose (5 mg/d, 20 mg/d); animal info (Male Sprague-Dawley rats, approximately 250 g); dependence;  

Q8923: T. C. Ooi, et al. Neuroprotection of Tropical Fruit Juice Mixture via the Reduction of iNOS Expression and CRH Level in beta-Amyloid-Induced Rats Model of Alzheimer's Disease. Evidence-Based Complementary and Alternative Medicine 2020;2020(5126457

**Agents:** Amyloid beta 1-42  
**Vehicle:** PBS;  
**Route:** CSF/CNS (left lateral ventricle);  
**Species:** Rat;  
**Duration:** 2 weeks;  
**ALZET Comments:** Dose (0.5 μl/hour); Controls received mp w/ vehicle; animal info (Wistar male rats weighing 200 to 250 g); behavioral testing (Open Field Test); Amyloid beta 1-42 aka AB1-42; Brain coordinates (anteroposterior +1.2 mm from Bregma, mediolateral +2.0 mm, dorsoventral +4.0 mm); cyanoacrylate adhesive; neurodegenerative (Alzheimer's Disease);  

Q8671: T. Miyata, et al. Osteoprotegerin Prevents Intracranial Aneurysm Progression by Promoting Collagen Biosynthesis and Vascular Smooth Muscle Cell Proliferation. Journal of American Heart Association 2020;9(17):e015731

**Agents:** Osteoprotegerin  
**Vehicle:** PBS;  
**Route:** CSF/CNS (lateral ventricle);  
**Species:** Rat;  
**Pump:** 2004;  
**Duration:** 28 days;  
**ALZET Comments:** Dose (125 μg/mL); Controls received mp w/ vehicle; animal info (7-week-old male Sprague-Dawley rats); ALZET brain infusion kit 2 used; Brain coordinates (stereotaxic coordinates of bregma: anteroposterior: 0.8 mm, mediolateral: −1.8 mm [both from bregma], dorsoventral: 4 mm below the skull surface); dependence;  

Q8882: W. C. Liu, et al. Environmental Stimulation Counteracts the Suppressive Effects of Maternal High-Fructose Diet on Cell Proliferation and Neuronal Differentiation in the Dentate Gyrus of Adult Female Offspring via Histone Deacetylase 4. International Journal of Environmental Research and Public Health 2020;17(11):

**Agents:** Mc1568  
**Vehicle:** CSF, artificial;  
**Route:** CSF/CNS (right lateral ventricle);  
**Species:** Rat;  
**Pump:** 1002;  
**Duration:** 28 days;  
**ALZET Comments:** Controls received mp w/ vehicle; animal info (Seven-week old nulliparous female Sprague–Dawley rats); Mc1568 aka Histone deacetylase inhibitor; ALZET brain infusion kit used; Brain coordinates (reference to the Bregma: anterior/posterior −1.4 mm; medial/lateral 1.8 mm; dorsal/ventral −3.0 mm); dependence;  

Q8643: M. Li, et al. Impact of Peripheral alpha7-Nicotinic Acetylcholine Receptors on Cardioprotective Effects of Donepezil in Chronic Heart Failure Rats. Cardiovasc Drugs Ther 2020;

**Agents:** Methyllycaconitine  
**Vehicle:** Saline;  
**Route:** SC; CSF/CNS (right lateral ventricle);  
**Species:** Rat;  
**Pump:** 2ML4;  
**Duration:** 4 weeks;  
**ALZET Comments:** "Dose (0.1 μg/kg/day Methyllycaconitine); Controls received mp w/ vehicle; animal info (male Sprague-Dawley rats, 250-280 g, 8 weeks old); Methyllycaconitine aka MLA; ALZET brain infusion kit used; Brain coordinates (4–4.5 mm ventral, 1.4 mm lateral, and 0.8 mm posterior from the bregma); dental cement used;cardiovascular; "  

Q8871: T. J. Lee, et al. Dual functions of CNS inflammation in food intake and metabolic regulation. Brain Research 2020;1740(146859

**Agents:** Tumor necrosis factor, alpha  
**Vehicle:** Saline;  
**Route:** CSF/CNS (third ventricle);  
**Species:** Rat;  
**Pump:** 1004;  
**Duration:** 3 weeks;  
**ALZET Comments:** Dose (0.5 pg/day); Controls received mp w/ vehicle; animal info (Male Sprague Dawley rats, 250-300 g); Brain coordinates (2.2 mm posterior to bregma, and 7.5 mm ventral to the dura); cardiovascular;  

Q8870: D. S. Lee, et al. PDI-Mediated Reduction of Disulfide Bond on PSD95 Increases Spontaneous Seizure Activity by Regulating NR2A-PSD95 Interaction in Epileptic Rats Independent of S-Nitrosylation. International Journal of Molecular Sciences 2020;21(6):

**Agents:** RNA, small interfering (PDI)  
**Vehicle:** Not Stated;  
**Route:** CSF/CNS (right lateral ventricle);  
**Species:** Rat;  
**Pump:** 1007D;  
**Duration:** 7 days;  
**ALZET Comments:** Animal info (Male Sprague Dawley rats, 7 weeks old); ALZET brain infusion kit 1 used; Brain coordinates (1 mm posterior; 1.5 mm lateral; 3.5 mm depth from bregma); neurodegenerative (Epilepsy);
Q8580: J. E. Kim, et al. Blockade of 67-kDa Laminin Receptor Facilitates AQP4 Down-Regulation and BBB Disruption via ERK1/2- and p38 MAPK-Mediated PI3K/AKT Activations. Cells 2020;9(7):
Agents: Immunoglobulin G; SB202190; Wortmannin; 3-chloroacetyl indole; U0126 Vehicle: Not stated; Route: CSF/CNS (right lateral ventricle); Species: Rat; Pump: 1003D; 1007D; Duration: 3 days;
ALZET Comments: Dose (0.3 mg/mL SB202190, 0.1 nmol wortmannin; 25 uM 3-chloroacetyl indole; 25 uM U0126); Controls received mp w/ vehicle; animal info (Adult male Sprague-Dawley rats (7 weeks old)); Immunoglobulin G aka IgG; SB202190 aka p38 MAPK inhibitor; Wortmannin aka PI3K inhibitor; 3-chloroacetyl indole aka 3CAI; U0126 aka ERK1/2; ALZET brain infusion kit 1 used; Brain coordinates (1 mm posterior; 1.5 mm lateral; -3.5 mm depth to bregma); dependence;

Q8579: J. E. Kim, et al. CDDO-Me Inhibits Microglial Activation and Monocyte Infiltration by Abrogating NFκB- and p38 MAPK-Mediated Signaling Pathways Following Status Epilepticus. Cells 2020;9(5):
Agents: 2-Cyano-3; 12-Dioxooleana-1; 9-Dien-28-Oic acid methyl ester Vehicle: Not stated; Route: CSF/CNS (right lateral ventricle); Species: Rat; Pump: 1007D; Duration: 7 days;
ALZET Comments: Dose (0.5 nmol/kg/day); Controls received mp w/ vehicle; animal info (Adult male Sprague–Dawley rats (7 weeks old)); 2-cyano-3,12-dioxooleana-19-dien-28-oic acid methyl ester aka CDDO-Me; ALZET brain infusion kit 1 used; Brain coordinates (1 mm posterior; 1.5 mm lateral; 3.5 mm depth); dependence;

Q10006: J. E. Kim, et al. CDDO-Me Distinctly Regulates Regional Specific Astroglial Responses to Status Epilepticus via ERK1/2-Nrf2, PTEN-PI3K-AKT and NFKappaB Signaling Pathways. Antioxidants (Basel) 2020;9(10):
Agents: 2-Cyano-3,12-dioxo-oleana-1,9(11)-dien-28-oic acid methyl ester; 3-chloroacetyl-indole; SC79; U0126 Vehicle: Not stated; Route: CSF/CNS (right lateral ventricle); Species: Rat; Pump: 1007D; Duration: 7 days;
ALZET Comments: Dose (10 uM 2-Cyano-3,12-dioxo-oleana-1,9(11)-dien-28-oic acid methyl ester; 25 uM 3-chloroacetyl-indole; 25 uM SC79; 25 uM U0126); Controls received mp w/ vehicle; animal info (male Sprague-Dawley rats, 7 weeks old); 2-Cyano-3,12-dioxo-oleana-1,9(11)-dien-28-oic acid methyl ester aka CDDO-Me; 3-chloroacetyl-indole aka 3CAI; SC79 aka AKT activator; U0126 aka ERK1/2 inhibitor; ALZET brain infusion kit 1 used; Brain coordinates (1 mm posterior; 1.5 mm lateral; -3.5 mm depth to the bregma); neurodegenerative (Status Epilepticus);

Q8578: J. E. Kim, et al. Epigallocatechin-3-Gallate and PEDF 335 Peptide, 67LR Activators, Attenuate Vasogenic Edema, and Astroglial Degeneration Following Status Epilepticus. Antioxidants (Basel) 2020;9(9):
Agents: NU335; Epigallocatechin-3-O-gallate Vehicle: Not stated; Route: CSF/CNS (right lateral ventricle); Species: Rat; Pump: 1003D; 1007D; Duration: 3 days;
ALZET Comments: Dose (50 uM Epigallocatechin-3-O-gallate; 1 uM NU335); Controls received mp w/ vehicle; animal info (Adult male Sprague-Dawley rats, 7 weeks old); Epigallocatechin-3-O-gallate; NU335 aka pigment epithelium-derived factor-derived peptide; peptides; ALZET brain infusion kit 1 used; Brain coordinates (1 mm posterior; 1.5 mm lateral; –3.5 mm depth to the bregma); neurodegenerative (Epilepsy);

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); dental cement used;neurodegenerative (Depression);

Q9239: G. Hong-Li, PhD, et al. Chronic Infusion of Astaxanthin Into Hypothalamic Paraventricular Nucleus Modulates Cytokines and Attenuates the Renin–Angiotensin System in Spontaneously Hypertensive Rats. Journal of Cardiovascular Pharmacology 2020;
Agents: Astaxanthin Vehicle: CSF, artificial; Route: CSF/CNS (bilateral paraventricular nuclei); Species: Rat; Pump: 2004; Duration: 4 weeks;
ALZET Comments: Dose (10 ug/h); Controls received mp w/ vehicle; animal info (Spontaneous Hypertensive and Wistar–Kyoto Rats, 12 weeks old, male, 280–300 g); Blood pressure measured via tail cuff method;Brain coordinates (1.8 mm posterior to bregma, 0.4 mm from midline, and 7.9 mm ventral to dura); dependence;
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**Bibliography**

Q8508: G. Gomez-Correa, et al. Chronic Bumetanide Infusion Alters Young Neuron Morphology in the Dentate Gyrus Without Affecting Contextual Fear Memory. Frontiers in Neuroscience 2020;14(514)

**Agents:** Bumetanide **Vehicle:** Propylene; Glycol; **Route:** CSF/CNS (lateral ventricle); **Species:** Rat; **Pump:** 2002; **Duration:** 28 days;

**ALZET Comments:** Dose (0.4 mg/kg/day); Controls received mp w/ vehicle; animal info (male Wistar rats (250–350 g)); Multiple pumps per animal (2 pumps); ALZET brain infusion kit used; Brain coordinates (AP ~ 1.4 mm; ML ~2.0 mm); dependence;

Q8465: M. B. Fernandes, et al. Reprogramming of Lipid Metabolism as a New Driving Force Behind Taurolsodeoxycholic Acid-Induced Neural Stem Cell Proliferation. Frontiers in Cell & Developmental Biology 2020;8(335)

**Agents:** Taurolsodeoxycholic acid **Vehicle:** CSF, Artificial; **Route:** CSF/CNS (lateral ventricle); **Species:** Rat; **Pump:** Not stated; **Duration:** 28 days;

**ALZET Comments:** Dose (300 µM); Controls received mp w/ vehicle; animal info (6- weeks old male Wistar rats); Taurolsodeoxycholic acid aka TUCDA; Brain coordinates (anterior-posterior: ~0.4 mm, medial-lateral: 1.2 mm, dorso-ventral: 3.5 mm); dependence;

Q7647: D. D. Zhang, et al. Carbon Monoxide Attenuates High Salt-Induced Hypertension While Reducing Pro-inflammatory Cytokines and Oxidative Stress in the Paraventricular Nucleus. Cardiovascular Toxicology 2019;

**Agents:** Carbon monoxide-releasing molecule-2; Zinc protoporphyrin IX **Vehicle:** CSF, Artificial; DMSO, Buffered; **Route:** CSF/CNS (paraventricular nucleus); **Species:** Rat; **Pump:** 2006; **Duration:** 6 weeks;

**ALZET Comments:** Dose ([CORM-2 2 nmol/h],[ZnPP IX 2 nmol/h]); 0.5% DMSO in aCSF used; Controls received normal-salt diet and mp w/ vehicle; animal info (male, Dahl Salt-Sensitive, 250-275g); post op. care (buprenorphine 0.01 mg/kg SC immediately after and 12 h postoperatively); Carbon monoxide-releasing molecule-2 (aka CORM-2) is an agent that releases CO from tricarbonyldichlororuthenium (II) dimer; ZnPP IX is an enzyme inhibitor (heme oxygenase-1); Brain coordinates (1.8 mm posterior to the bregma, 0.4 mm lateral to the central line, and 7.9 mm ventral to the zero level); Pump implantation occurred at week 4 of study. Cannulae were secured using dental acrylic. Author states “The success rate of bilateral PVN brain infusion and pump implantation was 75%.” p.2; Therapeutic indication (exogenous or endogenous CO within the PVN might have potential antihypertensive treatment by downregulating COX2 and PICs in the PVN and by reducing PVN oxidative stress-mediated sympathetic activity in high salt-induced hypertension);

Q6949: T. Zera, et al. Microglia and brain angiotensin type 1 receptors are involved in desensitising baroreflex by intracerebroventricular hypertonic saline in male Sprague-Dawley rats. Autonomic Neuroscience: Basic and Clinical 2019;217(49-57)

**Agents:** Minocycline, Losartan **Vehicle:** Saline, iso-osmotic, Saline, hyperosmotic; **Route:** CSF/CNS (lateral ventricle); **Species:** Rat; **Pump:** 2ML2; **Duration:** 2 weeks;

**ALZET Comments:** Dose (Minocycline–5 µg/h; Losartan- 12.5 µg/h); 0.9% isosmotic saline with minocycline, 5% Hyperosmotic saline with Losartan used; animal info (Normotensive adult male Sprague-Dawley rats); enzyme inhibitor (microglia); ALZET brain infusion kit 2 used; Brain coordinates (1.2mm posterior to bregma, ~1.8mm laterolateral from sagittal suture, diameter 0.5 mm) bilateral cannula used; cyanoacrylate adhesive; cardiovascular;

Q7159: X. J. Yu, et al. Chronic Intracerebroventricular Infusion of Metformin Inhibits Salt-Sensitive Hypertension via Attenuation of Oxidative Stress and Neurohormonal Excitation in Rat Paraventricular Nucleus. Neurosci Bull 2019;35(1):57-66

**Agents:** Metformin **Vehicle:** CSF, artificial; **Route:** CSF/CNS (lateral ventricle); **Species:** Rat; **Pump:** 2006; **Duration:** Not Stated;

**ALZET Comments:** Dose (25 ug/day); animal info (Eight-week-old male Dahl salt-sensitive rats); Brain coordinates (0.5 mm posterior to bregma, 1.5 mm lateral to the midline, and 2.7 mm below the skull surface); diabetes;

Q6991: N. Yousefi, et al. Prestimulation of Microglia Through TLR4 Pathway Promotes Interferon Beta Expression in a Rat Model of Alzheimer’s Disease. J Mol Neurosci 2019;

**Agents:** Amyloid beta oligomers; High-density lipoprotein, human **Vehicle:** Not Stated; **Route:** CSF/CNS (lateral ventricle); **Species:** Rat; **Pump:** 1002; **Duration:** 14 days;

**ALZET Comments:** Dose (25 µg- Aß oligomer, 250 µg/ml human high-density lipoprotein); Controls received mp w/ vehicle; animal info (Male Wistar rats, 220–250 g); Brain coordinates (AP, – 0.96; L ± 1.8; DV, – 3.4); neurodegenerative (Alzheimer’s);
Q8836: S. Xing, et al. EphrinB2 activation enhances angiogenesis, reduces amyloid-b deposits and secondary damage in thalamus at the early stage after cortical infarction in hypertensive rats. Journal of Cerebral Blood Flow & Metabolism 2019;39(1776–1789)

**Agents:** Ephrin B2-Fc, human recombinant; Fc-IgG, human recombinant  
**Vehicle:** PBS, Human Serum Albumin buffered;  
**Route:** CSF/CNS (lateral ventricle);  
**Species:** Rat;  
**Pump:** Not Stated;  
**Duration:** 3 days;  

**ALZET Comments:**  
Dose (EphB2-Fc 100 μl), (IgG-Fc 100 μl)); 0.01M phosphate-buffered saline (pH7.4) containing 0.1% human serum albumin used; Controls received sham surgery; animal info (male, Sprague-Dawley, 80-100g); post op. care (Body temperature of animals kept at 37±0.5C with a heating pad during recovery); behavioral testing (Adhesive removal test); Brain coordinates (1.0 mm anteroposterior, 1.4 mm lateral, 4.0 mm dorsoventral relative to bregma); Cannula placement verified via stereotaxic frame; ischemia (cerebral infarction); pump model not stated although flow rate listed as 100ul; Therapeutic indication (EphB2-Fc treatment significantly accelerated the sensory recovery compared with those in the IgG-Fc group. Activation of ephrinB2 can promote angiogenesis, decrease Abeta deposits and rescue the secondary neurodegeneration of thalamus after cerebral infarction.);

Q6799: H. Tian, et al. Chronic infusion of berberine into the hypothalamic paraventricular nucleus attenuates hypertension and sympathoexcitation via the ROS/Erk1/2/iNOS pathway. Phytomedicine 2019;52(216-224

**Agents:** Berberine  
**Vehicle:** CSF, artificial;  
**Route:** CSF/CNS (Paraventricular nucleus);  
**Species:** Rat;  
**Pump:** 2006;  
**Duration:** 28 days;  

**ALZET Comments:** Dose (2 μg / h); Controls received mp w/ vehicle; animal info (adult male Sprague-Dawley rats (240–280 g).); bilateral cannula used;

Q7633: S. Tekin, et al. Effects of intracerebroventricular administration of irisin on the hypothalamus-pituitary-gonadal axis in male rats. J Cell Physiol 2019;234(6):815–824

**Agents:** Irisin  
**Vehicle:** CSF, artificial;  
**Route:** CSF/CNS (right lateral ventricle);  
**Species:** Rat;  
**Pump:** 2ML1;  
**Duration:** 7 days;  

**ALZET Comments:** Dose (10nM, 100nM); Controls received mp w/ vehicle; animal info (adult male Wistar Albino rats (250–270 g)); ALZET brain infusion kit 1 used; Pumps implanted 7 days after cannula; Therapeutic indication (infertility);

Q7265: R. K. Sharma, et al. Microglial Cells Impact Gut Microbiota and Gut Pathology in Angiotensin II-Induced Hypertension. Circulation Research 2019;124(5):727-736

**Agents:** Angiotensin II, Tetracycline -3, chemically modified  
**Vehicle:** Saline; CSF, artificial;  
**Route:** SC; CSF/CNS (left lateral ventricle);  
**Species:** Rat;  
**Pump:** 2004;  
**Duration:** 4 weeks;  

**ALZET Comments:** Dose: Ang II (200 ng/kg/min), CMT-3 (3.5μg/h); Controls received mp w/ vehicle; animal info (Sprague-Dawley rats (250-280g) and six-week old male SHR and their normotensive controls); Brain coordinates (1.0mm caudal to bregma,1.8mm lateral to midline and 4.4mm ventral to the skull surface); cardiovascular;

Q7422: V. V. Senatorov, et al. Blood-brain barrier dysfunction in aging induces hyper-activation of TGF-beta signaling and chronic yet reversible neural dysfunction. bioRxiv 2019;537431

**Agents:** Albumin, bovine serum; BSA, Alexa Fluor 647 conjugated  
**Vehicle:** CSF, artificial;  
**Route:** CSF/CNS (right lateral ventricle);  
**Species:** Mice, Rat;  
**Pump:** 2001, 2ML1;  
**Duration:** 7 days;  

**ALZET Comments:** Dose (0.4mM bovine serum albumin for mice, 0.2 mM bovine serum albumin for rat, 2.68 g/L BSA ); animal info (adult male mice, 10 week-old male Wistar rats were used.); behavioral testing (Morris water maze); ALZET brain infusion kit 3 used; Brain coordinates (0.5 mm posterior, 1 mm lateral to bregma for mice, -1 mm posterior and 1.5 mm lateral to bregma for rat); neurodegenerative (astrocytic TGF-beta signaling, aberrant ECG activity, cognitive impairment);

Q7004: S. Moon, et al. Morphine Dependence is Attenuated by Treatment of 3,4,5-Trimethoxy Cinnamic Acid in Mice and Rats. Neurochem Res 2019;  

**Agents:** Morphine; Trimethoxy cinnamic acid, 3, 4, 5-  
**Vehicle:** Saline;  
**Route:** CSF/CNS (lateral ventricle);  
**Species:** Rat;  
**Pump:** 2ML1;  
**Duration:** 7 days;  

**ALZET Comments:** Dose (26 nmol/10μ l/hr); Controls received mp w/ vehicle; animal info (male Sprague–Dawley rats, 220–240 g)); behavioral testing (Conditioned Place Preference Test); dependence;
Q7009: N. R. Laferriere, et al. Inhibition of microRNA-124-3p as a novel therapeutic strategy for the treatment of Gulf War Illness: Evaluation in a rat model. Neurotoxicology 2019;71(16-30

**Agents:** mo-miR-124-3p  
**Vehicle:** CSF, artificial  
**Route:** CSF/CNS (lateral ventricle)  
**Species:** Rat  
**Pump:** 2004  
**Duration:** 28 days  
**ALZET Comments:** Dose (concentrations of 0, 0.05, 0.1 or 0.5 nmol/day); post op. care (carprofen); ALZET brain infusion kit 2 used; Brain coordinates (1.00mm caudal and 1.40mm lateral to bregma, with no height adjustment spacers); bilateral cannula used; dependence; Therapeutic indication (Gulf War Illness);

Q8569: J. E. Kim, et al. Roscovitine Attenuates Microglia Activation and Monocyte Infiltration via p38 MAPK Inhibition in the Rat Frontoparietal Cortex Following Status Epilepticus. Cells 2019;8(7):  

**Agents:** Roscovitine; SB202190  
**Route:** CSF/CNS (right lateral ventricle)  
**Species:** Rat  
**Pump:** 1007D  
**Duration:** 7 days  
**ALZET Comments:** Dose (100 uM roscovitine; 0.3 mg/mL SB202190); Controls received mp w/ vehicle; animal info (adult male Sprague-Dawley rats, 7 weeks old); SB202190 aka p38 MAPK inhibitor; ALZET brain infusion kit 1 used; Brain coordinates (1 mm posterior; 1.5 mm lateral; -3.5 mm depth to the bregma); neurodegenerative (Epilepsy);

Q8568: J. E. Kim, et al. CDDO-Me Selectively Attenuates CA1 Neuronal Death Induced by Status Epilepticus via Facilitating Mitochondrial Fission Independent of LONP1. Cells 2019;8(8):  

**Agents:** CDDO-Me; LONP1  
**Route:** CSF/CNS (right lateral ventricle)  
**Species:** Rat  
**Pump:** 1007D  
**Duration:** 3 days  
**ALZET Comments:** Dose (10 uM CDDO-Me); Controls received mp w/ vehicle; animal info (Male Sprague-Dawley rats, 7 weeks old); LONP1 aka Lon protease-1, CDDO-Me aka 2-Cyano-3,12-dioxo-oleana-1,9(11)-dien-28-oic acid methyl ester; ALZET brain infusion kit 1 used; Brain coordinates (1 mm posterior; 1.5 mm lateral; -3.5 mm depth to the bregma); neurodegenerative (Epilepsy);

Q8571: J. E. Kim, et al. PKC, AKT and ERK1/2-Mediated Modulations of PARP1, NF-kappaB and PEA15 Activities Distinctly Regulate Regional Specific Astroglial Responses Following Status Epilepticus. Frontiers in Molecular Neuroscience 2019;12(180  

**Agents:** Bisindolylmaleimide; 3-chloroacetyl-indole; U0126; KN-93; PJ-34; SC79  
**Vehicle:** Not stated  
**Route:** CSF/CNS (lateral ventricle)  
**Species:** Rat  
**Pump:** 1007D  
**Duration:** 3 days  
**ALZET Comments:** Dose (25 uM Bisindolylmaleimide; 25 uM 3-chloroacetyl-indole; 25 uM U0126; 25 uM KN-93; 3 uM PJ-34; 25 uM SC79); Controls received mp w/ vehicle; animal info (adult male Sprague-Dawley rats, 250-280 g); Bisindolylmaleimide aka BIM; 3-chloroacetyl-indole aka 3CAI; U0126 aka PARP inhibitor VIII; SC79 aka AKT activator; ALZET brain infusion kit 1 used; Brain coordinates (1 mm posterior; 1.5 mm lateral; -3.5 mm depth to the bregma); neurodegenerative (Epilepsy);

Q8570: J. E. Kim, et al. Blockade of AMPA Receptor Regulates Mitochondrial Dynamics by Modulating ERK1/2 and PP1/PP2A-Mediated DRP1-S616 Phosphorylations in the Normal Rat Hippocampus. Frontiers in Cell Neurosciences 2019;13(179  

**Agents:** U0126; SP600125; Okadaic acid; Cyclosporin A  
**Vehicle:** Not stated  
**Route:** CSF/CNS (right lateral ventricle)  
**Species:** Rat  
**Pump:** 1007D  
**Duration:** 7 days  
**ALZET Comments:** Dose (BIM 25uM, KN-93 25uM, H-89 10uM, U0126 25uM, Okadaic acid 10uM, Cyclosporine A 250uM); animal info (Male Sprague-Dawley rats, 7 weeks old); U0126 aka ERK1/2 inhibitor, KN-93 aka CAMKII inhibitor, PJ-34 aka PARP inhibitor VIII; SC79 aka AKT activator; ALZET brain infusion kit 1 used; Brain coordinates (1 mm posterior; 1.5 mm lateral; -3.5 mm depth to the bregma); dependence;

Q7349: J. E. Kim, et al. Perampanel Affects Up-Stream Regulatory Signaling Pathways of GluA1 Phosphorylation in Normal and Epileptic Rats. Front Cell Neurosci 2019;13(80  

**Agents:** Bisindolylmaleimide; KN-93; H-89; U0126; SP600125; okadaic acid; cyclosporin A  
**Vehicle:** Not Stated  
**Route:** CSF/CNS (right lateral ventricle)  
**Species:** Rat  
**Pump:** 1003D  
**Duration:** 3 days  
**ALZET Comments:** Dose (25 uM U0126; 10 uM SP600125; 10 uM Okadaic acid; 250 uM Cyclosporin A); Controls received mp w/ vehicle; animal info (Male Sprague-Dawley rats, 7 weeks old); U0126 aka ERK1/2 inhibitor, SP600125 aka JNK inhibitor, Okadaic acid aka PKP/P2A inhibitor, Cyclosporin A aka CsA; ALZET brain infusion kit 1 used; Brain coordinates (1 mm posterior; 1.5 mm lateral; -3.5 mm depth to the bregma); neurodegenerative (Epilepsy);
Q7348: P. S. Khansari, et al. Mechanisms Underlying Neuroprotection by the NSAID Mefenamic Acid in an Experimental Model of Stroke. Front Neurosci 2019;13(64

**Agents:** Mefenamic Acid, Sodium Salicylate  
**Vehicle:** Not Stated;  
**Route:** CSF/CNS (Left Lateral Ventricle);  
**Species:** Rat;  
**Pump:** 2001D;  
**Duration:** 24 Hours;  

**ALZET Comments:** Dose (MFA (0.5 or 1 mg/kg), sodium salicylate (1 mg/kg)); Controls received mp w/ vehicle; animal info (32 male Wistar rats weighing 300–350 g); animal info (32 male Wistar rats weighing 300–350 g); Brain coordinates (1.5 mm lateral and 2 mm posterior to the left of bregma); ischemia (ischemic stroke);

Q7621: M. Janecek, et al. Oxytocin facilitates adaptive fear and attenuates anxiety responses in animal models and human studies-potential interaction with the corticotropin-releasing factor (CRF) system in the bed nucleus of the stria terminals (BNST). Cell and Tissue Research 2019;375(1):143-172

**Agents:** Oxytocin; atosiban  
**Vehicle:** Not Stated;  
**Route:** CSF/CNS (lateral ventricle);  
**Species:** Mice; Rats;  
**Pump:** Not Stated;  
**Duration:** 15 days; 14 days;  

**ALZET Comments:** Dose (Oxytocin 1, 10 ng/h), (atosiban 600 μg/kg/day)); animal info (adult, male); behavioral testing (elevated plus maze, light-dark box, chronic subordinate colony stress); Atosiban is an inhibitor of the hormones oxytocin and vasopressin; literature review: author lists studies where oxytocin was administered to mice and atosiban was administered to rats;

Q8021: M. T. Hackl, et al. Brain leptin reduces liver lipids by increasing hepatic triglyceride secretion and lowering lipogenesis. Nat Commun 2019;10(1):2717

**Agents:** Leptin; LpR  
**Vehicle:** Saline; CSF, artificial;  
**Route:** IP; CSF/CNS (third ventricle);  
**Species:** Rat;  
**Pump:** 2004;  
**Duration:** 2 weeks;  

**ALZET Comments:** Dose (0.3 ug/day); 0.9% used; Controls received mp w/ vehicle; animal info (10 weeks old, Male, Sprague Dawley); dependence; LpR AKA Leptin Receptor Antagonist;

Q8010: Y. Gong, et al. Increased TRPM4 Activity in Cerebral Artery Myocytes Contributes to Cerebral Blood Flow Reduction After Subarachnoid Hemorrhage in Rats. Neurotherapeutics 2019;16(3):901-911

**Agents:** Transient receptor potential melastatin-4 blocker (TRPM4)  
**Vehicle:** Saline;  
**Route:** CSF/CNS (right lateral ventricle);  
**Species:** Rat;  
**Pump:** Not stated;  
**Duration:** 3, 5, 7 days;  

**ALZET Comments:** Dose (900 uL); Controls received mp w/ vehicle; animal info (Sprague Dawley, 300-350 g); TRPM4 aka 9-phenanthrol; Brain coordinates (bregma, − 0.8 mm; lateral, 1.4 mm and depth, 4 mm); bilateral cannula used; neurodegenerative (Subarachnoid hemorrhage);

Q7473: C. Fekete, et al. Chronic Amyloid beta Oligomer Infusion Evokes Sustained Inflammation and Microglial Changes in the Rat Hippocampus via NLRP3. Neuroscience 2019;405(35-46

**Agents:** Amyloid, Beta 1-42; MCC950  
**Vehicle:** CSF, artificial;  
**Route:** CSF/CNS (right lateral cerebral ventricle);  
**Species:** Rat;  
**Pump:** 2004;  
**Duration:** 4 weeks;  

**ALZET Comments:** Dose (1.67 ug/d-AB 1-42, 0.167 ug/ml- MCC950); Controls received mp w/ vehicle; animal info (Male, Long Evans, 8 months old); behavioral testing (Morris water-maze, ); enzyme inhibitor (NLRP3 inhibitor); Brain coordinates (D= 5.3 mm, L= 1.4 mm, AP= 0.8 mm); bilateral cannula used; neurodegenerative (Spatial Memory);

Q7472: K. Farrell, et al. Systemic Inhibition of Soluble Tumor Necrosis Factor with XPro1595 Exacerbates a Post-Spinal Cord Injury Depressive Phenotype in Female Rats. J Neurotrauma 2019;

**Agents:** XPro1595  
**Vehicle:** Saline;  
**Route:** CSF/CNS (left lateral ventricle);  
**Species:** Rat;  
**Pump:** 2004;  
**Duration:** 28 days;  

**ALZET Comments:** Dose (10 mg/kg); Controls received mp w/ vehicle; animal info (Female, Sprague Dawley, 223-250 g); post op. care (); behavioral testing (Sucrose Preference, Novel Object Recognition, Open Field, Social Exploration, Modified forced swim test, Basso Beattie Bresnahan open field, Automated von Frey, Hargreaves’ Thermal Testing, ); ALZET brain infusion kit 2 used; Brain coordinates (AP: -1.0 ML, +2.0, DV: -4.0- to -3.5); bilateral cannula used; cyanoacrylate adhesive; spinal cord injury;
Q7954: A. Carvalho-Galvao, et al. Central Inhibition of Tumor Necrosis Factor Alpha Reduces Hypertension by Attenuating Oxidative Stress in the Rostral Ventrolateral Medulla in Renovascular Hypertensive Rats. Front Physiol 2019;10(491
Agents: pentoxifylline Vehicle: Not stated; Route: CSF/CNS (lateral ventricle); Species: Rat; Pump: 2002; Duration: 14 days; ALZET Comments: Dose (30 nmol/μL/h); Controls received sham surgery; animal info (male, Wistar, 150–300g); enzyme inhibitor (TNF-alpha); ALZET brain infusion kit 2 used; Brain coordinates (0.9 mm posterior to the bregma, 1.5 mm lateral to the midline, 4.0 mm below the pial surface); cardiovascular; Therapeutic indication (TNFalpha inhibition promotes an improvement in baroreflex sensitivity and reduces superoxide accumulation in RVLM of 2K1C hypertensive rats.);

Q7953: M. Carmo, et al. Enhanced ATP release and CD73-mediated adenosine formation sustain adenosine A2A receptor over-activation in a rat model of Parkinson's disease. Br J Pharmacol 2019;176(18):3666-3680
Agents: adenosine diphosphate, alpha-beta-methylene- Vehicle: saline; Route: CSF/CNS (lateral ventricle); Species: Rat; Pump: 1002; Duration: Not stated; ALZET Comments: Dose (100 μM at 0.25 μl/hr); Controls received mp w/ vehicle; animal info (male, Wistar, 220–250g); behavioral testing (open field, object recognition, cylinder test); alpha-beta-methyleneADP is a CDP inhibitor; enzyme inhibitor (Ecto-5'-Nucleotidase); ALZET brain infusion kit 2 used; Brain coordinates (1.5 mm posterior, 1.0 mm lateral, and 3.7 mm below the horizontal plane of bregma); neurodegenerative (Parkinson’s);

Q4964: S. Bake, et al. Insulin-like Growth Factor (IGF)-1 treatment stabilizes the microvascular cytoskeleton under ischemic conditions. Experimental Neurology 2019;311(162-172
Agents: Insulin-like growth factor-I, recomb. Human; JB-1 Vehicle: saline; Route: CSF/CNS (right lateral ventricle); Species: Rat; Pump: 1003D; 1007D; Duration: 1 day; 5 days; ALZET Comments: Dose (100 μg/ml rhIGF-1; 20 μg/ml JB-1); Controls received mp with vehicle; animal info (Female Sprague Dawley rats; 10–12 months; weight range 325–350 g); JB-1 is an IGFR inhibitor; Brain coordinates (+1.0 mm lateral & −0.9 mm posterior to Bregma); Cannula placement verified via RARE T2 weighted sequence; ischemia (middle cerebral artery occlusion);

Q7271: M. M. C. Arroja, et al. Assessing the effects of Ang-(1-7) therapy following transient middle cerebral artery occlusion. Sci Rep 2019;9(1):3154
Agents: Angiotensin (1-7) Vehicle: CSF, artificial; Route: CSF/CNS (lateral ventricle); Species: Rat; Pump: 2001; Duration: 7 Days; ALZET Comments: Controls received mp w/ vehicle; animal info (Male Wistar rats, 300–380 g); Brain coordinates (+1.6 mm lateral & −0.9 mm posterior to Bregma); Cannula placement verified via RARE T2 weighted sequence; ischemia (middle cerebral artery occlusion);

Q7939: K. A. Alkadhi, et al. Effect of Exercise and Abeta Protein Infusion on Long-Term Memory-Related Signaling Molecules in Hippocampal Areas. Mol Neurobiol 2019;56(7):4980-4987
Agents: Amyloid protein, beta (1-42) Vehicle: Water, Distilled, Acetonitrile and trifluoroacetate buffered; Route: CSF/CNS (lateral ventricle); Species: Rat; Pump: Not stated; Duration: 14 days; ALZET Comments: Dose (250 pmol/day); 64.9% distilled water, 35% acetonitrile, and 0.1% trifluoroacetate used; Controls received mp with inactive A-beta protein; animal info (male, Wistar, 176–200g); Brain coordinates (AP ~ 0.3, L 1.2, V 4); Cannula placement verified via stereotaxic frame; neurodegenerative (Alzheimer’s); mp model not stated although listed as 14-day model used;

Q7360: D. Aguado-Llera, et al. Improvement in inflammation is associated with the protective effect of Gly-Pro-Glu and cycloprolylglycine against Abeta-induced depletion of the hippocampal somatostatinergic system. Neuropharmacology 2019;151(112-126
Agents: Beta-amyloid 25-35 peptide Vehicle: Saline; Route: CSF/CNS (right lateral ventricle); Species: Rat; Pump: Pump model not stated; Duration: 14 days; ALZET Comments: Dose (0.5 ul/hr); 0.9% saline used; Controls received mp w/ vehicle; animal info (Female, Wistar, 8 weeks old, 250–280 g); bilateral cannula used; neurodegenerative (Alzheimer’s disease);