How the FLP do nematodes jump?

Robert Morris, Leonie Wilson, Neil D. Warnock, Daniel Carrizo, Deborah Cox, Matthew Sturrock, Kilian McGrath, Aaron G. Maule and Johnathan J. Dalzell*

School of Biological Sciences, Institute for Global Food Security, Queen's University Belfast

*Corresponding author: j.dalzell@qub.ac.uk

Keywords: Neuropeptide; Entomopathogenic nematode; RNAi; Nictation; Dispersal; Jumping; SPME GC-MS

Abstract

Entomopathogenic nematodes (EPNs) are a guild of obligate insect parasites which share many physiological and behavioural traits with mammalian strongylid and strongyloidid parasites; including host-finding nictation behaviour. EPNs are also interesting from the perspective of insect biocontrol. Like other parasitic nematodes, EPNs employ a sophisticated chemosensory apparatus to detect potential hosts and communicate with conspecifics. Understanding the underlying molecular basis of relevant host-finding behaviours could facilitate improved EPN biocontrol approaches, and could lend insight to similar behaviours in economically important animal parasites. FMRFamide-like peptides are enriched and conserved across the Phylum Nematoda, and have been linked with motor and sensory function, including dispersal and aggregating behaviours in the free living nematode *Caenorhabditis elegans*. RNA interference (RNAi) was used to knockdown the expression of the FMRFamide-like protein 21 (GLGPRPLRFamide) gene (*flp-21*) in *Steinernema carpocapsae* infective juveniles (IJs). Our data show that *S. carpocapsae* is sensitive to neuronal RNAi, and that knockdown of *flp-21* has a significant impact on dispersal, nictation and jumping behaviours. Immunocytochemical localisation of FLP-21 to paired anterior neurons corroborates the RNAi data, further suggesting a role in sensory modulation. This study represents the first demonstration of a functional RNAi pathway in *S. carpocapsae*, through which we have linked a single gene product to the coordination of nematode jumping, nictation, and dispersal behaviours in IJs. These data can underpin efforts to study these behaviours in other economically important parasites, and could facilitate molecular approaches to EPN strain improvement for biocontrol.

Introduction

Entomopathogenic nematodes (EPNs) borrow their name from the entomopathogenic bacteria (*Photorhabdus*, *Serratia* and *Xenorhabdus* spp.) with which they form a commensal relationship. These nematodes provide a stable environment for the bacteria, and act as a vector between insect hosts. Once the nematode has invaded an insect, the nematode exsheaths (or ‘recovers’) and entomopathogenic bacteria are regurgitated into the insect haemolymph; the bacteria then rapidly kill and metabolise the insect, providing nutrition and developmental cues for the nematode. These entomopathogenic bacteria are then transmitted between nematode generations (Dillman et al., 2012). The entomopathogenic lifestyle has been found to arise independently in nematodes, at least three times, spanning significant phylogenetic diversity. *Heterorhabditis* and *Oscheius* spp. (Torrini et al., 2015) reside within clade 9 along with major strongylid parasites of man and animal (Holterman et al., 2006); Steinernema spp. reside within clade 10 alongside strongyloidid parasites (Viney and Lok, 2007).

Nictation is a dispersal and host-finding strategy, enacted by nematodes which stand upright on their tails, waving their anterior in the air (Lee et al., 2012). This behaviour is shared amongst many economically important animal parasitic and entomopathogenic nematodes, alongside the model nematode *C. elegans*, for which nictation is a phoretic dispersal behaviour of dauer larvae, used to increase the likelihood of attachment to passing animals. Nictation is regulated by amphidial IL2 neurons in *C. elegans*, which occur in lateral triplets either side of the pharyngeal metacorpus (Lee et al., 2012; Schroeder et al., 2013). IL2 neurons display significant remodelling from *C. elegans* L3 to dauer (the only life-stage to enact nictation behaviours) such that connectivity with other chemosensory and cephalic neurons is enhanced (Schroeder et al., 2013). It has been shown that IL2 neurons express the DES-2 acetylcholine receptor subunit, and that cholinergic signalling is requisite for nictation (Pereira et al., 2015; Zhang et al., 2014; Lee et al., 2012; Yassin et al., 2001). Additionally, the central pair of IL2 neurons express the FMRFamide-like peptide (FLP) receptor, NPR-1 (Coates and de Bono, 2002. To date there are two known NPR-1 agonists; FLP-18 and FLP-21 (Rogers et al., 2003). However, there is also known redundancy of FLP-18 and FLP-21 in signalling through other neuropeptide receptors (NPR-4, -5, -6 -10, -11, and NPR-2, -3, -5, -6, 11, respectively) in heterologous systems (Ezcurra et al., 2016; and reviewed by Li and Kim, 2014), making functional linkage difficult.

Steinernema spp. also display a highly specialised jumping behaviour which is thought to enhance both dispersal and host attachment. Jumping occurs when a nictating infective juvenile (IJ) unilaterally contracts body wall muscles bringing the anterior region towards the posterior region, forming a loop. This generates high pressure within the IJ pseudocoel, and differential stretching and compression forces across the nematode cuticle. Release of this unilateral contraction, in conjunction with the correction of cuticle pressure, triggers enough momentum for an IJ to jump a distance of nine times body length, to a height of seven times body length (Campbell and Kaya, 1999).

The recent publication of five *Steinernema* spp. genomes, along with stage-specific transcriptomes (Dillman et al., 2015) represents a valuable resource, alongside the previously published genome of *Heterorhabditis bacteriophora* (Bai et al., 2013). The genome of *Steinernema carpocapsae* is the most complete, at an estimated 85.6 Mb, with predicted coverage of 98% (Dillman et al., 2015). *S. carpocapsae* was selected as a test subject for our study due to the quality of genome sequence, and the interesting biology underpinning dispersal and host-finding behaviours in this species. The close phylogenetic relationship between *Steinernema* spp. coupled with a diverse behavioural repertoire, particularly in terms of dispersal and host-finding (Castelletto et al., 2014; Lee et al., 2016), make this genus an extremely attractive model for comparative neurobiology. The aim of this study was to examine RNAi functionality in *S. carpocapsae*, and to probe the involvement of FLP-21 in coordinating nictation, jumping and dispersal phenotypes, as a prelim to probing the neuronal and molecular underpinnings of host-finding behaviour in this genus.

Materials and Methods

***S. carpocapsae* culture**

S. carpocapsae (ALL) was maintained in *Galleria mellonella* at 23°C. IJs were collected by White trap (White, 1927) in a solution of Phosphate Buffered Saline (PBS). Freshly emerged IJs were used for each experiment.

BLAST analysis of *S. carpocapsae* RNAi pathway

BLAST analysis of RNAi pathway components was conducted as in Dalzell et al. (2011), using a modified list of core RNAi pathway components from *C. elegans,* against predicted protein sets and contigs of the *S. carpocapsae* genome, through the Wormbase Parasite BLAST server (Howe et al., 2016; Altschul et al., 1990).

dsRNA synthesis

Sc-flp-21 (Gene ID: L596_g19959.t1) dsRNA templates were generated from *S. carpocapsae* IJ cDNA using gene-specific primers with T7 recognition sites (see Table 1). Neomycin phosphotransferase (*neo*) and Green Fluorescent Protein (*gfp*) dsRNA templates were generated from pEGFP-N1 (GenBank: U55762.1). Template PCR products were generated as follows: [95 °C x 10 min, 40 x (95 °C x 30 s, 60 °C x 30 s, 72 °C x 30 s) 72 °C x 10 min]. PCR products were assessed by gel electrophoresis, and cleaned using the Chargeswitch PCR clean-up kit (Life Technologies). dsRNA was synthesised using the T7 RiboMAX™ Express Large Scale RNA Production System (Promega), and quantified by a Nanodrop 1000 spectrophotometer.

RNAi

1000 *S. carpocapsae* were incubated in 50 µl PBS with dsRNA and 50 mM serotonin across four experimental regimes; (i) 24 h in 5 mg/ml dsRNA / serotonin / PBS; (ii) 24 h in 5 mg/ml dsRNA / serotonin / PBS, followed by washes to remove the initial dsRNA, and 24 h recovery in PBS only; (iii) 48 h in 5 mg/ml dsRNA / serotonin / PBS; and (iv) 48 h in 1 mg/ml dsRNA and serotonin. Each experiment was conducted at 23 ºC. We found that 50 mM serotonin induced oral uptake of fluorescent dyes under all conditions tested; 50 mM octopamine did not (data not shown).

RNA extraction, cDNA synthesis and quantitative (q)RT-PCR

Total RNA was extracted from 1000 IJs using the Simply RNA extraction kit (Promega, UK) and Maxwell 16 extraction system (Promega, UK). cDNA was synthesised using the High Capacity RNA to cDNA kit (Applied Biosystems, UK). Each individual qRT-PCR reaction comprised 5 µl Faststart SYBR Green mastermix (Roche Applied Science), 1 µl each of the forward and reverse primers (10 µM), 1 µl water, 2 µl cDNA. PCR reactions were conducted in triplicate for each individual cDNA using a Rotorgene Q thermal cycler under the following conditions: [95 °C x 10 min, 40 x (95 °C x 20 s, 60 °C x 20 s, 72 °C x 20 s) 72 °C x 10 min].

Primer sets were optimised for working concentration, annealing temperature and analysed by dissociation curve for contamination or non-specific amplification by primer–dimer as standard. The PCR efficiency of each specific amplicon was calculated using the Rotorgene Q software. Relative quantification of target transcript relative to two endogenous control genes (*Sc-act* and *Sc-β-tubulin*) was calculated by the augmented ΔΔCt method (Pfaffl, 2001), relative to the geometric mean of endogenous references (Vandesompele et al., 2002). One way ANOVA and Fisher's LSD test were used to analyse data (GraphPad Prism 6). The most similar non-target gene (*L596_g5821.t1)* was identified using BLASTn against the *S. carpocapsae* genomic contigs (supplemental figure S1), and primers *Sc-L596_g5821.t1-f* and *Sc- L596_g5821.t1-r* were used to assess transcript abundance relative to *Sc-act* across control and experimental conditions for the 48h dsRNA exposure experiments only (Table 1).

Table 1. dsRNA synthesis and qRT-PCR primer sequences.

Primer designation	**Sequence (5' – 3')**
Sc-flp-21-F	TTCTGAGCCGCTATCTGAGC
Sc-flp-21-Ft7	TAATACGACTCACTATAGGTTCTGAGCCGCTATCTGAGC
Sc-flp-21-R	AGTCGCAGGGAACAAACAAT
Sc-flp-21-Rt7	TAATACGACTCACTATAGGAGTCGCAGGGAACAAACAAT
neo-F	GGTGGAGAGGCTATTCGGCTA
neo-Ft7	TAATACGACTCACTATAGGGGTGGAGAGGCTATTCGGCTA
neo-R	CCTTCCCGCTTCAGTGACAA
neo-Rt7	TAATACGACTCACTATAGGCCTTCCCGCTTCAGTGACAA
gfp-F	GGCATCGACTTCAAGGAGGA
gfp-Ft7	TAATACGACTCACTATAGGGGCATCGACTTCAAGGAGGA
gfp-R	GTAGTGGTTGTCGGGCAGCA
gfp-Rt7	TAATACGACTCACTATAGGGTAGTGGTTGTCGGGCAGCA
Sc-act-Fq	ATGTTCCAGCCCTCTTTCCT
Sc-act-Rq	GATGTCGCACTTCATGATCG
Sc-βtub-Fq	CTCGGAGGAGGAGATGACAG
Sc-βtub-Rq	ATCATAACGGCACGAGGAAC
Sc-flp-21-Fq	GCTGCCTTCCTCGTACTCTTC
Sc-flp-21-Rq	TCAGATAGCGGCTCAGAAGC
Sc-L596_g5821.t1-Fq	GTGGGAAATCCGACACAAA
Sc-L596_g5821.t1-Rq	GTCACGTCGTCCACTATAAAC

Headspace Solid-Phase MicroExtraction (SPME) GC-MS

Approximately 5 g of fresh waxworm (*Galleria mellonella*) and mealworm (*Tenebrio molitor*) larvae were placed into 20 mL glass tubes and sealed. The holder needle was exposed to the headspace of the tube over a 120 min timecourse (extraction time) at room temperature (22 ºC). After this time, the SPME syringe was directly desorbed in the GC injection port for 5 min. A fused silica fibre coated with a 95 µm layer of carboxen–polydimethylsiloxane (CAR–PDMS; Supelco) was used to extract the volatile compounds from the samples. Fibres were immediately thermally desorbed in the GC injector for 5 min (with this time we desorb the analytes and re-activated the fiber for the next analysis) at 250 °C and the compounds were analysed by GC-MS.

A CTC Analytics CombiPal autosampler was coupled to a 7890N Agilent gas chromatograph (Agilent, Palo Alto, California) and connected to a 5975C MSD mass spectrometer. The manual SPME holder (Supelco, Bellefonte, PA, USA) was used to perform the experiments. Chromatographic separation was carried out on 30 m x 0.25 mm I.D. ZB-semivolatiles, Zebron column (Phenomenex, Macclescfield, UK).The oven temperature was set at 40 ºC for 3 min, temperature increased from 40 to 250 º C at 5 ºC min^{-1} and set at the maximum temperature for 4 min. Helium was used as carrier gas at 1 ml min^{-1}. Mass spectra were recorded in electron impact (EI) mode at 70 eV. Scan mode was used for the acquisition to get all the volatile compounds sampled. Quadrupole and source temperature were set at 150 and 230 ºC respectively. Compounds were identified using MS data from the NIST library (>95% confidence).

Dispersal assays

100 *S. carpocapsae* IJs were placed in the centre of a 90 mm PBS agar plate (1.5 % w/v) in a 5 µl aliquot of PBS. Plates were divided into four zones; a central zone 15 mm in diameter, and three further zones equally spaced over the remainder of the plate. Plates were allowed to air dry for ~5 min. Evaporation of the PBS allowed the IJs to begin

movement over the agar surface. Lids were then placed back onto the Petri dishes, and plates were incubated at 23 °C in darkness for one hour. IJs were counted across central and peripheral zones and expressed as percentage of total worms. Our subsequent analysis was conducted on total IJs found within the two central zones. Relative to those found in the two peripheral zones.

Nictation & jumping assays

3.5 g of compost (John Innes No.2) was placed in a petri dish (55 mm), and dampened evenly with 150 µl PBS. Approximately ten IJs were pipetted onto the compost in 5 µl of PBS, and left for 5 minutes at room temperature; this enabled IJs to begin nictating. For the waxworm volatile challenge, one healthy waxworm (UK Waxworms Ltd.) was placed inside a 1 mL pipette tip, without filter. For the mealworm volatile challenge, two mealworms (Monkfield Nutrition, UK), weight-matched to the waxworm, were placed inside a 1 mL pipette tip, without filter. Blank exposure data were captured using an empty 1 ml pipette tip, without filter. In each case, the pipette was set to eject a volume of 500 µL, comprising air and the corresponding insect volatiles. A binocular microscope was used to record IJ behavioural responses following up to five volatile exposures each, on gentle ejection from the pipette within a distance of ~1 cm of the *S. carpocapsae* IJs. A five second period was allowed between each volatile exposure. Recording ended for any individual when jumping was observed or the IJ abandoned a nictating stance (this always corresponded with migration away from the stimulus). A jumping index was calculated for each treatment group (Dillman et al., 2012). Additional behavioural observations were recorded, and subsequently reported as percentage IJs displaying the behaviour over the course of up to five volatile exposures, or until the IJ migrated / jumped out of the field of vision.

Immunocytochemistry

Freshly emerged *S. carpocapsae* IJs were fixed in 4 % paraformaldehyde overnight at 4 °C, followed by a brief wash in antibody diluent (AbD; 0.1 % bovine serum albumin, 0.1 %

sodium azide, 0.1 % Triton-X-100 and PBS pH 7.4). The fixed specimens were roughly chopped on a glass microscope slide with a flat edged razor, and incubated in primary polyclonal antiserum raised against GLGPRPLRFamide, N-terminally coupled to KLH, and affinity purified (1:800 dilution in AbD) for 72 h at 4 °C. Subsequently, chopped IJs were washed in AbD for 24 h at 4 °C, and then incubated in secondary antibody conjugated to fluorescein isothiocyanate (1:100 dilution in AbD) for 72 h at 4 °C. A further AbD wash for 24 h at 4 °C was followed by incubation in Phalloidin–Tetramethylrhodamine B isothiocyanate (1:100 dilution in AbD) for 24 h at 4 °C. Finally, chopped IJs were washed in AbD for 24 h at 4 °C. Specimens were mounted onto a glass slide with Vectasheild mounting medium and viewed with a Leica TCS SP5 confocal scanning laser microscope. Controls included the omission of primary antiserum, and pre-adsorption of the primary antiserum with ≥250 ng of GLGPRPLRFamide. Pre-adsorption in GLGPRPLRFamide did not alter staining patterns.

Statistical analysis

Data pertaining to both qRT-PCR and behavioural assays were assessed by Brown-Forsythe and Bartlett's tests to examine homogeneity of variance between groups. Were variance differed statistically between groups a Kruskal-Wallis test was followed by Dunn's multiple comparison test. In all other instances, One-way or two-way ANOVA was followed by Fisher's Least Significant Difference (LSD) test. All statistical tests were performed using GraphPad Prism 6.

Results

The RNAi pathway of *S. carpocapsae*

As is the case for other parasitic nematode species, *S. carpocapsae* was found to encode a less diverse RNAi pathway than that of *C. elegans,* in terms of gene for gene conservation

(Dalzell et al., 2011). However, the apparent reduction in AGO homologue diversity is offset by significant expansions across several putative *ago* genes, to give a predicted overall increase in the *S. carpocapsae* AGO complement (38 in total), relative to *C. elegans* (24, not including pseudogenes) (Vasquez-Rifo et al., 2012); WAGO-1 (19), ALG-1 (three), ALG-3 (two), WAGO-5 (four), WAGO-10 (two), WAGO-11 (three) are all expanded relative to *C. elegans*. Notably, no identifiable homologue of RDE-1, the primary AGO for exogenously triggered RNAi events in *C. elegans,* could be identified (Supplementary table S2).

The presence of PRG-1 and components of the piwi interacting (pi)RNA biosynthetic machinery suggests that a functional piRNA (or 21U RNA) pathway may be present. Whilst ERGO-1 is not conserved, two putative ALG-3 orthologues suggest that a functional endo-siRNA (26G RNA) pathway may also exist, which is supported by broad conservation of associated proteins. MicroRNA-associated AGOs, ALG-1 and ALG-2 are conserved, with a small apparent expansion of ALG-1 to three related proteins in *S. carpocapsae*. Further understanding of how RNAi pathway complements influence functionality will require small RNA sequencing efforts, and functional genomics approaches.

The RNA-dependent RNA Polymerase (RdRp), RRF-3 is conserved, and known to function antagonistically to exogenously primed RNAi, through competing activity for pathway components required for both exogenous RNAi, and the endo-siRNA (26G RNA) pathway within which RRF-3 operates (Simmer et al., 2002; Sijen et al., 2001; reviewed by Billi et al., 2014). The RdRps, RRF-1 and EGO-1, which are involved in the biosynthesis of secondary siRNAs (22G RNAs) are also conserved. Loss of the argonaute ERGO-1 which functions upstream of secondary siRNA biogenesis in the endo-siRNA (26G RNA) pathway in *C. elegans,* also leads to an exogenous ERI phenotype (Enhanced RNAi), but is not conserved in *S, carpocapsae,* suggesting that ALG-3 / -4 may be solely responsible for endo-siRNA functionality (Conine et al., 2010; Han et al., 2009).

The apparent absence of the intestinal dsRNA transporter, SID-2 is consistent with findings from other parasitic nematodes (Dalzell et al., 2011; Geldhof et al., 2007; Knox et al., 2005). SID-1 also appears to be absent, however CHUP-1, a putative cholesterol uptake protein which contains a SID-1 RNA channel is present, and may assist in the intercellular spread of dsRNA. RSD-3, which also effects intercellular spread of dsRNA is conserved (see Figure 1 for pathway overview).

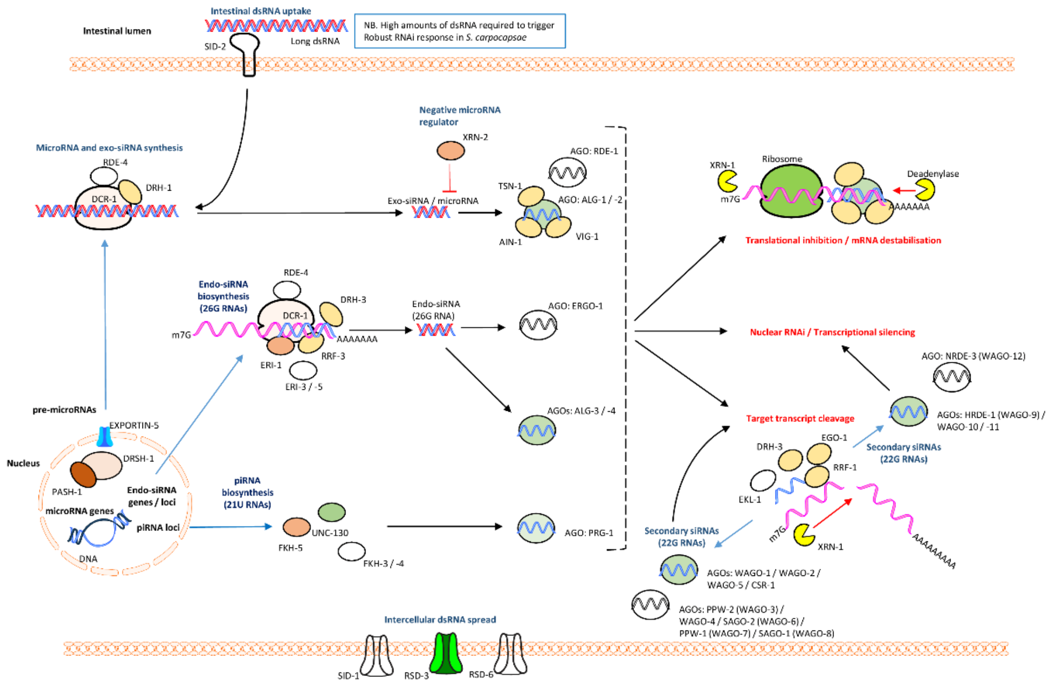


Figure 1. Core RNAi pathway components of *S. carpocapsae* relative to *C. elegans.* Proteins with at least one putative homologue are represented in colour; those without any identifiable homologues are colourless. See supplemental tables for information on number of putative related homologues.

Knockdown of *Sc-flp-21*

Various treatment regimens were employed in order to assess the responsiveness of *S. carpocapsae* IJs to exogenous dsRNA. 24h incubation in 5 mg/ml dsRNA, with 50 mM serotonin was not sufficient to trigger statistically significant *Sc-flp-21* knockdown (Fig. 2A), however a 24h dsRNA / serotonin incubation followed by a 24h recovery in PBS only, did trigger a small decrease in *Sc-flp-21* relative to *Sc-act* when compared to *gfp* and *neo* dsRNA controls (0.70 ±0.11, P<0.05) (Fig. 2B). Extended incubation of *S. carpocapsae* IJs in 5 mg/ml dsRNA and 50 mM serotonin for 48 h triggered robust knockdown of *Sc-flp-21* (0.16 ±0.07, P<0.0001) (Fig. 2C). 48 h incubation in 1 mg/ml dsRNA, with 50 mM serotonin also triggered significant levels of *Sc-flp-21* knockdown (0.49 ±0.27, P<0.01), however this was not as effective as the 5 mg/ml dsRNA treatment (Fig. 2D). A BLAST analysis identified predicted *S. carpocapsae* transcript *L596_g5821.t* as the non-target gene with most similarity to the *Sc-flp-21* dsRNA (supplemental figure S1). The relative expression level of *L596_g5821.t1* was unaffected by a 48 h incubation in 5 mg/ml *Sc-flp-21* dsRNA with 50 mM serotonin, relative to *neo* and *gfp* dsRNA (1.013 ±0.04, P>0.05) (Fig. 2E).

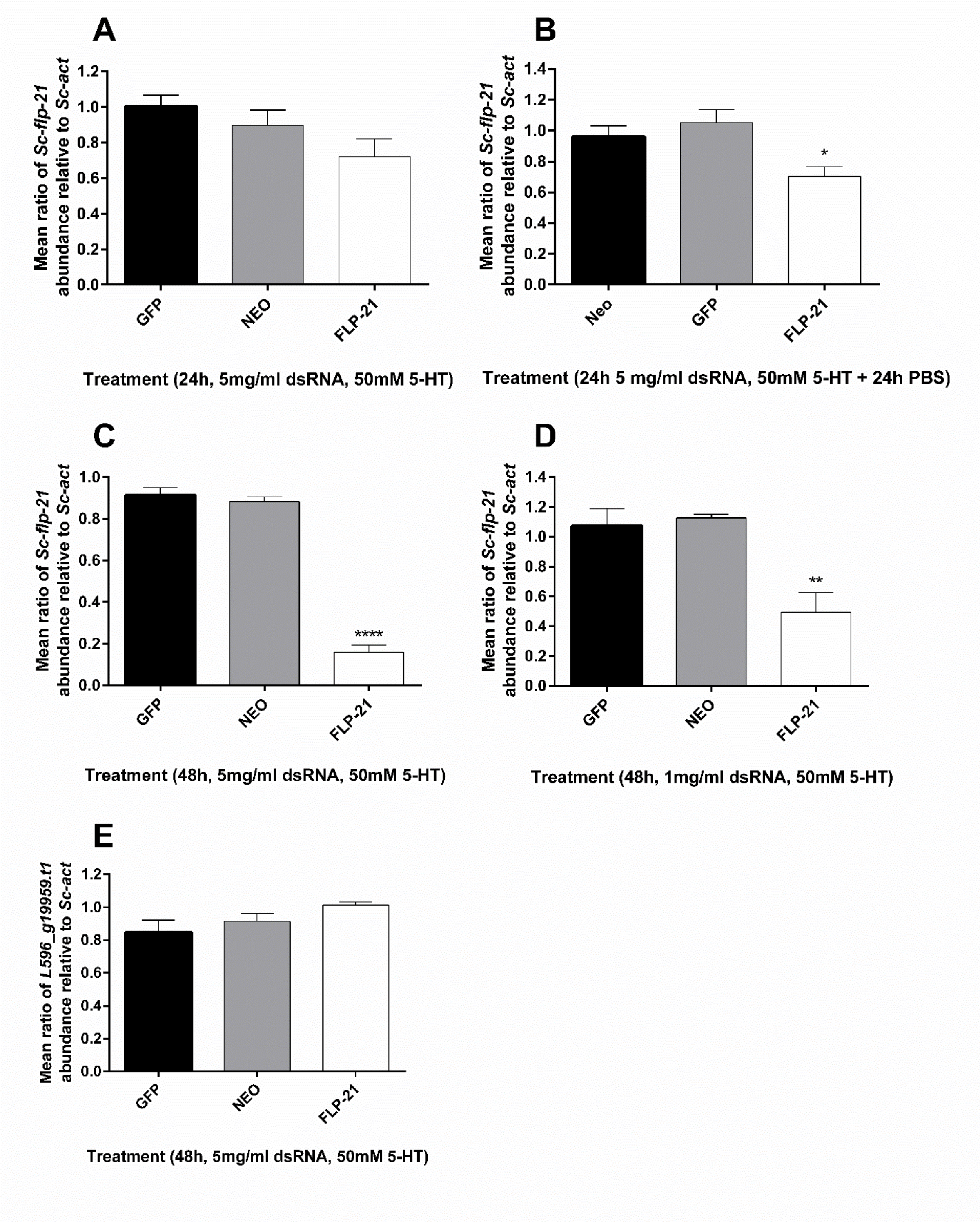


Figure 2. qRT-PCR expression analysis of *Sc-flp-21* and off-target control gene (A) *Sc-flp-21* transcript ratio relative to *Sc-act* following 24 h incubation in 5 mg/ml dsRNA, 50 mM serotonin. (B) *Sc-flp-21* transcript ratio relative to *Sc-act* following 24 h incubation in 5 mg/ml dsRNA, 50 mM serotonin, and 24 h in PBS; (C) *Sc-flp-21* transcript ratio relative to *Sc-act*

following 48 h incubation in 5 mg/ml dsRNA, 50 mM serotonin; (D) *Sc-flp-21* transcript ratio relative to *Sc-act* following 48 h incubation in a reduced 1 mg/ml dsRNA, 50 mM serotonin; (E) *L596_g5821.t1* transcript ratio relative to *Sc-act* following 48 h incubation in 5 mg/ml dsRNA, 50 mM serotonin. *P<0.05; **P<0.01; ****P<0.0001.

Host insect volatiles

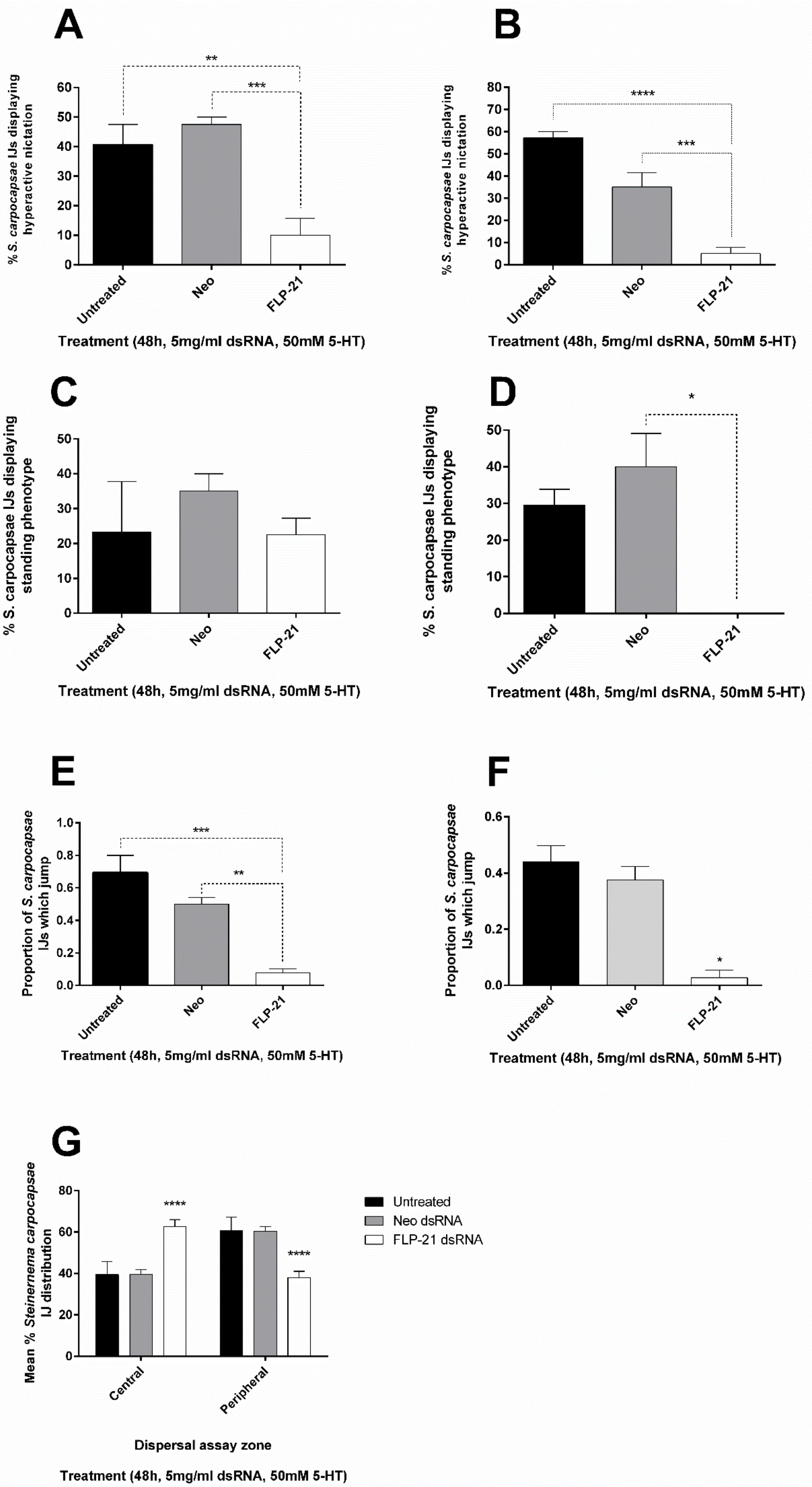
Comprehensive volatile signatures were characterised, and significant differences noted between *G. mellonella* and *T. molitor* larvae. In total, we identified 10 compounds unique to *G. mellonella*, four compounds unique to *T. molitor,* and 14 compounds shared between both species. These profiles vary significantly from headspace GC-MS data presented by Hallem et al. (2011) for the same insect species (see Table 1).

Table 1. Headspace SPME GC-MS volatile profiles of *Galleria mellonella* and *Tenebrio molitor* larvae

Galleria mellonella	***Tenebrio molitor***	**Shared**
α-pinene	decanal	nonanal
butanoic acid	1-tetradecanol-methyl ether	hexanoic acid
tetradecanal	1-hexadecanol	octanoic acid
tridecanol	cyclohexadecane	cyclododecane
nonanoic acid		decanoic acid
2-[phenyl methylene]-octanal		dodecanoic acid
tetracosanol		tetradecanoic acid
tridecane		pentadecanoic acid
1-heptacosanol		bis(2-ethylhexyl) ester-hexanedioic acid
cis-9-hexadecenoic acid		hexadecanoic acid
		heptadecanoic acid
		cis-10-heptadecenoic acid
		squalene
		octadecanoic acid

Behavioural impact of *Sc-flp-21* knockdown

S. carpocapsae IJs were challenged by exposure to volatiles from *G. mellonella* or *T. molitor* following RNAi (48h 5 mg/ml dsRNA, 50 mM serotonin) and control treatments. A decrease in hyperactive nictation following *Sc-flp-21* knockdown was observed (10% ±5.774) relative to untreated (40.75% ±6.75; P<0.01) and *neo* dsRNA treatment (47.5% ±2.5; P<0.001) following *G. mellonella* volatile challenge (Fig. 3A). Likewise, a decrease in hyperactive nictation was observed following *T. molitor* volatile challenge to *Sc-flp-21* RNAi IJs (5.0% ±2.9), relative to untreated (57.25% ±2.8; P<0.0001) and *neo* dsRNA treatment (35.0% ±6.5; P<0.001) (Fig. 3B). A decrease in the jumping index of IJs following *Sc.flp-21* dsRNA treatment was observed when challenged by *G. mellonella* volatiles (0.08 ±0.03) relative to untreated (0.69 ±0.11; P<0.001) and *neo* dsRNA treated (0.50 ±0.04; P<0.01) (Fig. 3E) . Similarly, a decrease in jumping index as a response to *T. molitor* volatiles was observed following *Sc-flp-21* RNAi (0.03 ±0.03) relative to untreated (0.44 ±0.06; P<0.001) and *neo* dsRNA treatment (0.38 ±0.05; P<0.001) (Fig 3F). However, it appears that *Sc-flp-21* knockdown does result in a discrimination between *G. mellonella* and *T. molitor* volatiles in triggering standing phenotypes (as described by Campbell and Gaugler, 1993; Ishibashi and Kondo, 1990). No statistically significant difference in the percentage of IJs displaying a standing phenotype is observed in response to *G. mellonella* volatiles between experimental groups, however a significant decrease in standing phenotypes was observed in response to *Sc-flp-21* knockdown following exposure to *T. molitor* volatiles (0.00%) relative to *neo* dsRNA treated (40.0% ±9.13; P<0.05) but not untreated (29.5% ±4.4; P>0.05) using Kruskal-Wallis and Dunn's multiple comparison tests. Undoubtedly, the significant difference in variance across experimental groups in this instance has reduced statistical power (Fig. 3D). It was also found that *Sc-flp-21* RNAi resulted in significantly decreased lateral dispersal, relative to both untreated and *neo* dsRNA treatment (P<0.0001) (Fig. 3G). In all instances, dsRNA treatment regimens which triggered lower levels of *Sc-flp-21* knockdown relative to the 48h 5 mg/ml dsRNA, 50 mM serotonin approach, failed to trigger null phenotypes (data not shown).


A
% S. carpocapsae IJs displaying hyperactive nictation
**
***
Untreated
Neo
FLP-21
Treatment (48h, 5mg/ml dsRNA, 50mM 5-HT)
B
% S. carpocapsae IJs displaying hyperactive nictation
****
***
Untreated
Neo
FLP-21
Treatment (48h, 5mg/ml dsRNA, 50mM 5-HT)
C
% S. carpocapsae IJs displaying standing phenotype
Untreated
Neo
FLP-21
Treatment (48h, 5mg/ml dsRNA, 50mM 5-HT)
D
% S. carpocapsae IJs displaying standing phenotype
*
Untreated
Neo
FLP-21
Treatment (48h, 5mg/ml dsRNA, 50mM 5-HT)
E
Proportion of S. carpocapsae IJs which jump
***
**
Untreated
Neo
FLP-21
Treatment (48h, 5mg/ml dsRNA, 50mM 5-HT)
F
Proportion of S. carpocapsae IJs which jump
*
Untreated
Neo
FLP-21
Treatment (48h, 5mg/ml dsRNA, 50mM 5-HT)
G
Mean % Steinernema carpocapsae IJ distribution
****
****
Central
Peripheral
Untreated
Neo dsRNA
FLP-21 dsRNA
Dispersal assay zone
Treatment (48h, 5mg/ml dsRNA, 50mM 5-HT)

370

Figure 3. *S. carpocapsae* IJ behavioural assays post-RNAi

Behavioural impact of *Sc-flp-21* knockdown following IJ incubation in 5 mg/ml dsRNA, 50 mM serotonin: (A) Mean percentage of *S. carpocapsae* displaying hyperactive nictation upon challenge by *G. mellonella* volatiles. (B) Mean percentage of *S. carpocapsae* displaying hyperactive nictation upon challenge by *T. molitor* volatiles. (C) Mean percentage of *S. carpocapsae* displaying standing upon challenge by *G. mellonella* volatiles. (D) Mean percentage of *S. carpocapsae* displaying standing upon challenge by *T. molitor* volatiles. (E) Mean jumping index of *S. carpocapsae* displaying upon challenge by *G. mellonella* volatiles. (F) Mean jumping index of *S. carpocapsae* upon challenge by *T. molitor* volatiles. (G) Mean percentage distribution of *S. carpocapsae* IJs across central and peripheral assay zones. *P<0.05; **P<0.01; ****P<0.0001.

Immunocytochemical localisation of FLP-21 in *S. carpocapsae* IJs

FLP-21 was localised to paired neurons within the central nerve ring region of *S. carpocapsae* IJs. Without additional neuroanatomical information on *S. carpocapsae* IJs it is impossible to define these cells, however they do appear to project posteriorly, terminating in synapses around the region of the pharyngeal metacarpal bulb (Fig. 4).

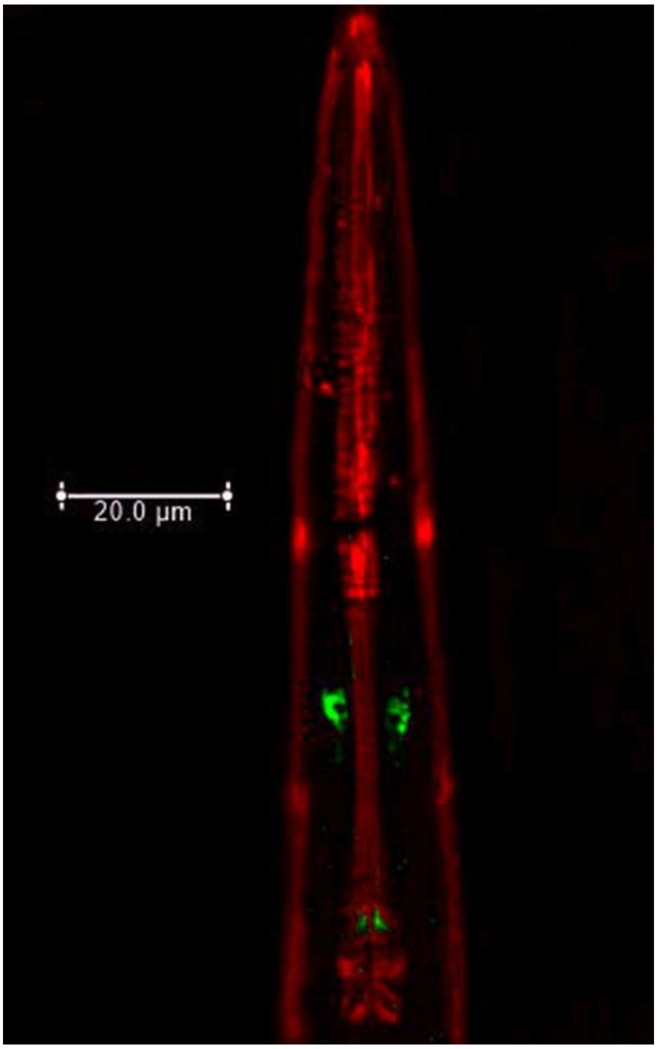


Figure 4. Immunocytochemical localisation of FLP-21 (GLGPRPLRFamide) to paired neurons within the central nerve ring of *S. carpocapsae* IJs. Positive FLP-21 immunostaining is visible as green, muscle is counterstained red.

Discussion

RNA interference is an extremely important tool for the study of gene function in parasitic nematodes (Dalzell et al., 2012; Maule et al., 2011). Three independent reports of a functional RNAi pathway in the entomopathogenic nematode *Heterorhabditis bacteriophora* have been published. Ciche and Sternberg (2007) assessed the efficacy of RNAi through soaking egg / L1 stage *H. bacteriophora* in 5-7.5 mg/ml dsRNA targeting a number of genes which had been selected on the basis of phenotypic impact on the model *C. elegans*.

Demonstrable phenotypes and target transcript knockdown signified an active pathway. Moshayov, Koltai and Glazer (2013) employed the methodology of Ciche and Sternberg (2007) to study the involvement of genes in the regulation of IJ exsheathment (or 'recovery'). Subsequently, Ratnappan et al. (2016) demonstrated that microinjection was also a suitable method for introducing dsRNA into hermaphrodite gonads, effectively triggering the RNAi pathway in F1 progeny. To date, no such assessment of a functional RNAi pathway has been published for *Steinernema* spp.

The RNAi pathway of *S. carpocapsae* has been characterised by BLAST and validated through silencing *Sc-flp-21* in IJs*.* Our data indicate that neuronal cells are sensitive to RNAi in *S. carpocapsae* IJs, and that knockdown is highly sequence specific. Like other parasitic nematodes *S. carpocapsae* encodes an expanded set of WAGO-1 (R06C7.1) family AGOs (19 in total) which function primarily with secondary siRNAs (22G RNAs) in *C. elegans,* along with CSR-1 which is also conserved. Whilst RDE-1 is primarily responsible for triggering the onset of an exogenous RNAi response, acting upstream of secondary siRNAs (22G RNAs), it is not conserved in *S. carpocapsae* (Billi et al., 2014; Dalzell et al., 2011). Our observation of RNAi sensitivity in *S. carpocapsae* reveals that RDE-1 is not required to trigger an exogenous RNAi response, however the functional significance of AGO homologue expansions relative to *C. elegans* remains to be determined. The lack of SID-2 seems to correlate with our observation that relatively high amounts of dsRNA are required to trigger the RNAi pathway by oral delivery.

The nearest non-target gene sequence within the *S. carpocapsae* genome represents an uncharacterised predicted gene (*L596_g5821.t1*). The *Sc-flp-21* dsRNA shared high levels of sequence similarity over a 21 bp stretch of *L596_g5821.t1* (20 of 21 bp shared), however qRT-PCR indicates that *L596_g5821.t1* had not been silenced, which could suggest: (i) the level of sequence similarity was either insufficient for gene knockdown; (ii) dsRNA was not diced in the correct register to produce this exact 21 bp sequence within a significant population of siRNAs; or (iii) the *L596_g5821.t1* gene is not expressed in cells / tissue which is sufficiently susceptible to dsRNA delivered under the conditions tested. In order to trigger significant knockdown of *Sc-flp-21,* 48h continuous exposure to dsRNA was required in the presence of 50 mM serotonin. Reducing dsRNA exposure time lead to a corresponding reduction in *Sc-flp-21* knockdown, as did a reduction of dsRNA amount from 5mg/ml to 1mg/ml over a 48h time-course. Phenotypes which developed following 48h dsRNA exposure were not observed across any of the experimental variations which resulted in decreased gene knockdown (shorter exposure timeframes / lower dsRNA amounts).

The neuronal RNAi sensitivity of *S. carpocapsae* IJs, and the ease of behavioural assays makes these species ideal models for studying the neurobiology of nictation. Within the Steinernematid EPNs, a number of species also display a highly specialised jumping behaviour which can be triggered in nictating IJs on exposure to host Insect volatiles (Castelletto et al., 2014). Silencing *Sc-flp-21* triggers pleiotropic effects on lateral dispersal, hyperactive nictation and jumping phenotypes. The frequency of standing phenotypes which is observed of nictating IJs which are stimulated by host volatile cues was found to differ between *flp-21*-silenced IJs exposed to mealworm volatiles, but not waxworm volatiles (Fig. 3C-D). Specifically, the standing phenotype is enacted by IJs which adopt a temporary, upright torpid stance. The mechanistic significance of torpid standing nictation relative to hyperactive waving nictation is not clear, however we observe that both can be triggered by insect volatiles under the conditions tested here. The waxworm and mealworm headspace SPME GC-MS profiles are expanded relative to those presented by Hallem et al. (2011), and likely reflects the increased sensitivity of analysis in this study. These data could provide a valuable tool for comparative analysis of neurobiology and host-finding behaviours across EPN species.

Given the redundancy of FLP-21 and FLP-18 in activating NPR-1 (and other NPRs), further work is required to understand the neuronal basis of nictation and jumping behaviours is *S.*

carpocapsae and other EPN species. Of particular interest is the function of FLP-21 in EPN species which do not nictate or jump, such as *Steinernema glaseri* and *H. bacteriophora*. Likewise, it is not yet known if, or how FLP-21 signalling is differentially regulated in *Steinernema feltiae* which displays a less pronounced nictation behaviour involving partial lifting of the IJ anterior from the substrate surface (Campbell and Gaugler, 1993).

Collectively, these data provide the first mechanistic insight to a behaviour which may have implications for biocontrol efficacy. Through isolating genes and signalling pathways which coordinate these behaviours, efforts to identify molecular markers of desired behaviours and traits could facilitate the identification of more suitable isolates and strains for biocontrol use, and the enhancement of current strains through selective breeding approaches. The selection or manipulation of behavioural tendencies could lead to strains which are capable of operating within new ecological niches, expanding their utility.

Acknowledgements

Waxworms infected with *S. carpocapsae* (ALL) were kindly provided by Ali Mortazavi and Marissa Macchietto, University of California, Irvine. Morris was supported by a PhD studentship from the Business Alliance Fund, Queen's University Belfast; Wilson was supported by a PhD studentship from the EUPHRESCO Plant Health Fellowship Scheme; Warnock and Cox were supported by a Bill and Melinda Gates Foundation grant. Sturrock was supported by a PhD studentship from the Department of Education and Learning. Dalzell was supported by a Leverhulme early career fellowship.

References

Altschul SF, Gish W, Miller W, Myers EW, Lipman DJ. 1990. Basic local alignment search tool. J Mol Biol 215: 403–410.

Billi AC, Fischer SEJ, Kim JK. 2014. Endogenous RNAi pathways in *C. elegans* (May 7, 2014), *WormBook*, ed. The *C. elegans* Research Community, WormBook, doi/10.1895/wormbook.1.170.1,http://www.wormbook.org.

Brown FD, D'Anna I, and Sommer RJ. 2011. Host-finding behaviour in the nematode *Pristionchus pacificus*. *Proceedings of the Royal Society B* 278: 3260-3269. doi: 10.1098/rspb.2011.0129

Campbell JF, Gaugler R. 1993. Nictation behaviour and its ecological implications in the host search strategies of entomopathogenic nematodes (Heterorhabditidae and Steinernematidae). *Behaviour* 126(3-4): 155-169.

Campbell JF, and Kaya HK. 1999. How and why a parasitic nematode jumps. *Nature* 397: 485-486. doi:10.1038/17254.

Castelletto ML, Gang SS, Okubo RP, Tselikova AA, Nolan TJ, Platzer EJ, Lok JB, Hallem EA. 2014. Diverse host-seeking behaviors of skin-penetrating nematodes. *PLoS Pathogens* 10, no. 8: e1004305.

Ciche TA, Sternberg PW. 2007. Postembryonic RNAi in *Heterorhabditis bacteriophora*: a nematode insect parasite and host for insect pathogenic symbionts. *BMC Dev Biol* 7: 101. doi: 10.1186/1471-213X-7-101.

Coates JC, de Bono M. 2002. Antagonistic pathways in neurons exposed to body fluid regulate social feeding in *Caenorhabditis elegans*. *Nature* 419: 925-929. doi:10.1038/nature01170

Conine CC, Batista PJ, Gu W, Claycomb JM, Chaves DA, Shirayama M, Mello CC. 2010. Argonautes ALG-3 and ALG-4 are required for spermatogenesis-specific 26G-RNAs and thermotolerant sperm in *Caenorhabditis elegans*. Proc. Natl. Acad. Sci. U. S. A. *107*, 3588-3593.

Dalzell JJ, McVeigh P, Warnock ND, Mitreva M, Bird DM, Abad P, Fleming CC, Day TA, Mousley A, Marks NJ, Maule AG. 2011. RNAi effector diversity in nematodes. *PLoS Neglected Tropical Diseases*, 5(6), p.e1176.

Dalzell JJ, Warnock ND, McVeigh P, Marks NJ, Mousley A, Atkinson L, Maule AG. 2012. Considering RNAi experimental design in parasitic helminths. *Parasitology* 139(5): 589 – 604. doi:10.1017/S0031182011001946.

Dillman AR, Guillermin ML, Lee JH, Kim B, Sternberg PW, and Hallem EA. 2012. Olfaction shapes host-parasite interactions in parasitic nematodes. *Proc Natl Acad Sci U S A* 109(35): E2324-2333. doi: 10.1073/pnas.1211436109

Ezcurra M, Walker DS, Beets I, Swoboda P, Schafer WR. 2016. Neuropeptidergic Signaling and Active Feeding State Inhibit Nociception in *Caenorhabditis elegans. The Journal of Neuroscience* 36(11): 3157-3169; doi: 10.1523/JNEUROSCI.1128-15.2016

Geldhof P, Visser A, Clark D, Saunders G, Britton C, Gilleard J, Berriman M, Knox D. 2007. RNA interference in parasitic helminths: Current situation, potential pitfalls and future prospects. *Parasitology* 134: 609–619.

Hallem EA, Dillman DR, Hong AV, Zhang Y, Yano JM, DeMarco SF, Sternberg PW. 2011. A sensory code for host seeking in parasitic nematodes. *Curr Biol* 21, 377-383.

Han T, Manoharan AP, Harkins TT, Bouffard P, Fitzpatrick C, Fitzpatrick C, Chu DS, Thierry-Mieg D, Thierry-Mieg J, Kim JK. 2009. 26G endo-siRNAs regulate spermatogenic and zygotic gene expression in *Caenorhabditis elegans*. Proc. Natl. Acad. Sci. U. S. A. *106*, 18674-18679.

Holterman, M., van der Wurff, A., van den Elsen, S., van Megen, H., Bongers, T., Holovachov, O., Bakker, J. and Helder, J., 2006. Phylum-wide analysis of SSU rDNA reveals deep phylogenetic relationships among nematodes and accelerated evolution toward crown clades. Molecular biology and evolution, 23(9), pp.1792-1800.

Howe KL, Bolt BJ, Cain S, et al. 2016. WormBase 2016: expanding to enable helminth genomic research. *Nucleic Acids Res* 44(D1): D774-80. DOI: 10.1093/nar/gkv1217.

Knox DP, Geldhof P, Visser A, Britton C. 2005. RNA interference in parasitic nematodes of animals: A reality check? *Trends in Parasitology* 23: 105–107.

Lee H, Choi MK, Lee D, Kim HS, Hwang H, Kim H, Park S, Young-ki P, Junho L. 2012. Nictation, a dispersal behaviour of the nematode *Caenorhabditis elegans*, is regulated by IL2 neurons. *Nature Neuroscience* 15(1): 107. DOI: 10.1038/nn.2975.

Lee JH, Dillman AR, Hallem EA. 2016. Temperature-dependent changes in the host-seeking behaviors of parasitic nematodes. BMC biology, 14(1), 1.

Li C, Kim K. 2014. Family of FLP peptides in *Caenorhabditis elegans* and related nematodes. *Frontiers in Endocrinology* 5: 150. doi: 10.3389/fendo.2014.00150

Maule AG, McVeigh P, Dalzell JJ, Atkinson L, Mousley A, Marks NJ. 2011. An eye on RNAi in nematode parasites. *Trends in Parasitology* 27(11): 505-513. doi: 10.1016/j.pt.2011.07.004.

McWilliam H, Li W, Uludag M, Squizzato S, Park YM, Buso N, Cowley AP, Lopez R. Analysis Tool Web Services from the EMBL-EBI. 2013**.** *Nucleic acids research* Jul;41(Web Server issue):W597-600 doi:10.1093/nar/gkt376

Moshayov A, Koltai H, Glazer I. 2013. Molecular characterisation of the recovery process in the entomopathogenic nematode *Heterorhabditis bacteriophora*. *International Journal for Parasitology* 43: 843-852.

Pereira L, Kratsios P, Serrano-Saiz E, Sheftel H, Mayo AE, Hall DH, White JG, LeBoeuf B, Garcia LR, Alon U, Hobert O. 2015. A cellular and regulatory map of the cholinergic nervous system of *C. elegans. eLife* 4:e12432. doi: http://dx.doi.org/10.7554/eLife.12432

Pfaffl MW. 2001. A new mathematical model for relative quantification in real-time RT-PCR. *Nucleic Acid Res* 29(9), e45.

Ratnappan R, Vadnal J, Keaney M, Eleftherianos I, O'Halloran D, Hawdon JM. 2016. RNAi-mediated gene knockdown by microinjection in the model entomopathogenic nematode *Heterorhabditis bacteriophora*. *Parasites & Vectors* 9: 160. doi: 10.1186/s13071-016-1442-4.

Schroeder NE, Androwski RJ, Rashid A, Lee H, Lee J, Barr MM. 2013. Dauer-Specific Dendrite Arborization in C. elegans is regulated by KPC-1/Furin. *Current Biology* 23(16): 1527-1535. DOI: 10.1016/j.cub.2013.06.058.

Sijen T, Fleenor J, Simmer F, Thijssen KL, Parrish S, Timmons L, Plasterk RH, and Fire A. 2001. On the role of RNA amplification in dsRNA-triggered gene silencing. Cell *107*, 465-476.

Simmer F, Tijsterman M, Parrish S, Koushika SP, Nonet ML, Fire A, Ahringer J, Plasterk RH. 2002. Loss of the putative RNA-directed RNA polymerase RRF-3 makes *C. elegans* hypersensitive to RNAi. Curr. Biol. *12*, 1317-1319

Torrini G, Mazza G, Carletti B, Benvenuti C, Roversi PF, Fanelli E, De Luca F, Troccoli A, Tarasco E. 2015. Oscheius onirici sp. n. (Nematoda: Rhabditidae): a new entomopathogenic nematode from an Italian cave. *Zootaxa* 3937(3), pp.533-548.

Vandesompele J, De Preter K, Pattyn F, Poppe B, Van Roy N, De Paepe A, Speleman F. 2002. Accurate normalization of real-time quantitative RT-PCR data by geometric averaging of multiple internal control genes. *Genome Biol*. 3, RESEARCH0034.

Vasquez-Rifo A, Jannot G, Armisen J, Labouesse M, Bukhari SIA, Rondeau EL, Miska EA, and Simard MJ. 2012. Developmental Characterization of the MicroRNA-Specific C. elegans Argonautes alg-1 and alg-2. *PLoS One* 7(3): e33750 doi: 10.1371/journal.pone.0033750

Viney ME, and Lok JB. *Strongyloides* spp. 2007. WormBook, ed. The *C. elegans* Research Community, WormBook, doi/10.1895/wormbook.1.141.1, http://www.wormbook.org.

Wang XD, and Ishibashi N. 1999. Infection of the Entomopathogenic Nematode, *Steinernema carpocapsae*, as Affected by the Presence of *Steinernema glaseri*. *J Nematol* 31(2): 207-211.

White GF. 1927. A method for obtaining infective nematodes larvae from cultures. *Nature* 66: 302-303.

Yassin L, Gillo B, Kahan T, Halevi S, Eshel M, Treinen M. 2001. Characterisation of the DEG-3/DES-2 receptor: a nicotinic acetylcholine receptor that mutates to cause neuronal degeneration. *Molecular and Cellular Neuroscience* 17: 589-599. doi:10.1006/mcne.2000.0944

Zhang F, Bhattacharya A, Nelson JC, Abe N, Gordon P, Lloret-Fernandez C, Maicas M, Flames N, Mann RS, Colón-Ramos DA, Hobert O. 2014. The LIM and POU homeobox genes ttx-3 and unc-86 act as terminal selectors in distinct cholinergic and serotonergic neuron types. *Development* 141(2): 422–435. doi: 10.1242/dev.099721

Supplemental Data

Figure S1. Alignment of *Sc-flp-21* dsRNA against most similar non-target *S. carpocapsae* gene (McWilliam et al., 2013).

```
CLUSTAL O(1.2.1) multiple sequence alignment


exon_14_L596g5821       CAAATTCAAGAGCGCAGCAGGGATAAAGGCTTGTAGCTGGCCGCAAAAGCCATCAGACGC
Sc-flp-21_dsRNA         ------------------------------------------------------------


exon_14_L596g5821       TAATTGCGCCAGAACTCGGTCAGCGTAGTATTCGGCGATCTTGCAAATGCATTGGACAAG
Sc-flp-21_dsRNA         ------------------------------------------------------------


exon_14_L596g5821       TTTCTCCGTCAGGTCAGCCCTGAGAACTGCATCGCTGACATGCATCCTTTCCCAGATGGC
Sc-flp-21_dsRNA         ------------------------------------------------------------


exon_14_L596g5821       CAAGTATTGATCGATGATGTGGCAAACATCTACATAAGAACTAGTGTGCCGAATCTCCGA
Sc-flp-21_dsRNA         -------------------------------------------------------TTCTG
                                                                               * * .

exon_14_L596g5821       AGACGCGATTTGGATTGTGGCGTCGAGTTGGCAAGCCAGTTCCACGCGCCCGAACG--CC
Sc-flp-21_dsRNA         AGCCGCT---------------------ATCTGAGCCAGTTCAACGCGCCCGAATACGAC
                        **.***                      :   .*********.*********** .  .*

exon_14_L596g5821       TTCAGCTTCGCCGTGTCCATCCA---CTTCACG--------ACGACTCGGTCGAAAATCT
Sc-flp-21_dsRNA         CCCAGCGGCTACATGTACTTCGATCAGCGCTCGATGAAGCGAGGCCTCGGTCCTC-----
                          ****  * .*.***.*:** *      *:**        * *.******* :.

exon_14_L596g5821       GGCTCCAGTCGGATTTGTCCAGCCGGTATTTCTGCTTTGGAAGACGGTACTGACGAAATT
Sc-flp-21_dsRNA         ------------------------GACCTCTCCGCTTTGGTTAACTGCTA-----GAAAT
                                                *. .* ** *******::.** * :.     .**:*

exon_14_L596g5821       CTTGCGCTGCCAGATGTACCTTCAGAATCGTGATCAAAAGTTCTTCATTGTCGCCTTCGC
Sc-flp-21_dsRNA         CGTGATATTTCAGAATTCTC------------CTCTTTTGATCTCTTTGATTGTTTGTTC
                        * **. .*  ****: *. *            .**::::*:***  :* .* *  *   *

exon_14_L596g5821       TCTTCGACGCGCTCATCAT
Sc-flp-21_dsRNA         CCTGCGACT----------
                         ** ****
```

Table S2. *Steinernema carpocapsae* argonaute proteins.

AGOs Protein List	Homologues	Accession *
ALG-1	x2	L596_g7718.t1
ALG-2	x1	L596_g16709.t1
ALG-3 (T22B3.2)	x2	L596_g3457.t1
ALG-4		
CSR-1	x1	L596_g20174.t1
C04F12.1	x1	L596_g11107.t1
C14B1.7a		
ERGO-1		
HPO-24		
HRDE-1 (WAGO-9)	x1	L596_g11197.t1
NRDE-3 (WAGO-12)		
PPW-1 (WAGO-7)		
PPW-2 (WAGO-3)		
PRG-1	x1	L596_g25491.t1
RDE-1		
SAGO-2 (WAGO-6)		
SAGO-1 (WAGO-8)		
T23B3.2	x1	L596_g21112.t1
WAGO-1 (R06C7.1)	x19	L596_g19943.t1
WAGO-10 (T22H9.3)	x2	L596_g19923.t1
WAGO-11 (Y49F6A.1)	x3	L596_g17524.t1
WAGO-2 (F55A12.1)	x1	L596_g16917.t1
WAGO-4 (F58G1.1)		
WAGO-5 (ZK1248.7)	x4	L596_g12936.t1

* Accession numbers presented are the top returning hits for each RNAi pathway protein.

Table S3. *Steinernema carpocapsae* non-argonaute RNA interference pathway proteins.

Non AGO Protein List	Homologues	Accession *
AIN-1	x1	L596_g5788.t1
DCR-1	x1	L596_g26648.t1
DRH-1	x1	L596_g26385.t1
DRH-3	x1	L596_g25860.t1
DRSH-1	x4	L596_g13580.t1
EGO-1	X3	L596_g919.t1
EKL-1		
ERI-1	x5	L596_g16241.t2
ERI-3		
ERI-5		
FKH-3		
FKH-4		
FKH-5	x1	L596_g10448.t1
PASH-1	x2	L596_g24740.t1
RDE-4		
RRF-1	x1	L596_g7841.t1
RRF-3	x1	L596_g11915.t1
RSD-3	x1	L596_g5786.t2
RSD-6		
SID-1		
SID-2		
TSN-1	x1	L596_g28061.t1
UNC-130	x1	L596_g11813.t1
VIG-1	x1	L596_g22586.t1
XPO-5		
XRN-1	x1	L596_g18210.t1
XRN-2	x1	L596_g10155.t1

RNAi pathway proteins

>AIN-1 - L596_g5788.t1
MWGEETGAETMTLNPWAGVSQQPQVWQNMNSRGNGNPSVANSVGSFAPNGGSVRPGSQQW
DGGATPAGRSAWNPNPHAPRWTPSVNHGNASGWPNAQQHWSVANSNGTYAEQTKKNMALG
RSSGPNLNMSQRFDGSQGWGSKVDQGTPWDTGNSGGVSQQMHEGKEQWSNPTRWTQPPGT
WPTPIVAPMVADWQQGQPRHDHWANHPTGGMVPSGGAWAQQALGVASSSEQGRVPYDPNP
QTPGPWVAPQPAEMNNDMMWHDPNPKQKKIQKDVGTGIWGDPTSQIEIRRWKDLEAEGGE
FPGGSDWGSGSNSSTQPTGWGDVGPAQGNDGTDRWGAQGQALQGGWSDKVDQDRDLNGGK
SDLNQIQRGIQNAIANGALCPDGQSRLQQWKKQRGGIGVGSPEEKMGVASSSDSNVPSLI
AATKIMNIHGDWTPPSSVADDSAKSEDQVSSSGTNNEKESSVKESASPTPPPTQLDDGPQ
EFVPGKKWEWRDPNKVAEDPNATPGNCKPNPLMAAGNNMNFAFSNSAVNTANPYGPEVPS
GNASTFWPNNSQGFNVPYGRDMYNSVRARLPSNGQFMPQRGMSGGYSNSNHNRMQTPPGK
GVFIVLNHQGANETQLNFSCTRAGQLLNVASLGGQTVLLRYADSSSEGVLQKLKADFPGN
ERIKTVSEEEVEKLLKNRSPTMSGSAWAPNSDTPLWSNGGSPLATGEIMSSQNVFSNQED
LNRQQY

>DCR-1 - L596_g26648.t1
MSKFAGKPPQAPPRPQKLCGLKSTTRRRGLHFDGRAPAAKSRFQISLANFKFVWRRSGDS
LADRLQKRDENWILKLRSPSDSAKAKNAAQMVVKATEINPNFFTPRDYQIELLEKALNYN
TIIPLGTGSGKTFIAVLLIKEYTQLLLPKFSNGGKRAVFIVDKVALVKQQADHIECHTEL
KVAQFHGYMNTDVCNTREAFEKVIEDSQVLVLTAQIFLMLLDHAIFSFDRVPVIVMDECH
HVLGGKHPYRLIVQRYSELSEETRPRMLGLTASLINNKTAPSELEALLRQLETIMKCRIE
ASSDIISVAKYGARPKELVIACRDNDFAEDWIRVCLKSLQNLRESAANCLDFHPDLDVDP
RKSVVEAATKILSVLQQMGPWCAWKVAMVWEKQLRKIHTSKSKASGLGEKQIAFLQNGES
KIHEIIKEFEQKVKTVRSYEELKKYIPHKVERLLELLRYYHPNIQKTLQGGGVKSLSAMV
FVDQRYVAYAMNLLMKSLYKWNQIDFGHLRSDFVIGFNGTSLGEESAGFHKRQETVLEKF
RQSQLNLLFTTSVLEEGVDVKHCNLVIKFDSPGDFRSYIQSRGRARKQGAHYFMLTEAKN
KLEFALNLRNFCEIERMLITRTVTIHDPEHQVPARNVDDVVQPYVVTSTGAKVTMSTAIA
LINKYCAKLPSDVFTRLVPQSCIEPVTVNGVTKFLATLSLPINSPFKEEIRLKTPMDTKK
LAQMAVALEACRQLHEKNELNDYLLPAGKDAIAATFLLDEDPDEYVPHMPHKAGSIRRKQ
LYDKKMDLLVEASGAANPKRRKIANPLDNDYFFGFLSKRILPEVPSFPIFPRQGKVLVSI
KLCKNQITLDEETFERAMKFHEYLFDDVLGLAKQGFVEFVPRHAPIATVIVPLKRREHAV
YDLDRVYLSNILEYRRIPYTPSEEERRTFQFREEDFTDAIVVPWYRNQDVFYDVAVINHS
LTPASGFPDGNYTNFREYYMKRYNLEIFNETQPLLDVDYTSTRMNLVMPRIPTRSQGKEK
KSDRTQHQVMVPELVNVHPIPASLWNSIVTLPTIIYRANALLLADELRELICAEALGPND
NSVHICWEPLDYVTSYSEDAQLPINKLSHLEKDLEAERAKARAENPEPEIVDMEDDSSND
GFNIGVWDPKLGDGGELAGRILTVPFPMASSARTDEEIADEAADMIVTSGNLNNGNMSDD
EDDQGEMKMLMDYAHIYKNDSSSFLPVRDNIEELGWDADIGQLNISEDAFPVSITGTSAS
IDGKSLMKDIASVLDPSFAGNGVASANGSAPNGSGDAVFAKSKPVATRLDLSAFDDRDAP
LIRTGENESLNLIEYFMDSNDSQEVERMKKASLEIESSRPHLENFPVVEVEEEGTPQKAI
EIDNSLFTNPNVLQPEINAYTDGDVGERSEVARVIPKTTFMKPDVKVNFTDEGMPECSAG
VSPCVLLQALTLSHASDGINLERLETVGDSFLKFAVTDYLFHEHKEQHEGKLSFARSKEV
SNYNLYRIGKKKNLPSILVASKFEPTDSWLPPCYMPTGDFKGPNAEDAEATDKFMDAVFE
GKPIPQSKKPLTGWDEDNNEAEKVVDGIETINLLKNPTGNTQYDVNEEISPLPYNVMTQQ
YISDKAIADTVEALIGAHLLQLGPKVALRFMRWLGLRVISEQTVADEPLLRFLDTPEDPN
RSNQELVSYIERFQLSSVEKTIGYRFNNKAYLLQAFTHASYYKNRITSCYQRLEFLGDAV
LDYMITRFLFQHRKKYSPGVLTDLRSALVNNTIFASLAVKYNFHKHFVAMCPGLHHMIEK
FVRLCESQAKNTNFNSELYMVTEEEFDDGDEEDIEVPKALGDIFESLAGAIYLDSGRRLD
VVWEVFYNLMHDTIMECCEHPPKSPIRELLEREPDKARFSKLERIRENGKIRVTVDIQGK
CRFTGIGRSYRIAKCTAAKRALRYLRDLDKEREAAKKASAHH

```
>DRH-1 - L596_g26385.t1
MNTHLKTSHPLSVINWDKFTPETPVAIRPEHFDLRPYQEELAHHALKGENTIIWAPTGSG
KTIVAVHVIAQHLLKGNGRKVCFVVPNVTLLEQQKRVCERHMDAKVNIIKAESKAPFSGM
VAASHIVLLTPQMLVNALQNTTEGKENFSLSVFSMIVLDECHHTAESHPYNVLMHHYHDV
KLKGTGKSPQIVGLTASLGAGTSRNANEAFRHIQKLCANLDSPKISTVEKHKADLTGFAV
ETKDRIRYVESNYRSKPFFKDVMELMSELENGIFVHPAIACDPVKKAMIKEQVCRSSDAS
STANYRSSASTRYSQAYQNWLGNALMITLPKVDLPSDARVEIMTRFRLLKILYKMIELWA
NFNGKCAMDYYMKESEGLPIPLPVHDRIRELVSYRNDNSDMLIEMCQLLVEKFGEGTDGA
SPARVLIFVKEREYTYMLANIIDCCNELKALGVRPDFLISTNSGDGECRLNPEEQRSKLE
KFRSGEINLLCSTSVAEEGLDVAECNLVIKYNYASSDIAHVQRRGRRARHQNSYAVLFTH
DKNLEQQENKNILSEELSNQAIALLRQMPQKMFEAEVQELVRKSYSDRVIERAAKETASL
ALKDVGARTCTEFIGRSTDVRHSNHSLHILCDGSIWDRFTCEESVSQENFLKTSELPIGK
IYCNNCKEVWGRIVIFKGIAVPIIACKGILLQNARGERFPCAKWAGIKGRYFCPEEVKSV
DLARLSAAPHRPQFLTVLMGETESRSL

>DRH-3 - L596_g25860.t1
MTSNGTRFELDYVLTVITTLDFILEPFFLFLALTKSTPSMWFYRIFLIAISLCNCAFSIV
FFLLSAKFIPIDDAVCLISSHFALRSGRVLWQLSMFFMMIQFQIVLLMLIYSSYEISHPL
RPLNWRSKAVILAVFVFIFLPASLVLILEQQVIMGEIEEEKREKVPLSHVRLFRKEFLES
GRINEAFIDKCEKFLSFDVVEILKKLFTINPGLARKFFFRQIRLKHPKESGIIIPIIERC
YGDDTEVLSELRLENLKNASKERYLKIFSDDEFCAGDTLSTQIRPQPFIKNLAAKYGNRY
EKMIKKVEALLKDKEHDAAACQILRSMPKIADDDEDDSWWLHLLDICDMDPHNRACLVLL
DVDYRNIIDMFRAEQRAKRTPAIQGKDEVMFDETISDLDREFRGQEPYMEHRETVDENLI
DDPDKIVLRDYQEEQMEGVRKGNTIVCAPTGSGKTIIAAQTLLEHFKENEKARAVMFVPT
IPLVEQQAQLLTRFLRKRKYILTASGAERVVSLGRKMLSADVVVITPQLFYNYMTDPRES
ERIYISDFTLFIFDECHHCDSNHPYRKITKRISAFEGKKPHVVGLTASVGVGTKTMNPQE
AVDHMIRICANMTAQSITTVQRCLKSLDEKVRIPDDYIRTVHRDLESPFRGKIAEVLGKF
VYIAEEKLKNTVLAGGEFESFPDKRKVCQFFGFVKRLKNELERNQKVEDRNALIYTLARI
EVLYKLFNLSDLLPARYAAHVLKEFNDENKDGLQEKYKHYLRELGEAAIKNEERDMNKDI
LVTLKEILVDQYQKDPFSKTLIFVSTRDLARDLSLYLRDQWDKYGLPRKVKPTREGEDSE
KTYKPVSYITSSNQATSAGGLTAQQQRETVAHFRSGHHLVLVATSVADEGLDIAECNLII
KYNTSESSELKLIQRRGRARAKQSSSILLALDGAIEKAEYDGMLREKLMYAAIKHLHTLP
DTHVYRLIEAKAQQLLVDEKEAEERAKQRKEEASEEVWIVACKKCSEQLTTTGSLRNAGD
KRVASCDPSIWEKLKIVGNQKAESHGNASLEISVAVCSNGDCDNTIATLGTDGNTFMPFL
RAQSVSLYRQAEYDADNREGKQSLKKWRSLEAGEYNIVLRSIDDEDRKRMCSSWESQNSE
KAKEIVQKRQDQRAFKRARYLTKESRNRELAKKVILKQKEDPNAEEDDYGYSSIADDKIR
GEDLEKVKIKAEDFAQVLHSEPNYLSAMKGYEAEVSDNSDNDYE

>DRSH-1 #1 - L596_g13580.t1
MEDPGCSGTQKLFEGAKRTLDKREDAQENEKTENKEQLLTESDVFKRLAEIDLTTEESTA
NSPDPSKIQDLSKFTVAVSKRTISEPDASEFYVKTENGDTIGTDRLKTVHEAMQFRVLDV
IDMARREQPQSEPPTMPTFHENCKCGHVSESEADSSSGSESEEDDENADLSNVSDANKHS
LVAKREIARKQQHPAGLSQEMCFNEPGQMNDGPACRCSWASKQSGIRHSIFVGEERVEPC
NPMSSNLRNLHHYFMKVTPNPVEQSRNASLIYHNDKGYVFEGFSVFFHRKLPQFFPQTPV
NKLSQEFEVVFIEEKAPEQFTVHDLESFHTYMFDHLLEMYDLNRRAKDVFDGCPVYHCMP
RFVFKDYATEAVEVLPMSAVLHHIAGAFQPVFDDRLVQKIRRDENLFHNMSSHMKGQIFV
NPSKRPATIRVDLIERQDPYTKSVNKDFHPVLTHIGLRPSVYTFSAKPAYQQAMKKYLRT
RHLMSLQGKLSYEDKQKLVEQEANIRKLKAEAQHKRDMVMSVTSRGFYSTTFYPDIVQHA
VLLTLACSHVRYHWCLETFEKRIGYSFKNRTLLELALTHPSFRANYGTNSDHTRNALANC
GLRIDKARNDNRNSQVDRPSRKRGYENLREVMSMKGTEKAVLSPVHHNERLEFLGDSVIE
```

FITTIHLFYMLTDLDEGALATYRSALVQNKHLAVLAKKIGLDEFMLYSHGPDLCHESDFR
HAMANTYEAMMAAVYLDCDLNECDRIFADTLFMDEKEEKSKEKLAWTKLLDHPLKRDNPY
GDRHLIPKIDSLQLLTQFEDSIGIKFKHIRVLAKAFTRRCIGYNNLTHGHNQRLEFLGDT
VLQLVTTEYLYKHFPNHHEGHLSLLRTCLVCNRTQGVICDDLAMAKYLVIPPNSRKHTHV
MSIRWKERADLVESFIGALYVDRGLEYCKTFCKVCFFPRLKYFIESQRWNDPKSQLQQNC
IALRDGKNEPEIPEYRVIAIEGPTNTRLYRVGVYFRAVRLADGVGHTVHLAQMNAAENAL
KQHADMWPSMSTKKTEKKASHNNWERASYRREGNSAKYERSSNRQGGGNDYRNDLSGQDY
RKVPDGRESRRNSQNSDAPRSTFNAPYMQQNRRPYDNGQEKPHRSRNGQQYDDRSNQNDL
RNGRNHHAPSYQNEPSRFGPTRHRHDHEFRKPYDRPQHDFRHFTNDRRPHNESQNTSYGR
DQNKGEAYSGVRSRYYESQSERPPYRPSGSQKDSNPVYQRNAQPYRQQNNEQNSCRQPTW
QDSQNKPH

> DRSH-1 #2 - L596_g13580.t2
MPRFVFKDYATEAVEVLPMSAVLHHIAGAFQPVFDDRLVQKIRRDENLFHNMSSHMKGQI
FVNPSKRPATIRVDLIERQDPYTKSVNKDFHPVLTHIGLRPSVYTFSAKPAYQQAMKKYL
RTRHLMSLQGKLSYEDKQKLVEQEANIRKLKAEAQHKRDMVMSVTSRGFYSTTFYPDIVQ
HAVLLTLACSHVRYHWCLETFEKRIGYSFKNRTLLELALTHPSFRANYGTNSDHTRNALA
NCGLRIDKARNDNRNSQVDRPSRKRGYENLREVMSMKGTEKAVLSPVHHNERLEFLGDSV
IEFITTIHLFYMLTDLDEGALATYRSALVQNKHLAVLAKKIGLDEFMLYSHGPDLCHESD
FRHAMANTYEAMMAAVYLDCDLNECDRIFADTLFMDEKEEKSKEKLAWTKLLDHPLKRDN
PYGDRHLIPKIDSLQLLTQFEDSIGIKFKHIRVLAKAFTRRCIGYNNLTHGHNQRLEFLG
DTVLQLVTTEYLYKHFPNHHEGHLSLLRTCLVCNRTQGVICDDLAMAKYLVIPPNSRKHT
HVMSIRWKERADLVESFIGALYVDRGLEYCKTFCKVCFFPRLKYFIESQRWNDPKSQLQQ
NCIALRDGKNEPEIPEYRVIAIEGPTNTRLYRVGVYFRAVRLADGVGHTVHLAQMNAAEN
ALKQHADMWPSMSTKKTEKKASHNNWERASYRREGNSAKYERSSNRQGGGNDYRNDLSGQ
DYRKVPDGRESRRNSQNSDAPRSTFNAPYMQQNRRPYDNGQEKPHRSRNGQQYDDRSNQN
DLRNGRNHHAPSYQNEPSRFGPTRHRHDHEFRKPYDRPQHDFRHFTNDRRPHNESQNTSY
GRDQNKGEAYSGVRSRYYESQSERPPYRPSGSQKDSNPVYQRNAQPYRQQNNEQNSCRQP
TWQDSQNKPH

> DRSH-1 #3 - L596_g28273.t1
MTTSPDIELFNISSDEEDDLLDFPKMAPARKATQAPSREKHCQAELSRACEAFSVQTLDA
IGVARCRAADGNAAENGFETLLGCPCPKSQLGTGLRHGFYPKEECIPACDKEQINPPNLH
HYVLKVDSPNVPQVTRIMHGNKEFVFDGFSLFFHQKLPVELLCTPLKIALGTSATVTLLP
ARSPKGFNVKSLDWFHKYLFEEILSFPMSQPNQNQCSFYHCLPHFVHKEGKNVHLLPMIA
VLQHLQANFKPIFGVNDLFKNHRGENVVAKIRGQVVFNPTKTFSALRLDHVEDPRDLLGQ
PKLVSFTKWKKSVHTRSRTKRKFMPNRIKSDQTERPFFENAVPSKGYYKTGLYPDVIQHA
LLLVPTVNYMRFHFNLQILEVRIGYTFKDKTLLELALTHGNFRGSYGPHRLIVKRQNETF
GFRTNLDTATKELKRPSSNGSKREPGQTYERLEFLGDAVLGFIAATHLFYMFSMADEGTL
SLFKSKNVDNSRLCDLAKRSGLQQFILYECDRNLIIDEGSHPLLANIFEALFGAIYLDGG
LNECDRVFADITFRNEQNGEENKLAWKNMLEHPLKRENPHGDRHLIPKCKSLLLLTKFEK
SINAKFKHIRVLAKAFSRACIGLNNLTHGSNQRLEFFGDTILQFLTTEFLFHKFPSHSEG
ALSLLRQGLVNNKALSTICDKLSMRTYIVVPEDMEKMEHVWILTEKSKADLVECMKRWKR
KAGRTRNPPSKKRSTSSAEALDAQIYLDTKFSATRDHQIIDLTMSPSTSGTFNTLKLFKS
LFRGKQLGVGKERTIKKGEMEAAKNALESITEAVFKDMKRKLLEEKKIDVPRTGVCSYPS
L

> DRSH-1 #4 -L596_g13580.t3
MEDPGCSGTQKLFEGAKRTLDKREDAQENEKTENKEQLLTESDVFKRLAEIDLTTEESTA
NSPDPSKIQDLSKFTVAVSKRTISEPDASEFYVKTENGDTIGTDRLKTVHEAMQFRVLDV
IDMARREQPQSEPPTMPTFHENCKCGHVSESEADSSSGSESEEDDENADLSNVSDANKHS

```
LVAKREIARKQQHPAGLSQEMCFNEPGQMNDGPACRCSWASKQSGIRHSIFVGEERVEPC
NPMSSNLRNLHHYFMKVTPNPVEQSRNASLIYHNDKGYVFEGFSVFFHRKLPQFFPQTPV
NKLSQEFEVVFIEEKAPEQFTVHDLESFHTYMFDHLLEMYDLNRRAKDVFDGCPVYHCMP
RFVFKDYATEAVEVXXXXPKLQLLLLVTVCAFH

>EGO-1 #1 - L596_g919.t1
MLAAENDRPPTSDDSQMELKEGGTAVMDVKARDAPSKKAPRVFPESDDSDLVRIITEAER
DRRMQLKLDKADFQKKVIHEMSADIAGCSASCKRVSEVPGNVNGVPKSAHFEVELTAPEW
DRAFFPMVHNFLQISKDYAETKKANALMQVSNPTLLREDFEPTNKLLPLQSFAFGCMRSP
FEFTNHHEFHSSESNAELLHDYFNHCREEPNHKEAMTIDFNHDLGDSFVKFASEEGNGYF
VYMLKLIYNKVRRIIVNFERLDSTTSTVHGVKLFLLFNNPIEVRRSQKIKGRKGDSYWRF
DTNGDRCLTWNNNEERQAIIADCLNLKLQFEKLEKNVLYNILSRLRRRCNVILEFSSVQE
VPFKGHVDRPMFGDHAIARKLKEMDKYDVNYLIEALCSRGAVINDQFLESEKTRDDYVEM
ILEDYERNSFITIAALERILNIIDEHLEVRDIHLLYRTCFNEEAAHEKDLKETEERRKAD
GFLKVRKIVITPTRVLFVVPEMMMGNKFLREYDPDGLYSLRVAFRDDSGLKMNNSNVGSQ
LVEKTIRESFKGVMVAGKEFVWIGSSNSQMRDHGCYFLLNQTRDMRKILMEKTGEFDEKD
PIKAQARFGQRFTQARAVPFDLSRDDYDFFDDIKGGEDENGERYTFSDGVGSISVHFARR
IAEALKLQNFVPSVYQIRFRGIKGIVTLDPNLDYYRDHAKKYGIQERRKHHRFDLQIAFR
KSQDKFNARVDVEIDIVKFSTPTPMQLNRPMINIMDQVTAMQSEASHRRMCARVHQLLDQ
QLSDLGKCLVDEHKAREKLFDIPRRVDVHLLTLEKGFHLTEEPFFRSLIQCHVHTTLNRL
RAKNQVQIPFNKGRMMFGVIDESGGLQYGQIFCQVTNNLQLKTPGVTAAKTILTGPVLMT
KNPQNVAGDMRMFNAVDIPELRHLVDVVVFPRYGPRPHPDQMAGSDLDGDEYAVIWDPEL
FFDRNEEPIEFPKPKKPVPPADADSTDLVINHIVNYIQQDSIGVISYAFLVNSDLYGIDS
EVCKRIARKHSMAVDFPKTGVPPQKLTREPDEDNNVPPEKPDRYPDFMEKSGRDPDYVSA
GLNGQIYRRSKEIQGILQFTVGHQESRAPEPDPDFLVEGWKTYELDAREAMDAYNASIRA
LLDNYGVKDEAELFTGNISNARNRLSDKDNDDMSLFNTNYAIEQRVSTIFQTHREQFFDK
CGGYMELTVSDMTFIPTAPKINSRDLERRLCTEISPEMKKRASAYYQVCYTLQPKRESRR
ILSFPWIAYDVLAEIKKENYARKIRNQELRIDIGRPIMSRLDDYIKEYLKHPRFAAFAKA
LVFDKVCHRYATVYPALTELFFVLWQFGFEQKIFDGCILPENLFYLFLLFAVSTENPFLE
KIPADANVKAMEKRDLHARIGGMGGPLMDFLEYLCTREFQSQLFVSFNEIGVDDCLQGAT
LASLSRAAIHTYYRITFSGMFFALPQLGADHSKNPSTKEQKFDTSGVRVYEIDPFVIEVP
SFAKEEGKLDELTQMLKLRTGMQHLVVRIKFIVRKTGNLRLLVSGIGSLEAIEALRDVVS
IKPNLRSGSATVVAKAHLMADMVYAKIMGSDNFGGGPFGYCHDISDIKKATPRKKPIRKD
LRN

>EGO-1 #2 - L596_g10626.t1
MSADSDSSANAKTSGVIRIFLDRTYERYDRCTELQHYVLEKLTREETFQTFTLKRNGLPR
HHKGDYEERLSEYELTRMPPPKNADKSKEPWDREEYPPRKRLLQLVTEFTEALSATMKGP
LPAIMQISDDFFLKKDYDPIDENLRVAEFALGNLVDPFTFHYSELKSSTDDKAQHDTHIL
RSFMKDNNIKSGMIATFEHDKNILWIRCVHWQKNPQAVYGVSLKVPYNQIRRLIIDVDKK
ADCATIYFCLNYPVEIRRAKMKSQKGRNMSAFGTEFDRKGRDGERCLSWEGEDSENGRLK
QAIADSPVLALTLTDYKDEGFYNVLSRLRSRCKVPEFTHVHKEKRSDYVDPPDVLLHLRT
KSGKLNDFSVAYFVQAVFSRGALVKDALLRSEDVRNKFIAKICKQCDKNRIVAVCALERF
LNAIDEKRELRDPIKLWDFLVNQVSGDIGTIQKQLDKNEKDGYTLVRKAVVTPSRILLLT
PELIMGNRGLRDFVNNSDDVIRVLFRDEDGTQMRKISVGEIIIQKVVGQVLEDGIRIAGR
HLCYLGSSNSQLRDNGCYFFEKSQIPDIRKKMGTFKEMSVPKRMSRMGQFFTQAQRVQRP
LERKEYRESYDLIGGADLVNEPYTFSDGVGMSVALGEEFSRSLKLNGCVPSCFQIRYRG
FKGVLSVNPMLDEIRAWAEANLSDEDIPKYRNNVVFRSSQKKFDASKNAKLDSAPFEVVK
YSAPCQISLNRPMIDILDQVSEIQSYKAHERIWSRIDELFEKQVAKAASSLTSEHYARER
LAELPKRIGTSDLKEEDGFMLTQEPFFRSLIMSSVRLSMSKLRKKNNVDIPSNLGRLVYG
IVDETGQLQYNQIFCQVSSSIFVKHPKKSALKRILKGPVMMTKNPAIVKGDIRRFEAVDI
```

PELRHLVDVVVFPRYGPRSMPDEMAGSDLDGDEYVIIWDPKFLFDKNEAAMNYPRPLKTF
EKVREDEIEKKSCEFFIKYIIQDAVGMLAHAFLANSDYYGIESEVCENVARKHAKALDFP
KTGDQPDALTKMPTKSEIYEGKQIPQEKPDRYPDFMEKDHQRCYASIGLNGHIYRRARAL
DDILHRSVDRHLSDKIEVDPDLIVDGWEDYEDEAKKTMNDYNSQIRSVLETYGIEDEGQL
FSGAISKMRSGVGDATQDKDLFGAFNVLSTVSKHVALIFDEFRRSFFDEHGFGGYLHCTD
LKYETVGRSDEMHHSYKRTCRKPTLEMKKLASAYYKLTYEAARQESQQAVKLLSFPWTVW
DVLAAIKHDVAEEKRRSSDRRDQYMNRRVKPFANLLSEHIAKFCRQRQEDLDDFKNLLVN
TDGIIALMLERYEGLVSILFFVCVWADDSNVFSDFFNYQHLCWILILFGQGIYPWNHAKT
FHTDLPIFYPIDKLKEVQNIGKESVNLNHLLGGIGSVILLFLEFLSSYYFGHKMKSISFN
PLGLNSSLGSCYLQKLFHAATKTYNEVIFSVSFDTLPQPEEGKVHRSLREFEIEPFMIEL
PLQKESEGSEARYNLSDVEDQIKEMTGASHVRVRPLNDVFLSGVTRLMVSAKGTLESSQK
LRTLLSVMPSCRNEHNAKWGKLFMSERLLMRLNLVHS

>EGO-1 #3 - L596_g1037.t1
MHEILFLLAEGFVEGPVGALEGKDLTVFFSKSFALNFSWIKSPPVTINRLTLCVHQIDSM
LNDETKALARLSELTRRIDFNHLTSEKGFQFIDEPFFKSLIQCCVKFTLSKPMGRFKW

>ERI-1 #1 - L596_g16241.t2
MRDRLKRRLRKDLLSTREYEDEFSRNKLRQHFDFLVIIDFECTCEDEVVDYPFEIIEFPA
VLVDTHQKKIVSRFRTFVRPKVNPVLSAFCVELTGVTQADVDKAPRFSEAVLKFHRWLFS
HVYPSGQHDFGGLMKSYAIVTDGPWDLGKFFQLECIRLECIRSERYNAKIPHHFRAYINI
RRVFTLKYKKTHALSKVNLAGMLAVLGMEFEGREHCGLDDAMNLARIAIRMMEDGAEFRI
NEKLVAAEYADKYTSFVPTISTTGMSTAERDRRKWRLNLPYRIVNICKDRFMTGAYADCD
SCDEDANFYEKAANRK

>ERI-1 #2 - L596_g986.t1
PISAHNFRGTSQQMRDRLKRRLRKDLLSTREYEDEFSRNKLRQHFDFLVIIDFECTCEDE
VVDYPFEIIEFPAVLVDTHQKKIVSRFRTFVRPKVNPVLSAFCVELTGVTQADVDKAPRF
SEAVLKFHRWLFSHVYPSGQHDFGGLMKSYAIVTDGPWD

>ERI-1 #3 - L596_g8761.t1
MSLEELSALISEASKRKPKRAKRGEEEAPNGRYEDPKEFPAVLVDTHQKKIVSRFRTFVR
PKVNPVLSAFYVELTGVTQADVDKAPRFSEAVLKFHRWLFSHVYPSGQHDFGGLMKSYAI
DDDGLWELRNFLQXXXXSILTGLSVKKRNSAFIVQVRTTYPMHTASTDGLAKMSWGSDEG
SISMAIAALRKSRPAAFELEYPDLMAKTKPTPLPRQPSPAQQVEPKSPAQSIAPTSSSED
LHAHLAKIQVTQPSVYLPSRPAYPSVAPSVPTPEAVVPQPEPPRGPPGFDRSAKPKETTF
DTRVMGGASQTDVQVVPSREVPHVPSLPVAPARPRVDRSTKEAVARKEAEFQRNLFAVYE
ACTQDFRNMT

>ERI-1 #4 - L596_g16232.t1
MLAVLGMEFEGREHCGLDDAMNLARIAIRMMEDGAEFRINEKLVAAEYADKYASFVPTIS
TTGMSTAERDRRKWRLNLPYXXXXVYCGNAIINGRLIRITFKFSRIAWSQHLACEGVTKI
EMLAAYVAFEARRRLAQFVTYRES

>ERI-1 #5 - L596_g16263.t1
MSVSVTRIQELPSVLRPFVPRQSLPSFSRDGRTPETELRSGKTRGRLLRVRGRRRGRRRG
FRRRRVRLQPGLRRRSDDLRGTLGAYLRSLETDAEESEKRGRGCSKWPLMIEDPNEPLRC
EGYQVPKHDFEFPREVSVXXXXKANLQKELEELQLNTGGTSQQMRDRLKRRLRKDLLPKY
KDEFSRNKLRQHFDFLVVIDFECTCEDEVVSRFRTFVRPRVNPVLSAFCVELTGVNKAPR
FSEAVRDEFSPGRESDEGQGRVSDQREARGGRVRGQIHRVCPRNFDHRHERRGAGSQMMW
RLNLPYRIVNICKHRFMSEAYADCDLYDEDANFYEKAANRK

>FKH-5 - L596_g10448.t1
MTPRGLCVCNLSSQPQHSMEPSSESSRKFMDMISTLCAEVDNKQKLPEKKPQRNASGKCM
KPAYAFSAIIALALKNSPDGRLPVWKIYAFILEHFRYFRTANEAWRNSVRHSLSKNGNFE
KCLKEDGSKMKDGNMWQIIESRREAIDREILKYRLSDKYHAMNLAALNKPEILTSLEEGS
FGLPPFVFEKEYKQAYRILANQKNKRPEIPKNFEVASNVFKESNMNTLNTDLDTLARPNP
ISVLLNENTPSPISRIDLLKPSIPSSSSQNMSEASMNAEEKQIYEKYLTSDSNPLLSSAA
LPGAVVPEIDDCMLWECEQDTLEAGIQTRLRHDENDFWLPTRSNCIFDLPSDNLSVVSDG
F

>PASH-1 #1 - L596_g24740.t1
MRKHKKLKPRILLAKTWCSPSPFGDLXXXXSCRKEKSLTTPTDHLIEDSDSDGGIRNRSF
GETQDQPQTTQTDHLDGSRSGDEFEDETLEKTPNKSHTSKNEKEEQGTSKRVLAYSEYGL
SNKLPEGWVEVSHESGVQVYLHRMTRVCTFSRPYLLGEGSVRHHKVPQTAIPCFFQRKVR
EQLEQREKEIEEVVKSQKGAETSAHLIAKLQAPDVKTIAQSQLTPDDLFDYAKSVFEFKT
ITVYRDKASKWRHLKEQKRAEGKINAAAKAALLDSAPEIPQNMKIITIALDVESEKKAVT
IDPRAKTSINILSEYFQKVFRSTPRFTDELTSVPLKEKIMSFQNLAKSELNPEIGDEVIL
GEGVGAKKKTAKLRAAAEAASFLIPEIKFDLDGKVISWNEDSGNKTEKDITVDFNQYEIT
DPRIAELCKSYAQPSPYTVLQECLRRISACSNDEIQIKTKHKNYSSFIEFTMAVGEQKVS
VTCSNQQEGTQRASQLMLALLYPDLQNWGDVLRLYGEEPQRVVKDRSKEVTTLQTFVQNG
GDKVLSDHNNAILDKLKEEMKATADGLDLQKGLLKEVSASHLPISECDAVLSAVYAEFHR
VKREVPEMGI

>PASH-1 #2 - L596_g24745.t1
MGDVSDDLKLLMLERERILRELNSQNPGYDPDDVEPPPPPPPELPDEESSLSSAEDMYPP
PPPPFTESFPSPSCSPAAPVCLTASPANPEPCTSFDSVSRDPSSLQRDSSSTALPATPLQ
APIKKDAEESFDSPVAKRPRMDGCPFSGTQFSEESPAVNDRKSTYNDDNVVSDADVSNEA
NNSQAQSVENSGDSDLSDDSDDDFVDGLLEKTLDESRTVKNEEDLEIKSKRVLEHRGCDH
FDVLPEGWVEVSHESGLSVYLHRKLRVCTFSRPYFLGTGSVRHHKVPQTAIPCFFQRKVR
EQVEQREKEIDELIKSHKETESSAHLIAKLQAPEVKTVQDFEQSQLTPDDLHDYAKTVFK
FKTINVHRDRTWASHRMRIKDKKRADAEMNAEANAASLDCDRPVLPSDVKLITIPSLDQN
GKPQRKNFLMNPQGKTSVSVLHEYVQKVVKSTIRYHYEETRSSSNPYIAIAYLKLGQISG
KATSAVSIKEKIMLLHEQQRREGLKNSSENTDEVFLGKGSGVSKKLAKLRAAVEAVSILI
PGIEFDSEGMVVNSKKETGTENNANEDVISMFNKFDITHERIPELCSRSGQPAPFLVLQE
CLKRYSASADTKLSISSTRQKHHRHEFVMSVGKHETKVICTNKQEGKQRASQQMLQLLHP
ELKTWGEIIRMYGYEAQRQFKDARKKGNDVTKLQALAADGSSKVSLNPNAAILSRLNEEM
RKTAERVGQLKGPFRPDLSNDETAVTDWEVALSAQYSEIHRDRVEVPIIDL

>RRF-1 - L596_g7841.t1
MDDMSMFNTNFVIEERFSKIFQKYRLEFFEEFGGFEACTVDESSLVNRSKNLHANKAESD
MDRRICKNPTEAMKDKACAWYNVCYFYANKAKRRYLSFAWIVWDVLAEVKRENHFKNNRE
QRLMGIPIHTRLHAYIEKYTGDVSNRVALEELKKLIAKEERHIAKYVEAHEGEIWIVNCS

>RRF-3 - L596_g11915.t1
MSSKAVSTRGVAFALRLSVSQEGLPKEILLHAARQMLQSCGCSSVRLETPVQALQAEYED
CRLEISGTVTFAVPSSVDAWQMIIVFTSKFCAETGMGLELQPSLEMDAFDRPNHDNCHIL
WFAFGNMPNEGLFLTRGDYISGYNKKSNRFVPDRGYNVNYVAGTQLLLSWANFEHDRKLL
TIYFAVQLPCPASDGLLFKGYKLVFTYHNIISVIADTDDSRAGNNVVYLKLRHPPQLWEA
IPRLYANRRLVNLEACRDWIRVFEFPGSNRFYGCTKSTLGSSSVFAFGMPKNVVDPKILF
EEEREEWKSFAEDLTTRENPTRSLYDILSRLKRKANIRLYFGSILSVVRSVMRTCDLPST

```
DSFRVNYCLEALASRGFSVMDQWFPIDNQEANYFPVFFSRVVWCLGECKEAVENTLENML
SIFDERKHHVNMVTVFEYLYEQNIKSLVEERDMDDCSYNDLPTNCVMVRKIMVMPSRTLL
MPPEVMMTNRVIRQFGEENALRCVFRDDGGNKLVPKEFTRGRSVEGQSVTIKEIVKGTLS
SGIVISDRHYRFLAWSNSQMRDHGCYMYADIITQDETTGEEIVQDITTIRKWMGDFSSSR
NVPKLMSRMGQCFTQAQPTIRLGPSHWCVEKDFFTGPFGNPTKYCFSDGVGRISLRYAER
ISNLMGLTFSPSCFQVRYRGFKGVLCVDPQLDRTSDTPIVFRESQMKFIDYERGSQGPVL
EVVKYSMPSPVCLNRPLIMILDQVAEKNGSHCHRRVCSAIHQTLENELNELAVMLYDESA
AIRALSQRVNLSIDFGQFVNTGFRLTEEPFLRSLLLAIHKYNIRQQLSKVKIPLPNGMGR
TMYGVLDEYGVLQYGQVFIQYSQSINRAGQRKILHEGPVMVTKNPCHVAGDVRMFEAVYQ
PCLEHLVDVIVFPRYGPRPHPDEMAGSDLDGDEYTVIFDTDLFFGSNEPAMEFPKSEAPE
FDVMPETDDMVDFFLKYLEQDSIGRMSNAHLMMSDKLGLFHEICNNIARKCSVAVDFPKS
GQPAEPLQMDEQCADCPDYMKSNTKPSYRSKRLIGQLYRKAKNIEDIIDLMPNPGTDRNI
PFDEDLNAEAYLEKNPDVLRECIRVRNAYNCKMQQLLDEYAISDEASLITGHIISMKRLT
EMEKDDYTFYHTDRIVELRYGKIFAVFRKMFFDEFGGEEGHFEIHTSGLREFKMNDILIR
KACCWYTATYGKYGVHKGGIRFLSFPWILWDVLTSIKKQKTLQASRICSVKSPLADELSK
IALFKCQNEEKAFVEFCNDIQKAVPIVKTYRENYGDHFLKACYVLNYWLLKERFYERTGM
TSQQLVIIFLQFGIAIRHGTLNNYTGRIPRIFPKMITQSKDIIDIDSEGPLLPEIGLQII
EFLRYVSGYDFMFSECIDLSLGNILESTRLITRNTIWKSFSLASFKVFHHVTLSYSFRAL
HCGSTDVGNPEARQVAWDYGEIDNPLIVHKEALLVNTPGMPPVHLESTLNILQAWSGVDD
LMVRPMNHRDLFIVTCAGGAESRQMLRRLLQLPPTVLREALLTDSIPSEIVTGTEM

>RSD-3 - L596_g5786.t2
MSCVIDSGMDFTFIPSTFAGRRSVGAGAMSDLFSGIANLTKSVTDTFNTYEIRKLGDKVQ
GYVMNYTEAENKVRDATNEDPWGPTGPQMQEIAHMTFQYDAFPEIMNMLWKRMLQENRAA
WRRVYKSLILLNYLLKNGSERVVGNARDHVYEMRSLESYKNHDERGKDQGVNIRHRVKLI
IELIQDEDLLREERKKAKSEGKEKYQGYSKEEMRMGKGGSYSSSSMGNIDDWNGRSYKSD
NFSGGYRDEPSREVNSFNFPDDERNRSESPELGIRETKPVEDEDEFGEFTEARSTSNSIP
SKSDGVIPPAIQGPGVAVHSPIKPPQGGVHLSLDNDPFGDFTSAPIPKTQPEVDLFGDFS
TPAIDAIPNLPRPPTPGYSAPSNSNQPSSTLVDLFGDAVPSNPTPNAAAPQVDFFADFSN
PAPQAPTSSVAANDFFASIPQMTNVTPNQSFVANFDSSVQTQAVSSNLDLFADVSLLSSP
SHPSTNAVPPMASPMLFQSQSMTPSPAASSSHTPRSVASANPSKASSSMWDDMKGRVNID
LDNLSLRNSGNMKQSLSMNQMQKNKNQGPLF

>TSN-1 - L596_g28061.t1
MTDSAPQQTPAPAGAVKRGTVKQVLSGDALILQGPAVNGPPKEITVYLSNINVPRLAKRP
AEGQPVSSDEPFAWEAREFLRQKVVGKTVSFVRDFTATSGREHGRIYLGGTSIENAENVN
ETGVAEGFFEVRTGKQIDEYAQKLLDLQEQAKSAKKGRWAFDEQQLKEKVRNVKWNIDDL
RNLVDTYKHKPVKAVIEQIRDGSTVRAFLLPEFHYVTVMLSGVKAPAVRLGSEGRAEEYS
EEAKFFVESRLLQREVEIILEGVSNNNFVGSVIHPKGNIAVLLLENGLAKCVDWSIGLAT
GGAPALRAAEKLAKDKKLRLWKHFKSVSSGDKKSFVAKVTEIGMGDSFFVQKDNGDEIKI
FLASIRPPRNEAGQEKQSVGRQFRPLYDIPYMFEAREFLRKRLIGKKVNVCVDYVQPKSE
QFPEKTCCTVTVGGQNVAEGLVSHGLAKVVRHRGDDENRSSHYDALLAAEAKAETGKKGM
FAEGDPNEKGGVIRVQELTGDANRSKQFMPYLQRSTRPEGVVEFVSSGSRCRVYVPKETC
IITFLLGGITCPRTARPGPGGKLIGESEPYAEEAMKFTRSKCLQHEVQIEVETMDKAGGF
VGYMFVPNDKGGHNNLSELLVENGLASVHFTAERSHYYNQLNAAEERARRARLGIWKDFK
EEKQIDALEQENAENVERKLNYKQVAVTEVAKDLLRFACQSYEEGPKIVQLMRDLQQEMN
ANAIAGSYTPRRNELAAAKFSQDKQWHRVRVEGAKAGMVDVYYIDFGNRETLPVDQMAAL
PSKFVTQAPGAQEYQLALVGVPNDPHYAAETIAAFENLVFSNSNILLNVEYKAGNTEYAT
LSIDADGTKSDIGKTLVMEGNALAEQRREKRLQTLVSEYTEAEQKARRARKNIWEYGDFT
GSEV
```

```
>UNC-130 - L596_g11813.t1
MRFSMDSILCPPSATPDNKLVAASRKRLLTQSLTPSPPPVESKMAKLDSEDSSSSTSSED
RQPPAVTQIVVAAIDKGELAAAAVLRSDGDSSGGEELATEAKQNALAAAAVVGQHARGGG
EDTTTSPGTSRSPVTSDEGDSGDECNESSNGDKRIGMSSTRSRSGATKPAYSYIALIAMA
IYNSPEKKLTLSQICDYICNRFQYYRDKFPAWQNSIRHNLSLNDCFTKIPREPGNPGKGN
YWSLDPNAEDMFDNGSFLRRRKRFKRQSSNNDFASLPFAPPGAHFLPPQAAFLANPAFVL
RSPMMPRVGPHLGLPPQLYRTPYSPGFLLPPVTSTNGLPHGLPLSLSSLPPGMDHQRLLA
AMAAQSAALSSASSPPNTVSPPSPAGAQAH

>XRN-1 - L596_g18210.t1
MGVPKFFRFISERYAALMERVQENQIPEFDNLYLDMNGIIHNCSHPNDDDVSFRISEEEI
FGNIFQYLDQLFSIIGPKKVFFMAVDGVAPRAKMNQQRARRFMSARNAEHQQKQALAAGK
PLPTSDRFDSNCITPGTSFMIELQKQLEFFIQMKQSTDAKWRDVRVYLSGHNVPGEGEHK
IMDFIRTERSKPDYDPNTRHCCYGLDADLIILGLCSHEPHFALLREEVTFNRAGQKKDKV
GIEGTKFFLLHLSLMREYLAMEFQDLKETTTYRKSNTDSLPFALNEENVIDDWVLMTFLI
GNDFLPHLPNVHIHEDALPRLYKAYKAVLPSLGGYINERGILNLKRLETFFERFSVIDRD
NYLDQFEDADWMRNKKQREQGEGPPDVIPQVVFEGLLEEEDVIESSSTCVSSSDIGAFDT
DSEDERKEVEKITGVKKKKNGGDVIPSASEALAAGGWDSESSLEIDGLNLEDSDESPDEN
WNIVIHRSFKKKRRDYYAEKLNYVNISAEELDDQARGYVRALQWNLHYYYHGCMSWSWYY
PHHYAPYLTDVRNFGDMKIEFDLGEPFNPYEQLLAVLPAASCRCVPPALRPLMTESSSPI
SAFYPTDFKTDLNGKRNDWEAVVLVPFIDENLLLRTAKAAYPSLTEAERRANTHTGDLLY
TYSTKDLGELNSSCAKFDRVAENHSKCENMEKNAFRLPRSKIVTGLLPQTKLDVYFPGFP
TTKHLNYTGSLEIAPVKVFHMPTRKPVMILKIGDNTENKYSASGVDPRSLLGQEVQVNWP
LLKLAKVCSVVTPDGRYLMENHQTSFTDFGPNKHKVFKDIKDMVTDREFGRYGICVSNVK
AIVEVNLFTGSRMKFKGNNVIVEKSWSDDVFAVSDGLVLQNVEVKNDMEQKFKSAADAFP
VGSKVFLNSFKVSAYGMMGTVARNDVAARGTCLVEGVAPLQVNVKAAVSKKQYKKFWFSV
FDLAKIIGQDKHVVNRVTGTVIVQMDSDFKDEEQEERGKHHHKHGHERPRNNINVGINLK
YTKRNEAIVDFSKRENETWYYSLFTLKVVQDYAQRFPEVFRALRQNKDQYLLEDFWPELS
PEERTNKAKEVVEFLKALPCSSRRPETCNYKYADPEELLLIQKEIAATVAETNVQQFTVH
ARALFRPDFVTGDSPPVPNVEFKILDRVIVAKTHRYVSPGAAGTVIGIKSQIGKETELDV
MFDVPIVGGSNERTGPNGLKYTRVFSHQLLNITHAARLRGGDQSESPSDNQPQSSRQRFG
NNRTDQRPQQHHKPGHYKGADSRMDNPKPSHHRAGNSRPENQRSGPPKIQVLQRPKQGDR
QHASDPPGSVGQRLFQNSQNNRRGQNNRHQQNRQCQPKPERNEKAKSVEDQANKGVED


>XRN-2 - L596_g10155.t1
MGVPAFFRWLSRKYPSIIVNATEERPTEVNGVNVPVNSTKPNPNYQEFDNLYLDMNGIIH
PCTHPEDRPAPKTEDEMFALIFEYIDRMFAIVRPRRLLYMAIDGVAPRAKMNQQRSRRFR
SSKEAAEKEEQIRLVRERLEAEGVPVPPEKSPEDKFDSNCITPGTPFMARLADALRYYIN
MRITNDAAWAKIEVILSDANVPGEGEHKIMDYIRHQRAQPNHDPNTVHCLCGADADLIML
GLATHEANFNIIREEFVPNQPRPCELCGQYGHELDECQGLAREEPGPDQCEPMSKSTNFI
FIRLPVLREYLEKELEMPNLPFPFDLERVIDDWVFMCFFVGNDFLPHLPSLEIREGAIDR
LIKLYKDTCFTTGGFLTENGTVAIERAQQILNGLGDVEDQIFQERQRKEVQFKERNKAKR
RRERQQAPAYFPKVGLLAPMSTPQTFSGERTREMARDARAEAMDFTNQQQRMQSIMQPVG
TGNQPQIGQKRKAVDPAESSEEEEVHDEVRLYEQGWRERYYASKFDVSPSDMDFRRKVAE
AYMEGLCWVLRYYYQGCASWDWFYPYHYAPFASDFDRIYDFKPDFSKPTAPFKPLEQLMC
VFPAASRKHIPETWHHLMTEIDSPIIDFYPNDFQIDLNGKKFAWQGVALLPFVDEDRLLG
TLSEVQDKLSEEEKHRNSLGPNRIFIGTQHPAYQLFEEIYNHEGGADVHIDSALAYGMGG
SIAKDSLVVMPGTPYGSAVSHETCHDIESNACISAIYADPAYPEGFVFPAVRLPGCKEVE
KTLKPGDWNQHRNGNYRPQIGFDRHAPRASLDQGAHRGFRNEVRDRSFNNDRRQSDRFDR
RNDRHPYRGQGSPQQHHNRGPRHSYPPPGGHGGHGGGYQHGYPQRGHPHDHWNGGRGGRG
```

GRGGRH

>VIG-1 - L596_g22586.t1
MEYGINVNNKYGYLSDEEAEDPEVFIKKAIQRKDQKMAEEKKMAEEKAAAEKAAEAATEQ
KRAANKENRRETTERGTRGARGPRGPRGEGFRGLRRDGPKPEGEGTGPRGPRAPRGEGRG
GQNRPRRERPVKEGETEAAVPAGGDEARLNEEGDNRRGGARGGRVFRRGGPRVPGTRLDR
KSGSDQTGVRSIEKKDGHGKGNWGTEQDELAAAEDVNVSSGGEVEREKTEEDLKREAELE
KAARELTLSEFKARMAQKADKPEFNIRQAGEGVDAKNQPKLVPLQRENDEDHVAEEVVVV
RREPKNKRLNIDINFGDENRQRGGGRGGARGGARGAGRPTKERRGKDTHFDFTAESFPAL
GAR

Argonaute proteins

>ALG-1 #1 - L596_g7718.t1
MTTMTGGPQQQQLDQTQQQVISMLDQLSFSEGGGMPPNYGMLGGPLMGPGPLAPGPQQMP
FGPGPPGPQMPQDIYFQQFAPPGMPGQMMMGGGGGFDPRPGSLAPGAPIDPSQTMMPSAM
TPSLVSTQGQGAPGTPSQLAPAIPASTIFQCPRRPNHGVEGRAIVLRANHFSVRMPGGTI
QHYHVEVQPDKCPRRVNREIISTMIRSYTRIFDNIRPVYDGKRNMYTRHPLPVGRDRVDL
EVTLPGDSAVERKFVVGIRWVTTVNLTTLEEAMEGRVRQVPFESVQAMDVILRHLPSLKY
TPVGRSFFSSPTAGGAAPAQGHFQQESKLGGGREVWFGFHQSVRPSQWKMMLNIDVSATA
FYRSMPVIEFIAEVLELPVQALAEKRALSDAQRVKFTKEIRGLKIEITHCGQMRRKYRVC
NVTRRPAQTQTFPLMLESGQTIECTVAKYFYDKYKIQLKYPHLPCLQVGQEQKHTYLPPE
VCNIVPGQRCIKKLTDTQTSTMIKATARSAPEREREISNLVRHAEFNADPYAHEFGIAIN
TAMTEVKGRVLNAPKLVYGGRTRQTALPNQGVWDMRGKQFHTGIEVRIWAIACFAQQQHV
KENDLRTFTSQLQRISADAGMPIIGQPCFCKYAVGVDQVEPMFKYLKQTFAGIQLVCVVL
PGKTPVYAEVKRVGDTVLGLATQCVQAKNVIKTTPQTLSNLCLKMNVKLGGVNSILMPQV
RPRIFNEPVIFLGCDITHPPAGDSRKPSIAAVVGSMDAHPSRYAATVRVQQHRQEIIQEL
TYMVRELLVQFYRNTRFKPTRIIVYRDGVSEGQFYNVLQNELRSMREACMMLERGYQPGI
TFIAVQKRHHTRLFAVDKKDQVGKANNIPPGTTVDVGITHPTEFDFYLCSHAGIQGTSRP
SHYHVLWDDNNLSADELQQLTYQMCHTYVRCTRSVSIPAPAYYAHLVAFRARYHLVDREH
DSGEGSQPSGTSEDTTLSNMARAVQVHPDANQVMYFA

>ALG-1 #2 - L596_g21728.t1
MQQPDEKKPMKPIPLRAMEGSESVQVGRLNVQVNGYTLRIAADTQRTVVHQHEITLFGVF
SRDEGQKDVNLLNMGGGLKDYKKQGRRLIIYAVFDKIVEANPLIFPKNIYQCVYDGGNIL
FCKQQLVDYKLPMESVMESSKFCGSVRDFLGARCEKIKFKITYTGVVPLDTKELNGNSRS
LVQFLDIVTSQQICRSEEQLVFKNRRYDSDSVRDVQASMAKIIKAGSEKTISIVGENSSH
QEALLLIEPKRSPFFMGGNLKDIFDIVQREMGVGNPRLVSELTKLVKGLGVFTLHAKKLR
QFQIKDLTKEPAGRQIITIERSGQATDLTVAQYFQDMYQMAVNPNLPCIACEAIIRGQKQ
VLLYPSEVLSVMPGQRVQTQKQTPKLVEELIRQAQFVPADLMQEVQKERLLFGLENSKYL
AEFGIKLDGKPREAPAKVLPTPAICYGRDTTVQPDQEGRWMIRENQYFKPATQCKWALCV
VENAMDSQVATRFKDSLVRAAAGHGLMIGEPSLHRFQKADPEDLTREFAYLKANKVQFVM
GIFGGDRNCIERNLLKEMEIRFQLITQTIQSKTAFKGTTNKMVIDNILMKTNLKLGGLNH
QVTTSRAYATRFLDAIFPKNRIFIGLDMQSPGSPMLGGINEFTTDPTIVGMCVSVKNAAQ
MRGHYWCQPATFKFIMGIEKALGSVLKMYQAQRENVNDDDFPTDIVVYRGGVSDGDIPMI
VDEEIPQMKAAFANLKIRGRSYCPHLTVLLAQRASERLMPVSSPMDGGGGYNNPKSNGNV
APGTCVSSGIVSPTRSEFILAAHKAIKGTAKPMRYIVLDEYGSQSKRFTIQELENMTNQL
CYTHGIVTSPVSRPGPLYGATDLVKRGRADWKAREYRSRNAAPVGPVDDQFLEGYNKQRL
AWQLEYDGKFWA

>ALG-2 - L596_g16709.t1
MNVFLSTAATQLTIPIDRATDRTGGVSHSPPAILRRIFWDVVDNNRSLFPAFGIVFNDKD
QLWSKRKFNQFEFEAQFGSNNDHTIKLKLVDMFDFQISPTSDQIQAEFLNSLLTQTDRCK
LLSVLCLDCPTAISVCTCAVFLKMRIPIIDYFLSVVSRRPRLTDADYRGLENFHWNPDQI
TALRESLKGLTMVTTYGGTSYYHYKFLDVYRGNASETMFNWRRPENNEEEEITIQEYYFK
KWGIRLRLPHFPLIQAAPLQKNIYLPMELLMISDRPQRFQKPIPEDCMRAALEKATISPR
DRFDLICDMIQQSSINDDNRFMQKFGVYVDTTLMITEARVLLLPILTVRDGHTVIRPDTT
ATWRSREVQSNSRRRAIIAVIINSEVRSSMGNSFFPYFNALMRACRSIGINLVDQQDSFQ
PVIHTYNRDQQEIDVAVXXXXILSFSGFTIPNSVKFFVQRDRLFFIPTEGSRPGADDLGR
GLQMWYALHSLVSVGEKAEAIVNYDRTCAVFLKMRIPIIDYFLSVVSRRPRLTDADYRGL
ENFHWSPDQIAALRESLKGLTMVTTYGGTSYYLYKFLDVYRDNASETMFNWRRPEDNEEE
EITIQEYYFKKWHPTPTALSSDSSRSPAEEHLFADGASDDIRPSAVPGIKQ

>ALG-3 (T22B3.2) - L596_g3457.t1
MIDNIDERVSTPIQVIDIIFPSTSSLTCPLISGATSTESDSASSSSRLSTTDDSGSFVSD
SEEHLTRPSLSPAPSCPQLPKLGAGSRAPSEGSGRFMDGESSESEDEDEAEAQQRRVIAQ
KEAGCGGLLSEDQSKMQIRALMARPGFGTNGRKIPVLANFFEIGIRNKDMIVMQYHVDIT
HPGNRKLDRDENRTVFWKAVEQNPQVFQNRFAIAFDGAHQLYAVQKLRLPHGGSSAEIPI
DIALARDLRSSSKCAINLQLVGPMIVDIGKSKSMNIDERVSTPIQVIDIIFRQSLTCPLI
ANSSNFCAWKSSFYRLPTPNSNDALDLEGGKQMWTGFFSSAHVAQNYRPLLNIDVSHSAF
YKQHIEMVDFMCEVINERASAFTCRATNPGPGAYRGGMKPGGPRGMGGNINDNSPGFLSR
DKLYENFSLSSQELKVLDDAIRGVKIRVTHRPGVVRVYRVNGLQVSADQLTFVGKDSDGA
ENRLTVAKYFELKYAKLKYPRLPCLHVGPPSRNIFFPMEVCRLDSPQKYAKKLSERQTSS
IIRAAAVDAEQREKRIVSLVQQAGFDTDPFLKEFGLKISPQMVETVGRVLRPPAIQYGEN
NRRMDPIVMPKDGAWSMDNQVLYLPAACRSYSLIALVNPREQPNIQNFCQALHQKAQNMG
LMLPQWPDLVKYGRTKECIVQLFKEIAFEYEQTKQQCDLIIVVLQAKNSDLYMTVKECGD
MNYGIMSQCVLMKNVQRPSPATCSNIILKINAKLGGINSRVVPDAVTRKFLIDVPTLIVG
VDVTHPTQSEERQNIPSVAAIVGNVDCYPQTYGAHVKVQRKCRESVVYLVDAVKERLLCF
YRNTRKKPARIIVYRDGVSEGQFGEVLREELIGIRKACMELSSEYRPPITYIIVQKRHHA
RMFCKNPRDSVGKAKNIPPGTIIDTGVVSPEGFDFYLCSHFGIQGTSRPARYHVLWDDSK
FSADELQQITFSICHTYARCARSVSIPAPVYYADLVATRARCHIKRKLGVHETEHFDMDK
FSRKPSTTTTTTTPFDNEIVGARGDCRKGQMPDFTNLKQSTCEAALQDFVNVTEGFKTRM
YFI

>ALG-3 (T22B3.2) - L596_g16708.t1
MTTIAGYGDQSVNLRAAIQTSLKEFYKGTGGLYPSHIIMYRLGCTSSQMTAAAKNELRAV
FSAVKEMAELANQGHFDPTITYLHIERKHQKRFHCGADVGNLPNGFAKANNGNVPAGTIV
DRDVTSQAFYDFYLCSHHGALGTSRPTRYIVFYDDWNLTADQIQAATFCLCFLNSNCTKA
ISLPAPAYYASKGVERGKKYLNTCMLRREDIQPNEPLMMPKSISNSMYII

>CSR-1 - L596_g20174.t1
MIGEVTLADLHAESFGAPLQYPDLPCVEWERQGPARFFALETLIVMPDQRVAFERTDARQ
SAQLQKINTVRPEHRLKNIEDQMRRLHLWGDSQCPVLTGFGISIEQQLLSITAGVRTAPV
IQFGSSTDKLQPGRPKWEMALKKNRYRIPANVKSWALIYRCEDKDVDVVRLFTTKLRSTA
KMRGMNVEVPLAVIRFSPNRQAGEGDDEVLGRHVNEARSAGAEFIVYVSSKCIQDHDLLK
LLERRRLRVTQHISLESVRAVVIENKITTLDNIIHKLNVKNGGFNYTPLIEHVGNSRELE
LASGNVLVIGLDVAHPAPMNASQRRMMHSVDATIRSLEPSSIGIVANVIKNPHAFVGDYH
FQTARREAVEPRILKERVKWIFDLLAQNRPEHQRPKHVVYLRDGVSEGQYTMTIRDELGA
IREAVREIDPKYRPKFALIIVTKRHNKRFFDSSKGVVGNPLPGTVVDHSVVRTDITEFFL
QSHIPILGTVKIPQYDIPVNEGGFFMDELQAFANCLCHSHQIICTPVSLPEPVYYAAHEVA

KRGHNNFLEFRRSHPEMVPYVDGNVNIIDCEEVTAKLAYRGTPLEAIRFNA

>C04F12.1 - L596_g11107.t1
MMGSKYPDKLPAHTKGNPKVPLVSNSFEVSLGDKIIHVYDVSIIQDCESRGRKKVIDWST
SSGDSAKRRIKLAVSKEIFKKALEVKKFASKEAALVFDFSKILFSSEKLKDHLCSAIILT
PEDFDVLPSFEGNSKLCRGTYTVRIVPTKAGSHQFRANDLEKALAKNQEDHSLRQFLEVA
TSFKPIQEGTHKFFRGILHDVRTSAPGRRDLQNGPFEIAYGISKGARIIGDMDNPKAALV
MDSKRFAVYSESKETFLEDIQKVLGDKDLKIHLPRITKMFQGVTLGHCFNKAVEVKFSSL
SNVLAEKLTFENSDGQKSFIVDYLEERYENYQCRARRWPVVVDKFPGRSGDVCYYPLDIL
YVKEGQLVPLPLQQEFGITQELLKEVSKPHLRSAEIGRAPKDLELNARNAHLREHGINVK
QAPIKLEGYRAQPPKLGYANGQTAAVDANRANWEAGRYIYPAKVDSFRYFVRQGCMGRDQ
ANLFLNKFLDMCRSKGLDMPKPQIEFIKGPLALKNLLSAEDKAVGKKKSVTFVLFVDSEK
SKTHDALKFYEAKYQILTQQVRSETTFKAGRQTMENIVAKTNEKCFGQNYAIHGDEFIST
KDTLILAYDVWHPTGASAQKRILDIPDDTPSVVGMSFNGGVHADGFIGFYAYQEPLQERV
DVLKSYMQHILRIFKKTRGLLPKNIVVIRDGVSEGQFDMVCQHELASIRAGCRQFANAEK
VGWNPKFMVVTVTKRHDKRFFVQDGHRVLNPPPGTVVDCTVTRPDMTEIFLQPHRPFQGS
AKAAAYSLLVNELEIPKQKSGSDLWLTNFLMKLCYSHQIAPSSISIPEPVKQADEWAKRG
AANLEFLKRENGDKSLDMHNFLKSSSEGSFYDWAALSDALGYHTKRLEGTRANA

>HRDE-1 (WAGO-9) - L596_g11197.t1
MTSTSVNLNSFKIDISETVHRVQQYELVFVLYKSFKPGFTATPSRTRVPLGFKYKYNLDT
FQNGDHWVGGYDIAYGPQNPVKIRMRKEMLFHFFEFFKQQFSHTLAIGDVVPMMIFDCDR
TIYSNQQLKVGRGFSHTWSYIEHLPEKVQDHIDILCGNVSDFCGLSVFLNRVGEVDMTDL
GSEKNPNKGVIQFLETLLWQPLYTQFTDHVIYGKTFFDLAEKNRISVMQDGLFLATGYDI
SVDLIPDYEKDMSKLMPVVRFTPGSSVFYQNYSRMDALLMSLSGTNGRDTLYQLEYDCKH
PSIVEKLSQTVRGATVQFIYDSDQIFEVDHLDPRTPHQITFLLQGRRRISVTDYFMAKYN
IQITSELPCVARKTRYGMSFYPVEVLRVAPNTKAIHKYLPADVKDMIEKGTILLPSAVQQ
RIKEAIGEMKLYSAGIRKHDMARINPFLFVFGIALVDKDRPVRIAAHVSESPLIEYCYRR
GATSTLMKTEQNHPGVWNKSMKFLPPFLKPADLGKPVKIRFVNTFVEEVHLINRFMDKTI
HKLRLKGIDVMKERTISGSERFGKIRDARDIFGRNKDYRTMLKAAEDILTSSGADLFYII
GSTDPMNPTRDIFKLAEITKPSDKRIVTQHIGCKTLCTTVSTGLSKRSPGILESIVMKTN
MKLGGTNYTLREKDRSSGYRYGYPRSTHLIIAFDKVNPQHTDEKGEKLYHPKACAMTYMI
PHTTGLITRGTYWFQTSNETNLTMMISAFEEALKFYHKDSRGYDPEKVVVYWDVSHGEKE
VTQEMDAMMAIVAEQRGESVRGPFLTFITVDQNHNTLLLPTEANVRDRLSLQNVTAGTWI
QESTIGESFTMVSYESDDKMTRAVKYDVKVAETHMHSIQDLTHKLTYLQNSGWRSVSVPA
PLKGATKLAKRAMKSYDIMDQIRGRSGPIEKQLFEERVKEISDWIAVKHLTNYWA

>PRG-1 - L596_g25491.t1
MDARTGQLKSFRAASRQNRGPQTDESLICFAYQNHPRFIVKRTKSISLLKTLILRRFDAL
ASALMRQQKSIIYDFQMVIALKTKF

>T23B3.2 - T23B3.2
MRSRRIYSFNSSIEMSDGEIPIRVVDNRNRDDLLKILLLVVLIIVFPPAAVAVQANECNV
HVWISLFLMLFFIIPSYIHAVWYVFIRKPKELTIA

>WAGO-1 (R06C7.1) #1 - L596_g19943.t1
MSDFENPNVKRPVTRIVDDVEELFERLQLEPGKPVMADKQLPGTTGRKVKLQTNIYGLSL
QKIPVHRYDVNVIARLGEREVLFTKRSKEDAVSTDRKDKCRTAFELAVNTFGEQFFGQER
YALYYDCQSILYSMKPIPALEDKMSHELSLLPHHLTDFPAFTGLDAVVVEIKKVADTFNL
NLGNLGFLNRELIEQDHSLQQFLELITSQHALFTPADHICYGSGTSFLLNHKKYGFLDED
CPDLGEGKYLAVGSHKSVRFVEGPGGRSGAHAAVVVDTKKAAFHACENLIQKAMAIINLT

```
PQTHCRKNEVDKLRGQLKGLFVHTKHGRRQRLFPIASITEDTAADKQFEDPDGNDVTLQI
YFQQKYGITLRFPHAPLVVVQENKQTNYYPMEVCYVNDNQRVALNQQTPLQIQKMIRACA
TPPAQRVRQNKENMRALELNNSNRYLQAAEVRISNNALILEGRVLQPPDVYYGNGVKAVV
HPDKGSWRLQNKPHFLLAVEIHRWAIYVVGTGNRDILDQPKFENFIRMYMAECRSRGIRI
NDPCEHRILPADPEIIKDRIKAACEGECYFMYFITSDAVTDIHKIMKYAERECGVITQDM
RMSSANDVVAKGKRQTLENVVNKTNIKLGGINYDIRFNSPDLNVLRNDRLFLGFAMSHPA
PQTQHERNKGVAPRSPSVIGFSANMKSSPVDFVGDCVFQEPRRDEKIGVIRGVVNNVVTR
FRDSRGYLPKELIIYRNGSSEGQYPLILKYEVPLIKKALEEVQCDAKVTLIVSQKMHNVR
LMLSQINERDRAPEQNIKPGTVLDVGAVHPVYNEFYLNSHVSLQGSAKTPRYTVLFDENN
YNMDQLEYMTYHLSYGHQIVTLATSLPAPAYIASRYADRGRNLFNASNTNWNVLQDGQLD
YNQITRDLSYGVSDLRDYRVNA

>WAGO-1 (R06C7.1) #2 - L596_g995.t1
MDALKGHCESDETLYKIETALVSKSGTIRFYPQEAKKVLNWAVEPVMVEEDPYKEEDGAF
YSLCHVNIEFLASGVHCIAKLLAPFSNFRRSSATKSSSRRPKTTANVENRSATEPMTNLR
SKIAGPATKTASITVYLTMESVTTKMAHLTMAPKLGAGTGGRPVPLVTNMYQAKMMRAQP
VYRYDVAMEMRFGAKSVSLVKKTIDDMVAIDHKDKCRAAFRIAVRLHDKVLGSPVGLFYD
LQSTLYAIDKIKDAKENTECKEIELCIPSDMLKNNDYFKDRNPDSVTITIKRVEADYQLS
LGDLSFATDASKAHLNADLVQFLEIATTQYAYLKAGDVLTYSSGLIYFSEKRRKLNGGNL
LIDGVQKSIKVIEGSQKGQPQLAVVLDPKKTAFHAKDVAVSDKIYEAGFMEDDGRVHPAK
LETVKNQVKNLFVEVRYGKKPTRFMINGIDKESARVKTFLSSTGETTVESYYLKQYQIEL
QYPLAPLLAANKKVNGERTTIYFPMELCYVCDTQRVKNTQQTSKQISDMIRSCAMLPADR
VKEIKDCAKRLQLNGDAVSGSLRSAGLSVATQLTSVQGRALPPPEIVYKDNKKFSVDPNS
GKWKATGAQKPKFLLGASINRWAMMCVADRPQPRDDALMKNFAEKMVRECQGRGMRVNNP
VFYQAVQGRPDSLESMFRRAKQDNMEFLFFVQDGRLQAHKDIKFFERKYEIITQDLNQQT
CRSVVEQNKFLSLENIVNKTNVKLGGLNYSLIVNAPNTQHLFAKGRLYLGFQVSHPAPLS
DDQKAKGMKPKQPTVVGVAGNITNQPAAFVGDVFFQEPRDDRMADAMETLVRDFALRYKD
AVGVAPAEVIIYRNGASDGQYQTILDVEVQEVIRAALTAAGAGSAKLTYMVVSKLHNVRL
MPAQITGIKAPEQNVKPGTVVDTNIVDPVFAEFYLNSHQTLQGSAKTPKYTVLYDQNNFP
MSYLELMTYVLSYGHQIVGLPTSLPTPVYVAGRYAERGATLLSASRHDSDMCKFSELTEA
LGYGSTKIGKNRLNA

>WAGO-1 (R06C7.1) #3 - L596_g15757.t1
MDTRSQAQGGFDTSIKVVYEMAPKQYAPENKAPVDLVCNAYRLRMPQPSSDYPARVYVYD
VTLTLTRADGSLLTLVKTKMDDYTHYVSKQRCRSALEAFSQKFPGFFRTNEQRLFYDLQS
ILFTRVELPMRNLTEAMSIEASEFSRFGFAEGGQGMQRLNIVVQKTQSGTSIGLTDFSFL
SSDIAEVGQRHDLSQFIEICSSQNAYMNPDQRVTFPGGVSYERGNPGDLVDGSKRVWNGV
RKSVRYLTGAGNPVPAVVLDARKSAFHKEGEMVSDKVYAMGLMNDDGSVFDYNIDNITRQ
LKGLFVMVKHLNNQRTFPILKLDKKTPATYRFTSDDGVEMSVADYMSKKYGTALEYPKSP
LVVVWMKQREVHYPMEMLYVCPNQRVTTNQQTSKLVSEMIKKCAIVPSERIKEIKHQATS
LHLHDGALREVCIEVDPNMLHLQGKAVEAPKLKYGSSALVSVERNTGKWRTSNTKFLHPV
QIKKWAVIVLPTGGKLTGQDSQVPTKFVDLMIKALIIKGVQVGPPAYTGMSSGCQLEEDF
KECARDGYDFMFFIQDSKLQFHKDIKVMERRYEIVTQDLNLNTARNVVQQRKHLSLENII
CKTNVKLGGVNYSIHIDRPEFADFFHDRRLYVGMQMSNSRVFELGDGSDVEKAGKPTIIG
ISANVDRELSSFVGDFMCGPANIEDLSSVVTEIFKYYSEEFLKMRGHFPEEIVVYIGGIS
DGDMPKLLRWHIPAIRHGLNTAKCTAKMTVIFTSKSHNVRLFPKNVTGERAPEQNVKPGT
VVDTGIVHPEFTEFFVTSHQTLQGTAKVPKYTVMIDDNNLSLSYLETMTYVLAFGHQIVA
LPTSLPTPLYVAGRYGDRGGVLYNAFDGKDDLYAVNDQLTFATSKKLCGKRVNA

>WAGO-1 (R06C7.1) #4 - L596_g16574.t1
MPTGEDPVLAEPVASTEAEDNASPRTPHAIHEAGDAIGLERRLEASTSARDGNFYVALGL
```

```
PILQGVVGNKKEALAVGVPIELSTNAFGFVLPALPVWQYEIEIEGLLAGSERRVFFTKRS
PDDAFKIRKSQECRRLFQAIKHKYAHSFSEDNETYFYDNQGLLFAIAPLDLSLNEKMDCM
LTAEELAALSPPTYASFSEVIVTIKNVAANPMTVGHVMTYTSQVLENNSRRLQQFLEVLT
SQHMLANPNEFLTYGTRSAYLLDTSAHGLEAGHLTKDKEIKIGCEKSVKLVEGPMRGGQP
DGKAVALIDVKKTPFHIPEGTVLDKARAILNREPKPSDAPRLKKDLAELVVYTKHTSKEH
RYVVENVIADTAVSMTFPWTEEGREVTLSEFFVQKYRQNISFPRTPLLVARFGRERKLIH
LPMELCYVARNQRVTSRQQEVDNISAKMIKACAIAPAERQLQIQETVNALQITSSNPYLR
AARTKITAAPLIVTGHRLEAPKIAYANNEVLSPDARFGFWKPPNAHRRPKFFKPAVINSW
AIVVLPSQAEFLQGDIISREILARFTDLFRSECRDRGMQIGQPVFTEFMKADVQQLRDLI
KSLTRPDPSVCRPPLRYVIFITNGGITFCHQPMKYFERETEIITQDLKMQTVVNVVQQNK
RLTLENIVNKANIKNGGINYVVIRNMPGQRPILKPGRLVIGLAMSYSVRRQAEEISTLPT
AVGWAANITREEGELIGDFLLQESFKKDRVAVIQTIVDRVADAFKHPGGPKEVILYRSGE
EGRFRAILEEDLAVLRATFDNMASKPKLTVIAVQKHHNLRLMPTKINRQDRPSLQNLVPG
TVVDRYVTHPTFTEFYLNSHVAIQGTARTPKYTVLQDDANMSLEELEEMTFGLCFNHQIV
SLPTSLPSPLYIAGRYAERGMTLYRQHQEHEEDQGTSASSPSSGSSGEPHLDVERLGTHI
SYGSSRKLKHLRVNA

>WAGO-1 (R06C7.1) #5 - L596_g20961.t1
MEREGTELRPSTIVRQTQNAAASSAPAAQVSTSAGAPPAAFGIRGPATSAETSFYSQLVN
IPTPPLEEKKQPGTTGREQFKLRTNVFGLSLPKDAQVFRYSVDASGTLQRNDRRIEFAKR
VGDDITYLNRREKCRHVVDQVVAKNPAIFGDRRELFWYDSQSILFSRNQLDIGSEAQFVL
DQSDIGQNTLFEGFAHLKMVIRPAQTNFAVSIGDLEAYIQAELFESDHALQQFLEILTAQ
YAFNTPTEAMSFGTRTAYLLQPEKYGFKPADCADVGDGKFLGVGCDKSVRFIEGPGGAGG
QRAALVVDLKKTAFHKVQSLYEKAREILNNRDPKSTDASRLRMQLKGIVVETKHGSRRQE
FAVDNVVADTPATKKFKDLTGHEVTLQQYFQQKYNITLQHPDSPIVLTDRTKKFAAFPME
VCWVVDGQRVALAQQTPVQIQKMIRQCAVPPADRQRQILGLVQGLQLNSENKYHKAAGVG
ITPTALQVQARLLQNPIIVYGGKSTMRPDEKATWRLARQKPVYLKPVKIDKWAMFVIRGG
NRSDCVDQAILNQFSNMMVQECRARGMTVPDRPTGLSFIGASREEVQETLEKAKTEGNQF
CFFITNNDVTHIHQFMKFQERKLSIVTQDLKMSSAFDVVKKGKRQTLENVVNKTNIKNGG
INYSLRFDDPVFNMDKLLPKDRMVIGLSTTHPKPIPGKKEQDQAPQDKKKQMHEQRTGPP
VPSVVGVAANVLTESIEIVGDCLFQQPNREEKIALLQPVIRSLMLQFMKHRGMPPVEIVV
YRQGTSEGQFRNVMELEYKMVKAAALQQGLNPKITFIVVQKMHNVRLMPTDCKAGDRAPE
QNVKPGTVVDTMVTHPKYNEFFLNSHVALQGSARTPRFTVLYDENRLPMDEIEALSHSLA
FGHQIVNLTTSLPAPLYIANRYAERGHNIFIASQEDYTKSKSSLQSPHSTTIEDNLDFSR
MMNELSYCNSELRDKRVNA

>WAGO-1 (R06C7.1) #6 - L596_g322.t1
MSEELHAASKLKPTEGIASRKVKLTTNHFTLSFKSSKPVYRYDVAMVHYMMTKDGEKSRD
MCKGERDDAAILERQRRCLVLMEAAKKVAHFTPSKSCCVYDNSKTLFSSEKLLENQCAQI
RIEGEHIPDGFKNHPKLKQGYFFIEITPVSTNHKFTIDDLKSGVSDDLLNTDHTLRQFYE
ILTNAYAVTNDSHMVFYGNLYDNDKGESGRKKLKEARNLIFGVNKGARIIEGSSSRLVAA
LVLDSKKSTFFDDANNKGLAGNIRDLLGSHFNAQPHEVVIGDHNRKTVVTYLKDLRVYCR
YQEDRDFVIAGVTKEPIEDLYFEYGSTKTSVMDYHKQAYNTKILYPHWPAVIMQGPRSKN
YFPIEVLGVSKGQRVPISKQTPGQMAETIHDCAARPHIRFAEILKKLDGLNLASNVPNEF
LQSFGVKIDCNPIQVQAHRRLAPKMVYAGNKEVDYDDIKGNWFANNAYILPAKIPKWFVI
TDRIDVSIVRKFAGILKDTMKMKRMTVGEPQFLEMPVAQLDGFLGKMAKELKPEDQSPFI
LFADTNDDSHALLKLYEAKHQILTQHLRARTVIECLEPRKRLTVGNICNKLNCKNYGLVY
AVNPQDHAKTMYLSKGDVMVVGYDVSHPEPQPAHERRLGIPPTTPSVVGFSFNGGVHPGM
FIGDYQFCAPRQERVDILEERIQWMLRVFTTNRKTLPSRIVIVRDGVSEGQMPMVLQHEL
ESIRRGVKKLKAGYNPKFLLVTTTKRHAKRFFAETERGIDNPMPLSVIDHTVVRPDVTEF
FMQAHKAIKGTAKMPAYTLLLNELGMTLDQIQSFMMGLCFEHQIVNSPISIPEPVYQSDE
```

```
WAKRGHSNILAFFRLMDCPDPQKPSQKMIQRYLKASENPTTGQPEVEGYDWVRISKMLCY
RGRRLEKTRANA

>WAGO-1 (R06C7.1) #7 - L596_g9675.t1
MLEIRIPPIVDDQKRRSETELNTVNVRTNVYEFELPTGTSEIYHYEVAVIGKLKSGRTVD
LTARTTNDVLTLERRDSCRKVLGIVSERYPAVFDHNLVFYDQARLLFTSKNVEINTAAGI
YSVILGCQDHLKGDEMFAAFTSVEFRLARVSVVEVGNVQKYLNKNLRLVNHSLEQYLNVL
TSQHVANKTITFGNESVYLEQDDQCGVRNNVDLGSGKLLKTGFAKASRLIEGLTEQPAAA
LVVDLKKAAFHVQQTVLDKARLILQADRKRCGGSQPRIEDTEDLSRELVGLVVETKHGSR
VRKYKIAGFDKSTPASRSFEKDGRNVLIADYFAQQYKVKVENLDTPLVIVRGYGRDFHLP
MELCYVKDQRVGLKQQTPDQIKDMIKQCAVKPVVRIAEIEKIVKGLRLIDERKDILGSKV
GIKDKPLKVEGHLLPPPLIVYADKDTCNQRVPPSREPASNGTWSSLTANTTPAAFFKPAK
IEKWAVIAIHTEDNGDPHDERNKRILAQNTLETNILHQFATVFTEECRNRGMTLPEAEHV
KFLDDTSTTVRDFIHQAKLSFVLFVCNNAITHIHQSMKCYERKFETVTQDVRMATVNDIM
TKRRFQTLENIVAKTNVKNGGLNYNVEMPSKNGVRELMPKGRLVIGLTVRVVRVPKSPKE
IEEDKKKAEEREKQHKKARDSKFARKESTTAKLKPIMTVGYAANFTDVPTEFIGDHLYQE
YRETGDILGMQIIFERVVLEFKRARGMFPTEIVIYRECTENSDFIGQLQLEQMLLKSAIK
STASFRPGFEPKLTLIAVQKRHHVRLMPIAMRREAKAPEQNLQPGTVVDRMITHPEFTEF
YLNSHTTLQGTARIPRYTVLKDENNLSMHEVQLMTYGLSYAHQIVNSPTSLPTPVYVAVT
CAERGMNLAKHNFRAMNIKFNANDDYSKLEDQHVDISHLNEQLSFGNCKLSSIRNNA

>WAGO-1 (R06C7.1) #8 - L596_g18735.t1
METLTKAVANMMPPVNLASKREDAKPNAQERALPLQTNMFSLSMRDEVPVFMYSVDVFMK
VRSKAISLVKHSRDDYIVIDRKNKCRAAFRFVVRANPAVFGNPGKIYYDLQAQLFTLEKL
NMDNEDEGLELVIDGADARRSTDFAEIPLDGIVVQIKRAGPKFDLALGELQLKFVAQEPK
SHELLQFLEVATSQYAFLTPSDFVTYPAGLSFIKQKDPKAGTELEGGKLLLDGAQKSVRL
IEGEKKTDGGGKLAVIVDAKKTAFHKTYQKVIEKVNDFGFLQSDGTVHRMRIPDLAKLLK
HIYVESRYRKRTQRFLINDVNPDNARNKMFTRNGVMISVEQYYREVYNITLRYPLAPLIV
SKPMKSKDSEEKMVCLFPMEVLFVCPDQRVKINQQTPRQISDMIKRCAMQPDVRVKETKN
YAEKLQLNGPASQACLNYAGVSIANEVVKVSGRKLVAPEIQYKDKKIAVDSNTGTWRSSG
REKPKFLVGSSLKKWAVYLLGVRQPLPDENLGRKFVMRMLEEARARGMQWESPTAVKGVL
GHVDNIEKLFKAAQKEGLEFLFFIGDQKVQVHTELKFFERKYEVITQDLDLKTCRNVVEQ
GKFLTMENVIAKSNMKLGGVNYSIQVNDPTIKQFFKPGRLILGFQVSHAAPLKPDEIAAG
VKPRVPTVVGVAGNVSKGDPACFVGDFFYQTPREDRMLEAMDTLIADFAQRYKRATGKDV
AELIIYRNGASEAQYTDLVRDEIPSIRDALQSAGFRGVKLTVMVVTKLHNVRLMPVAIKT
GAKASEQNIASGTVVDKGITHPKRAEFYLNGHVTLQGSAKTPKYTVLTDDQGFTLQQLER
MTYALSYGHQIVSLPTSLPSPAYIAGRYAERGALIYQGFNHTVQHDADLQTLNGTLGYGK
SKLGDKRVNA

>WAGO-1 (R06C7.1) #9 - L596_g18947.t1
MSNPSHNGGRRPGANGNGNGSQPGGLEMRAATHVRQIRSGASSGSMSSEVRYYQELTQAG
QQLHLEEKKPPGTLCREELIVHTNVYGVGLPDVQVYRYDVDACGFLERNDRRVEFAKRAV
DDVADTTRRNKCRAVVQLVCQNYANIFGNHREYFWYDSQSILFSKNMLDGIPEREKKEFV
LTQEMLAGNPMFRGFKNVRLNIQRVSNSFAINIGDLTQYISADLEENDHSLQQFLEILTS
QYAFNTPSEAICFGSRAAYLMQPDKHGFKAQDCADVGDGKYLGVGCSKSVRFIEGPRGDQ
RAGLVVDLKKTAFHYEQSLLAKSRAILNREPRGNDAGRLRQQLKGLVVETRHAQKPVRFT
IEQVSDETPRNKKFMLQPDNREVTLLQYFQEKYNITLESPDSPIIVGDRLTKFAVFPLEA
CFVVDGQRVSMDQQTPTQIQKMIRACAVPPADRQRQILSLVQGLQLTSSNVYHQAAGITI
TEKPLLVRGRILPNPKIIYANNVVVSPDAQKATWRLDRQKPHYLIPAKIEKWAMYSIRAG
GRSDVLDQPTLLRFAQTMVTECRMRGMQLGNPGEVSFIGCAQEEITATMEQAKKDGCTFC
FFITNNDVTHIHQHMKLLERQTGVITQDLKMSSAVDVIQKNKRQTLENIINKTNMKNGGL
```

```
NYTIRCEGLSNEQLLPSQRLIIGISTTHPKVAQTALEDRDRADKNEDPLTKKKPHHEKHH
RSEHITPSVVGFAANFKKDPIEFIGDCLYQYPQRDEKIGVMQPLLRAVINEFSNNRGVPP
NEIIVYRNGINSISTMELEFLMVKAVARCQGITPKVTMIACQKMHNMRLMPAKINPRDRA
PDQNLKPGAVVDSNVTHPKFNEFYLNSHVCLQGSARTPRYTVLHDEGQFSMDELQALTYN
LAFGHQIVNLTTSLPTPVYVAAAYADRGHNIYGVSQKDYTKSRTSDLNSSTLEGNLDFNR
IMMDLSYSNSELRSKRVNA

>WAGO-1 (R06C7.1) #10 - L596_g1747.t1
MASVDVELREKTKIRQEADRMFKEDYGIDVGSTEMPAKMMKPAAQNTMSLVTNLFPVKTH
QQMPIYRWDVDITIAGKNGKTFSLTKKSDSDAVAVNRKLKTRSIFKRLVAAHPEKFGKLE
ENYYDLESMLFTLKDLSTDQEAQDFVVDGLDAKIIPGIASANVILKKVTDRYQVDLTDFR
HLTRDVANVDLSHKQFLEVVTSQYPLMAEDYVCYPGGVSFSVKEKTTPLAEGKYLGHGVQ
KSVRYIENDGRSPCAAVALDLKKTVFHSEINALEYLKMQNTYVKQLIESKQRAKDNDMTL
KTACQRIKGLRAYTQHTKRQRVVTMDRVGPETANEARFQLQDGEEITVAAYFHRTYGAPL
LFPNAPVAVERKPGSKDVNYHPLELLTIAENQRVTGELPQAVISDVIKQAAVVPLDRQQQ
IMRAHRDLKISTNDYVDNVGTSIAPQMMQVKGRLLMTPKVVYGRNTQIEAREGKWRAERK
TFLKPAGAARWTCMMLTNNRLGEQMMHNFLNKYVAVCRRNGMQMADPIEPFVVDWRRTDL
QTEIDAFMKDCTQQYKLEFVLCIQDNNMHEHKYLKFLERQYGLITQDICTRTVERCIGNA
SATIDNIVQKTNVKLGGLNYGLEYKSPDGRHDVLSATTMFVGLGMSHSKPPKPDATGQEP
SRPASVIGFAANVLAQSFAFVGDYYFQKADRDEKIFAIVPIVTRLLEQWCEHHGGQMPKN
VVFFRNGGSEGQFQMILKYEVPLIKFAIEEFAKKSAVQQQFETKFCLLVANKRHNVRFFK
SNITSGGRAAQQNLQPGVVVDSGVTHPVFSEFYVNSHTTLQGTGKTPRYTVLHNDCGLTL
NQLEHFVFALSHGHQIVNLTTSLPTPAYIANDYAERGMAVLGQFLRASGAPVDEYETFNS
KLTFAAMHPGSKFHHCRVNA

>WAGO-1 (R06C7.1) #11 - L596_g1696.t1
MERFKKLPPTTPLKARQVTLVTNHFRLNPTGRTVFRYDVAMSHTRMVKGTEKIRDLCKGD
RDDAAILERNRRCLALMDAAFAAAPFASTSAAVIYDNSKTLIAAEELDMRQCACIRLEGG
TIPPGFINHPRFKEGYFTIQITPTSSNHRLVINDLEAALAGDEANPDRSLRQFLEILTNQ
ETLKKNSFMAFYGNLYSREAADQRKLREARILKSGMSKGARIIGSSSDLVAALVLDSKKA
TFFDDTNKNGLAGNIRELLNRAPNDAPSRVHINDFDRPDIVKYIKDLRVYCLNKPDNTFQ
ISGLTREPLRNVFFDMGGEQLSVLEYHQRDGARLAYSHWPAVIVQSPRGRNYFPIEVLGV
CEGQRVPISKQTPGQMKVVVNDCAVLPNVRFAEIHQMLNALNLASTTPNRYLQAFGVTID
VRPMKITAYRRQAPKIVYGGNIKVQYDDVKGSWFSSGPYVLPAKIPKWFVVYDGIDQRTV
QQFVGVLQQAMKDKRMEVAQPKYMEMKVAGMDAFLSSIVKSLKPGERSPFVLFTDANEDS
HAFLKLQEAKHQIVTQHLRTKTVRECIEPRKKLTVGNILNKLNCKNFGLNHLVAPDHEKN
YLQKADVMVLGYDVSHPEPQSPQDRRLGIPPSTPSVVGFSFNGGQNPEMFIGDYQFCPPR
QERVDILESRIQWMLKVFNDHRKKLPERIVVVRDGVSEGQLDMVLQHEMASIRRGAAMIK
EGYKPKFLLVVATKRHQKRFFIDKSNGEVDNSMPLTVIDHTVVRPDVTEFFMQSHKAIKG
TAKVPAYTVLQNELGMSLDEIQAFLMGLCFEHQIVSSPISIPEPVYQADQWASRGHSNVL
AFFRVMDIEDPEDPSKKMINRYLKPVEDPLPGRPKFEYDWTRISKLLCYRGRRLEKTRAN
A

>WAGO-1 (R06C7.1) #12 - L596_g18749.t1
MPLITVEMSLFVAEGSVVIFFNAIVLLIIVTDSTLRESTELMFIGGLCFADMTDGIAYFY
AGIHRLCNILSRTDDVMISRLECFQKPFMFFFFYGYQLPAMMIFIVALDRFVAVFAPMWQ
RKVERSSKLMVMVAIFLWVTLTYVINVFLFHSYSTGYTTAQCFAHDVFLSQLWDFIIVQR
SILILLCVLLYVPILIKTRRIFQSNDKSVQSNSFNVTIGLTMTCSVLLLFIPDVIIYFDL
IMDFHLILYLLGLNKCVANVFIYTLRQKEIRKKIELICRRVFCNLKGPFDLELSKRRQRS
NITRTLGIAKRCQSLSAVAWSVVLSSAVPQETWHVISRPPLGEARFDGRIDKGFIAPLLY
FYVSKMSAGPSNLQPDVELRPATKIRHAAEIKFKEMGIEVGIPEMPPKIPVPPNGNVKLT
```

SNLYAVRTSSQIPIYRYDLDITISQRNGKQLALTKKSDSDAVSIDRKLKTKIIFFKMVQT
YPELFSGVHHCIYDLESTLFTLNDIMKDDPEAEPKTLVIEGLDGAKFQGTTSATVILKKC
HDRFEVDLTNFSHLELNIESTDLSHKQFLELVTSQIPMMSDSFVTFPGGVSFSMNASTTE
LPEGKYLGHGVQKSVRYVENPQTRKPMAAIALDLKKTAFHAVLTGLDYLSQIVDDRPLHN
GQKLPNSVFGSFGALKKMKGLRCCLQYGNRYREVVIHEISNKTAQEHYFDREGQQITVEN
YFYQMYNLRLKCPTAPLAGEKKPGQKALCYYPLELIRVLDNQRVTGELPQKVIRDVIKHA
AVVPALRIRQIQDSCADLGLFGNDYLQNVDTVIDSRPIGVEGRQLKNPKMVFGKNTSVES
RNGQWPNRGAMRPPFFIPSTIRKWSVLMISNLQNGFASETMHTFVSSFINECRARGMTLP
APSDPWALNAREELKPQMEGFFSECPGLGIEFVLVLQDDCFHEHKFLKFIERKYNVISQD
VNMKTVQKCLQRAAATLENIVQKTNIKLGGLNYSIEMTNPAGTSNVFQPDTMYVGLAMSH
SKPPKPDSTGREPPKPASVVGFAANVLPQNFAFVGDYYFQAADRDEKIDSIVPIMHRILD
MWCQHHEGQMPKNILFFRNGASEGQYKSILKFEVPLIKHALEKFRNNCGVEQMTPETKFS
LVVATKRHNVRIFKANIQAGRPNEQNLPPGIAVDRSIVHPMFAEFFVNSHTTLQGTGKTP
RYTIMHNGADFKIGQLEHIVFGLAHGHQIVNLCTSLPTPSYIAGDYADRGMVVLHEFLKT
TRAEADQYDTFNEQLTYAALQPESRFHYCRVNA

>WAGO-1 (R06C7.1) #13 – L596_g18732.t1
MLGKWRTVRVEFEAAEELDFRWEFDHMVAAIFEALQPHCRCLLGFGTRSTFQINTVYPKE
LQSPAILFPDDPNGLCKRNLLVQVSLFLLLKSFQLHDFSSSQLSGRFLLLFRTCGESECE
RKRPRFATFGLPNLRSSANVQKLRYANSIAKTERAANRRSNPLQTNSSPGPARKTAPHRN
PAANPKTCFAIGVRGQVADTVDRSFVPRGPLLTVAPPALSPSALPVFSPIRLFTPPHPAA
YFRQSTMDLHTKLAELSVADNAMKPTPATEFKETVEVVSSYFEISIGQNALAYRYEVDIL
AISQRGQEKNLTRGPADDGAASLRRQLCHEVFNAALKKSNGFGTKQGVRLPVVYDCRATL
FLPAPLKMEDEVVVILDKDADFAEMSKETLFTLDPTDVIRVRIAPTTQNAFEMDLRAELM
KADFCEPDCEFARDRSFRTFLEMLTSVNAVRSGSHTQLGVGNFFDNDPSMIVDIGDAKCL
RPGLSKGVRVVEKDDRPYPALVVDAKSSCFFKAQNLAQSIMELGRQKGRPDDMWKTARFL
FKDVRVISAPVDKKGRVKSFPIRAITKMPATELNVKVKGFNGSLADYYARVLKIKLQHPN
FMCVEADVPGPKKEFFPVEVLFVSPNQRVPIEKTEANQSSIVLKANAIKPDRRIKNIKDQ
MSRMSLFANTPVMEAFKVFVCPDFIRLTAGVRVAPQISMGDRDVKIDQKKANWAKEANGA
NYKQESFSLDSWAVLYANTEPGLIRQFVQRYVAAAQRRGFTVREPTILKFNQDFERTFSE
CIDNDIRFLMLIDPKYVKTHESLKLFERLCHVLTQHVSLERVFDVVQKNSRMTLDNILSK
THMKLGGLNYVPIIENVGSRFALDSGEVLVIGYDVAHPTAMSPQERRLVRSLNLDVKSLE
PSVVGITANCSFNPHEFIGDYHYQTARKESIDVSILERRMVWIMRLLEKNRPDQCRPKHV
VILRDGVSEGQYDMARNEEMAALRDGLKLVDPEYNPTFTLVIATKRHNKRFFGQDGRNYV
NTDPGTVIDKTVVRKDVPEFFLQSHYPLQGTVKIPQYNKLHDEANFSMDELQAFVNCLCH
THQIVNLAVSIPEPIYQADELAKRGRNNYAELRRRFTSEVPRMNEAGVIDCNALTKILSY
WDSPLEAVRFTA

>WAGO-1 (R06C7.1) #14 – L596_g20920.t1
MEPSSQPPPTPSLPENMAPKIVGPRDIYERPVPIASNLFPLEMKADVPIFMYHVQIHMKI
GAHEINLVKRHTDDYMHIDHKDKCRAAFRFAVRSSPATFGDPKGLFYDLQGQLYSDHKLK
DVLGHDLIVREEIGIPGEEAGRAPEFKNLGVEYLRVEVEPTRENRPTMILGEMMATRAKM
QESVSRELTQFLEVATSQYAFLTPSKMVTYPSGVSYFKPTTAEPVQVFPAAKELLDGVHK
VVKLIDGTKRGEMAVVVDPKKAVFHKSNITVIDKTVEMGFLDRGSGTVLRETIPELAKKL
KNLYVETRYGKKPIRFAVHDVVLDTARTSRFNKNGDMTSVEEHFKDEYNVILKHPHAPLV
VSTPLKKNPESLQLLYFPMELLFVCPNQRVLFNQQTAKEAFAIKKASTILPENRLKEVVN
SASKLRINGASVQGCFKKAKIEVGNAPLTVEGRSLVPPHIEYRAQQVQVDAVSGRWRSSS
RRGKPQYLVGGKIERWAMYVLSQAPSQAEEELGKNLLAKMEDEFQARGMQIAQAKFLATV
KASPEYMKKIFDRAKAHQLEFLFFIQDTKICLHKEMKYYERKYEIISQDLNMETAKAVTE
EGKYHALDSLIAKLNVKVGGTNYGLVGPSIPDLFKRGKLYIGFHASFSANPADAEDPTVI
GSSANVTQTSAAFVGDMFFQEKNDVDMNTAMAKATLKYVLRYKNVHGHAPSEVVIYRSGS

SEGQFGQILRDEVPALRNALQNAEADEAKLTLLMVNKQHSVRLMPSVIMPGSRAIEQNIK
PGTVVDTKITHPRFAEFYLNSHQVLHGTAKTPKYTIIVDDSAHQIEYLERVTYALSYGHQ
IVDNPTNLPSPLYIAGEYADRGLTLIKAKRKLGDTVDVKDLEKDLPYMASQVLADKRVNA

>WAGO-1 (R06C7.1) #15 – L596_g16096.t1
MSNNERVKTIQNGMETISISATMPVKKKIANAPGAPLQVATNIYKVGLSQVPIFRYDVDI
TLKLPNGKDVKVVKKDRADHVIIQNKNKACKTFQKAVQKFPNVFGNVELFYDCQSILFSL
RKLNISDKGQEFTLSPNDLPEVYGHVDSVNFIVKSVREKYQLTLNDLGFLSTQEVNGIKH
DLAQFIEVATSQNALFNGKHSVYDGGVSYLMSTGEAVRNEPSKQLITGVQKSVRFIEGQG
KPEATLVLDLAKTVFHKGGQNLYEKAISSVRNWPRNDQVDRREIKSLSQQFKGLSIKTEH
QKTKEYELAGLSEFSAHTHKFDHNGKQMSVAEYFKKQYNKNLMHPNAPLAIAKNFFMGKR
NTMMLPLEICTVLPNQKVSKQQETPLQTAAVIRYCAVLPSDRKEQIYTQVKELGFWGNKN
LPITVDQQPIVVTGRQLPQPSIVFGGNQTVSVNPANGKWQATKGVNRNARLPFALPGNPM
PWAVVLVGQGTQDTAKSFALAVKTECESRGLKMGDPSAVIQANYEDIEINARNNTFENLT
KMTPRVKFCLVIENERSPAYIHALIKKNEQNWRIITQVTDSATVQQFNFALGPAQGYGKG
QTLENICLKTNVKFGGLNHFIKPPQGHEKVFASDRMYVGLGISHASPISDAQRARNVKPS
PSVIGISCNYLAHPQALAGTFVFQEPRENKMVESLKKVFFDLATKFKNIRKVIPKEVVIY
RVGASEGQYATILEQEVPQIRAGLKEAGCNAKLVLIVPSRTHNVRLFPQTIKKEDKASFQ
NLKPGVVVDSVIVHPKFPEFFLNSHCTLQGTANTPRYNVLVDDLQAPISDHEMATYMWSF
GHEIVGSPTSLPSPAYIADKYAERGRVLAVEARRKDEKFLNEEGEVDFTEMTAKLSFAGT
PLANFRVNA

>WAGO-1 (R06C7.1) #16 – L596_g21757.t1
MSEISVDELSSYISLESMSIGSSSAYHKKAPVPDSSLHHPVELLSSYLEIGIQEGSKAYR
YDVEIEASKSGSLTRGPADDGHGAMRRKVCYDLLYAALAKSKGFGTGQDYHMPLVYNRQN
HVFFAQPLPEDFITIDLDDNADFTGITNYLYYMTGATESIQVKISKPQSEEHVLDLYESI
FDTAPLDCDGNLEISSRDRSFRTFLELLTSGPASFTGSHVACGTSFYEATNGKDMKDGKT
MRAGLKKGVCVIERDGILYPALVVDSKTGAFFKEQNLLKSMKEMNNGEVPRSAAEPMWQK
ARKLYKDVRVLVVSNVYKNSTQRRLTFPIQDFTREPASRQMMNMKGFRGTVEQYFRQKHN
LSLLHPHLPCAIHASNSKIPVPTFFPIELLFVCGDQKVPLEKSDRFHSETLLRENAVDPK
LRKERTEVQLKKLGLWREKREKMSVDDKKDLSEDGTNLLTAFGVSIINEFIPIRAGVRVA
PTIEVANSEKISIVQKTANWEKKLTNKRYFSSVEITNWAVICSQISAENPMIVRFLKQMV
NVSKRRGIRMDSPMKYSLKSGSREDFDDIFRHIAESGRHFVMYFSPLKEKQHDLVKWMEH
HYSVVTQHVCLERIENVVTGRIQILDNIIHKANMKLGGLNVIPRIEKLGQRMEIESGDFL
VIAYDVCHPAPMTSRERVLMRSMTSFDPSIRSLDPSVVGIVANCVAHPHAFVGDYHYQAS
RKESVDGRILVDRVKWIFELLAERRPNASRPKHIIILRDGVSEGQYKMAEHEELSAIRRA
VAMIDPNYHPTFTLVIATKRHNKRFYDKNEGIAVNTEPGTIIDKDVVRGDVTEFFLQSHF
PLKGTVKMPQYAILCDEADFSQDEIQAFVNCLCHSHQIVASAVSIPEPIYAADELAKRGS
NNFAEHVKIHGRKSLRKDPMNPNLIDFEALTHELAYWKTNLEAIRFNA

>WAGO-1 (R06C7.1) #17 – L596_g18751.t1
MSDQPSSSHQLDVQLRPATIIRQDAEKMFKELGIEVPEPIMPARIPVPPNGNVRLVSNFY
PAHVNGQVPIHRYDVEMTIARRNGSQLALTKKSTSDAVSIDRKAKTKAIFSKMVATHPEL
FTNMYSCIYDLESMLFTLKEIEEVNLIIDGLDGEMFQGTTSATVNLKKCHDRYELDLTNY
GFLQADVGSVDLSHKQFLELITSQIPMMSEEFVCFPGGISFGYHVDATPLSDAKNLYHGV
QKSIRYVENPATKKPMAAVAVDLRKTTFHQSINAFQYMCAQVQVDRNGCLTNASSLTKVS
KAMKGIRCKLTYGRRYREMVIHAVVNKSPRSTFFKRGEQDISVEQYFYEVYQITLRYPNG
LMAAEKKPGQRELCYFPMELLEILDNQRVSGELPQAVVSAVIKQAAVLPAQRRQEIQQAC
NDIGLFDNEYLRNIQTTVEPRPIEIEGRLITNPKLIYGNNVLVDSRKGQWPNRGANKPKF
FLPAVVRKWTFLMISEQRNGQATGTMNGFLKEFIRECQMRGMTLPHPSSPYVLDTNRNVE
DQLEEFMRDCSEGDYEFVFVLQDGIFKFHKLLKYLERKYQVITQDLKTQTGQRCLQRAAA

```
TLENIVQKTNMKLGGLNYSLQMTNPGGRKSVFDESTMFVGLSMTHGKPLKPDSTGELPPR
PASVVGFAANTLPQQFAFIGDYYFQAADRDEKIDSIVPIMTILLTKWSKHHDGQMPMNVV
IFRNGASEGQYKNVLRFEIPLVKYALEKFREAADVEQIHPETKLCMLVSNKHHSTRIFKT
NVPVQGRAPEQNLEPGIAVDRAIVNPVFQEFYINSHTTLQGTGRVPRYAILNNDAGYALG
HLEHIVFGLAHGHQIVNMTTSLPTPAYIASDYGDRGMVILTQFLREFEKLKGYEHPVDAY
QEFNQSLTYASLDPDCKFNLCRVNA

>WAGO-1 (R06C7.1) #18 - L596_g4755.t1
MLSVEEQAIHPGRCGKRLQVNSNVLNVRLPASRIYHYHIDVVGHKRCGPKIVLSRSFFND
SLGHERRTVLVNLFNWLAYFNEERIFAQPRNFLFYDAKSNLYTRKKLNCKCGEVVTISTA
QLTEAQIEGLEEFLCVRVKFTEADPFEIVLNEPEEFRDLGGPLQNFLETLFMQHSLFKNY
ESVVMNPLIQVAADYEARGIPEVEASTLVKDGSRIFPAIRTKLMNMEGPQALTMEGLHEA
DHACLCFRWEPFAVHSSVTLDQKARRALEKEGFESFFPFELDALNRELCGIRVFTELSGT
KKYFIVDHVSERTAWTAVDGQTLKDFLKTEYEVTLKKPDLFLIVEKRGSLDIYHAMELCT
VAPFQRPHKKLNVPPRFKWDCHQMKNKASPSKHTDHAKRLRESVGLVNENVFLQGSGVTL
ATEPMEVTARILESPMLRVKREGLFAVKSKGEWRYPPTTHFVHSAKIERWGVCLIFQERM
WCSDRYQAHIRLNNLMKVISDRAGGHGMRMAERFQEPYNVPIREGSSLSDQIEQVRLCFE
RCKETFDPQFLFFVIQEGIHGLRDCIEAFERKYQIAALDVNNNEALKMALAHCSSRQKSP
MAQVLTSTNIEAEKALRTLMAKINTKMGGLNFEVVPNHANRLLLQDGYLFIGIHAAFAWY
EQQRATVVGYAANLRYPMAFSGDARVRKFDESLPEFLAKIVKRCCIQFNKVRGVDPQHVI
IYQSQPSKDLCQLIVDRTAILLGEIGISTELTYVFVDEHHDIRLTNTHLNNTSVIEEQNL
LPGTVIDTHLVRKGASEFFLNSHIGLVGLSEVPKYTAHDFRSGLDGDNLQSLTYTLCYAV
QSLNAPVSVPAPLYVAKNKARHGASCLKLTGKVGARDFVN

>WAGO-1 (R06C7.1) #19 - L596_g20173.t1
MADEVIGRMRQLSICDDPAYALAPKLQRADKKSFVQHVDIVTSYVRINIVGPAKSYRYEV
TIEALAEGREPNILTKGPADDGHAVMRRTVCYFLLYAALDKSGAFGTGLGHELPLVYNGQ
TLVYFAKPLDRDVIQVTLDQHDDFANVPEELLYMVSGNDTVRISLQKALVDSEMDLQTQM
FETGQADVENLSTHDRSFRTFLEMATQQAAHYAQSYTSIGNAFFEKDPSRTRSLGDGKII
RPGLTKGVRLIERDGVVYPALVVDARSAAFYKEQNLFLSVKECMDSGDPNMSMNDKWDRI
DNLFRGMSIFLAT

>WAGO-10 (T22H9.3) #1 - L596_g19923.t1
MSFRIPKKRKPEDEGAGGTIPPKQNYSSSSSYASASSSSRQTSNGGKNASVYMNGFELQI
GRSVEIHKYEIKLFGVFRKRNGDEDRKDLTQGSKEAKDDISIQKRRRGCWEIFRAVVREN
NSLFGDRNHRFVYDCGLIFYSIDAIFPETETKTGTFDVAILSRECQDYYGQAMKMIEYSI
KKVRDGTFTLGVAPEDKDDRSMQQFLEVLTSQGVYAEGLDNLIFRNHRYDVKYDTPVLRN
KPEYPFCVRHGSSKSVFVAEIENSNKALQTILQLEKKTSPFFPRMNVLQFVDQSKSDIGE
RIVRGLFVTTTHLKKQKVFRVADFSKMNCNDITFKMRDRQNEDEFREISVTEYYQEAHKF
STRAGHRPCVVERKKRFNGEKEENNYPMDCLEIMDGQRIMDKKQSGDITAYLISEARVLP
RQMGDEIKEELNHRVLNQEAEKYLEAFGVRISRDLLRSDAKILQAPKIAYGDKEKYLTTD
NGQKNAWKIDDALKFYRPGKISDAGGENEQNRWIFAVLNEFQSERDHAAAKRFLGKLQDR
AKLRGMLMLNPEVRCLDVRDPDPDTVNKKLSELCQYAKANKVKFIMFIQYERKDMSRDTM
KQLETKFKLTTQQITMSTVNKGAGDKGDRMVLDNILNKTNEKLGGINCIMKPSPQIAQWF
SGNVMYMGLDISHPGLGGNALSSVTPTAVGMTFTKNRDEVQGRYWFQEAREHMLRSLKKQ
IVFAIEEFNRCSRRYPDKIVVYRGGVSEGEYDKVKTDEVEQFMEAFREINFPGKRKPALI
IVIVQRNSGYRLIPTQDNDFRGNDAIVQNVLPGTCAEVIGEGGRKEFILVPHQAIQGTAK
PSKYVLIYDEAKCITLSELETLTNTLCYSHGIVTSPVSCPSILYQAGDLAKRAINNYRIH
SSRRDFGAMPPIEEVDKRNEYFDQMCDMLQVTLDTRFWA

>WAGO-10 (T22H9.3) #2 - L596_g15911.t1
```

```
MLPNRAPQGNELQRNRKVELQVNGYRMRINESKVYMHEIKMEVAFNTLKGLRNVDLLARP
ANDVIRQKRRRLIWSIFHATRIKHPQQFLYNEYEYVYDCGGALFALHQIGDGNRIEFVMK
MADFPEEAKGQLHRAEHVILRLAFTRILDLRQSNLYDGGEAGEQRCRFVQQFLDILTSQY
VLGSDQHLVFQNSRYSADPREDIEAHLSKVIKKGASKTINIVGDQKNQEALLFVEPRRSP
FMADKKVLDIVEEVRRELGGRSSNAQLKKKLEDLLKGIVVETIHQKDAVQFPVKGFSAEP
AGVLSFTMDAGESTTVADYFKRRYHLHVDRDMLCVVCERRQQKFYFPCEVLVVLPGQRVH
CSRQTPKLVEQLIKESQQLPSRMKEEVNHEREVYGFHELNQQLKAFNVTVDTELCTAVGK
VLPPPVIQYEQRTVSADVDRSGQKITGRQWKVSGQRFVRPAPTPEKWVLCVFENALESES
TRTFARAYVNAARSHGLILGEPIIERLQEVNQSTIYARGQAYKSNDVKFILFIFGGDRKN
FERDIMKESETLFNYTTQAVNTKTAMKAISDRGAFMVLDNLVMKTNLKLGGINHELANAQ
DFPQGYLEKVLFKAGRVFIGLDLQSPGMLGGADEFTLDPTVVGMTFTLGSPADMRGTYWY
QPAKKKYISRLKDAIEDVLMVYQESVGSLPNDIVIYRAGVSEGDILMVVSEEIPAIKDYL
TTLDNPDGCPYRPHLTVMVAQKNSTMRLMPLVVHQTGRAQDENVEPGTSVSTNIVSARHT
EFVLAAQQALKGTARPTRYIVVHEEEGQFTVEQLENMTHQLCYLHGIVALPVSRPSPLYS
ATDLVKRGRANWKVRMERKEGSHTPLGPVNDTFFDPINEERLRFLPVTLPAKFWA

>WAGO-11 (Y49F6A.1) #1 - L596_g17524.t1
MNKSSKIAAMPSFKKKRPAENDDSPAPKRPAEKARRSQREEAPRRSHGGSKILMNGFRVE
IEKAMTIHKYYIQLNGIFKKRGGEEIARDLTEGVHRDDVSMQRKRRGCWDVFRQIVKENE
SLFGGNTHKFVYDCGRLFCSMEEIFPKSETKTGTVDLATLPDRSQTFYRGALRIEWTIKK
VEDGTFKLGVPEEARSSDRSAQQFLEILTSQGLYARGDDHLIFRNQRYDVQENAPVDKKS
TYPFCVRQGVQKSVILCESAEKIATILQLEKKTSPFFPEMNLLDFVRQCSSDDKAMAVLK
GLQVQTTHLKRQQKTFRISGYSNTACKDIHFENRDGEKISVPEYFLKHHAFRTAAGQLPC
VEEKRKPQNNHYPMDCLKIVGGQRILSQKQEPEIVEHLISTARILPLKMADEIGEQLGKH
ILNREAETFLRTFKVNVDRNLLETEATLIKAPQIQYGKNQNGVNPAKTLTTERGQKNAWK
MEDSLTFYRPGVVSDSGEAHRWMFVILNEPNQREHGDCRVFLEKFVARAGTRGIKIQFPH
VEKKRIENSDPWPELQEIGQYAKSNGVKFVMFVYERTGDIRKAMKLLETTFALTTQHVSL
KTISKAAGDKGAFMVLDNLLMKTNEKLGGLNTRVKAEPRVAEWFERGTTMFMGFDVSHPG
LGARNENGVTPTAVGMSFTKNSDLEVVGRLWYQEPREHLIPNMKDHIVEALETFKKHSGK
FPELVVVFRGGVSEGEYEKVQTKEVQEFQDAFQQLKFSRKPILKIVVVQRNSGYRLMPAQ
RNDFGYQKNEALVQNVVPGTCADAEIVDQKRTEFVLVPHQAIQGTAKPSKYVLLHDEAPK
MSKEELSTIAHTLCFMHGIVTSPVSCPSILYQAGDLAKRASCNFKAFLNRKGGNVPIPPV
EEKEKRKEFFDALCEKLKITLDTRFWA

>WAGO-11 (Y49F6A.1) #2 - L596_g17422.t1
MPFPRGKGYHPYRGKSYHRGFGRNNFQYRQTKREEYHSSDSSPTDNQPSTSRSHDRCDDY
KPKDEDDMKLYLSDRKPSPEPPEFQIRINAFPFNIDHAPKEVHTYELIFVMSQKLKKEKE
PANHKLRTNAKLFSAEDIGLGWFDAEEEGQVYHGTDMSCGPTDVVRRQRRKALLFQLFRH
LINQSKEYFPGSKYVYAYDGQRILYSPEVLKMDEGMFMAQLTDLPESVTQLLGPSDQENT
EINAYIRKAEDVIDLHDFGTEARPIHGIEGFLETLTWQHAFEGFEEHIVYGTRYFALNAG
KKLKHCTGFKSIVGFEKRIELLPDYTCSNILLERSLRPVMRMTPKFDLFFDNSTAISLDD
FAVLFFRVEVDDLSATLQKKENLQKLNQVFKNAVVRTIHRDDGRQDTFMIDHLDERNPFE
ITLKEEDEETVADYLYGVYGYKVDRNDRLPCVARKFKNEFAYYPLRTLVLLPNQKVASKF
LPEDMRKSYQEACQNLPSDALNNIFTAMSQLNLSRASEDYNNDEKVIHVNNKYMENFKIT
LESNQLIQMPAQRICEPRIAYRESTHLAQDGAWDYEKAAVFIDAVIKVRRIGLVNTCEDV
GEDDLGEFISKLIGWLRNKTIDLKLTPEDIFWWPDAWNEFKAGKSKKEMLATAEKIIETS
EVKLMFVICSGSADDEIHDIWKLAEVTNELVKVNKKDFVTTQCITPATLSNVLVKSTYQD
EILTNIIMKMNLKLGGTNYVLSKSPSNNEMSIPHIHSSRMFVGIDVLQPEKTQLNGEPTN
NPTVVGISFTDATSKFYLRGTYWYQQSPTVSLCLLQKHFDEALYWYDCHKMDSVPREVFV
YWRDSRIQKNMEEVKMVLEDVICNRAKDVRRDASKLFLIMVDTKPKTRLFTWETQFSGNA
QTQNVQAGTFVRESYRKRQFTMINHKSGAGLAHPVRFTMINDDVNEKDYVEAELEKTTNA
```

```
LCFLQNTSTRSTSIPAPLYSAMDLAKRGMKNYETMDAVMREEERDEDRKKREARTPEAWH
RYYKQLVKTHMSVMPIRDSKFWA

>WAGO-11 (Y49F6A.1) #3 - L596_g18655.t1
MSPPRNGSNFNRGNGHKRPPHGHNSQAKRVKWEEHSSDSSPIYNQPSTSRSYDRQPKEEN
DVKPLFSSRERSPRLRDLQIRINAFPFNLDHAPKEVYTYELIFVMSQKLKREKEPENYKI
RTNAKLLEAEDVGLGWFEAEEPGQFYHGTDMSCGPMDVVRRQKRKALLFQLFRHLINQSK
EYFPGSKYVYAYDGQRILYSPEVLKMDEGMFMAQLADLPESVTQFLGLDDQKNTEINAYI
KKSDEVIDLHDFGTESKPIHGIEGFLETLTWQHAFEGFDKHIVYGTRDFALNAGKKLKHC
TGFKSIVGFEKKIELLPDYTSSNMILERRIHPVMRMTPKFDLFFDNSTAISLEDFAVLFF
RVEVENLPATLQKEENLQKLNQVFKNAVVRTNHRDDGRQDTFMIDHLDKRNPFEIIVTEE
DQETVADYLYDVYSYKVDRNDRLPCVARRFRNELAYYPLRTLVLLPNQKVASKFLSEDMR
KSFQEACQNLPSDALNNIFTAMSQLNLSRASEDYNNDEEVTHVNNEYMENFKITLESNQL
IQISANRVHEPQIAYQKSVKPAQDGAWAYEKGAFFVHPKKGVRKIGLVNTCEDVKEDVLG
EFISKLIGWLRNKDIDLKLTKEDIFWWPDAFSDFGVMKSVKEMLAKAEKILETSAVNHMI
VICNGSAEDKTHDVWKLAEVTNGLAKKDRTNFVTTQCITPTTLGSILVKSTYQDEILTSV
IMKMNLKLGGTNYVLTNSNRNYMSVPHITQDRMFVGIAVLQPEKTRLNGDATYNPTVVGL
SYSEGSPNFYLRGTYWYQQSPSVDLSILKKTFAEALYRFDKFHLIPKEIFVFWRSGKFQR
SMEEEKIALQEVIDKRVKDVNAKSPKLFIISVNTKPKTRFFTWETKFSGNAQTQNVQAGT
FVQESFLRREFTMINHKSQAGLAHPVRFTMLNDEIGEQDYAEAEIERTTNALCFLQNNST
RSTAVPAPLYSAMDLAKRGMKNYETMDAVIREEESEEERKKRETRTPEGWQKYYGNLMER
HMPVPIKSSKFWA

>WAGO-2 (F55A12.1) - L596_g16917.t1
MHAHRLQQLTDGINRNLNDEGIARRTPMSPTPSVGRHDKEITLTSNLYELHLAHGKVRVY
HYTIKLSDYTGKTAEVHGDYGRVNLGSKLLLAADTFMKRNGFRDHDFFCDLAGMRLYTIK
PIPRSEGNPRFYVSEATKDGNFAVCRDDGRPFELNIRDVFKEVRIPNLQDATLDAFINTA
INKACLAKSDLYFPIFETCYPKTGAPVARKDGRSLILGTKTSVERVEGRYGSSTTPVVAL
NVSAEWFYMKKNLLDFCKQNIELNEKSVPVDAASFQLLSDSMQGVTVRLICSKNPLLFTI
KSLANKNVSMLKYPLPNIKGTGLIKFLWETYSVRLTYPESFAAEVKPDFHVTDPRPIFYP
VELLEIMPMQRALKGKKSCDGSAVDREKKIQEKVHQMERHVQKAGLGLSMDDAPVEVEAG
VLDLPKIVFADEKVVEVNPSSASWRFGSGECPERFARPAEVKELPWCVMLVSDVPPTKGM
SKKAKFFADLLKKQAAERGLQMKEPMYHPTKQGKVEIERFFNTTAVEFFVFLMAKSLDYH
DFTKILERKYQVITQTVKMENAFDVVEDPNSTKSRKIVEHIVMKMNLKLGGVNSTVKPSR
HLFSHEEVRRLLIGFTLIEGPKITGRDAAAFNRFGGKIPAVVGFSANMGSLEHEFLGDFT
FQYLDHTNIVQDIKKIVATILERFRKTRRGRDPAEVVIYRKLDEFHFPRVIQNEIAPLKN
LLEEKCHGFVSLIYIAMTKTHNIRFFPKGPPPEGDERKPNLVPGTVIDSGAVGGGLKQFF
IASYSASTGTTRPPRFTILENSKEAKIRDLEKLTLELTFAHQTSTRSLGVPAPLVVAKNY
ARRGNVLAKNEAEKISDVDTSVGVETMIDRLPYADAPVLRDKRVTA

>WAGO-5 (ZK1248.7) #1 - L596_g12936.t1
MEGEGTELRPSTVVRQARNAAASSAGAPPAAPGSRAATASVEKSFYSKLVNVPTPPPEEK
KPHGTAGRQLKLRTNVYGLSLPKDVQVFRYSVDASGTLQRNDLRIEFAKRVANDITYLNR
REKCRRVIDQVVAKYSAIFGDRRELFWYDSQSILFSRNQLDISSEGQFVLDQSDIGQNPL
FEGFAHLKMVIRPAQTNFAVSIGDLEAYIQAEVFESDHALQQFLEILTAQYAFNTPLEAM
SFGSRTAYLLNPEKYGFKPADCADVGDGKFLGVGCDKSVRFIEGPGGAGSQRAALVVDLK
KTAFHKDQSLYEKAREILNNRDPKSTDASRLRMQLKGIVVETKHGSRRQEFAVDNVVADT
PATKKFKDLTGQEVTLQQYFQQKYNITLQHPDSPIVLTDRTKKFAAFPMEVCSVVDGQRV
TLAQQTPVQIQKMIRQCAVPPADRQRQILGLVQGLQLNSENKYHKAASVGITPTALQVQA
RLLQNPTIVYGRNSTMKPDEKATWRLARQKPVYLKPAKVDKWAMFVICGGNRSDCVDQDI
LNQFSNMMVQECRARGMTVSDPTGFSFIGASREVVQETLEKAKTEGNQFCFFITNNDVTN
```

IHQFMKFQERKLSIVTQDMKMSSAFDVVRKGKRQTLENVVNKTNMKNGGVNYSLRFDDPA
FSMEKLLPKDRLVIGLATTHPKPIVGKKEQDEGPHDKKKQMHQQRTGPPVPSVVGVAANA
LTESIEIVGDCLFQQPNREEKIALLQPVIRSLMLQFMKHRGMPPAEIVVYRQGTSEGQFR
DVMELEYKMVKAAALQQGLNPKITFIVVQKMHNVRLMPMDSKAGDKAPEQNVKPGTVVDT
MVTHPKYNEFFLNSHVALQGSARTPRYTVLYDENRLPMDEIEALSHSLAFGHQIVNLTTS
LPAPLYIANRYAERGHNIFIASQEDYTKSKTSFQSPHSTTIEGNLDFGRMMNELSYCNSE
LKDKRVNA

>WAGO-5 (ZK1248.7) #2 - L596_g12936.t1
MEGEGTELRPSTVVRQARNAAASSAGAPPAAPGSRAATASVEKSFYSKLVNVPTPPPEEK
KPHGTAGRQLKLRTNVYGLSLPKDVQVFRYSVDASGTLQRNDLRIEFAKRVANDITYLNR
REKCRRVIDQVVAKYSAIFGDRRELFWYDSQSILFSRNQLDISSEGQFVLDQSDIGQNPL
FEGFAHLKMVIRPAQTNFAVSIGDLEAYIQAEVFESDHALQQFLEILTAQYAFNTPLEAM
SFGSRTAYLLNPEKYGFKPADCADVGDGKFLGVGCDKSVRFIEGPGGAGSQRAALVVDLK
KTAFHKDQSLYEKAREILNNRDPKSTDASRLRMQLKGIVVETKHGSRRQEFAVDNVVADT
PATKKFKDLTGQEVTLQQYFQQKYNITLQHPDSPIVLTDRTKKFAAFPMEVCSVVDGQRV
TLAQQTPVQIQKMIRQCAVPPADRQRQILGLVQGLQLNSENKYHKAASVGITPTALQVQA
RLLQNPTIVYGRNSTMKPDEKATWRLARQKPVYLKPAKVDKWAMFVICGGNRSDCVDQDI
LNQFSNMMVQECRARGMTVSDPTGFSFIGASREVVQETLEKAKTEGNQFCFFITNNDVTN
IHQFMKFQERKLSIVTQDMKMSSAFDVVRKGKRQTLENVVNKTNMKNGGVNYSLRFDDPA
FSMEKLLPKDRLVIGLATTHPKPIVGKKEQDEGPHDKKKQMHQQRTGPPVPSVVGVAANA
LTESIEIVGDCLFQQPNREEKIALLQPVIRSLMLQFMKHRGMPPAEIVVYRQGTSEGQFR
DVMELEYKMVKAAALQQGLNPKITFIVVQKMHNVRLMPMDSKAGDKAPEQNVKPGTVVDT
MVTHPKYNEFFLNSHVALQGSARTPRYTVLYDENRLPMDEIEALSHSLAFGHQIVNLTTS
LPAPLYIANRYAERGHNIFIASQEDYTKSKTSFQSPHSTTIEGNLDFGRMMNELSYCNSE
LKDKRVNA

>WAGO-5 (ZK1248.7) #3 - L596_g17875.t1
MVCKGQATSEIELTTNAYGFLPFLSAKVFQYDVEIVGILSGTGRTVNFTKCSKHDAFRAA
RIEECRDLFEMVKQKYPEVFNAPDSNYFYDNGRRLFTKESLLPPLVSKQEFPLNEFDTVY
LDRDYSRFDKILFSVEKAAEDPMDVKEVLKHVKDSGKSIRLNQFLNVLTSQHALSNPVKF
ATYRIGSAFFINADRYDHNHGVEDLTDDKEIRVGCEKSVKLIAGSSDDGSAIALVDIKRT
AFHKSGGTLLKKAREVLGKWPQPCDANRLKPHFIDLAVYTQHGSKDRRYVIDDVIAETPA
TLKFAWVRGSKELTLVEYFHQAYSIEIKFPRTPLAVAMAKEGRTIYLPLELCFVSPHQRV
TTAQQQATEEMIKRCSIPPLDRQKRIGRIVEAMKISDNPFLQIADTGCKLLSTIPLSVTG
RVIAPPKIRYGHSEIQKSAFLKPAKINSWAIVVLTAQDDPELARGDILSPSVLTKFARLF
RKECKARGMQLPDPFLKEFMKADVDQLGELMRCLAQGDSTECRPPLRFLIFVTNEKLTDL
HHPMKYFERQCGIITQDMKMQTVVDVVLHKKRQILENIVSKANIKNGGLNYSVIIPDVPG
KRPILGSGRLIVGLFTSPTFKWQFEDSPSRPTALGYAANTTPNEGEFIGDCLIQKGRASA
IQTILRRVLAEFKKQRRCDPADVIIYRSCEEGREKKTLEEDLAAVRSILKSSNPMPTLTV
IAVQKRHGLRLMPTAIQRQGEPQSENLKPGTVLDSCLTDPALTEFYLNSHATLQGTARTP
KYTVVHNDVGLSLEEMETLTYALSFSHQIVPLPTSLPSPLYIAGTYAERGVSLYQQDRER
GREGSLESCFTYGSSPGLKHLRITA

>WAGO-5 (ZK1248.7) #4 - L596_g24399.t1
MDVLTEAMSKMLPMNIAPKIVGAQDPYERVVPLTANMFPLHMRAEVPIFMYNVQVFMKVG
FREVNLVKRNTDDFTIIDHKNKCRSAFRFAVRAAPQVFGHPSGLFYDIQAQLYSVRELKD
VLGNDLKKKEEIIVPGEDARKAYDFQDIDLEYLRLVIEPVNGTNPSINLGELVLKQKNFS
DEVPCELLQFLDVACSQHAFLTPTKFTTYPGGFAYFNPTSEEPARELPDAARLHNGVHKS
VKVIEGSCTAGRCGELAVVLDPKKAAFHKPDITVVQKIQEMGFLQMASENVAPHRIPELA
EALKNVFVETRHGKRRSRFAIHSVVAESARTNRFTKDDGQVTVEEHFKKEYDIALKYPHL

PLVVSMPLRKKTPSNGRAPPRLLFFPMEVLFICPNQRVLRNQQSAKQNNEVIKSCAVAPE
HRLKDVIASGQKMRINGPNVHGCLNSAQIQVESEPLKVEGRTLVPPNIDYKGCQVQVDSF
TGKWRNFGRNKPHYLEGGKIGRWGLYVLSKAPSSEEEQLALKFKDKMLVEFQSRGMQIDL
PMFLATVKATPLYLRTIFEKARKERLEFLFFIQDKDLALHNEMKFYERAYEVITQDLRTD
TARAVIEQGKNLSLENIIAKLNVKVGGTNYSVNGPSVPDLFKKGRLYIGLQASTNGPPAA
GAHLPTVVGSAANVTTAPSSFVGDIYFQKFGEMDLQGAMASTTEGYVKRYAAVHGRAPDE
VFIYRSGTANTNIGQMLRDEVPAIRCALKNSGASRARLTLVMVTKQHNVRLMPTNMTLGG
RAIDQNIKPGTVVDQKITHPRFAEFYLNSHQALHGSAKTPKYVVVADDCSNPIQYLERVT
YALSYGHQIVGMPTSLPSPVYIAGKYAERGAALLQTKRNLGGALDVDALAEELAYANSKV
LGFKRINA