IVERMECTIN RESISTANCE CONFIRMED IN *OESOPHAGOSTOMUM* SPECIES WORMS IN PIGS

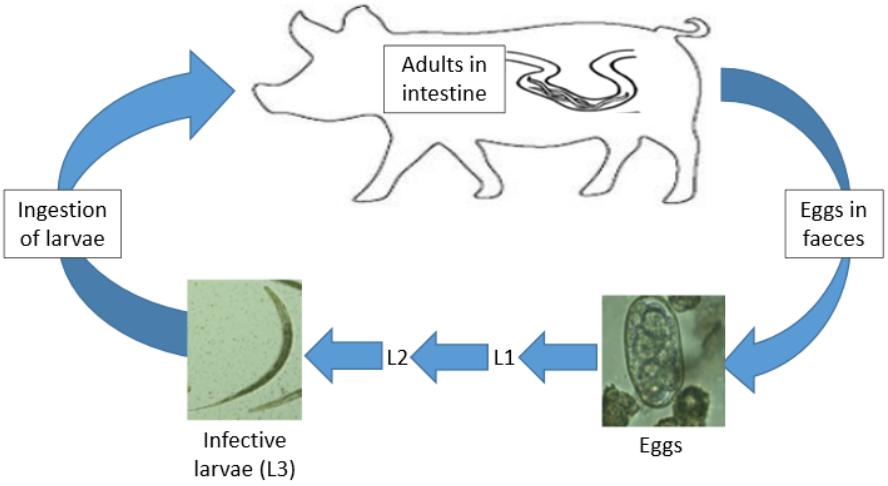
SUMMARY

Resistance to ivermectin was confirmed in the roundworm *Oesophagostomum dentatum* obtained from a pig farm in England. An initial investigation into a suspected case of reduced ivermectin efficacy was undertaken by the veterinary practitioner involved together with the Animal and Plant Health Agency (APHA). The results from the initial on-farm study led to a controlled efficacy trial being undertaken at the Moredun Research Institute in collaboration with APHA and AHDB Pork using worms from the farm on which the initial investigation took place. This trial confirmed the finding of the first reported case of resistance to ivermectin in adult *O. dentatum* worms in the UK. Factors that might have played a role in ivermectin resistance development include long-term use of ivermectin for parasite control in pigs on the farm and continued use of outdoor paddocks without land rotation for decades. Fortunately, FECR testing suggest that benzimidazole treatment remains effective. Wider testing is recommended to determine whether this detection is an isolated incident or is of wider significance.

OESOPHAGOSTUM DENTATUM

Oesophagostum dentatum represents one of the most common intestinal nematodes infecting pigs in the UK. The roundworm has a direct lifecycle (Figure 1). Animals become infected by eating infective larvae (L3) with pasture (Figure 2), three to seven weeks post infection larvae develop in to sexually mature adult worms that reside in the large intestine of pigs. Female worms lay eggs which are passed in faeces. After a week or so (depending mainly on temperature), infective larvae have developed from the eggs and infect pigs by being ingested from the ground to continue the cycle. In addition to worms utilising nutrients, the ingested (L3) larvae penetrate the wall of the intestine and cause some damage to the mucosa of the cecum and colon, however, the clinical significance of *O. dentatum* is uncertain. Immunity develops poorly; worm burdens may accumulate in older sows and production losses have been reported (RUMA, 2010). The worm eggs have an appearance similar to other Strongyle-type eggs in the faeces, as illustrated below in Figure 2.

Figure 1: Illustration of the direct lifecycle of *Oesophagostomum* species worms:



Infective (L3) larvae ingested by pigs penetrate the mucosa of the caecum and colon, moult to L4 larvae and return to the intestinal lumen as adults (A) in 6-20 days. Eggs laid by female worms can develop on the ground into infective (L3) larvae in a week – this is largely temperature dependent.

Figure 2: Strongyle eggs (2a) identified as *Oesophagostomum* sp*.* likely *O. dendatum* by larval differentiation (2b). Images kindly provided by Claire Corfield, APHA Shrewsbury

FAECAL EGG REDUCTION TEST (FECRT)

Faecal egg count reduction (FECR) testing is a well-recognised preliminary test to assess suspected reduced anthelmintic efficacy. It has been used widely in sheep flocks in which anthelmintic resistance in parasitic intestinal worms is an increasing issue. FECR involves collecting faeces for worm egg counts just prior to treatment and again at a specified time interval after treatment (according to which anthelmintic is involved, 14 days for ivermectin), sampling the same sows on each occasion. In this investigation, the farmer and vet collected samples. The egg counts carried out at APHA prior to treatment were found to be high and larval differentiation identified the worms as likely *Oesophagostomum* sp*.* likely *O.dentatum*. After treatment, the mean reduction in egg counts was only 52% which is much less than the 95% reduction expected. These FECR results supported significantly reduced ivermectin efficacy. As there is no laboratory marker for ivermectin (a macrocyclic lactone) resistance, confirmation of this depended on performing *in vivo* infections with worms from the farm in a controlled efficacy trial.

CONTROLLED EFFICACY TRIAL

This trial was undertaken at the Moredun Research Institute where researchers have expertise in this work with funding from AHDB Pork and APHA. Pigs which were free of parasites were given 5000 infective larvae orally on days 0 and day 40. On day 44, half the pigs were treated with ivermectin (treated group) and the other half were left untreated (control group). On day 50, total worm burdens (adult and larval) were assessed in the stomach, small and large intestines of all the pigs in both groups and compared. Reductions in worm egg counts were also compared. This protocol is based on internationally recognised recommendations. Faecal worm egg counts were monitored throughout the trial from day 15 post infection and worm eggs were detected in the faeces of all the pigs by day 22 post infection. Based on the fact that lower than 95% mean reductions in both worm burdens and worm egg counts occurred in the treated group after receiving ivermectin, compared to the control group, ivermectin resistance was confirmed in adult *Oesophagostomum dentatum* worms*.* There was also (likely temporary) suppression of egg development and egg laying in female worms in treated pigs.

CONCLUSION

Resistance to ivermectin was confirmed in *Oesophagostomum dentatum* worms derived from a UK pig farm based on the results of a faecal egg count reduction test and a controlled efficacy trial. Development of resistance is of concern especially as in the UK as only two classes of anthelminthic products are available for use against *Oesophagostomum spp*: avermectins (ivermectin) and benzimidazoles (flubendazole and fenbendazole). Wider testing based on worm egg counts for worm prevalence and faecal egg count reduction testing for nematode anthelmintic resistance in pigs is recommended to determine which worms are prevalent on pig farms in England and to see whether this detection is an isolated incident or of wider significance.