Induction patterns of Detoxification Genes against Heavy metal injection in *Tenebrio molitor*

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Abstract

The wheat contaminated by heavy metals not only escalates food insecurity crisis, but also affects the stability of future alternative food. Mealworms (*Tenebrio molitor*) are representative future replacement edible insects that feed on wheat bran. It is necessary to study detoxification mechanism of heavy metals contamination in *T. molitor*. Detoxification is a physiological function that neutralizes and removes toxic substances from living organisms. To investigate the expression patterns of detoxification enzymes, *T. molior* were injected with different concentration (0.5, 5, 50 μM) of cadmium (CdCl2) or zinc (ZnCl2) and the samples were collected at 3, 6, 9, 12, and 24 hours post-chemical injection. We analyzed the expression pattern of five detoxification gene families (gutathinone-S-transferases, peroxidases, catalases, superoxide dismutase and zinc transferase). This study will be supported to understand the *T. molitor* detoxification.

Keywords: Detoxification, heavy metals, *Tenebrio molitor*, induction patterns

Results

1. mRNA expression of glutathione-S-transferases (GSTs) in *Tenebrio molitor*

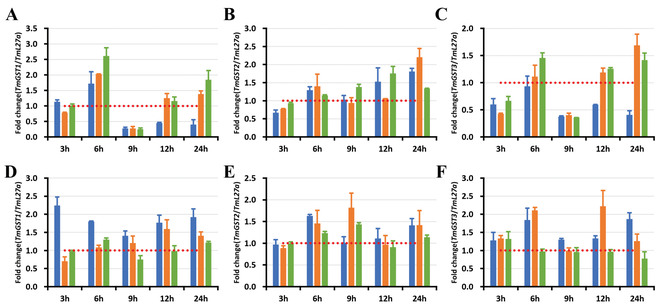

Fig.1 Effect of pesticides on the relative mRNA expression of glutathione-S-transferases (GSTs) in the whole body of *Tenebrio molitor* larvae. At 3, 6, 9, 12, 24 h post-pesticides injection, the expression levels of GSTs-encoding genes, including GST1 (A) and (D), GST2 (B) and (E), GST3 (C) and (F). 1 μL of cadmium (A, B, and C) or zinc (D, E, F) solutions with concentrations of 20 mg/mL, 2 mg/mL, and 0.2 mg/mL were injected into *T. molitor* larvae.

2. mRNA expression of peroxidases (Pxs) in *Tenebrio molitor*

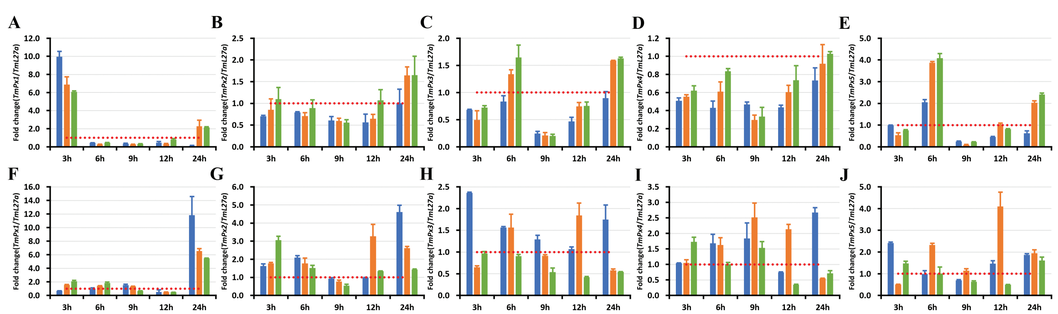

Fig.2 Effect of pesticides on the relative mRNA expression of peroxidases (Pxs) in the whole body of *Tenebrio molitor* larvae. At 3, 6, 9, 12, 24 h post-pesticides injection, the expression levels of Pxs-encoding genes, including Px1 (A) and (F), Px2 (B) and (G), Px3 (C) and (H) Px4 (D) and (I) Px5 (E) and (J). 1 μL of cadmium (A, B, C, D and E) or zinc (F, G, H, I and J) solutions with concentrations of 20 mg/mL, 2 mg/mL, and 0.2 mg/mL were injected into *T. molitor* larvae.

3. mRNA expression of catalases (CATs) in *Tenebrio molitor*

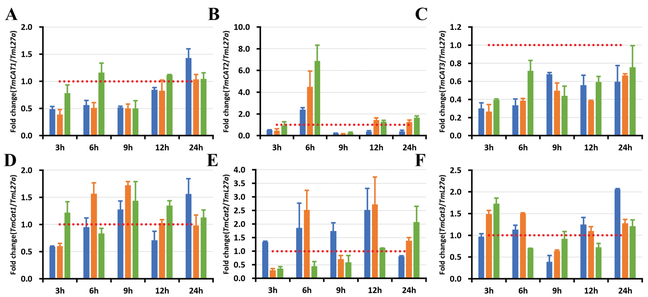

Fig.3 Effect of pesticides on the relative mRNA expression of catalases (CATs) in the whole body of *Tenebrio molitor* larvae. At 3, 6, 9, 12, 24 h post-pesticides injection, the expression levels of CATs-encoding genes, including CAT1 (A) and (D), CAT2 (B) and (E), CAT3 (C) and (F). 1 μL of cadmium (A, B, and C) or zinc (D, E, F) solutions with concentrations of 20 mg/mL, 2 mg/mL, and 0.2 mg/mL were injected into *T. molitor* larva

4. mRNA expression of superoxidases (SODs) in *Tenebrio molitor*

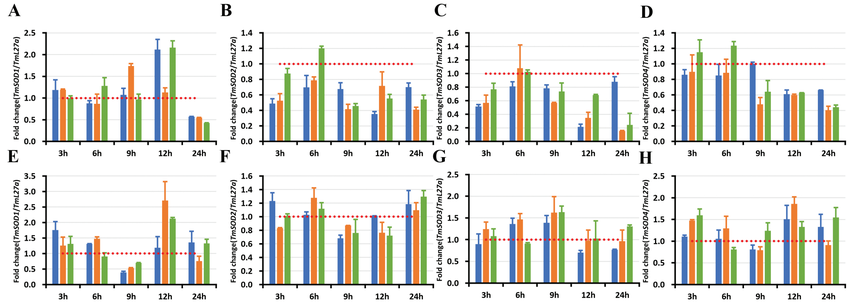

Fig.4 Effect of pesticides on the relative mRNA expression of superoxidases (SODs) in the whole body of *Tenebrio molitor* larvae. At 3, 6, 9, 12, 24 h post-pesticides injection, the expression levels of SODs-encoding genes, including SOD1 (A) and (E), SOD2 (B) and (F), SOD3 (C) and (G), SOD4 (D) and (H). 1 μL of cadmium (A, B, C and D) or zinc (E, F, G and H) solutions with concentrations of 20 mg/mL, 2 mg/mL, and 0.2 mg/mL were injected into *T. molitor* larvae.

Conclusion

This study to report the mRNA expression patterns of detoxificatio n genes in *T. molitor* post injection to different concentration of the heavy metal. *TmGST1, 3*, *TmPx5*, *TmCAT2* mRNA expression sign ificantly increased at 6 h post injection in the 50 μM of cadmium compare with control group. *TmGST1*, and *TmPx3* mRNA expression significantly increased at 3 h post injection in the 0.5 μM of zinc compare with control group. Highest expression of *TmPx1* mRNA showed at 3 h post injection in the 0.5 μM of cadmium and at 24 h post injection in the 0.5 μM of zinc compare with control group. These results suggested putative role of *peroxides1* gene was related to response against heavy metal.