Beneficial organisms react differently to parasite drug

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The substance ivermectin has been used for more than thirty years all over the world to combat parasites like roundworms, lice and mites in humans, livestock and pets. The active ingredient belongs to the chemical group of avermectins, which generally disrupt cell transport and thus attack pests. When ivermectin is excreted in the faeces of treated animals, at overly high doses it also harms dung-degrading beneficial insects like dung beetles and dung flies. This impairs the functioning of the ecosystem. In extreme cases the dung is not decomposed and the pasture is destroyed.

Sensitivity to ivermectin varies considerably

Since 2000 public regulators in many countries therefore mandate standardised safety tests for the use of avermectin derivatives. An international research team headed up by Wolf Blanckenhorn, an evolutionary biologist at the University of Zurich, has now shown that the safety tests used today are not able to sufficiently prevent environmental damage. Even closely related dung organisms react with varying degrees of sensitivity to the same veterinary pharmaceutical.

Blanckenhorn and his colleagues examined 23 species of sepsid flies that typically live in cow dung. "The individual species vary by a factor of 500 in their sensitivity to ivermectin", comments the evolutionary biologist. The standardised safety tests typically performed in toxicology in the laboratory today are based on single, arbitrarily selected dung

organisms. "There is a considerable risk that the more sensitive species will continue to be harmed by ivermectin and that important ecosystem functions will suffer long-term damage as a consequence", says Blanckenhorn. To prevent this, safety tests should be extended at least to include a representative selection of all dung-degrading organisms, if not the entire community. "Clearly, these tests would massively increase the costs of the authorisation process for new drugs, and investigators would have to possess specialised biological expertise", comments the biologist. For that reason a field test should be developed based on a genetic method of species identification, so-called DNA barcoding.

Evolutionary findings

With their study the authors further confirmed that in the course of evolution, as a consequence of pre-existing genetic modifications, first the sensitivity of moulting animals and later the non-sensitivity of particular species groups to avermectins has developed, long before any contact with the drug. Hence, their work also validates the still disputed molecular genetic classification of roundworms (nematodes) and arthropods as moulting animals, as only they are sensitive to avermectins.

The drug Ivermectin

Ivermectin was discovered in Japan in the late 1970s. Since then it has improved the quality of life of millions of people particularly in the tropics: ocular onchocerciasis, scabies and threadworms in the intestines can be successfully treated thanks to Ivermectin. Ivermectin is likewise used in animal husbandry across the globe.

More information: N. Puniamoorthy, M. A. Schäfer, J. Römbke, R. Meier, and W. U. Blanckenhorn. "Ivermectin sensitivity is an ancient trait affecting all ecdysozoa but shows phylogenetic clustering among

sepsid flies." *Evolutionary Applications*, April 14, 2014. DOI: 10.1111/eva.12152

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