

Secrets of the honeybee bite revealed

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A previously unknown honeybee defence weapon against varroa and a potential new natural anaesthetic for humans.

Researchers have discovered that honeybees can bite as well as sting and that the bite contains a natural anaesthetic. The anaesthetic may not only help honeybees fend off pests such as wax moth and the parasitic varroa mite, but it also has great potential for use in human medicine.

The surprise findings discovered by a team of researchers from Greek and French organisations in collaboration with Vita (Europe) Ltd, the UK-based honeybee health specialist, will cause a complete re-thinking of honeybee defence mechanisms and could lead to the production of a natural, low toxicity local anaesthetic for humans and animals.

The natural anaesthetic that has been discovered in the bite of the honeybee and measured at the University of Athens is 2-heptanone (2-H), a natural compound found in many foods and also secreted by certain insects, but never before understood to have anaesthetic properties. Independent tests have verified Vita's findings and the potential of 2-heptanone as a local anaesthetic.

As a naturally-occurring substance with a lower toxicity than conventional anaesthetics, 2-heptanone shows great potential. Vita has already patented the compound for use as a local anaesthetic and is seeking pharmaceutical partners to develop it further.

Until recently, research seemed to indicate that 2-heptanone was either a honeybee alarm pheromone that triggers defensive responses, or a chemical marker signalling to other foraging bees that a flower had already been visited. Vita's results contradicted these notions.

The new research clearly shows that 2-heptanone paralyses small insects and mites bitten by bees for up to nine minutes. Somewhat like a snake, the honeybee uses its mandibles to bite its enemy and then secretes 2-heptanone into the wound to anaesthetise it. This enables the honeybee to eject the enemy from the hive and is a particularly effective defence against pests, such as wax moth larvae and varroa mites, which are too small to sting.

Dr Max Watkins, Technical Director of Vita (Europe) Ltd, said "We are very excited about our findings on at least two levels. Firstly, the revelation that honeybees can bite enemies that they cannot sting confounds some existing ideas and adds significantly to our biological knowledge. Secondly, the discovery of a highly effective natural anaesthetic with huge potential will be of great interest to the pharmaceutical industry eager to develop better local anaesthetics."

In laboratory neurophysiological trials in the School of Biology of Aristotle University of Thessaloniki (Greece), 2-heptanone was found to have a similar mode of action to Lidocaine, the dominant local anaesthetic used in humans and other mammals. 2-heptanone is found naturally in many foods such as beer and white bread and is so safe that it is permitted as a food additive by USA regulatory authorities. 2-heptanone therefore offers considerable potential as an alternative to Lidocaine. Very recent

laboratory research using mammalian cells in the USA, has confirmed Vita's expectations that the anaesthetic could be as effective on humans and mammals as it is on insects and mites.

In considering the biological impacts of the findings, Dr Alexandros Papachristoforou, a Vita researcher working under the supervision of Professor G Theophilidis in the Aristotle University of Thessaloniki in Greece, said: "It is amazing that this second line of honeybee defence has gone undetected for so long. Beekeepers will be very surprised by our discovery and it is likely to cause a radical rethink of some long-held beliefs. It will probably stimulate honeybee research in many new directions. For instance, many beekeepers have spoken of the 'grooming' behaviour of honeybees in helping to control varroa populations. This grooming behaviour can now be interpreted as biting behaviour."

Dr Papachristoforou described how the unexpected properties of 2-heptanone were discovered: "We were investigating wax moth control. Wax moths are a serious honeybee pest whose larvae consume wax and pollen, often completely destroying honeycomb. When exposed to 2-heptanone, which is produced naturally by honeybees, the wax moths appeared to die. However, on closer inspection, we realised that the wax moths were merely anaesthetised for a period of one to nine minutes. This was quite unexpected, so our scientific team set up a series of rigorous experiments to find out what was really happening and came up with our remarkable discovery."

The research has just been published in the peer-reviewed journal, PLOS ONE:
<http://dx.plos.org/10.1371/journal.pone.0047432>

Several organisations contributed to the research in collaboration with Vita (Europe) Ltd: the Aristotle University of Thessaloniki in Greece, the French Centre National de la Recherche Scientifique (CNRS), Université Paris-Sud, Cyprus University of Technology, and the University of Athens.

Notes To Editors:

1 About Vita (Europe) Ltd

Vita (Europe) Limited is a mite control and honeybee health specialist. It is the world's largest dedicated supplier of honeybee health products to the honey and pollination industries. With headquarters in the UK, offices in Italy, France and Russia, and partners across the globe, Vita researches, develops, and manufactures a range of honeybee health products. These products are marketed internationally through a network of 60 distributors in 50 countries.

Vita's product range to improve honeybee health includes anti-varroa acaricides – Apistan® (outside the USA/Canada) and Apiguard® – chalkbrood and wax moth controls, foulbrood diagnostic kits and health-promoting feeds. Vita products have been registered by more than 60 veterinary authorities.

Vita promotes sustainable beekeeping through Integrated Pest Management (IPM). Its treatments are designed to inhibit the build-up of resistance and wherever possible contain natural compounds and biological controls that are benign to all but the target pests.

Vita invests a very high proportion of its turnover in research and development. Research partners

include universities such as Cardiff, Milan, Udine and Naples and institutes such as the Tierhygienisches Institut (Institute of Animal Health) in Freiburg, Germany, the UK Central Science Laboratory and the USDA in America. Vita's innovative research and development work has been recognised by and has received support from the UK Government.

As a result of its primary research of natural control agents, Vita is currently engaged in new projects exploring mite control in the agriculture, veterinary, and horticulture industries as well as public health and human allergen control.

See www.vita-europe.com for more information.

2 About PLOS ONE

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