Effect of *V. destructor* parasitism on honey bee health and neural gene expression

Nuria Morfin, Paul H. Goodwin and Ernesto Guzman-Novoa

nmorfinr@uoguelph.ca

@nuriamorfin

@MorfinNuria

Nuria Morfin

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V. destructor

Ectoparasitic mite that feeds on fat body of larvae, pupae and adult bees

V. destructor facilitates maintaining an open wound and transmission of viruses

Immunosuppression: cellular (decreasing haemocytes) and humoral (down-regulation of immune related genes)

Impact on non-associative learning

http://beeaware.org.au/archive-pest/varroa-mites

Rosenkranz et al., 2010; Kralj et al., 2007

Deformed wing virus

Vectored by *V. destructor* (Bowen-Walker et al., 1999)

Decrease longevity, causes weight loss, and inability to fly (De Miranda et al., 2010)

Affects associative learning (Iqbal and Mueller, 2007)

Neural related genes

- Neurexin (*AmNrx-1*) (Biswas et al., 2010; Hamiduzzaman et al., 2017)
- Neuroligin (*AmNlg-1*) (Biswas et al., 2010)
- Acetylcholinesterase (*AmAChE-2*) (Gauthier et al., 2010)
- Blue cheese (*BlCh*) (Navajas et al., 2008)

? Is *V. destructor* affecting the expression of neural related genes (like *AmNrx-1, AmNlg-1, AmAChE-2* and *BlCh*)

? Which neural related pathways are affected by *V. destructor*?

? Can *V. destructor* affect neural processes?

Adult long term effect

- NEB <24h
- n=40

Sugar syrup

- 1 mite/bee

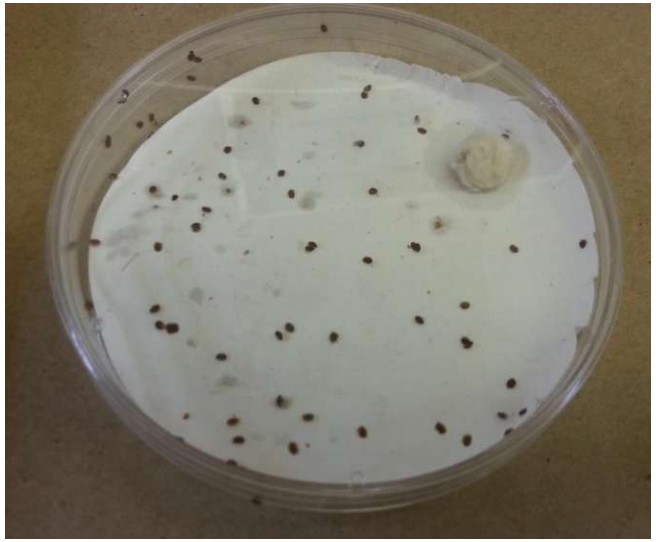
V. destructor

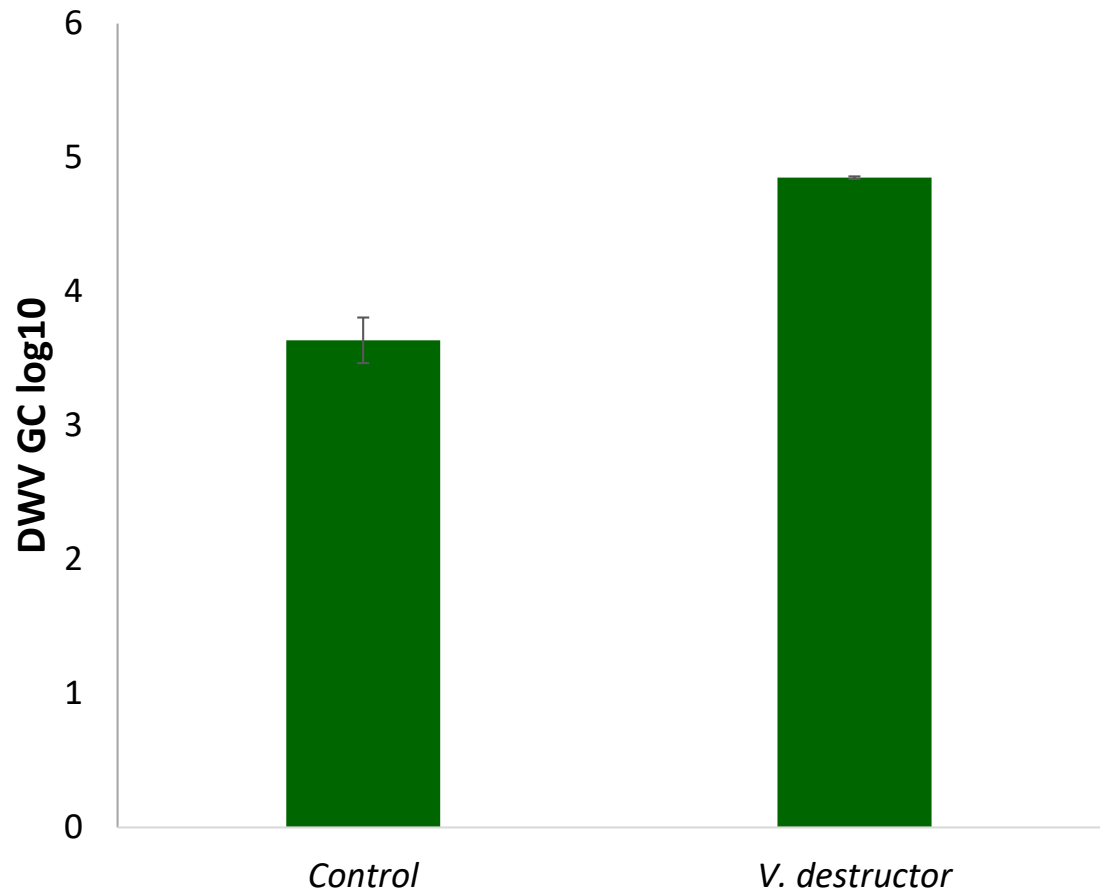
- In cages
- 35°C RH60

Incubator

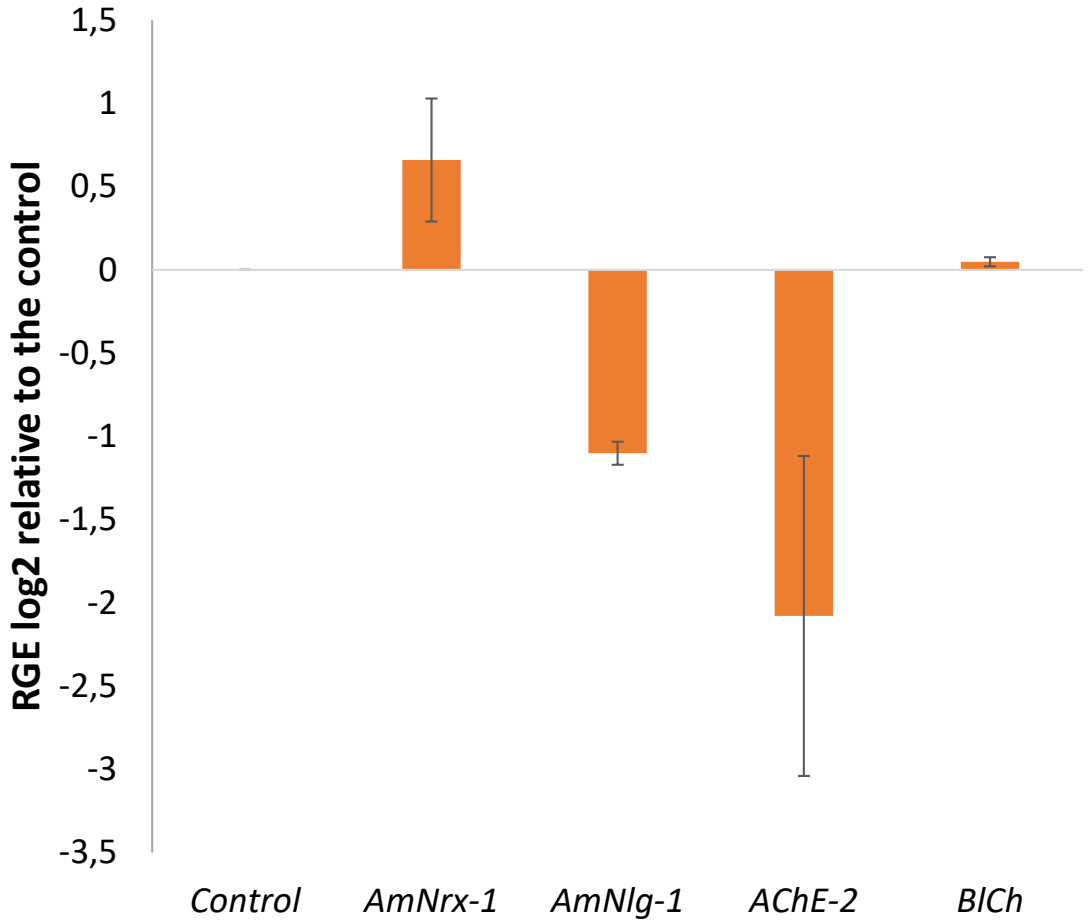
21 day-old

- Mortality
- Weight
- RNA analyses
- qPCR





Quantification of DWV, Guzman's lab (UofG)


RGE log2 relative to the control
1,5
1
0,5
0
-0,5
-1
-1,5
-2
-2,5
-3
-3,5
Control
AmNrx-1
AmNlg-1
AChE-2
BlCh

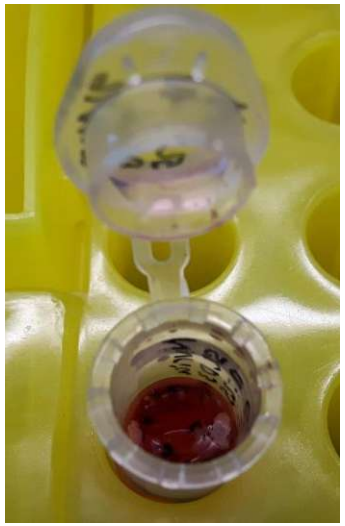
RNAseq

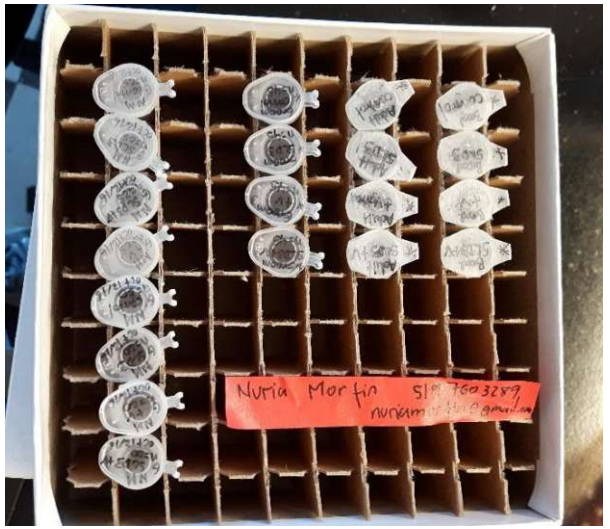
RNA extraction
- From brains

RNAseq
- Génome Québec Innovation Centre

Bioinformatics
- Canadian Centre for Computational Genomics

Results
- DEG = Differentially Expressed Genes compared to control
- Gene description
- Gene Ontology (biological pathways)





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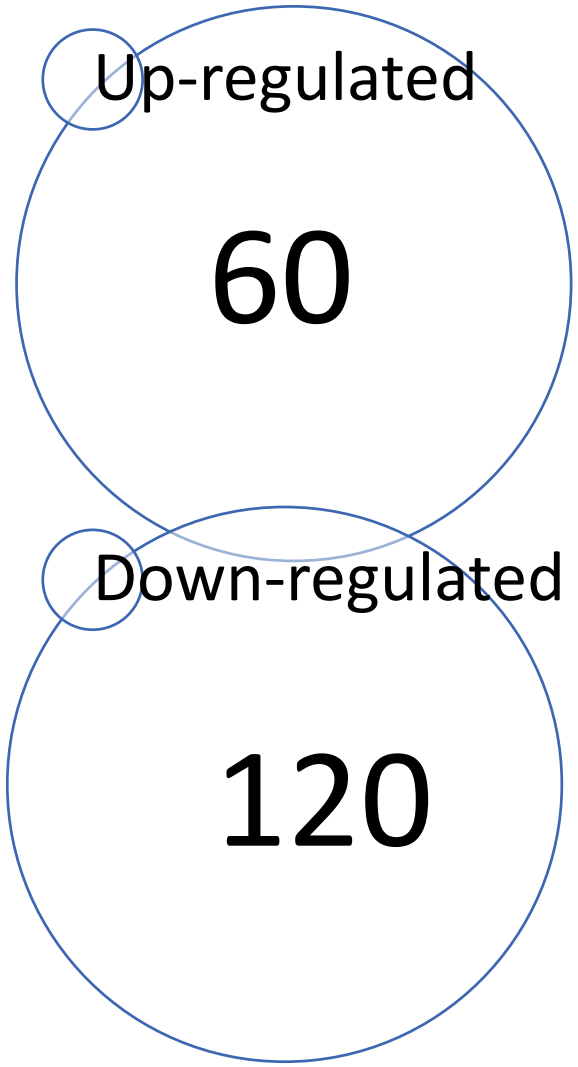
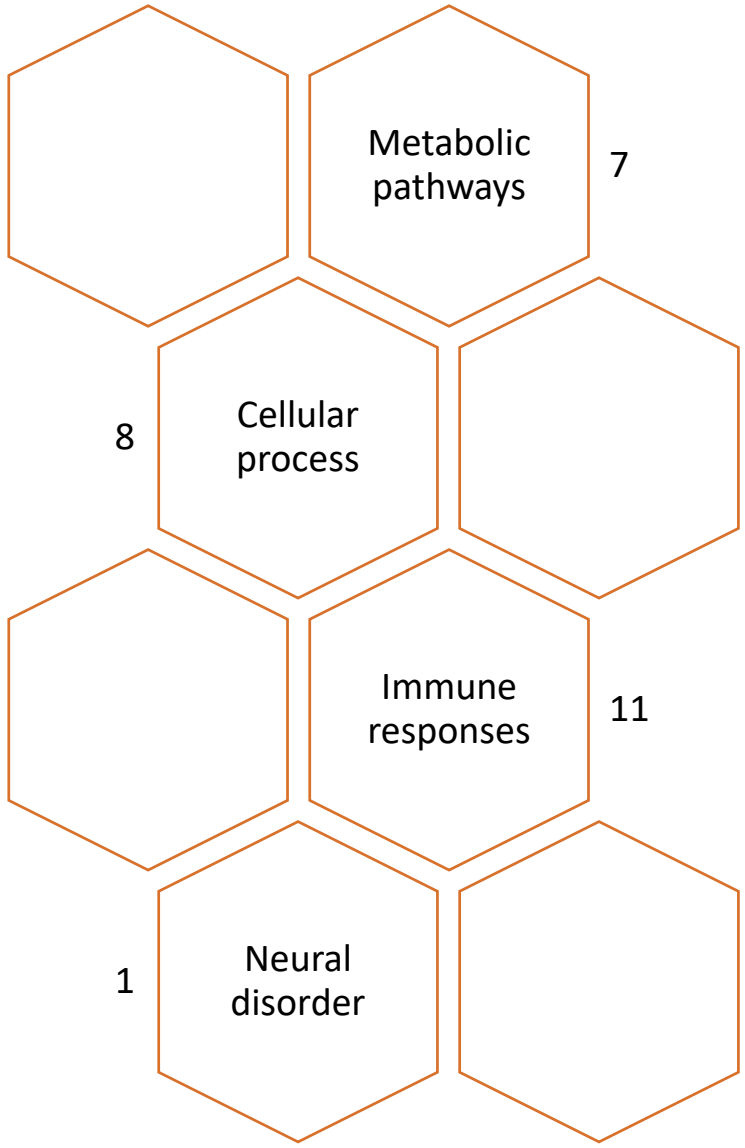
DEGs and Biological pathways





Proboscis Extension Response (PER)

- NEB <24h
- n=40
- 14 days

Sugar syrup

V. destructor

- 1 mite/bee

- Associative learning (3 trails)
- CS = odour
- US = sugar

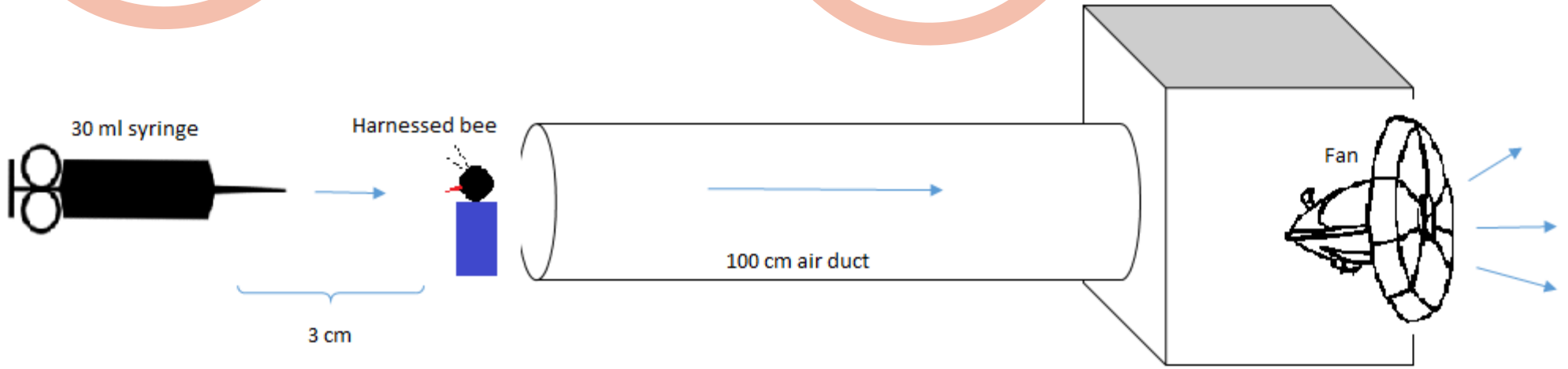
Training

Memory

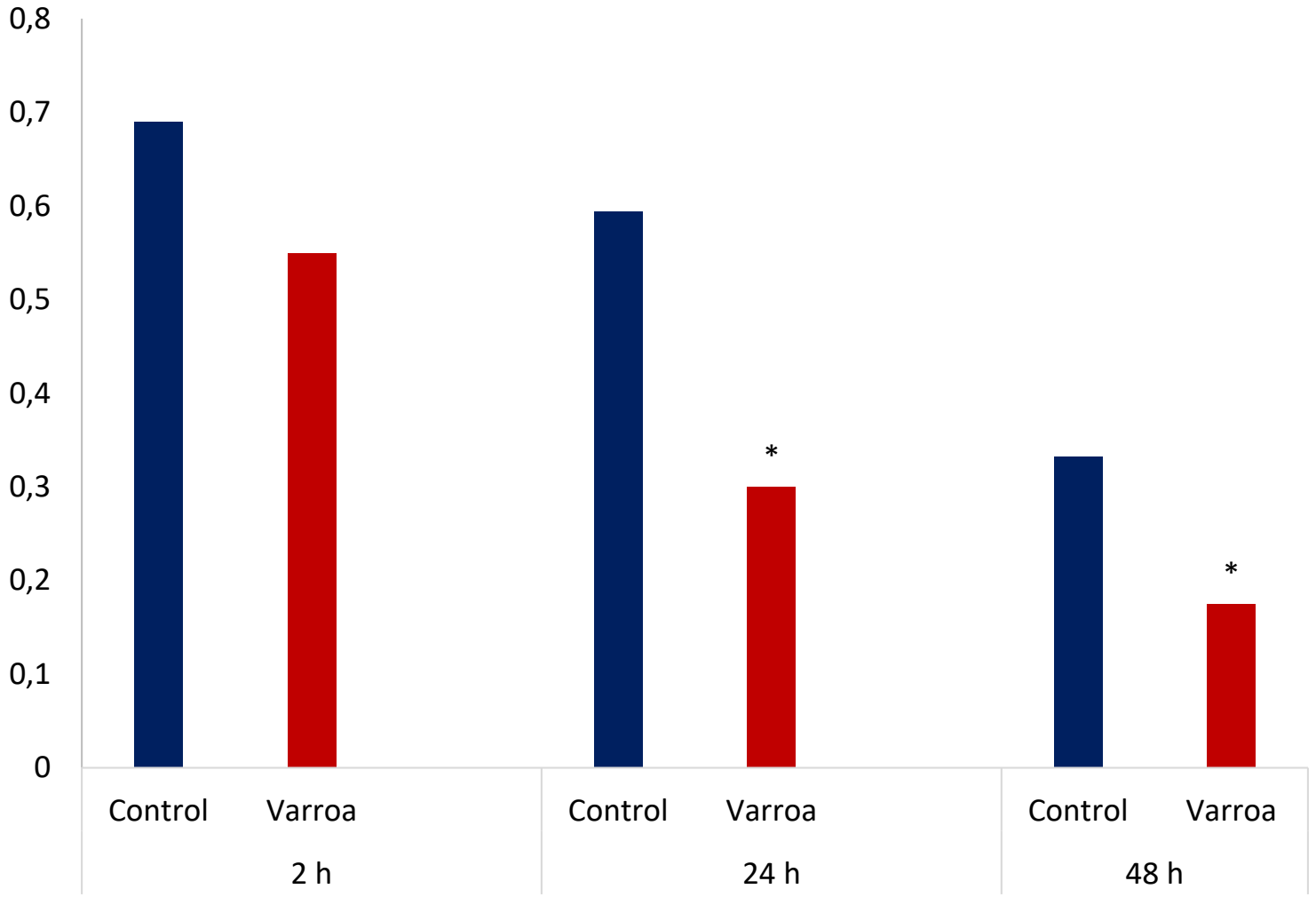
- 2 h
- 24 h
- 48 h

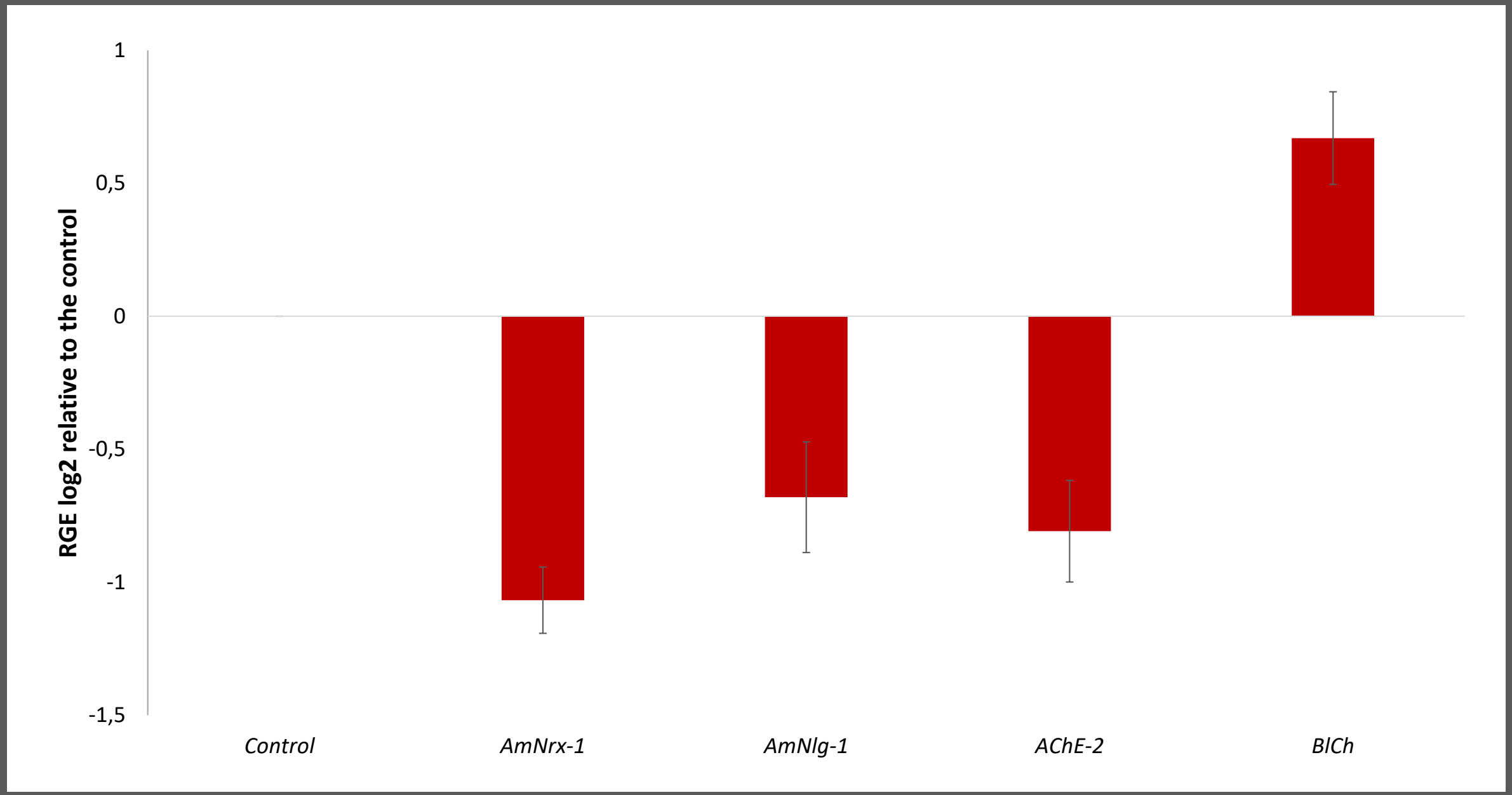
- qRT-PCR
- DWVq

RNA analyses



Proportion of bees + to memory test

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BlCh

- *V. destructor* down regulated neural related genes
- *V. destructor* affected immune related pathways, metabolic pathways and one neural disorder pathway

Photo: Zenaida Diez Marina

Potential effect of *V. destructor* and/or DWV on neural processes

- Antecedents of flavivirus (vectored by mites) causing encephalitis and memory loss (Raval et al., 2012)
- IgE vs mites causing neuropathies (Osoeawa, 2002)

UofG Honey Bee Research Centre

@honeybeesatuog

@HBRC1

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Thanks for your attention ☺