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Horizontal transfer of RNAi between honeybees and Varroa destructor

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RNAi is an RNA-mediated sequence specific gene-silencing mechanism. RNAi has been demonstrated to moderate gene expression in a wide variety of organisms including plants, mammals, insects and ticks. Acquisition of RNAi components (dsRNA, siRNA) by ingestion and their spread within the recipient organism has been previously reported by us and others. Here we extend such observations, demonstrating that RNAi is transferred within the same species and across species which, upon transmission from one organism to another still retains its biological activity. The mite *Varroa destructor* is an obligatory ectoparasite of the honeybee (*Apis mellifera*) and is one of the major threats to apiculture worldwide. Recently, *Varroa* resistance to acaricides has become a global concern and alternative means of control are needed. In recent years, plant-to-parasite RNAi transfer has been documented, suggesting a potential strategy for next-generation pest control. We previously reported that honeybees fed on double-stranded RNA (dsRNA) with a sequence homologous to that of the Israeli acute paralysis virus are protected from the viral disease. Here we show that dsRNA ingested by bees is detected in the bee hemolymph. We also show that bees that were fed with dsRNA transferred it to larval food that they produced (both worker and royal jelly). Finally, we show that dsRNA is transferred from bees to the *Varroa* mite and from mite on to parasitized bee. This cross-species, reciprocal exchange of dsRNA between bee and *Varroa* engendered targeted gene silencing in the latter, and resulted in an over 60% decrease in the mite population. Thus, transfer of gene-silencing-triggering molecules between this invertebrate host and its ectoparasite could lead to a conceptually novel approach to *Varroa* control.