Induction patterns of Detoxification Genes against pesticides injection in *Tenebrio molitor*

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Abstract

The use of agricultural chemicals has increased the quality and productivity of agricultural products. A large amount of agricultural products contaminated with agricultural chemicals are used as feed sources for insect. Because the edible insects containing high protein, unsaturated fatty acids, various minerals, and vitamins, insects were suggested as future alternative food. Therefore, agricultural use of chemical may cause as an insect contaminants. This may pose a risk to human health. The yellow mealworm, *Tenebrio molitor*, is main pest of stored grain, major edible insect, and model organisms for insect innate immunity. To screen the molecular diagnostic markers for pesticide contamination, we identified the genes-related to detoxify toxic substances in *T. molitor*. The induction patterns of detoxification gene were investigated at 3, 6, 9, 12, and 24 hours-post injection of pesticides or herbicides. This study presents basic information on how *T. molitor* detoxifies toxic substances.

Keywords: Detoxification, Pesticide, Herbicide, *Tenebrio molitor*, induction patterns

Results

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

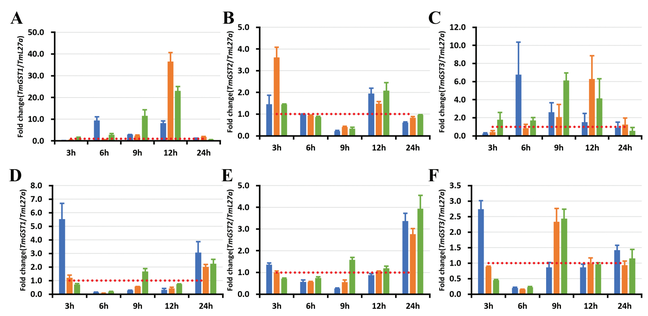

Fig.1 Effect of pesticides on the relative mRNA expression of glutathione-S-transferases (GSTs) in the whole body of *Tenebrio molitor* larvae. At 3, 6, 9, 12, 24 h post-pesticides injection, the expression levels of GSTs-encoding genes, including GST1 (A) and (D), GST2 (B) and (E), GST3 (C) and (F).). 1 μL of chlorantraniliprole (A, B, and C) or butachlor (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*

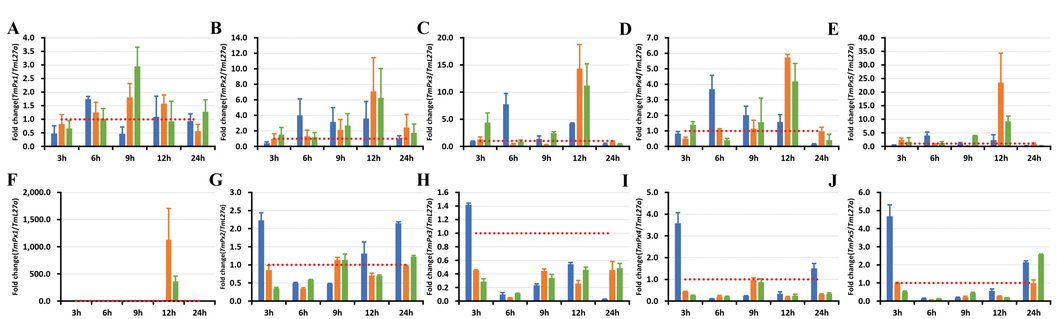

Fig.2 Effect of pesticides on the relative mRNA expression of peroxidases (Pxs) in the whole body of *Tenebrio molitor* larvae. At 3, 6, 9, 12, 24 h post-pesticides injection, the expression levels of Pxs-encoding genes, including Px1 (A) and (F), Px2 (B) and (G), Px3 (C) and (H) Px4 (D) and (I) Px5 (E) and (J). 1 μL of chlorantraniliprole (A, B, C, D and E) or butachlor (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*

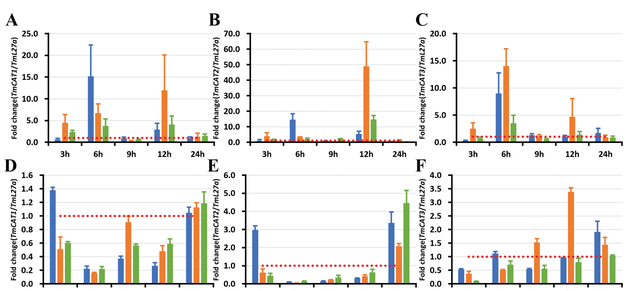

Fig.3 Effect of pesticides on the relative mRNA expression of catalases (CATs) in the whole body of *Tenebrio molitor* larvae. At 3, 6, 9, 12, 24 h post-pesticides injection, the expression levels of CATs-encoding genes, including CAT1 (A) and (D), CAT2 (B) and (E), CAT3 (C) and (F). 1 μL of chlorantraniliprole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

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

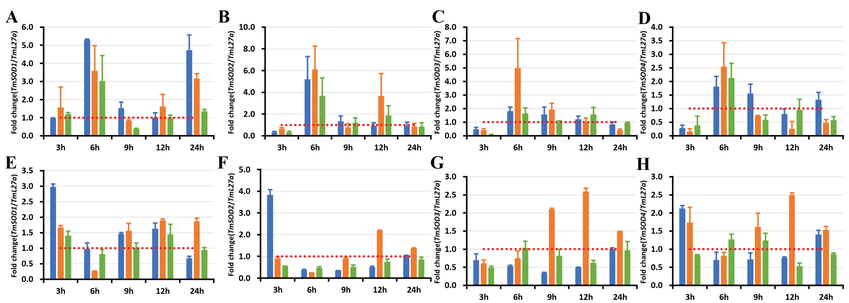

Fig.4 Effect of pesticides on the relative mRNA expression of superoxidases (SODs) in the whole body of *Tenebrio molitor* larvae. At 3, 6, 9, 12, 24 h post-pesticides injection, the expression levels of SODs-encoding genes, including SOD1 (A) and (E), SOD2 (B) and (F), SOD3 (C) and (G), SOD4 (D) and (H). 1 μL of chlorantraniliprole (A, B, C and D) or butachlor (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 detoxi fication genes in *T. molitor* post injection to different concent ration of the pesticide and herbicide. *TmGST1*, *TmPx2*, *3*, *4*, *5*, and *TmCAT2* mRNA expression significantly increased at 12 h post injection in the 2 μg/μL of pesticide compare with control group. *TmGST1*, *2*, *TmPx2*, *3*, *4*, *5*, *SOD1*, and *2* mRNA expression significantly increased at 3 h post injection in the 0.2 μg/μL of herbicide compare with control group. These results suggested putative roles of detoxification genes were related to late response against pesticide and early response against herbicide.