The influence of thymol on motor function in honeybees *Apis mellifera*

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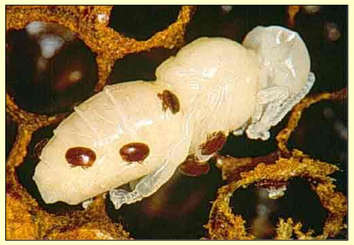
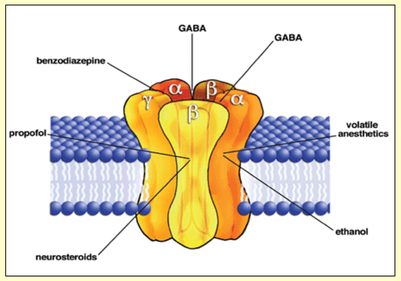
Introduction

The mite *Varroa destructor* is a parasite of the Honey bee *Apis mellifera* and has been associated with a decline in the number of honeybees worldwide.

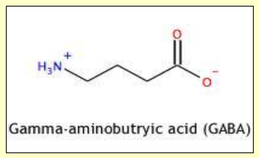


Many different types of treatments have been developed to help control the prevalence of the varroa mite, one of which is the monoterpenoid thymol, a plant essential oil. Plant essential oils are relatively inexpensive and kinder to the environment than synthetic products (Imdorf et al. 1999).

Studies have shown the neurotransmitter γ-aminobutyric acid (GABA) plays an inhibitory role in both vertebrate and invertebrate nervous systems (Rauh et al. 1990). Through this mechanism GABA and associated receptors play an important role in modulating synaptic transmission in locomotory networks (Alford et al. 1991). Evidence suggests thymol acts as a positive allosteric modulator on the insect GABA receptor which may increase the inhibitory affect upon locomotary neurons. This could disrupt the control GABA systems have upon locomotion and co-ordination with in animals (Priestley et al. 2003; Tong and Coats 2010).



This study intends to investigate the effects thymol has on honeybee motor function though behavioural observations. We predict thymol will have a negative behavioural effect on the honeybee's righting reflex and co-ordination of motor function



Methods

Honeybees were placed into a petri dish with breathing holes for 15 minutes to acclimatize before the treatment was added. A small piece of filter paper saturated with 3µl of a treatment was used to administer the drug. The treatments used were a control and thymol treatment: thymol 10mM, 1mM and 100µM. Observations were made using The Observer software (Noldus) observing the following behaviours: still, moving, grooming head, grooming antenna, grooming abdomen, grooming legs, upside down (unable to perform the righting reflex).

A honeybee unable to right itself after falling over (upside down behaviour)

Results

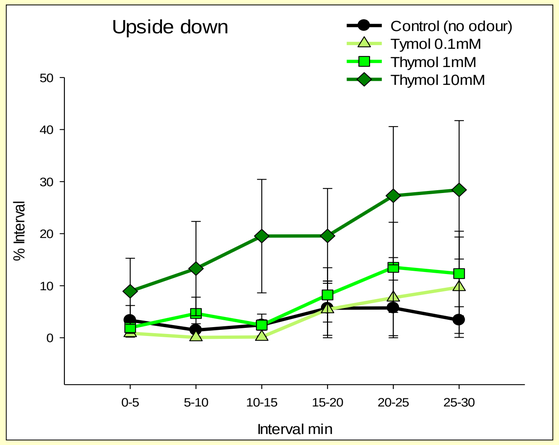


Figure 1. The 10mM dose of thymol significantly reduces the bees ability to perform the righting reflex compared to the control bees (Multivariate ANOVA. LSD P = >0.001)

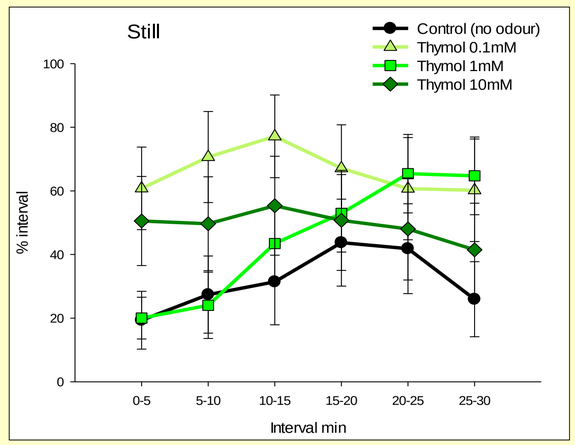


Figure 3. The 0.1mM and 10mM doses of thymol significantly increase the amount of time bees spent still compared to the control (Multivariate ANOVA. LSD P = >0.001 and P = 0.024 respectively)

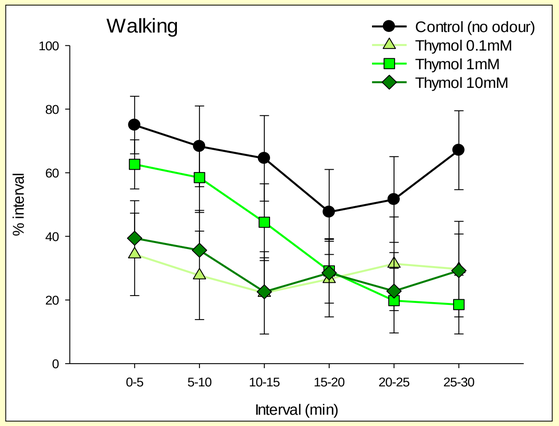


Figure 2. All thymol doses significantly reduced the time spent walking compared to the control bees (Multivariate ANOVA P = > 0.001)

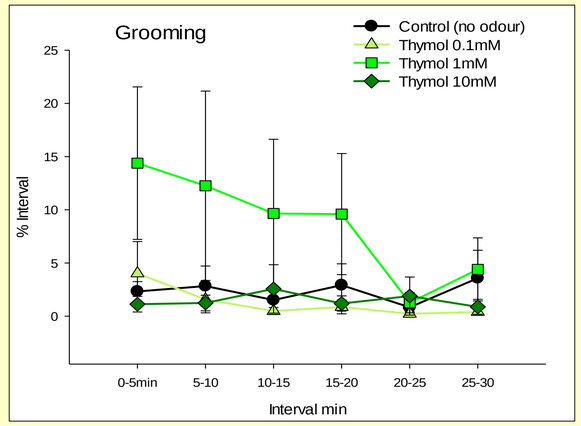


Figure 4. The 1mM dose of thymol increases the time spent grooming compared to the control bees (Multivariate ANOVA. LSD P = 0.001)

Discussion

Thymol affects honey bee motor function by decreasing locomotion and increasing grooming behaviour. It also reduced the bees ability to perform the righting reflex.

This supports other theories which suggest thymol interferes with GABAergic systems which modulate the locomotory network.

References

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