Intrinsic variability in transmission at excitatory synapses between ocellar L-neurons in the locust, *Schistocerca gregaria*

Peter J. Simmons* and Rob de Ruyter van Steveninck†

**Department of Neuroscience, Newcastle University, Newcastle upon Tyne NE2 4HH, UK and †Lewis Thomas Laboratory, Princeton University, Princeton, NJ 08544, USA*

Variation in the amount of neurotransmitter released from one trial to the next limits the reliability with which synapses transfer information. We have investigated this at an excitatory synapse made between two types of neuron in the ocellar system of the locust, *Schistocerca gregaria*. In the seven large second-order neurons of a lateral ocellus ('L-neurons'), small, graded changes in membrane potential convey information about changes in light and regulate release of neurotransmitter at output synapses. Small, rebound spikes, which are graded in amplitude, enhance responses to rapid decreases in light. Neurons L1–3 make excitatory synapses with large, third-order neurons and L-neurons L4–5 (Simmons, 1982). At these synapses, a regenerative response in the postsynaptic neuron normally hides the postsynaptic potential mediated by a rebound spike in a presynaptic neuron. We have used a two-electrode voltage clamp in order to measure the amplitudes of postsynaptic currents (PSCs) at the synapses made by L1–3 onto L4–5. Rebound spikes were elicited in the presynaptic neuron at the ends of pulses of injected hyperpolarising current. Over a range of presynaptic rebound spike amplitudes between 4 and 20 mV, there is a linear relationship between the amplitudes of a presynaptic spike and the PSC it mediates. Residuals either side of a regression line plotting this relationship have a standard deviation about twice as great as the standard deviation of background noise (means from three experiments, ±0.20 mV for residuals, ±0.13 mV for background noise). This indicates that there is considerable noise intrinsic to the process of transmission at these synapses. This intrinsic noise is constant in amplitude throughout the operating range of the synapse, which indicates that presynaptic potential does not regulate the rate at which neurotransmitter is released by simply altering the probability of release of individual vesicles.

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This work was supported by BBSRC.

Targeted limb movements of insects

Tom Matheson and Volker Dürr

Department of Zoology, University of Cambridge, Downing Street, Cambridge CB2 3EJ, UK and Abteilung für Biokybernetik und Theoretische Biologie, Fakultät für Biologie, Universität Bielefeld, Postfach 10 01 31, D-33501 Bielefeld, Germany

Touching different sites on the body of a locust elicits scratching movements of one or more legs that are directed towards the stimulus (Berkowitz & Laurent, 1996; Matheson, 1998). To determine how these movements are generated requires an understanding of how spatial information signalling target location is used to drive groups of motor neurones that control muscles of several limb joints. To address this question we have analysed in detail the kinematics of targeted scratching movements of the locust *Schistocerca gregaria*. Mechanical activation of localised arrays of tactile hairs on a front wing elicits appropriately targeted movements of a hindleg, which scratches the target site. Single frame analysis of 839 videotaped scratches from eight animals has allowed us to quantify leg joint angles and tarsal trajectories in relation to the start posture of the leg, three different loading conditions, and the target position on the wing.

We show that touching stimulus sites along the length of the wings elicits a graded series of scratches that form a behavioural continuum. There is no evidence for discrete switching between alternative strategies, at least for the combinations of two start positions and five target locations that we used. When the leg was unloaded, the precision of scratching (computed as the minimum distance between the tarsus and the target) was similar for all except the most anterior stimulus site, where it was reduced. The mean direction of tarsal movement calculated over the first 200 ms of each scratch revealed a biased lift-off direction that depended on the initial leg posture. This part of the response therefore differed systematically from the optimal direction required to reach the target.

A detailed analysis of the two-dimensional 'response fields' of tarsal position for different stimulus sites along the wing provides powerful evidence for precise graded limb targeting in insects.

Loading the leg with a mass of 142 mg at the proximal femur, distal femur or distal tibia (unloaded leg mass is 117 mg) made no significant difference to the precision of targeting (ANOVA, $P > 0.05$, $N = 3$ animals). This suggests that position is a controlled factor in these targeted scratching movements.

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This work was supported by a BBSRC Advanced Research Fellowship and a Royal Society Research Grant to T.M. and a FIF2 grant of the University of Bielefeld to V.D.

Effect of the anthelmintic emodepside on locomotion in *C. elegans*, and on the somatic muscle of *A. suum*

K. Amliwala, J. Willson, L. Holden-Dye, A. Harder* and R.J. Walker

*Neuroscience Research Group, School of Biological Sciences, University of Southampton, Southampton SO16 7PX, UK and *Animal Health, Bayer AG, OP-BIO/RD, Building 6210, 40789 Monheim, Germany*

Emodepside is an anthelmintic with a distinct mode of action which may involve a latrophilin receptor (Bernt *et al.* 1998). Here we report preliminary studies using the nematode *Caenorhabditis elegans* for behaviour and *Ascaris suum* for physiology, with the aim of identifying the genetic basis of emodepside action.

The effect of emodepside on a synchronized population of *C. elegans* (N2 Bristol strain) was determined. Approximately 100 eggs were placed on agar plates containing *E. coli* (*OP50*) and either emodepside (100 pM–90 nM) or vehicle control (1% ethanol). The developmental progress of the worm was monitored for 5 days. The effect of emodepside on locomotion was determined by counting body bends/min. Emodepside had no observable effect on larval stages of *C. elegans* at any of the concentrations tested. However, in mature fertile adults there was a concentration-dependent effect on locomotion. The threshold for this effect was observed at 4.5 nM (13 ± 2 compared with control 25 ± 1 body bends/min, $n = 4$), and at 90 nM locomotion was dramatically decreased ($P < 0.0001$, Student's unpaired t test) to 1.3 ± 0.3 body bends/min (means ± S.E.M.). This suggests emodepside interacts with a target that is expressed,

or is functionally important, in the adults only. Furthermore, this target is involved in motor control.

To determine whether the effect of emodepside may be mediated pre- or postsynaptic to the neuromuscular junction, we performed physiological experiments on an *in vitro* preparation of *A. suum* body wall muscle as described by Trim *et al.* (1997). The effect of drugs on muscle tension was compared for muscle strips with or without nerve cord. The excitatory neuromuscular junction transmitter acetylcholine, ACh (30 μM), elicited a rapid and reversible contraction in both preparations. Emodepside (10 μM) inhibited this contraction in muscle with nerve cord but not in denervated muscle (39 ± 6% inhibition with nerve cord, $n = 7$; 0.5 ± 6% inhibition in denervated muscle, $n = 6$; means ± S.E.M.).

These data show that emodepside has an inhibitory action on locomotion and that its action in the nematode motor nervous system is likely to be presynaptic to the neuromuscular junction. We are currently investigating the role of *C. elegans* candidate latrophilin-like receptors in the mode of action of emodepside.

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Kiran Amliwala is a BBSRC-CASE student.

GnRH and FMRFamide: two neuro-bioactive molecules involved in *Octopus vulgaris* reproduction

Carlo di Cristo, Marina Paolucci and Anna Di Cosmo

Faculty of Science, University of Sannio, Via Port'Arsa 11, 82100 Benevento, Italy

In *Octopus vulgaris*, the endocrine optic glands on the optic tract control the maturation of the gonads (Wells & Wells, 1959). The glands are innervated by the optic gland nerve which originates in the central nervous system (Young, 1971). This nerve provides direct and indirect signals, coming from the centres of integration of chemical, visual and olfactive stimuli, in order to modulate the glandular activity. In these centres, the subpedunculate area and the olfactory and optic lobes, FMRFamide-like and cGnRH-I-like immunoreactivities were detected (Di Cosmo & Di Cristo, 1998). The subpedunculate area seems to be the source of the FMRFamide-like peptide, whereas the posterior olfactory lobule is the source of the GnRH-like peptide. The immunoreactive fibres for both neuropeptides leave their sources and directly enter the optic gland nerve. FMRF-amide and GnRH-immunoreactive nerve endings are present on the glandular cells (Di Cosmo & Di Cristo, 1998).

Here we report the evidence of FMRFamide-like and cGnRH-I-like immunoreactivity in the reproductive tract of both female ($n = 3$) and male ($n = 3$) *Octopus vulgaris*. For experiments, animals were anaesthetised by immersion in 2% ethanol in seawater and humanely killed by cutting the dorsal aorta. Cell bodies and fibres are immunolocalized in the fusiform ganglion from which the duct nerves that reach the female and male reproductive tracts arise (Young, 1967). FMRFamide-like and cGnRH-I-like immunoreactive nerve endings are present in the oviduct, and in the oviducal gland of the female and in the seminal vesicle of the male. The GnRH-like peptide has been partially characterized by HPLC and MALDI-TOF analyses. The retention of the *Octopus* GnRH-like peptide is similar to the retention time of the cGnRH-I used as standard. We suggest that FMRFamide-like and GnRH-I-like peptides are involved in the control of gamete transport along the reproductive tract of both sexesand in the secretion of mucus and mucilaginous substances respectively from the oviducal gland and the seminal vesicle. Our data provide further evidence to support the hypothesis of the existence of a central and peripheral peptidergic control of the reproductive behaviour of *Octopus vulgaris*.

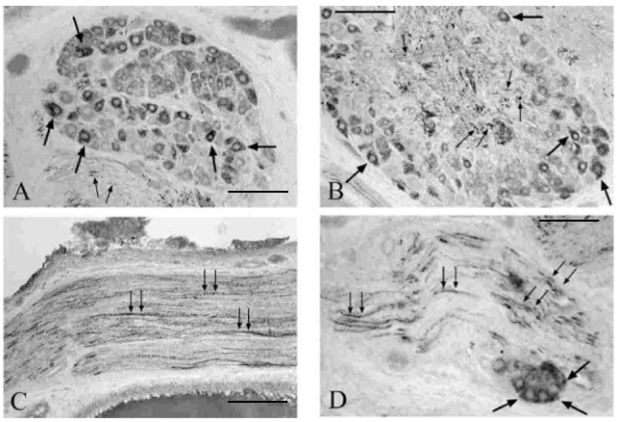

Figure 1. Transverse sections (A and B) of the fusiform ganglion and longitudinal sections (C and D) of nerves embracing the ducts of *Octopus vulgaris* showing FMRFamide-like and cGnRH-I-like immunoreactivity. FMRFamide (A) and cGnRH-I (B) immunopositive cell bodies (large arrows) and fibres (small arrows) in fusiform ganglia are shown. FMRFamide-like (C) and cGnRH-I-like (D) immunopositive fibres (small arrows) are seen in the nerves that arise from the ganglion. In D, cGnRH-I-like immunoreactive neurons (large arrows) are shown. Scale bars = 150 μm.

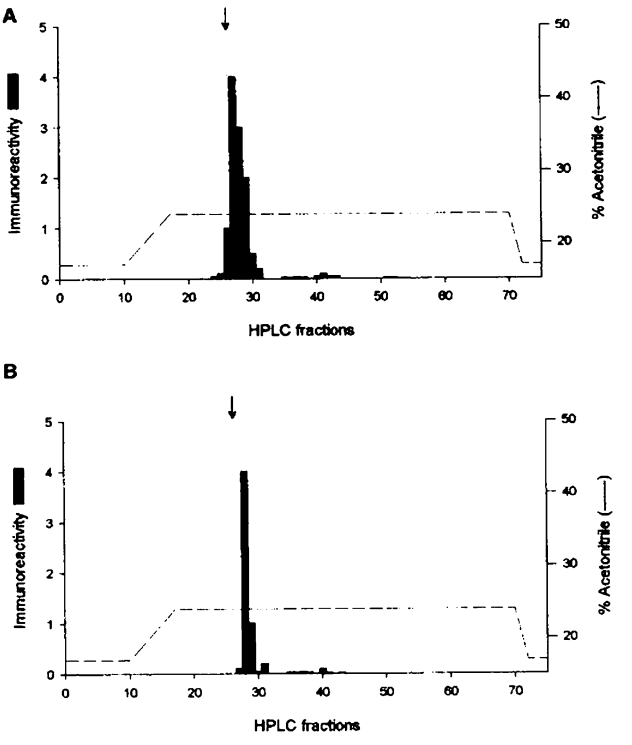

Figure 2. HPLC profile of extracts of the reproductive tract of female *Octopus*. A, cGnRH-I-like immunoreactivity was present in fraction 26–31 using acetonitrile in TEAF (triethylaamine-formic acid) (pH 2.25) as the mobile phase. Faint immunoreactivity is present in fractions 34–43. B, fractions from 26 to 31 were pooled and injected using acetonitrile in TEAF (pH 6.5) as the mobile phase. The arrow represents the retention time of the standard cGnRH-I. The profiles shown here are representative of at least three experiments. Fractions from males gave similar results.

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All procedures accord with current National and/or Local guidelines.

Localization and distribution of progesterone receptors in the hypothalamus and pituitary of the domestic fowl (*Gallus domesticus*)

B. Das*, R.W. Lea* and P.J. Sharp†

**University of Central Lancashire, Preston PR1 2HE and †The Roslin Institute, Roslin, Midlothian EH25 9PS, UK*

In avian species, gonadal steroids are closely involved with neuroendocrine events and the behaviour associated with the breeding cycle. The pre-ovulatory surge of progesterone in the domestic fowl is involved in the timing of oviposition and ovulation (Wilson & Sharp, 1976) and in addition, progesterone has a central action on the expression of appropriate nesting behaviour (Wood-Gush *et al.* 1977).

Previous studies using immunocytochemistry (ICC) have demonstrated the existence of central progesterone receptors in the hypothalamic region of the domestic fowl, but the identification of exact nuclei is as yet unclear (Kawashima *et al.* 1978; Sterling *et al.* 1987).

The purpose of this study is firstly to accurately identify the distribution of central and pituitary progesterone receptor immunoreactivity (PR-ir), and secondly to quantify any changes in PR-ir expression that may be associated with the stages of the breeding cycle.

Adult domestic fowl were terminally anaesthetized with an intramuscular injection of sodium pentobarbitone (60 mg kg^{-1} body weight) and the brain was perfused immediately through the two internal carotid arteries with 500 ml of Zamboni's fixative followed by 400 ml of 10 % sucrose. The tissue was frozen with isopentane and liquid nitrogen and 16 μm cryostat sections were collected and prepared for ICC. The expression of PR-ir was determined using a monoclonal antibody (clone H928; dilution 1:1000; Calbiochem) raised against the hinge region of the chicken progesterone receptor. Brains from laying hens ($n = 4$) and brooding hens ($n = 4$) were collected as matched pairs and processed accordingly.

PR-ir was confined to several discrete hypothalamic regions of the brain, the nucleus periventricularis hypothalami (PHN), nucleus paraventricularis (PVN), nucleus preopticus periventricularis (POP), organum vasculosum lamina terminalis (OVLT), nucleus suprachianmaticus (SCNm), nucleus preopticus medialis (POM), and tuberal region (Tu) (Kuenzel & Masson, 1988). Quantification studies demonstrated that the PHN, PVN, POM and POP of the brain of the laying (ly) hens does not possess a significantly greater number of PR-ir compared with the brains of broody (br) hens ($P > 0.05$), whereas OVLT, SCNm and Tu demonstrated a significantly greater number ($P < 0.05$). PR-ir was widespread in the anterior pituitary (Pit) of the laying hen but significantly depressed ($P < 0.05$, unpaired t test) in those glands taken from brooding birds.

Table 1.

	Mean	S.E.M.
ly Pit	198	4.12
br Pit	67.42	2.16
ly Tu	52.75	0.64
br Tu	2.67	0.18
ly OVLT	144.17	2.45
br OVLT	100.83	1.56
ly SCNm	28.42	0.45
br SCNm	22.67	0.81
ly POP	42.75	0.50
br POP	42.35	0.98
ly PHN	62.58	1.16
br PHN	60.67	1.35
ly PVN	71.25	0.74
br PVN	70.08	1.11
ly POM	25.83	0.46
br POM	24.83	0.57

Laying brain, $n = 4$; broody brain, $n = 4$.

Table 2.

	ANOVA*	*t* test**
ly and br Pit	7.99947×10^{-7}	1.51418×10^{-7}
ly and br Tu	2×10^{-10}	7×10^{-12}
ly and br OVLT	0.00048	0.00019
ly and br SCNm	0.05618	0.04594
ly and br POP	0.90475	0.44862
ly and br PHN	0.72771	0.37971
ly and br PVN	0.82829	0.40153
ly and br POM	0.67845	0.3497

*ANOVA: two factors without replication analysis tool.
**t test: two sample assuming unequal variances one tail.

These studies are consistent with progesterone having a central action associated with both neuroendocrine regulation and reproductive behaviour at different stages of the breeding cycle of the domestic fowl.

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All procedures accord with current UK legislation.

Physiological actions of putative neuropeptides in the nematode *Ascaris suum*

S. Papaioannou, L. Holden-Dye and R.J. Walker

Neurosciences Research Group, School of Biological Sciences, University of Southampton, Southampton SO16 7PX, UK

Neuropeptide-like immunoreactivity has a widespread distribution in the nematode nervous system (Sithigorngul *et al.* 1990) and sequences of more than 150 neuropeptides have been predicted from the genomes of *C. elegans* (Nelson *et al.* 1998; Nathoo *et al.* 2001). Here we report a preliminary assessment of the biological activity of six of these on the somatic muscle of the

parasitic nematode *A. suum*. Three of these are encoded by *flp* (FMRFamide-like peptides) genes and three by *nlp* (neuropeptide-like precursor) genes. Two of the latter show some sequence similarity to myomodulin, and one to buccalin, molluscan neuropeptides.

The effect of the peptides on the body wall muscle of *A. suum* was determined using an *in vitro* preparation of dorsal muscle strips as described by Trim *et al.* (1997). A 1 cm section of muscle was placed in an organ bath attached to an isometric transducer and perfused with artificial perienteric fluid (composition (mM): NaCl 67, sodium acetate 67, $MgCl_2$ 5.6, $CaCl_2$ 3, KCl 3, Tris-Cl 5; pH 7.6). The excitatory neuromuscular junction transmitter acetylcholine (ACh; 10 μM) was added for 1 min and then washed out. This elicited a rapid and reversible contraction. This was repeated twice to obtain contractions of reproducible amplitude. Subsequently the neuropeptide was added to the preparation 2 min prior to ACh, and the amplitude of the contraction to ACh in the presence of the peptide was expressed as a percentage of the average amplitude of the three contractions prior to the addition of neuropeptide. None of the neuropeptides had a marked effect on basal muscle tension. However, three had a potent effect on the contraction elicited by ACh, with two acting as inhibitors and one as a potentiator. The results are summarised in Table 1.

Table 1. The effect of putative nematode neuropeptides on *A. suum* somatic muscle

Peptide	Effect
APEASPFIRFamide	IC_{50} 0.3 ± 0.05 μM
AGSDPNFLRFamide	IC_{50} 0.5 ± 0.1 μM
SAEPFGTMRFamide	EC_{50} 0.7 ± 0.2 μM
SMAMGRLGLRPamide	IC_{50} 78 ± 5 μM
SMAYGRQGFRPamide	IC_{50} 100 ± 10 μM
MDANAFRMSFamide	IC_{50} 95 ± 20 μM

IC_{50} and EC_{50} are the concentrations estimated to cause, respectively, either a 50% inhibition or potentiation of the contraction elicited by ACh, $n > 3$. Statistical comparison was by paired *t* test. Data are expressed as means ± S.E.M.

In conclusion, all three of the RF-amide neuropeptides had potent effects, and one of the myomodulin-like peptides had a weak inhibitory action. Further studies are in progress to assess the activity of these peptides in *C. elegans*.

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All procedures accord with current UK legislation.

Cell cycle analysis of cerebral cortical cells following blockage of the cerebrospinal fluid pathway during development

Clare E. Draper, Jaleel Miyan and Jane Owen-Lynch*

*Department of Biomolecular Sciences, University of Manchester Institute of Science & Technology, PO Box 88, Sackville Street, Manchester M60 1QD and *Department of Biological Sciences, University of Lancaster, Bailrigg, Lancaster LA1 4YH, UK*

Cerebrospinal fluid (CSF) is continuously secreted into the brain ventricular system by the choroid plexus. The fluid flows through the ventricular system, passing over all regions of germinal activity. The hydrocephalic Texas (H-Tx) rat is an excellent model for fetal-onset hydrocephalus (Kohn *et al.* 1981), involving a constriction of the cerebral aqueduct leading to the blockage of CSF flow. Our recent studies have shown that prior to blockage, neurogenesis and migration occur as in normal rats but immediately following obstruction of fluid flow, cell proliferation decreases (Mashayekhi *et al.* 2002). We have suggested that it is the *in vivo* environment that is inhibiting their proliferation, since these cells are able to proliferate as normal when placed into culture for 96 h (Draper *et al.* 2001). The present study aimed at defining where the inhibition may be occurring.

Time-mated pregnant female H-Tx rats were humanely killed and cerebral cortical cells were isolated from the unaffected and affected fetuses (killed by decapitation) at gestation day 20 (2 days post-blockage of CSF flow) and cultured in Neurobasal medium containing B27 supplement (Invitrogen Limited). Samples were fixed in 70% ethanol at time zero (point of isolation) and following 24, 48 and 96 h in culture and analysed for cell cycle status using a flow cytometer. The proportion of cells in G0/G1, S and G2-M were quantified. There was no significant difference in the number of cells in the G0/G1 and G2-M phases between the unaffected and affected H-Tx cortices. However, there was a significantly greater (Student's two-tailed unpaired *t* test, $P < 0.05$) number of affected cells in the S phase at both time zero and following 24 h in culture, 6.9 ± 0.4 and 6.2 ± 0.97% (mean ± S.E.M., $n = 5$), respectively, when compared with the unaffected cells, 4.8 ± 0.3 and 2.8 ± 0.5% (mean ± S.E.M., $n = 5$), respectively. Following 48 and 96 h in culture, no differences were observed. The data suggest an *in vivo* inhibition, causing an arrest of cells in the S phase of the cell cycle, which is removed following 48 h in normal culture conditions.

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All procedures accord with current UK legislation.

Structural and functional aspects of mechanoreceptor endings in rat colon

Jonathan R. Coldwell, Stuart M. Brierley, Nicole J. Cooper and L. Ashley Blackshaw

Nerve-Gut Research Laboratory, Royal Adelaide Hospital and Department of Physiology, Adelaide University, SA 5000, Australia

Pelvic and lumbar splanchnic afferents may play an important role in mediating both noxious and non-noxious sensation from the colon. These afferents have been categorized previously by electrophysiological studies as three populations, according to the location of their receptive fields: mucosal afferents, muscular afferents and serosal afferents (Lynn & Blackshaw, 1999). No information is available on the structure of any of these endings. We aimed to correlate the function and structure of serosal afferent endings using a combination of electrophysiological recording and a modified anterograde labelling technique. The distal colon with attached inferior mesenteric ganglion (IMG) and lumbar splanchnic nerves (LSN) were removed from fifteen humanely killed rats and perfused in an organ bath with modified Krebs solution. The LSN was drawn into a second paraffin-filled chamber and small strands of fibres placed onto an electrode for recording. Receptive fields were located by mechanical stimulation. The recorded strand was treated with a 1–5% biotinamide tracer in artificial intracellular solution

(Tassicker *et al.* 1999) for 20 h at 35–37 °C. The tissue was then removed and fixed, then treated with extravidin-FITC for visualization with a fluorescence microscope. Histochemistry was also performed to visualize isolectin B4 (IB4) binding and calcitonin gene-related peptide (CGRP) immunoreactivity (specific for sensory fibres). Serosal afferents were characterized by their potent response to blunt probing with a glass rod, and their lack of response to stretch of the colonic muscle, or fine stroking of the mucosa. Six strands that contained active serosal afferents were treated with biotinamide tracer after accurate mapping of their receptive field. Endings of four afferents were observable with anterograde tracing, and two were not, but these could be visualised with IB4 binding. Anatomical assessment showed endings in the mesentery within 100 μm of vascular smooth muscle. They appeared consistently as spray-like endings occupying an area < 300 μm in diameter. They were not associated with any specialized non-neuronal tissue. Although IB4 consistently labelled mesenteric fibres, it did not label endings in the muscular layers. CGRP immunohistochemistry, however, revealed intraganglionic laminar endings in the myenteric plexus and intramuscular arrays in circular muscle that are known to belong to mechanoreceptors (Zagorodnyuk & Brookes, 2000). We presume these to correspond to stretch-sensitive muscular afferents. CGRP labelling in mucosa was sparse but clearly observed surrounding crypts. IB4 labelling in mucosa was inconclusive due to endothelial staining. In conclusion, we have generated a working model for the correlation of structure and function in mechanoreceptors of the colon, and provided evidence for specific chemical coding of two subpopulations.

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This work was funded by NHMRC project grant no. 104814.

Experiments were carried out with the approval and under the guidelines of the Ethics Committee of the IMVS, Adelaide.

Neurochemical coding of gastric vago-vagal pathways in the ferret

Richard L. Young*, Nicole J. Cooper* and L. Ashley Blackshaw*†

**Nerve-Gut Research Laboratory, Royal Adelaide Hospital and †Department of Medicine, Adelaide University, SA 5000, Australia*

Anatomical and functional subdivisions of the somatic and enteric nervous systems have been distinguished according to unique neurochemical content. In the ferret, a widely used model of the gut-brain axis, gastric vagal afferents exist as two broad modality-signalling populations (Page & Blackshaw, 1998) but no histochemical correlate has been evaluated. We assessed histochemistry of calcitonin gene-related peptide (CGRP) and isolectin B4 (IB4), selective markers of nociceptive afferents in the rat, as potential neurochemical markers of gastric vagal afferents in the ferret. Histochemistry of the nodose ganglia and dorsal medulla was performed with retrograde tracing of vagal pathways from the proximal stomach with a tracer cocktail containing cholera toxin subunit-B-conjugated FITC (5 %) and wheatgerm agglutinin-conjugated Alexa Fluor 488 (AF488, 2.5 %). Six ferrets were anaesthetized with halothane (2.5 % in O_2), a laparotomy performed and tracer (10×5 μl) injected into the ventral and dorsal subserosa of the proximal stomach, 10 mm from the gastro-oesophageal junction. Four days later ferrets were anaesthetized with urethane (1.25 g kg^{-1} I.P.), humanely killed and perfuse-fixed. The left nodose ganglia and dorsal medulla were then removed, cryoprotected and sectioned (20 μm). CGRP immunoreactivity was detected using a rabbit anti-rat CGRP primary and an AF350-conjugated secondary. IB4 labelling was detected using IB4-conjugated biotin and streptavidin-AF546. Nodose neurons were counted in six transverse sections representing the rostrocaudal extent of each ganglion; total cell counts were obtained using differential interference contrast. 16 % of left-nodose neurons (afferents) innervated the ferret proximal stomach; 69 % of these contained CGRP, 53 % were positive for IB4 labelling, 46 % showed dual labelling (CGRP/IB4) and 23 % showed no label. Centrally, CGRP and IB4 labelled fibres in the subnucleus gelatinosus, lateral medial subnucleus of the NTS and at the dorsal border of the dorsal motor vagal subnucleus (at obex); IB4 also selectively labelled medial regions of the medial subnucleus of the NTS. In rostral sections (obex +1.5 mm) CGRP selectively labelled the interstitial subnucleus. In the dorsal motor vagal nucleus, gastric vagal efferent soma were unlabelled, whereas CGRP, IB4 and dual labelled fibres were seen in close apposition with these pre-ganglionic motor neurons, where they may make functional connections. In conclusion, neurochemical coding of gastric vagal afferents in the ferret can be defined according to CGRP and IB4 labelling. Differential labelling of these markers in central subnuclei of the gastric circuit may be relevant to processing in these vago-vagal pathways. Triple immuno-histochemical studies are underway to assess these marker combinations, and others, to identify functional classes of gastric vagal afferents.

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This work was funded by AstraZeneca.

Experiments were carried out with the approval and under the guidelines of the Ethics Committee of the IMVS, Adelaide.

Intracellular recordings from the photoreceptors of the cuttlefish, *Sepia officinalis*

G. Groeger and R. Williamson

The Marine Biological Association of the UK, The Laboratory, Citadel Hill, Plymouth PL1 2PB and Department of Biological Sciences, University of Plymouth, Plymouth PL4 8AA, UK

Cuttlefish eyes are similar in size and visual performance to those of many vertebrates. Like its vertebrate analogue, it is a single chamber eye, with a variable pupil and accommodating lens, and is controlled by a complex set of oculomotor muscles. The retina has a foveal-like area, containing closely packed photoreceptors. However, the organisation of the cuttlefish retina is much simpler than equivalent vertebrate retinas as it contains only photoreceptors and some supporting cells. The bipolar, horizontal, amacrine and ganglion cells of the vertebrate eye have their analogues within the cuttlefish brain. As part of a larger study to investigate visual processing in the cuttlefish, we examine here the intracellular response of the retinal photoreceptors in *Sepia officinalis* to controlled flashes of light.

For experiments, an animal was anaesthetised by immersion in 2 % ethanol in seawater, humanely killed by decapitation, and then the eyes excised. The anterior portion of the eye was removed and pieces of retina, approximately 1 cm^2, dissected free and placed in a recording dish perfused with chilled, artificial seawater. Intracellular recordings were obtained from photoreceptors using glass pipettes of about 100 MΩ resistances, when filled with 4 M potassium acetate.

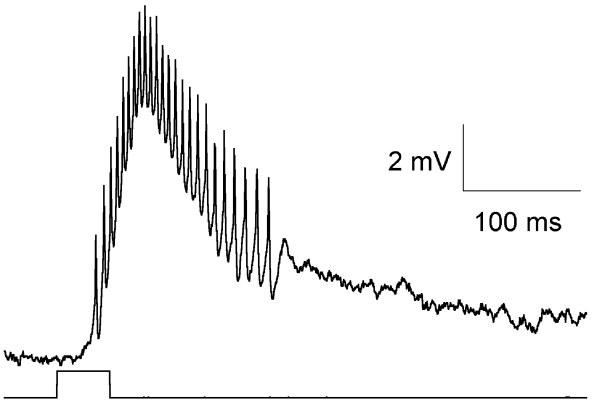

Figure 1. The upper trace shows an intracellular recording from a cuttlefish photoreceptor. The timing of the stimulus flash is shown in the lower trace.

Intracellular recordings from individual photoreceptors showed that they had membrane resting potentials of -61 ± 16.4 mV (mean ± S.D.; $n = 20$) in the dark-adapted condition, and that they responded to a controlled flash of light with a depolarising response of up to 45 mV. The shape and duration of the response is illustrated in Fig. 1. In about half of the recordings, a clear burst of action potentials was observed in response to the flash stimulus. As the flash duration was increased from 1 to 50 ms, the maximum amplitude of the response increased from 2 to 37 mV. Flashes longer than 50 ms produced a plateau in the response. For flash intensities within the range 1–50 μW cm^{-2}, increasing the intensity of the flash resulted in an increased depolarisation in an approximately logarithmic relationship. This is the first report of intracellular recordings from cuttlefish retinal photoreceptors, although similar results have been obtained from squid (Pinto & Brown, 1977) and octopus (Tomita, 1968). The next stage of this work will be to map the receptive fields of individual photoreceptors.

Pinto, L.H. & Brown, J.E. (1977). *J. Comp. Physiol.* **122**, 241–250.
Tomita, T. (1968). *Proc. IEEE* **56**, 1015–1023.

This work was supported by The Wellcome Trust.