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Short communication

Taeniid and other parasite ova in the faeces of working sheepdogs in south-west England

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Abstract

A study was conducted on 22 sheep farms in southwest England to assess parasite occurrence, farmer reports of meat inspection feedback, and management practices in relation to ovine cysticercosis control. Faecal worm egg counts were conducted using the FLOTAC technique (analytical sensitivity: 1 egg per gram). In addition, a short quantitative interview with participating farmers was conducted to collect background information on dog deworming treatments and meat inspection data. Most (82%) producers reported deworming working dogs every three months, some twice yearly (18%), and none more often than every three months. All but one producer used an oral praziquantel-based dog deworming product. No farms reported feeding raw sheep offal to their dogs. Public footpaths crossed grazing pastures on all farms and local hunts reportedly had right of access to farmland on 16/22 properties. Taeniid eggs were found in the faeces of four farm dogs (8% of dogs sampled) on two farms; other parasite ova were noted but their identity could not be confirmed. Findings suggest that there is a need for greater veterinary engagement in ovine cysticercosis control, including stronger advice on frequency of farm dog cestocide protocols.

Keywords: sheep; cysticercosis; dog; tapeworm treatment; meat inspection feedback, *Taenia ovis, Spirocerca lupi*.

Several taeniid cestode (tapeworm) parasites of dogs cause cysts in sheep, which act as intermediate hosts. Cysts of *Taenia hydatigena* and *T. ovis* infections are usually clinically silent (Gascoigne and Crilly, 2015), and unlike *Echinococcus granulosus*, do not pose public health risks. Infected sheep carcases and offal, however, are condemned and discarded due to their poor cosmetic appearance (Dewolf et al., 2012), leading to economic losses. High levels of cysticercosis were previously reported in south-west England (Green et al., 1995), with one outbreak leading to condemnation of 7% of carcases (Eichenberger et al., 2011). This study aimed to investigate the occurrence of taeniid ova in the faeces of dogs on sheep farms in south-west England. Twenty-four commercial farms participating in preventive veterinary flock health planning (FHP) were invited to submit faecal samples from working and pet dogs on the holding; non-responders were visited and fresh faeces collected from the kennel floor. Sampled dogs had not received anti-tapeworm treatment for four weeks prior to sampling. Faeces were examined using the FLOTAC method (analytical sensitivity = 1 egg per gram) (Lima et al., 2015) and the occurrence of taeniid and other parasite ova noted. Face-to-face producer interviews captured data on feeding and deworming of dogs, public footpath access, and meat inspection feedback. Taeniid ova were detected in four dogs (8% of those sampled) from two farms (Table 1). Since adult tapeworms are long-lived and fecund, each infected dog can provide a persistent source of eggs (Gregory, 1978). It is possible that some taeniid ova found here were *T. pisiformis* or *T. serialis* from scavenging on wildlife rather than *T. ovis* or *T. hydatigena* from sheep carcases (Jenkins et al., 2014), or *Echinococcus* spp., whose ova closely resemble those of *Taenia* spp. Additional specific identification using molecular methods (Bustos et al., 2012) would be useful in future studies.

A risk factor for *Taenia* (=*Cysticercus*) *ovis* condemnations is scavenging on sheep carcases by farm dogs (Dewolf et al., 2012). Control measures include deworming of dogs, prompt and secure disposal of dead stock, and preventing dogs from feeding on raw sheep offal (Dewolf et al., 2012 and 2014).

Of the 22 farms with dogs, 21 reported deworming with a praziquantel-based product; 18 dewormed dogs every three months and four twice yearly (n=4, 18%). One farm, with frequent *C. tenuicollis* condemnations and diagnosed cases of *Coenurus cerebralis* ('Gid'), wormed farm dogs with nitroscanate every two months. Nitroscanate is reportedly 98% effective against *T. hydatigena, T. ovis and T. pisiformis* but has limited activity against *E. granulosus* and immature stages of *Toxocara canis* (Boray et al., 1979). All farms dewormed dogs at an interval longer than the pre-patent periods for *T. ovis* (6-9 weeks, Heath and Lawrence 1980) and *T. hydatigena* (57 to 71 days, Deplazes et al., 1990), indicating incomplete prevention of egg shedding (Dewolf et al., 2013). Deworming of dogs may paradoxically increase cysticercosis: in New Zealand, dog treatment effectively reduced *E. granulosus* incidence but might have increased prevalence of *T. ovis* larvae due to elimination of *T. hydatigena* and decreased reciprocal immunity between these *Taenia* species (Gemmell et al., 1986; Roberts et al., 1987).

No dogs in this study were reportedly fed raw meat or offal but opportunities for scavenging of collected fallen stock were observed. Wild canids might also be implicated as maintenance hosts: in Italy, 6% of sampled red foxes were shedding *T. multiceps* eggs (Varcasia et al., 2015), and 1% of red foxes in Australia tested positive for *T. ovis* eggs (Jenkins et al., 2014).

Most (19/22) farms sold slaughter lambs direct to the abattoir. Of these, over 80% recalled at least one *C. tenuicollis* condemnation and four had whole carcase condemnations associated with *C. ovis* in the past two years. Public footpaths crossed grazing pastures on all farms, and awareness campaigns should target all land users, including dog walkers and local hunts (Eichenberger et al., 2011). Hunt dogs had access to land on 73% of the farms in this study. Awareness should also be increased among those communicating food chain information to producers. One farm received written advice to give general anthelmintic treatment to sheep following registrations of *C. tenuicollis* in slaughter lamb

livers. This would be an incorrect and ineffective treatment, contrary to recommendations aimed at slowing anthelmintic resistance (Abbott et al., 2012).

Taeniid eggs may survive on pasture and in soil. Manure and water sources contaminated with infected dog faeces could act as sources of infection, while wind and wildlife can disperse eggs over long distances (Torgerson et al., 1995). There is no passive transfer of immunity to *C. ovis* (Sutton, 1979) and rapid cyst development in non-immune lambs can lead to sporadic flock 'storms' (Roberts et al., 1987; Johnson et al., 1989; Gemmell et al., 1986; Eichenberger et al., 2011). Whilst experimental antigen vaccination against *T. ovis* is protective (Johnson et al., 1989), commercial vaccines are not currently available (DeWolf et al., 2012).

Various different nematode ova were identified in the faecal samples, although the possibility of coprophagia confounds specific identification (Table 1). The finding of spiruroid nematode eggs in samples from three dogs is notable, given the pathogenicity of the canine parasite *Spirocerca lupi*. This species has been widely reported from Europe (Kurz et al., 2013; Giannelli et al., 2014; Al-Sabi et al., 2014; Otranto et al., 2015), including putatively the UK (Wright et al., 2016). Transmission is via a dung beetle intermediate host and clinical consequences include oesophageal neoplasia (Fox et al., 1988). Further studies would be needed to determine whether it is truly present in the UK, or whether this is a spurious finding.

To reduce losses from cysticercosis, there is a need for greater veterinary engagement on sheep farms, to interpret meat inspection feedback and inform active and dynamic FHP, including advice on dog deworming regimens, avoidance of pasture contamination with taeniid eggs, and reduced access of dogs to meat and offal from sheep.

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Table 1: Taeniid and other parasite ova identified from farm dog faecal samples. Taeniid eggs are most likely those of *Taenia* species, but *Echinococcus* spp. cannot be excluded. Strongyle-type eggs included hookworms and *Strongyloides* spp., but ova of canine parasites, including spiruroids, could not be distinguished from those of other hosts ingested through coprophagia or scavenging. Of 24 farms in the study, two reported having no dogs and three were not sampled.

Farm ID	Sampling period	Dog ID	Approximate age	Breed	Taeniid eggs (EPG)	Nematode eggs (EPG); strongyle-type unless stated
1	May-13	1	unknown	Border Collie	0	0
		2	unknown	Springer spaniel	0	0
2	May-13	3	unknown	Border Collie	0	0
		4	unknown	Border Collie	0	0
3	May-13	5	unknown	Border Collie	328	74
		6	unknown	Border Collie	344	204 + 6 spiruroid
		7	unknown	Springer spaniel	2	0
4	May-13	8	8 years	Border Collie	2	0
		9	5 years	Border Collie	0	282
5	May-13	10	unknown	Border Collie	0	0
		11	unknown	Border Collie	0	0
6	Jun-13	12	unknown	Border Collie	0	0
		13	unknown	Border Collie	0	0
		14	unknown	Border Collie	0	0
		15	unknown	Border Collie	0	0
7	Jun-13	16	unknown	Border Collie	0	0
		17	unknown	Border Collie	0	234
8	Sep-13	18	11 years	Labrador	0	0
		19	11 years	Border Collie	0	28 + 2 spiruroid
		20	11 years	Labrador	0	15+ 8 spiruroid
		21	8 years	Labrador	0	0
9	Dec-12	22	15 years	Border Collie	0	0
		23	7 years	Border Collie	0	0
10	May-13	24	9 months	Border Collie	0	0
		25	7 years	Border Collie	0	0
11	May-13	26	1 year	Border Collie	0	75 *Toxocara* sp.
		27	9 years	Border Collie	0	0
		28	4 years	Labrador	0	5
12	Dec-12	29	6 month	Border Collie	0	5 +.25 *Toxocara* sp.
		30	2 years	Huntaway	0	0
13	Aug-13	31	8 years	Border Collie	0	0
		32	7 years	Border Collie	0	0
		33	Unknown	Border Collie	0	0
14	Jul-13	34	2 years	Border Collie	0	10
		35	Unknown	Border Collie	0	0
15	Aug-13	36	9 years	Border Collie cross	0	0
		37	2 years	Border Collie x Kelpie	0	0
		38	5 years	Border Collie x Kelpie	0	0
		39	13 years	Border Collie x Blue Merle	0	0
16	Aug-13	40	7 years	Golden Retriever	0	0
		41	1 years	Huntaway	0	0
		42	3 years	Border Collie	0	0
		43	10 years	Border Collie	0	5
17	Sep-13	44	5 years	Lurcher	0	0
		45	5 years	Border Collie	0	10
		46	5 years	Labrador	0	0
18	Sep-13	47	10 years	Border Collie	0	0

		48	2.5 years	Border Collie	0	0
19	Sep-13	49	4 years	Border Collie	0	170

188 EPG = eggs per gram