OP-107 [Bee Health]
Enhanced immune response and antimicrobial activity in honey bees (Apis mellifera) following application of oxalic acid-glycerine strips

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Honey bee (Apis mellifera) health is increasingly threatened by multiple stressors, with Varroa destructor mites being one of the most significant global concerns. While oxalic acid (OA) is widely used as a natural acaricide, its effects on honey bee immunity and physiology remain insufficiently understood. This study evaluates the immunological and physiological impacts of different OA treatment methods, focusing on OA-glycerine strips (OA-G) compared to OA trickling (OA-T) and flumethrin.

Despite OA's
effectiveness in controlling Varroa, its influence on honey bee immune responses and oxidative stress remains unclear. Beekeepers require optimized treatment strategies that minimize unintended physiological stress while maximizing colony health and mite control efficacy.

A total of twelve honey bee colonies were assigned to one of three treatment groups (OA-G, OA-T, and flumethrin) with untreated colonies serving as controls. Samples were collected at five time points (0, 24, 48, 72, and 192 hours post-treatment). Immunological parameters, including antimicrobial peptide (AMP) levels (abaecin, apidaecin, defensin, hymenoptaecin), antimicrobial hemolymph activity, and oxidative stress markers, were analyzed to determine the systemic effects of each treatment.

The OA-G treatment induced a significant humoral immune response, characterized by increased antimicrobial activity in the hemolymph and elevated AMP levels between 48 and 192 hours post-treatment. In contrast, OA-T and flumethrin treatments did not elicit notable immune activation. These findings suggest that OA-G not only targets Varroa mites but also stimulates honey bee immunity, which could have both protective and potentially energy-costly effects on colony health. Further research is needed to assess the long-term implications of immune activation induced by OA-G treatment. Understanding the immunomodulatory effects of OA is essential for refining Varroa treatment protocols. While OA-G strips appear to enhance immune responses in worker bees, their potential physiological trade-offs warrant further investigation. Beekeepers should consider these findings when selecting OA application methods to balance effective mite control with colony health maintenance. This research was supported by The Ministry of Agriculture of the Czech Republic – projects NAZV QK1910286 and QL24010241.

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DEPARTMENT OF BIOCHEMISTRY

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How does the treatment influence the physiology of individual bees?

OA-GLYCERINE STRIPS

FLUMETHRIN AMITRAZ

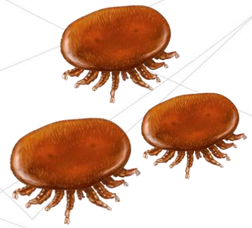
OA TRICKLING FORMIC ACID THYMOL

TREATMENT

side effect

HONEY BEE

main effect



VARROA DESTRUCTOR

Context of oxalic acid treatment againt Varroa mites

Sublimation

- highly effective
- instrumental equipment needed
- **approx. 1.5 g OA**

Trickling

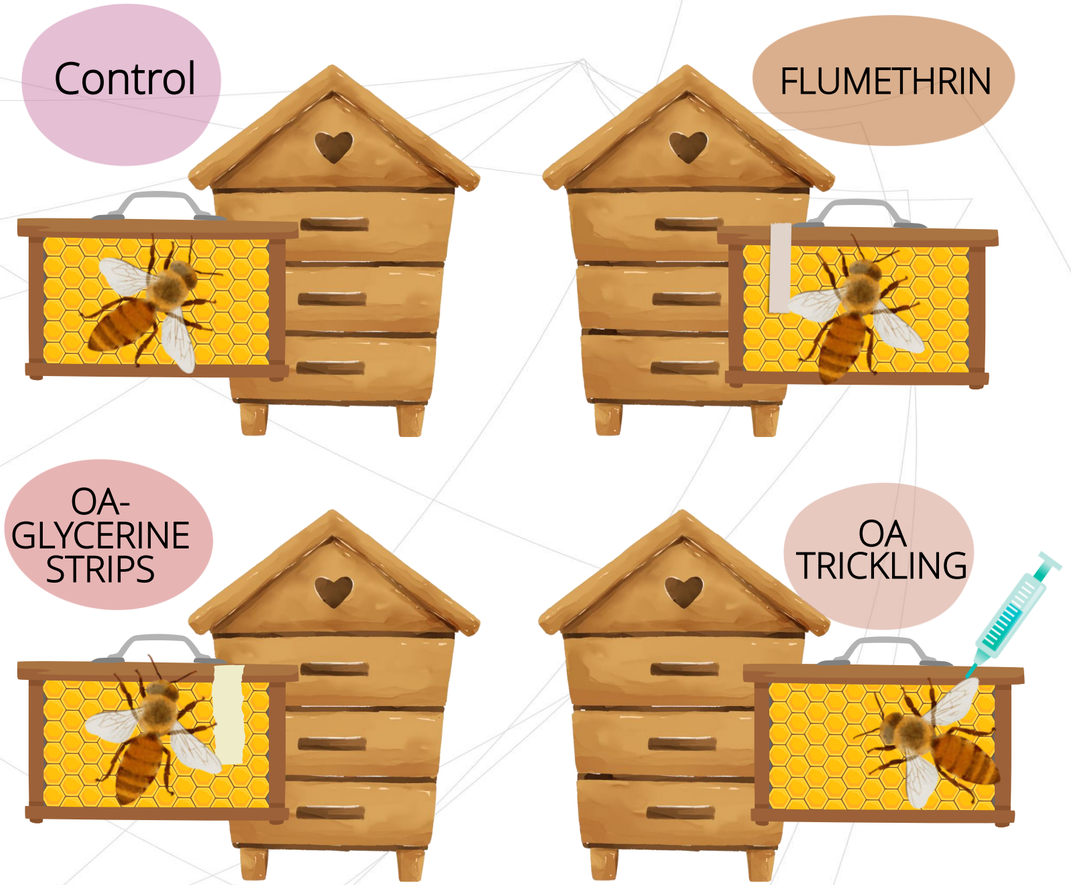
- simple and cheap
- high efficiency
- **approx. 1.5 g OA**

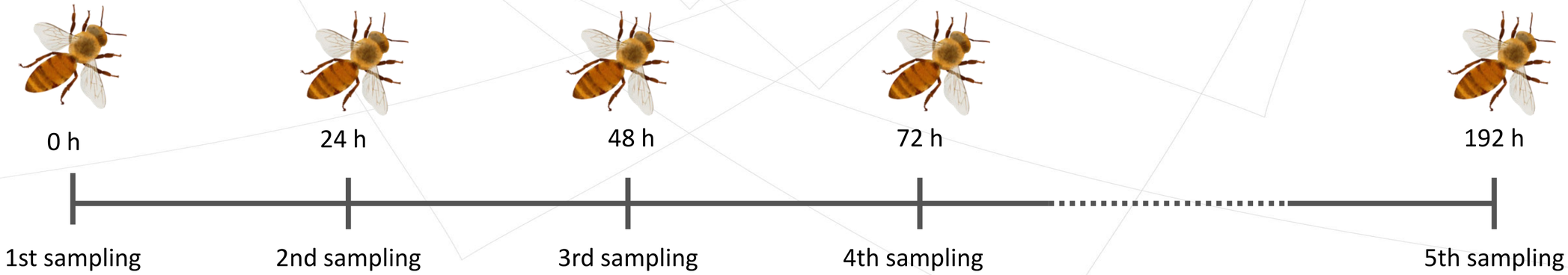
Paper strips with glycerol

- Maggi et al., 2016 - slowly and continuously released
- applied when brood is present
- **approx. 40 g OA**

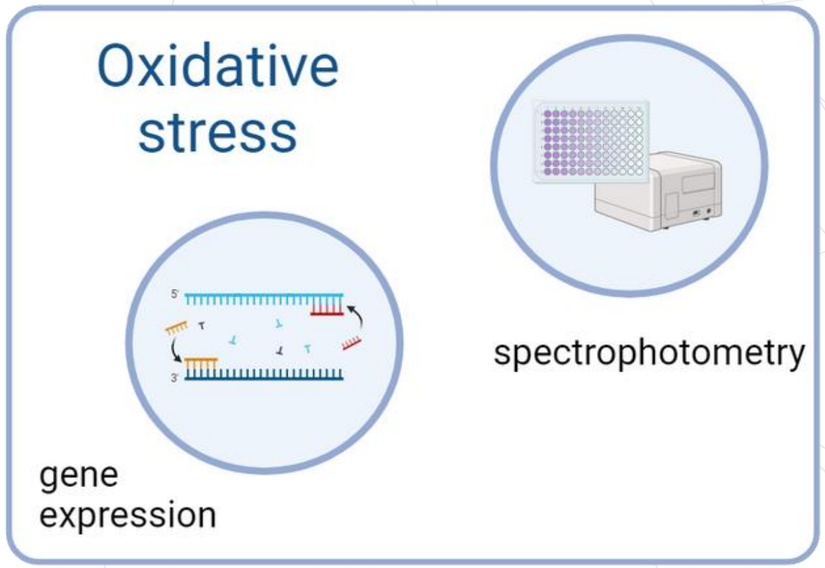
Experimental design

- Field experiment on colonies
- Performed at one apiary in summer
- 3 colonies per group
- Time points for sampling
- Sampled approx. 200 adult bees from brood area

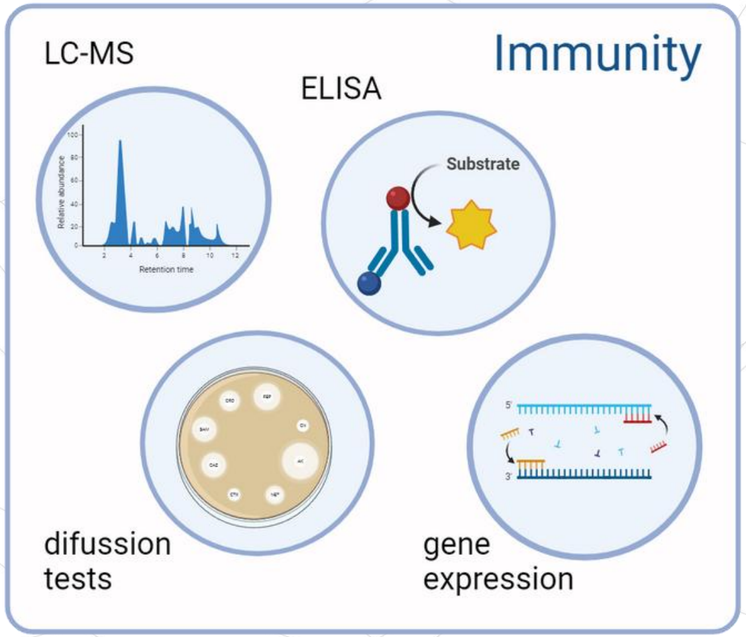




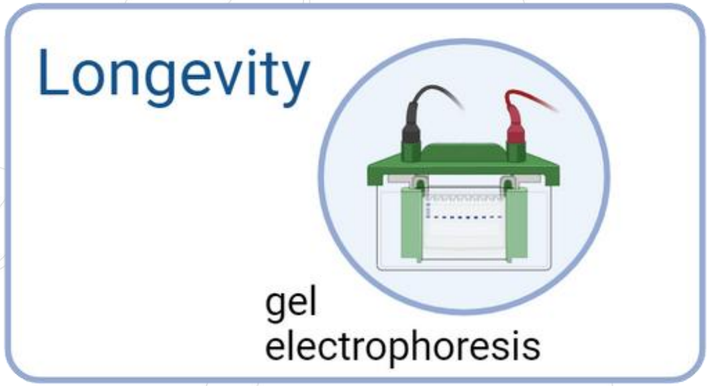
Methods and molecular targets



- Lipid peroxidation

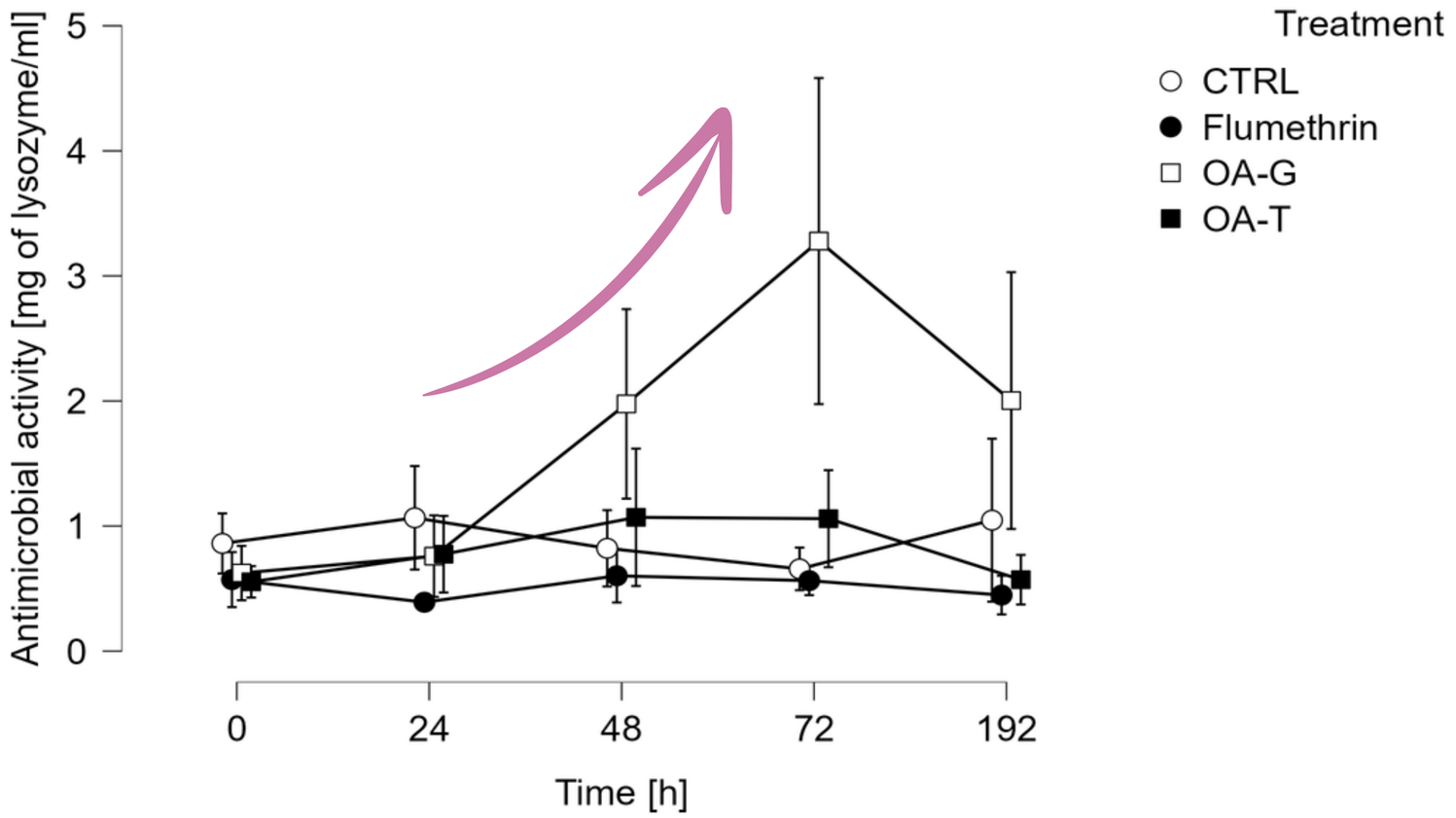


- Antimicrobial activity
- Antimicrobial peptides



- Vitellogenin

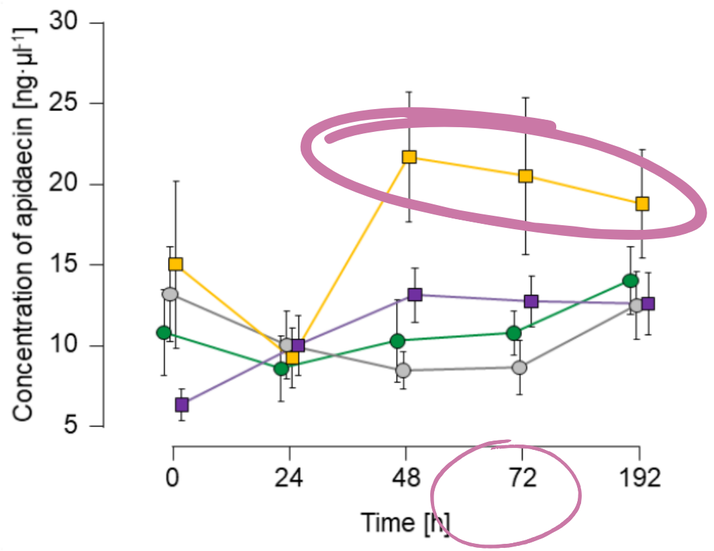
OA-G increased ANTIMICROBIAL ACTIVITY of hemolymph



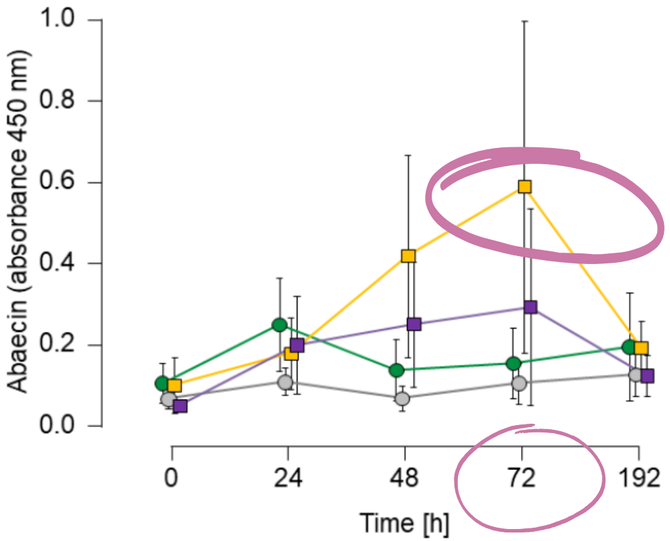
- Increased antimicrobial activity after treatment of the strips with oxalic acid and glycerin.
- The greatest increase occurred 72h after treatment.

OA-G strips increased production of ANTIMICROBIAL PEPTIDES

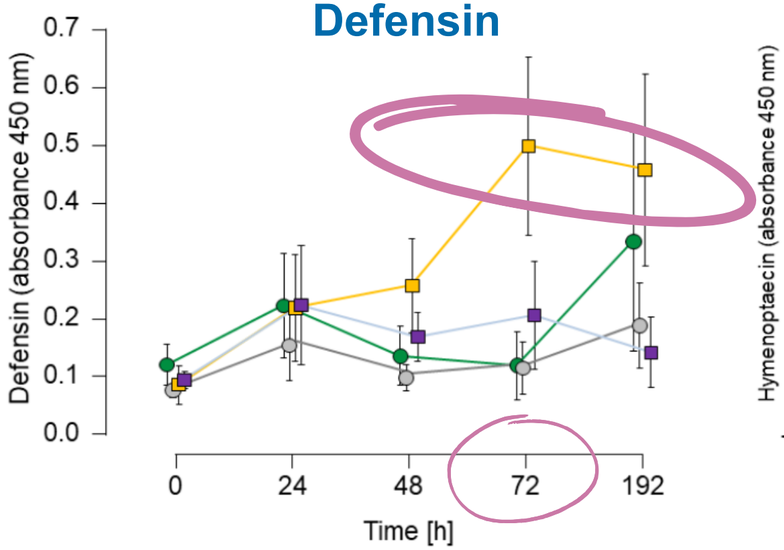
Apidaecin



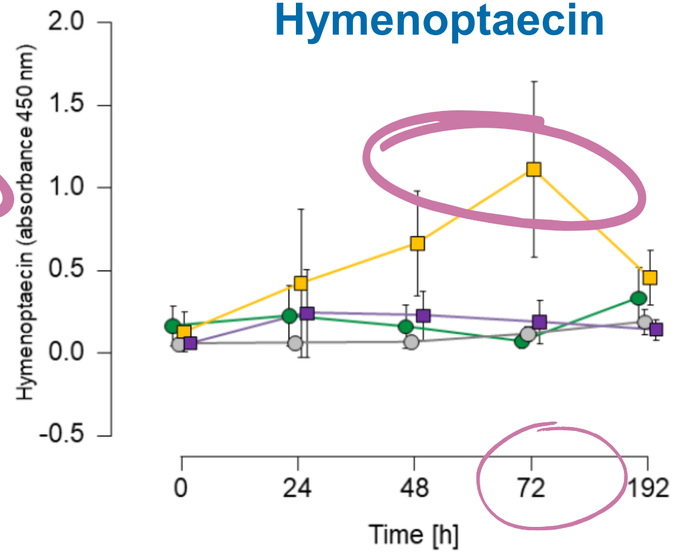
Abaecin

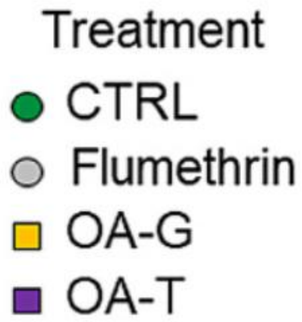


Defensin



Hymenoptaecin

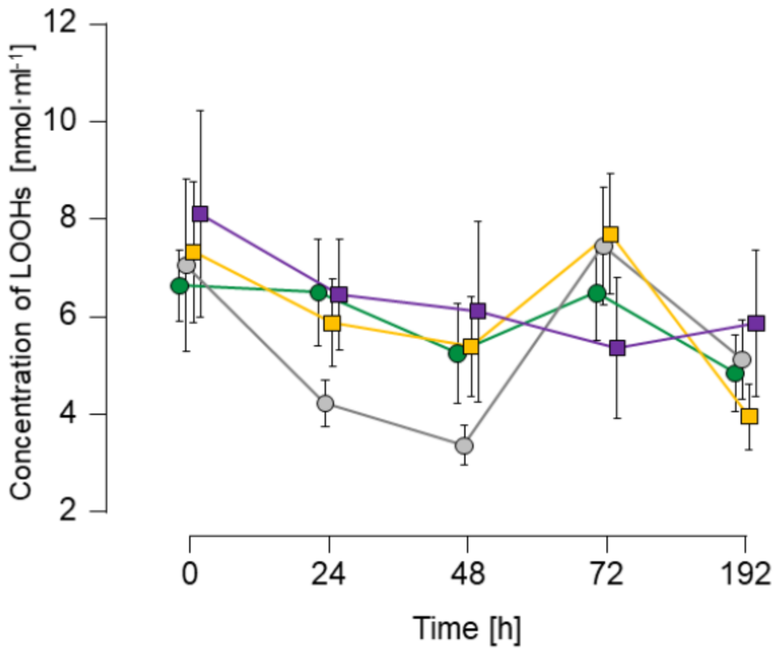




- The AmPs levels increase in the OA-G treated group with the peak level 72h post-treatment
- Control, Flumethrin and OA-T treated groups remained stable at the measured time points up to 192h.

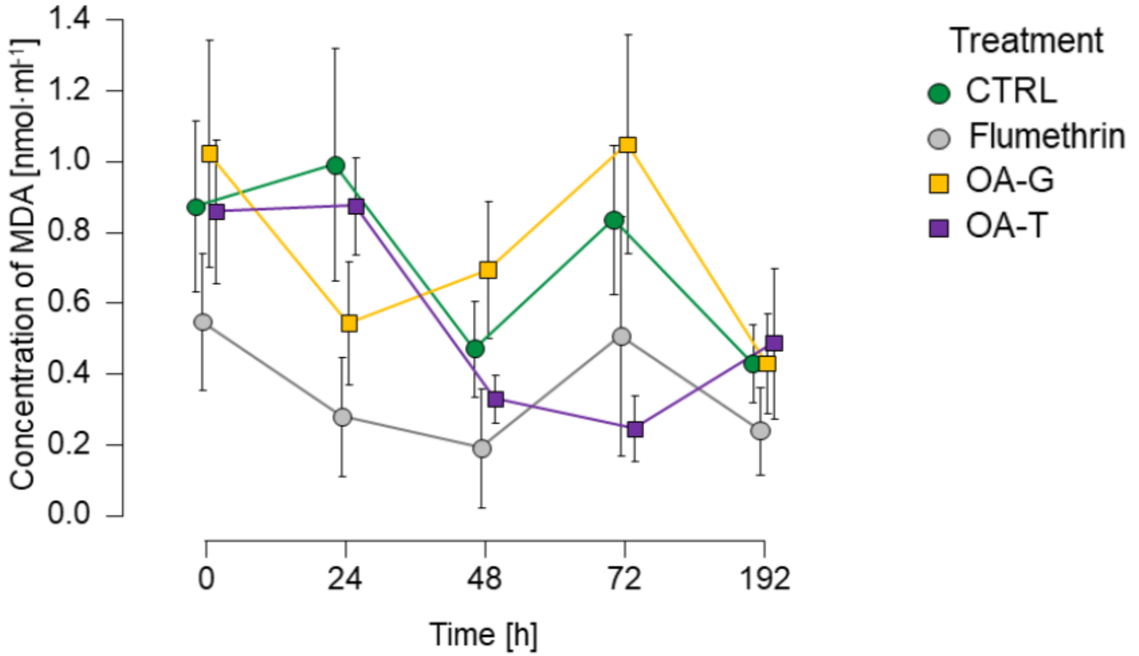
Applied treatment did not stimulate oxidative stress & LIPID DAMAGE

Hydroperoxides



Semiproducts of lipid peroxidation

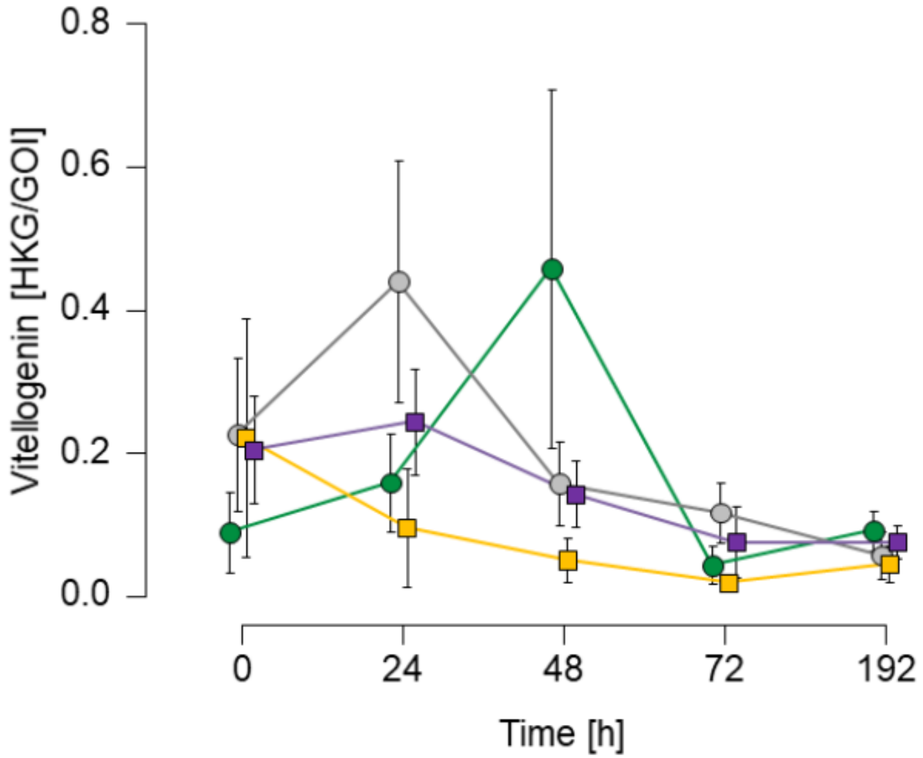
Malondialdehyde



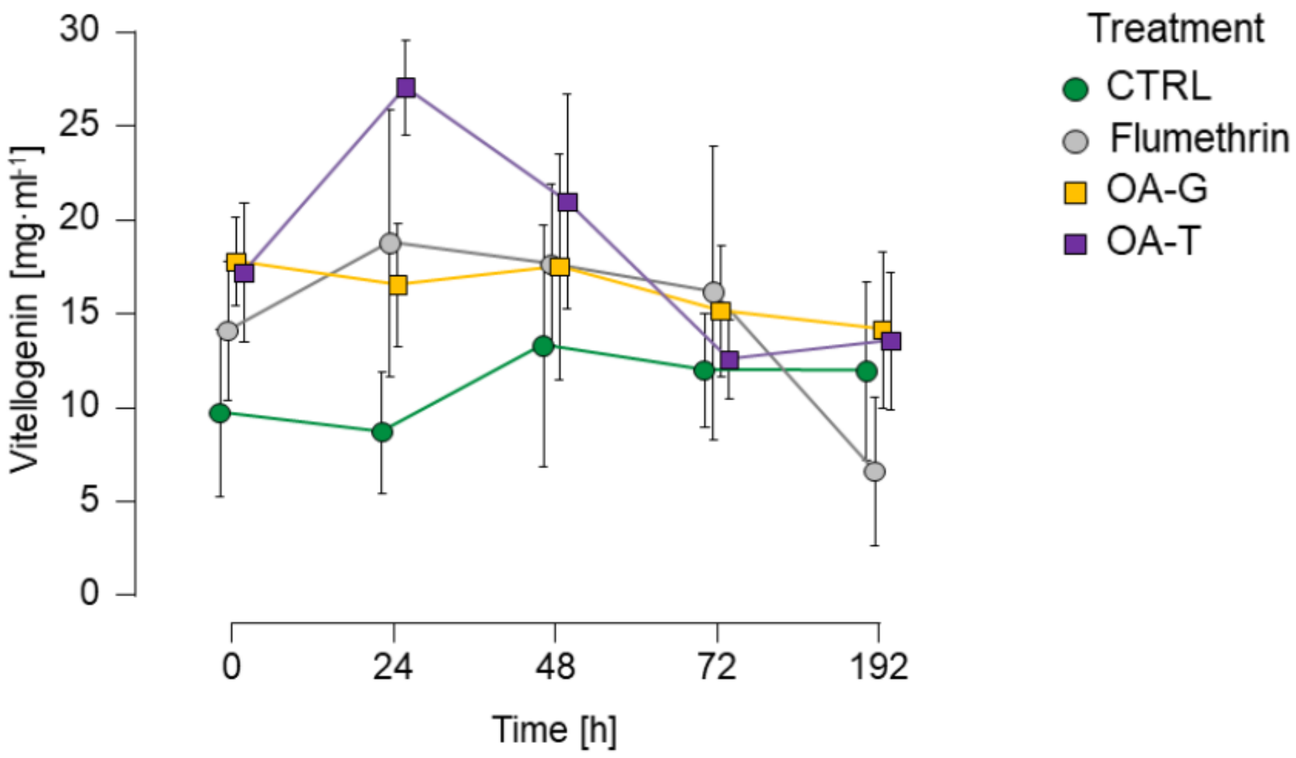
Terminal product of lipid peroxidation

Applied treatment did not influence VITELLOGENIN levels

Gene expression



Concentration in hemolymph



What did we find?

Treatment

01. Only OA-G influenced honey bee organism compared to flumethring and OA-trickling.

Immunity

02. Immune parameters were stimulated only by OA-G
No other effects observed

Impact

03. Is the immune stimulation **good** or **bad** for honey bee organism?

Detailed results were published

Pesticide Biochemistry and Physiology 209 (2025) 106353

Contents lists available at ScienceDirect

Pesticide Biochemistry and Physiology

journal homepage: www.elsevier.com/locate/pest

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doi: 10.1016/j.pestbp.2025.106353

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Thank you

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This research and Apimondia participation is supported by grants: NAZV QL24010241 **&** MŠMT LUAUS24085