

# The effect of raw propolis on *Varroa*-infested honey bee (*Apis mellifera*) workers

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## Introduction

Animal self-medication is defined as a specific therapeutic behavioral change in response to disease or parasitism and plays a main role among the variety of behavioral defense mechanisms evolved by animals against pathogens and parasites (Lozano, 1998). The conditions defining this adaptive behavior have been refined over time. According to Clayton and Wolfe (1993) there are at least three criteria that must met to establish self-medication:

(1) the substance in question must be deliberately contacted; (2) the substance must be detrimental to one or more parasites and (3) the substance must have a positive effect on fitness.

A recent study has shown that *Apis mellifera* colonies increase resin foraging rates when infested by the ectoparasite *Varroa destructor* (Pusceddu et al., 2017). This result fulfils the first criterion for self-medication.

Here we performed cage experiments to investigate the effects of propolis on the fitness of *Varroa* infested honey bee workers (3<sup>rd</sup> criterion).



*Varroa destructor* mites



Experimental cages



Pupa of *Apis mellifera*



*Varroa destructor* sampling in the experimental apiary and in the laboratory



## Materials and methods

The study was performed in the experimental apiary of the University of Sassari (north-western Sardinia, Italy). Propolis specimens used in the bioassays were collected from hives using specific collection nets placed above nest combs.

We used experimental cages to investigate the effect of propolis on *A. mellifera* workers artificially infested with the mite.

The following experimental groups were compared:

- Infested bees with raw propolis;
- Infested bees without raw propolis;
- Uninfested bees with raw propolis;
- Uninfested bees without raw propolis.

We performed the experiment in May and in October.

In the propolis treatments, 0,5 grams of raw powdered propolis was placed inside the cage over the sheets of wax comb.

## Results and Conclusion

This study demonstrates the positive effects of raw propolis on the lifespan of *Varroa*-infested adult bees. In fact, in both experiments, the infested bees reared with propolis showed a twice median survival time compared with infested bees reared without propolis.

In conclusion, this study provides a starting point for further investigation on the impact of raw propolis on the ectoparasite *Varroa destructor* within the hive; our findings seem to confirm the hypothesis that the resin collection and propolis used in the hive may represent an example of self-medication behavior in social insects.

However, before drawing definitive conclusions, other important aspects merit careful investigation.

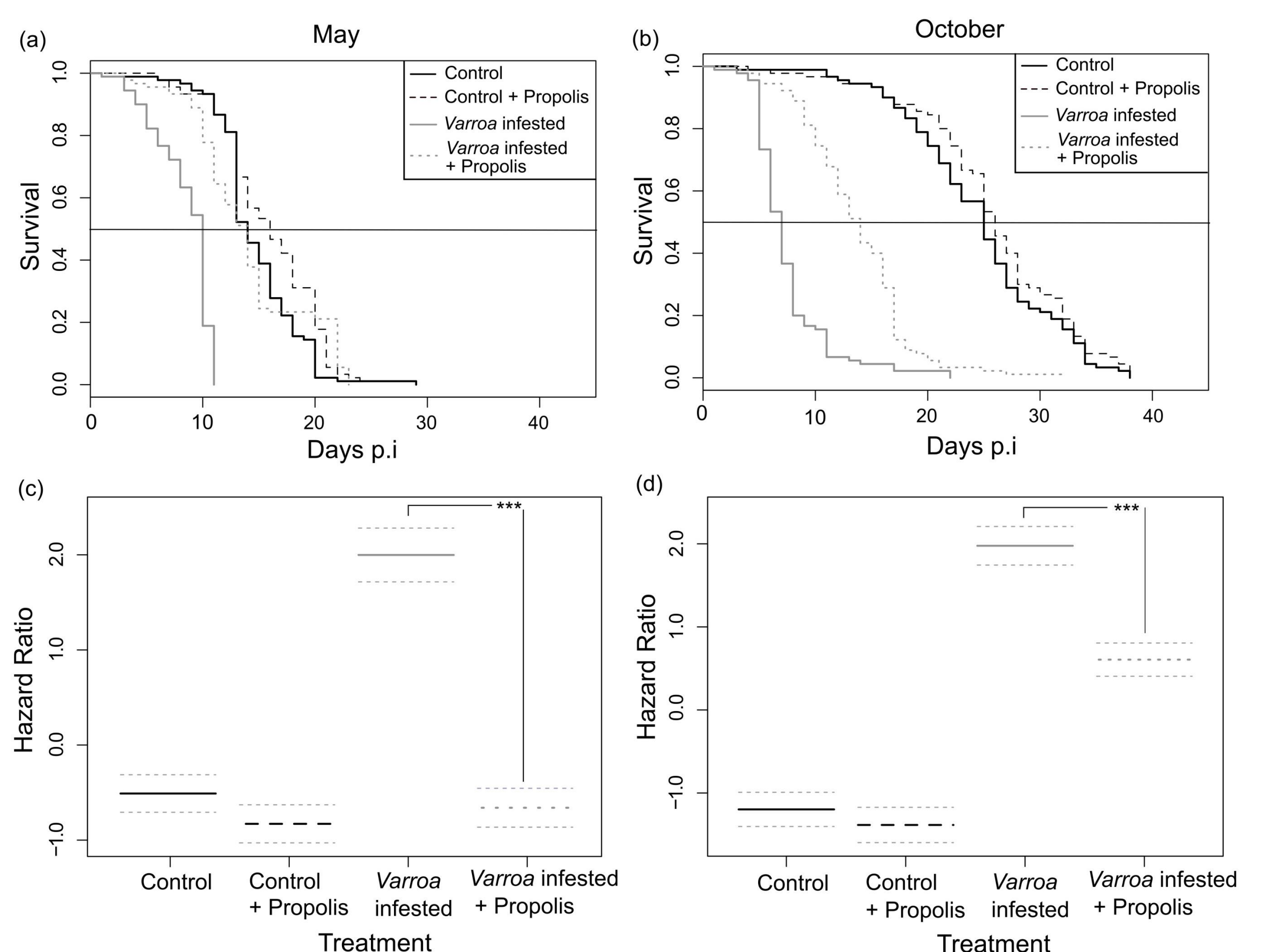


Figure 1. (a, b) Kaplan-Meier survivorship curves of *Apis mellifera* workers, (c) and (d) Instantaneous risk of death (hazard ratio,  $\pm$  95% CI)

## References

Lozano, G.A. (1998) Parasitic stress and self-medication in wild animals. *Advances in the Study of Behaviour*, 27, 291–317.

Pusceddu M., Piluzza G., Theodorou P., Buffa F., Ruiu L., Bullitta S., Floris I., Satta A. (2017). Resin foraging dynamics in *Varroa destructor*-infested hives: a case of medication of kin? *Insect Science* 00, 1–14, DOI 10.1111/1744-7917.12515.