

THE EFFECT OF THE ALLELOCHEMICAL QUERCETIN ON THE SURVIVAL OF *LYMANTRIA DISPAR* L. Vesna Perić-Mataruga, Jelica Lazarević and Vera Nenadović, *Institute for Biological Research Sinisa Stanković, Department of Insect Physiology and Biochemistry, 11000 Belgrade Yugoslavia.*

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Gypsy moth caterpillars consume locust-tree leaves (*Robinia pseudoacacia*) under special conditions (food shortage) mostly during outbreaks at high population density (Janković 1958). Negative effects of the locust-tree leaf diet on gypsy moth performance and preference were described previously (Perić *et al.* 1994) and could be explained in part by the presence of allelochemicals (alkaloids and flavonoids) (Barbosa and Krišćik 1987). These effects are more pronounced in individuals from the oak forest than in a group originating from the population that had been adapted to locust-tree leaves for over 40 generations which points to an evolution of certain adaptations. The aim of the present study was to investigate the population difference (oak forest and locust-tree forest) in response to a specific allelochemical quercetin in terms of gypsy moth survival. The ubiquitous flavonoid quercetin is an example of prooxidant plant allelochemicals. Upon insect ingestion, quercetin is metaboli-

cally activated by one-electron oxidation to a free radical (*o*-semiquinone) which in turn reacts with O₂ to generate superoxide anion radical O₂^{•-} and consequently, hydrogen peroxide H₂O₂ and hydroxyl radical •OH which result in numerous cell destructive reactions (Hodnick 1986).

The egg masses of *Lymantria dispar* used in this experiment, were collected at two localities: Kotor (oak forest, OF) and Bagremara (locust-tree forest, LF) and kept at 4°C from December to April, when they were set for hatching at a constant temperature of 23°C. The caterpillars from both populations were reared in plastic containers (200 cm³) at room temperature on the standard artificial diet for the gypsy moth (high wheat germ diet, Odell *et al.* 1985) supplemented with 0.01%, 1%, 1.5% and 2% (w/w) quercetin (3,3,4,5,7-pentahydroxyflavone, Sigma Chemical Co., St Louis, Missouri). Caterpillars in control groups were fed diet without quercetin. Each group consisted of 10 individuals.

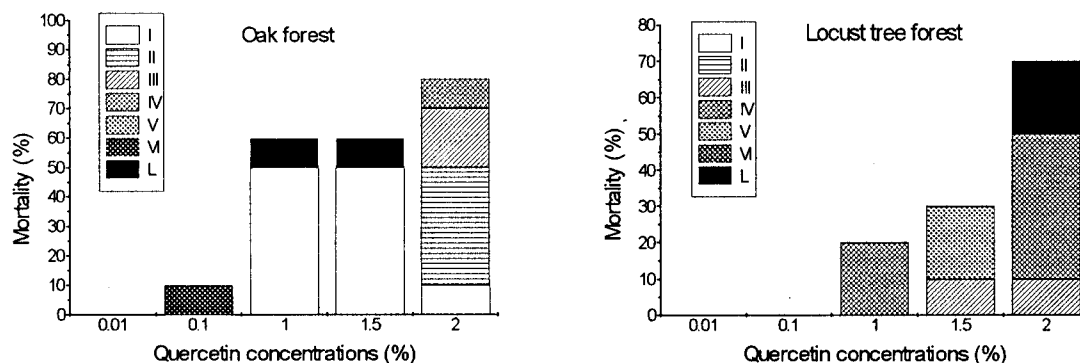


Fig. 1. The mortality of the gypsy moths exposed to various quercetin concentrations depending on population origin (oak and locust - tree forest).

The percentage of mortality was calculated in relation to the initial number of larvae within the groups. Our studies have shown that mortality of larvae and pupae at different concentrations of quercetin depends on the population origin (OF or LF). All caterpillars from both populations survived on diet supplemented with 0.01% quercetin. Caterpillars from the LF began to die at a higher concentration of quercetin (1%) and in later larval instars in comparison with OF caterpillars (0.1%)

(Fig.1). We also demonstrated a high mortality of the 1st instar caterpillars from OF reared on 1% and 1.5% quercetin while none of the LF caterpillars died in the 1st instar (Fig.1). Some flavonoids possess antiherbivore properties and can increase herbivore resistance (Hedin and Waage 1986). Elimination of flavonoids and alkaloids (as well as other allelochemicals) in insects is carried out by the microsomal detoxification system and glutathione-S-transferase (GST) (Yu 1982).

Superoxide dismutase (SOD) is one of the most important components of the antioxidative defence against prooxidant effects of quercetin (Pritsos *et al.* 1988). Inhibition of SOD in *Papilio polyxenes* and *Spodoptera eridania* dramatically increased quercetin-induced toxicity as measured by relative growth (RGR) and consumption rates (RCR) in these species (Pritsos *et al.* 1991).

Susceptibility of some Lepidopteran species to prooxidative effects of quercetin depends on their adaptations (including antioxidative status) to food containing flavonoids (Pritsos *et al.* 1988). *P. polyxenes* fed as much as 20% (w/w) of quercetin over 12^h showed no signs of toxicity. Quercetin up to 1.0% (w/w) dietary concentration caused no mortality and expressed no effect on RCRs and RGRs of the *S. eridania* while *Trichoplusia ni* was more susceptible to quercetin with an LC₅₀ of 0.0045% (w/w) (Ahmad and Pardini 1990). Our studies revealed differences in susceptibility to quercetin between populations within a species - the gypsy moth. Gypsy moth caterpillars from LF have been shown previously to have a higher constitutive activity of the SOD and GST in the midgut tissue in comparison with individuals from the OF (Perić-Mataruga *et al.* 1997). This explains a potential of the gypsy moth population from the LF to survive at higher quercetin concentrations (0.1%, 1% and 1.5%) in the artificial diet. Our previous results revealed that the first larval instar caterpillars from OF have higher susceptibility to locust-tree leaves than LF caterpillars (Perić *et al.* 1988) which is in agreement with the present results showing higher susceptibility of 1st instar OF caterpillars to a specific flavonoid quercetin (Fig.1.). It is interesting that microsomal oxidases and glutathione -S-transferase in young

lepidopteran larvae were less inducible than in older larvae (Yu 1982; Yu 1993). Trophic adaptations of the population from LF probably include mechanisms of tolerance to flavonoids in locust-tree leaves. We propose that adaptations at the level of detoxification and antioxidative defence enzymes represent the main mechanism of adaptation to unfavourable host plants.

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