Prospective utilization of insect stress hormones in pest control

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INTRODUCTION

Alternative control of insect pests plays an important role in modern pest management and helps to reduce the amount of classical pesticides deployed. Several studies showed that insect endocrine system, especially anti-stress neuropeptides, could be used as a potential target for pest control. Stress energy metabolism in insects is primarily operated by adipokinetic (neuro)hormones (AKHs).

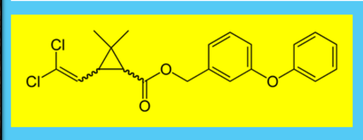
AKH structure: small peptides 8 - 10 amino acids

$pGlu^1\text{-}X^2\text{-}X^3\text{-}X^4\text{-}X^5\text{-}X^6\text{-}X^7\text{-}Trp^8\text{-}Gly^9\text{-}X^{10}\text{-}NH_2$

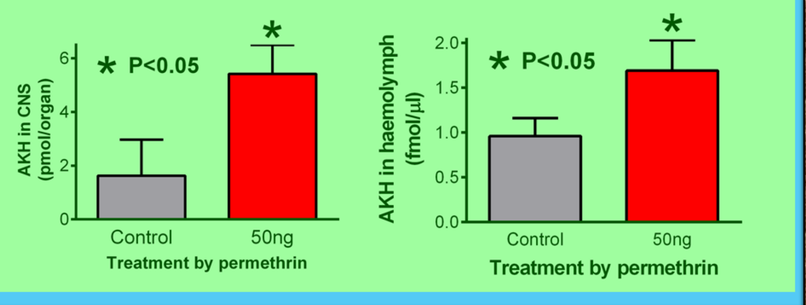
-X^2 - Leu, Val, Ile
-X^3- Asn, Thr
-X^4- Phe, Tyr (aromatic AA)
-X^5- Thr, Ser
-X^6- Pro, Ser, Thr, Ala
-X^7- Asn, Gly, Ser, Asp, Trp
-X^{10}- Thr, Asn, Ser, Tyr

RESULTS

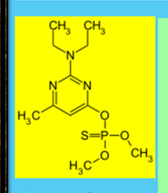
Effect of permethrin (50 ng, LD15) injected into the *P. apterus* body on the level of AKH monitored by specific antibody using competitive ELISA in CNS (left) and haemolymph (right) 24h after the treatment



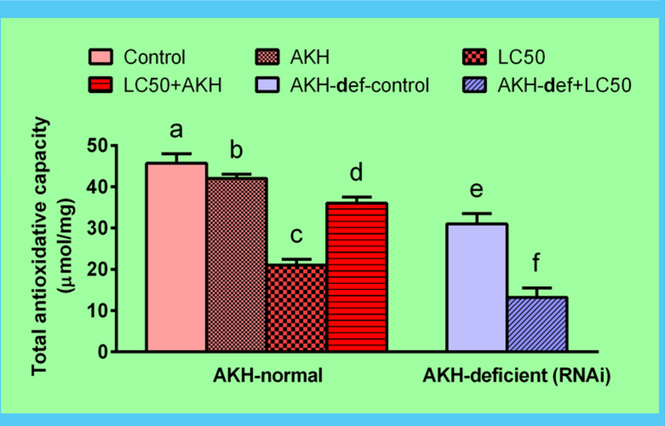
Permethrin



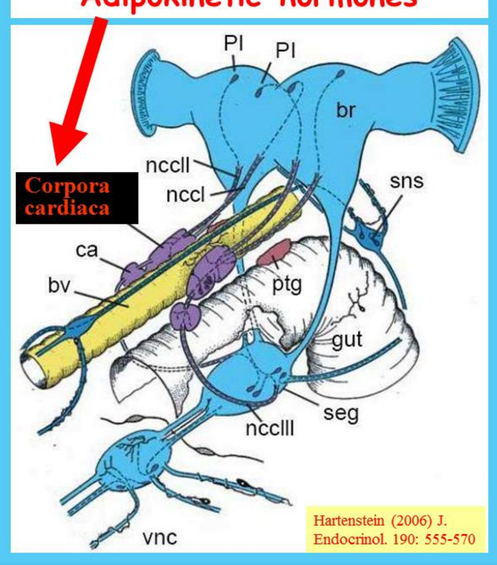
Effect of pirimiphos-methyl (0.53 µg/ml, LC50) applied by residual film method, and AKH (35 pmol/µl) applied by dipping on total anti-oxidative capacity of AKH-normal and AKH-deficient *T. castaneum* beetles 24 h after the insecticide/hormone exposure



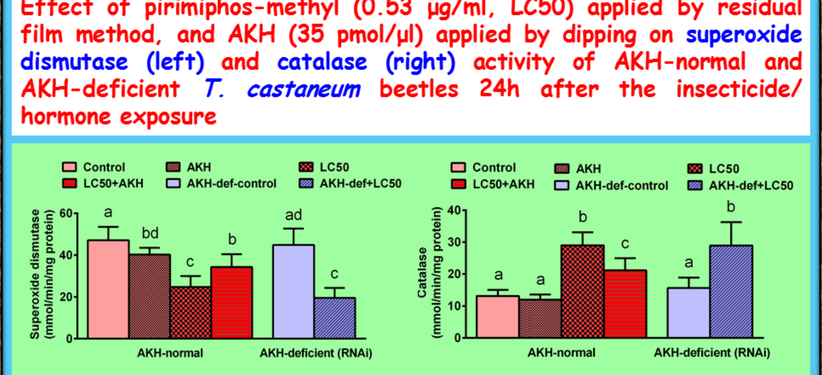
Pirimiphos-methyl



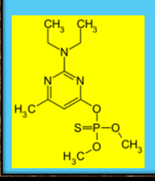
Adipokinetic hormones



Effect of pirimiphos-methyl (0.53 µg/ml, LC50) applied by residual film method, and AKH (35 pmol/µl) applied by dipping on superoxide dismutase (left) and catalase (right) activity of AKH-normal and AKH-deficient *T. castaneum* beetles 24h after the insecticide/ hormone exposure

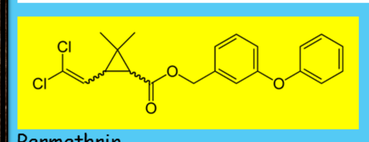


SOD function: $O^{\cdot} \xrightarrow{SOD} H_2O_2$ CAT function: $H_2O_2 \xrightarrow{CAT} H_2O$

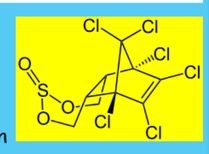


Pirimiphos-methyl

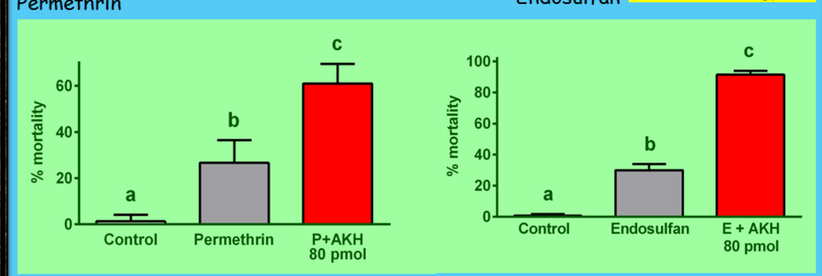
Effect of permethrin (left, 50ng, LD15) and endosulfan (right, 200ng, LD15) injected into the *P. apterus* body on mortality 24h after the treatment

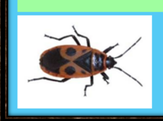


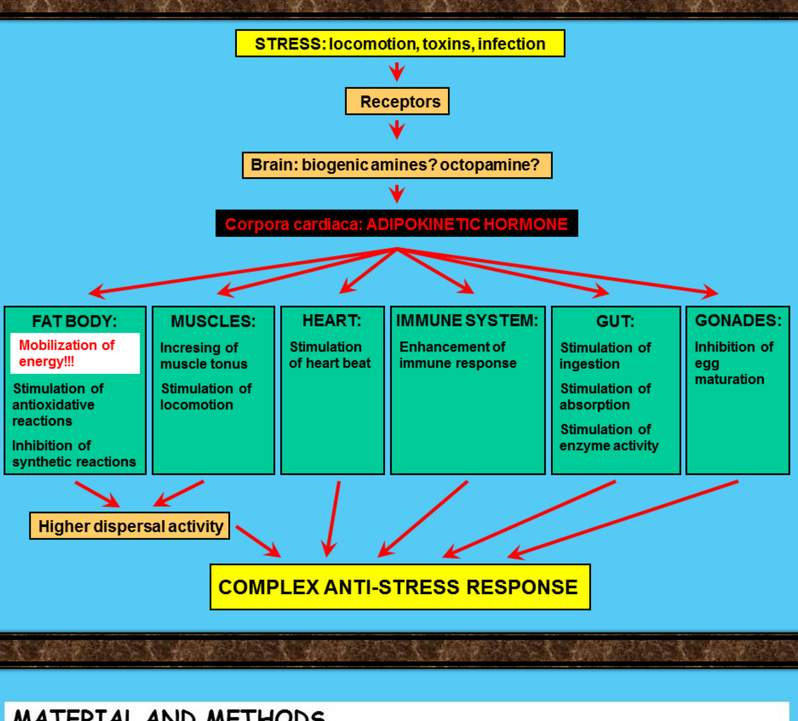
Permethrin



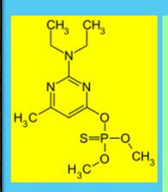
Endosulfan



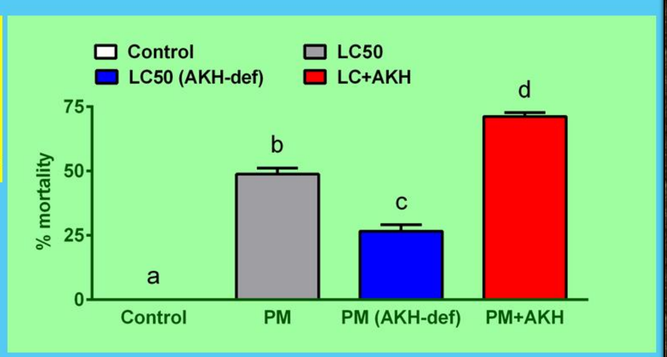




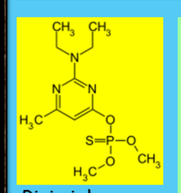
Effect of pirimiphos-methyl (0.53 µl/ml, LC50) applied by residual film method, and AKH (35 pmol/µl) applied by dipping on mortality of *T. castaneum* beetles 24h after the treatment



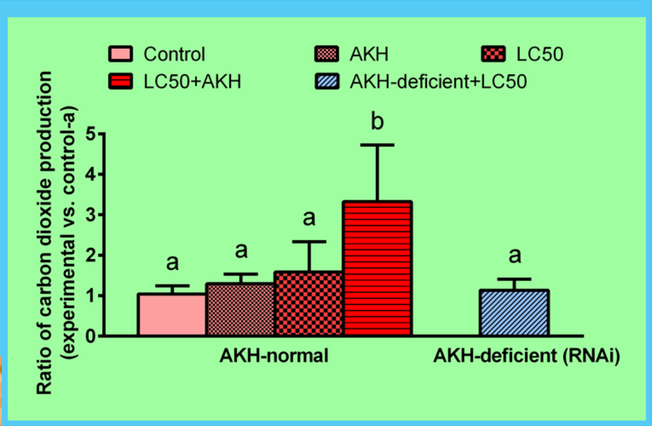
Pirimiphos - methyl



Effect of pirimiphos-methyl (0.53 µl/ml, LC50) applied by residual film method, and AKH (35 pmol/µl) applied by dipping on carbon dioxide production (Li-7000 CO_2/H_2O analyser LI-COR Biosciences) of AKH-normal and AKH-deficient *T. castaneum* beetles 24h after the insecticide/ hormone exposure



Pirimiphos-methyl



MATERIAL AND METHODS

Effect of insecticides on adipokinetic characteristics:
1. Tested insecticides – neurotoxins: permethrin, endosulfan, pirimiphos-methyl
2. Monitored characteristics: effect on AKH level, oxidative stress markers, mortality, total metabolism
3. Model insect species: firebug *Pyrrhocoris apterus* and red flour beetle *Tribolium castaneum* (AKH-normal, AKH-def-RNAi)

SUMMARY AND CONCLUSIONS

1. AKHs play a role in stress elicited by insecticides
2. AKHs modulate anti-oxidative stress response
3. AKHs increase mortality of insects treated with insecticides
4. Elevation of metabolism probably accompanied with faster turnover of toxins, might be responsible for the higher mortality

Acknowledgement

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