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Characterization of the effects of selected glycoalkaloids from the *Solanaceae* family on the key metabolic processes in the beetle *Tenebrio molitor*

Abstract

Plant protection products are used in huge quantities to reduce pest populations, which contributes to environmental pollution and poses a threat to other organisms. Plant-derived compounds offer an opportunity to reduce the use of pesticides. They are biodegradable, safer to use, easy and inexpensive to obtain. Glycoalkaloids (GA) are secondary plant metabolites that exhibit significant biological activity, also in insect organisms. However, their mechanisms of action have not been precisely studied. The aim of the presented PhD thesis was to determine the effects of selected GA on key metabolic processes in larvae of the beetle *Tenebrio molitor*. For this purpose, a series of experiments were carried out, in which solanine, chaconine, tomatine, and tomato leaf extract were tested at two concentrations, 10^{-8} and 10^{-5} M. The selected compounds were administered to larvae by injection. Tissues were isolated 2 and 24 hours after GA application. Tested samples were prepared separately from the gut, fat body and hemolymph to determine the tissue specificity of the observed effects, because of tropfic function of these tissues. The study began with quantitative analysis of GA over time after their injection. Subsequently, the effects of these compounds on nutrient levels (lipids, carbohydrates and amino acids) in the insect's tissues were determined. In addition, changes in the expression of genes encoding key enzymes of metabolic pathways: glycolysis (phosphofructokinase), Krebs cycle (citrate synthase) and fatty acid β-oxidation (hydroxyacyl-CoA dehydrogenase), as well as major antioxidant proteins (superoxide dismutase, catalase) and heat shock protein HSP70 after GA application were measured. In addition, the effect of GA on lipid peroxidation process and the catalytic activity of the mentioned enzymes was determined. Based on the results, it was found that the mechanisms of action of the tested compounds in mealworm tissues vary depending on the type and concentration of GA, incubation time and the type of tissue tested. These compounds regulate gene expression and activity of proteins involved in key metabolic pathways. Besides, GAs alter the nutrient content of insect tissues, probably as a result of increased energy requirements during detoxification. The tested compounds significantly affect beetle metabolism, suggesting their potential use as natural bioinsecticides.