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Fine-scale assessment of Chorella syrup as a nutritional supplement for honey bees

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One of the many challenges in modern beekeeping is the declining diversity and availability of flowering plants that provide pollen and nectar to bees, driven by global agricultural expansion. One solution to this shortfall is the additional feeding to honey bee colonies of feed supplements. However, the effectiveness of nutritional supplements on bee health and vitality (e.g., oxidative stress, immune function) is usually not well studied. Recently, microalgae have been a widely studied dietary supplement with promising applications due to a nutrient profile similar to natural pollen. This study evaluated Chlorella vulgaris-enriched syrup as a bee dietary supplement regarding its effect on honey bee and larvae oxidative stress, digestive enzyme activity, and protein vitellogenin level. After the application of Chlorella syrup to the colonies, no changes in digestive enzymes activity were observed in adult worker bees; however, higher gene expression of the antioxidant enzymes catalase (Mann-Whitney U test, $p=0.017$, $Z=-2.390$) and superoxide dismutase1 (Mann-Whitney U test, $p=0.044$, $Z=-2.016$) was observed. However, in larvae, the expression of those genes was not affected. In Chlorella-fed colonies, a three times higher concentration of vitellogenin was recorded in the hemolymph of worker bees (Mann-Whitney U test, $p=4\times10-6$, $Z=-4.629$); vitellogenin is a phospholipoglycoprotein which has many roles in honey bees as an antioxidant, as a store of nutrients for the individual, and in immunity. Our findings brought evidence that Chlorella vulgaris-enriched syrup did not negatively affect the digestive capacity or oxidative balance of honey bees. The results provide a solid base and guidelines for further implementing Chlorella as an effective and safe pollen substitute in apiculture practice.
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