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haplotypes were shared between Western Canadian and USA for all three parasite species, suggesting common origins of resistance in these two countries. Given the higher drug treatment selection pressure and more advanced stage of resistance in the USA, we propose the hypothesis that benzimidazole resistance has been originally imported into Canada from the USA related to the high-level animal movement. This supports the wider hypothesis that anthelmintic resistance typically emerges from a relatively small number of origins in a contiguous geographical region and emphasizes the importance of biosecurity in mitigation and control. We also show first steps into application of DNA sequencing for the diagnostic of anthelmintic resistance in the routine diagnostics.

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Combined anthelmintic treatments to control resistant nematodes in cattle: pharmacokinetic and field efficacy evaluations

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In an attempt to minimize therapeutic failures following anthelmintic treatments, the combined use of nematodicidal compounds with different mechanisms of action has been proposed. A pharmaco-parasitological assessment of different nematodicidal combinations was performed on two commercial cattle farms in Argentina(A and B). Two different nematodicidal combinations of a macrocyclic lactone(ML) and a benzimidazole(BZD) anthelmintics were evaluated in a multi-resistant field scenario. Ivermectin(IVM)+ricobendazole(RBZ) both given subcutaneously and abamectin(ABA)+oxfendazole(OXF) both given orally were assessed in calves naturally infected with gastrointestinal nematodes resistant to both chemical families. The observed pharmacokinetic(PK) data demonstrated that the co-administration of two anthelmintics did not modify the plasma PK disposition of either drug in cattle. In fact, no adverse PK interactions were observed after each combined treatment, with no differences in PK parameters($P>0.05$) observed between the single-drug and the combined-based strategies. While the observed initial efficacies were 40%(IVM), 64%(RBZ) and 90%(IVM+RBZ)(Farm A), the egg reductions were 54%(IVM), 84%(RBZ) and 98%(IVM-RBZ)(Farm B). After repeated annual(over 5 years) use of the same combination on both farms, the efficacy of the combined treatment decreased to 83% on Farm A. In contrast, the efficacy of the combination IVM-RBZ remained at 93% efficacy in Farm B .To optimize drug activity against those highly bi-resistant nematode population, oral combined treatments were assayed. Efficacies of ABA alone, OXF alone and the co-administration ABA+OXF were 62%, 88% and 99%, respectively(Farm A) and, 92%, 95% and 98%, respectively(Farm B).The *Haemonchus* spp. were resistant to ABA, the *Ostertagia* spp. were resistant to OXF and both anthelmintics failed to control the *Cooperia* spp.However, the combination ABA+OXF was the only treatment that achieved 99-100% efficacy against all genera, indicating the presence of an additive effect. Overall, anthelmintic combinations can be useful to optimize the control of resistant gastrointestinal nematodes of cattle.However, its rational use should be strongly supported by pre-treatment diagnosis and considering the epidemiological situation of each individual farm.