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## Anthelmintic activity of *Rosmarinus officinalis* against *Dactylogyrus minutus* (Monogenea) infections in *Cyprinus carpio*

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### Abstract

Monogenean parasites are important ectoparasites of fish, and are responsible for severe economic impacts in the aquaculture industry. They are usually treated with chemicals, but the chemicals can have harmful side effects in the fish and may pose threats to human health. Rosemary (*Rosmarinus officinalis*) is a common medicinal herb, with antimicrobial and antitumor properties. Here, we examined the anthelmintic activity of rosemary extract against the monogenean (*Dactylogyrus minutus*) in vitro and in vivo using bath treatment and oral administration. The in vitro experiments showed that parasite survival was affected by both rosemary extract concentration and the solvent (water and ethanol). Parasites were dead at  $61.8 \pm 5.6$  and  $7.8 \pm 1.4$  min when exposed to 100 and 200g aqueous rosemary extract solution/L of water respectively. It took  $166.7 \pm 48.2$  and  $5.4 \pm 1.01$  min to kill the parasites when exposed to 1 and 32g ethanol rosemary extract solution/L of water respectively. Moreover, pure component of rosemary extract obtained commercially used in in vitro experiments showed that 1,8-Cineole was the most toxic component of the main components tested. Parasite intensity and prevalence in fish exposed to 50 and 100g aqueous rosemary solution/L water for 30min were significantly lower than they were in controls ( $p < 0.05$ ). In oral treatment experiments, diets of *Cyprinus carpio* were supplemented with eight different concentrations of aqueous rosemary extract. The intensity of parasites was significantly less in fish fed for 30days with feed containing 60, 80 and 100ml aqueous extract/100g feed than in control ( $p < 0.05$ ). Together these results indicate that rosemary is a promising candidate for prevention and control of monogenean infection.

**Keywords:** Aquaculture; *Dactylogyrus minutus*; Disease management; Monogenea; Natural treatments; *Rosmarinus officinalis*.

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