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Intestinal parasites in dogs in Iceland: The past and the present

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SUMMARY

This article gives a resumé of the results of earlier studies on intestinal parasites of the native dog population in Iceland, the results of studies on intestinal parasites of dogs imported to Iceland during the recent years and other information on such parasites in Iceland.

Furthermore, in 1996 faecal samples from altogether 115 dogs of several different breeds were examined for the presence of parasites. In the Reykjavík urban area in SW-Iceland, samples were collected from 25 dogs, 2–12 months of age; 39 dogs over 1 year old; 8 bitches with litters and 31 of their 5–6 weeks old puppies. In a rural area in E-Iceland, samples were collected from 4 dogs, 2–12 months of age and 8 dogs over 1 year old.

The faecal samples were prepared, using the formalin-ethylacetate concentration method. The sediments were then stained with iodine and a microscope used to search for protozoan cysts and helminth eggs. Furthermore, the sediments from the faeces of dogs, 1 year of age or younger, were stained using the modified Ziehl-Neelsen method, and a microscope used for the specific detection of *Cryptosporidium* sp.

No protozoan cysts, trematode eggs or cestode eggs were detected. Eggs of the nematode *Toxocara canis* were found in puppies from two bitches and in one 3 months old puppy, all from the Reykjavík area.

The results from this study are compared with earlier information on intestinal parasites of dogs in Iceland.

Key words: dogs, Iceland, parasites.

YFIRLIT

Sníkjudýr í þörmum hunda á Íslandi, fyrr og nú

Í þessari grein er gefið yfirlit yfir fyrri rannsóknir á sníkjudýrum í meltingarvegi innlendra hunda og hunda sem biðu innflutnings í einangrun. Einnig eru dregnar fram ýmsar aðrar upplýsingar um sníkjudýr sem geta farið í meltingarveg hunda á Íslandi.

Ennfremur var árið 1996 safnað saursýnum úr alls 115 hundum af mismunandi hundakynjum og leitað í þeim að sníkjudýrum: Í Reykjavík og nágrannabæjarfélögunum var safnað sýnum úr 25 hundum á aldrinum 2–12 mánaða; 39 hundum sem voru eldri en eins árs, 8 tíkum með hvolpa og 31 5–6 vikna gömlum hvolpum þeirra (3–4 úr hverju goti). Á Breiðdalsvík var sýnum safnað úr 4 hundum á aldrinum 2–12 mánaða og 8 hundum eldri en eins árs.

Á saursýnin var notuð formalín-ethylacetat þéttniaðferð. Botnfall hvers sýnis var síðan joðlitað og leitað í því með smásjá að þolhjúpum frumdýra og ormaeggjum. Botnfall úr saur allra hunda, eins árs og yngri, var ennfremur litað með Ziehl-Neelsen aðferð og leitað með smásjá að þolhjúpum *Cryptosporidium* sp.

Engir frumdýraþolhjúpar, ögðuegg eða bandormaegg fundust. Egg þráðormsins *Toxocara canis* fundust í hvolpum í tveim gotum og í einum 3 mánaða gömlum hvolpi, öllum af Reykjavíkursvæðinu.

Niðurstöður þessarar rannsóknar gefa fyrst og fremst vísbendingu um sníkjudýrasýkingar hunda í Reykjavík og nágrannabæjarfélögunum en mun síður hunda í dreifbýli, vegna þess hve fáir hundar voru rannsakaðir þaðan.

Þetta er fyrsta leitin að sníkjufrumdýrum í meltingarvegi innlendra hunda á Íslandi og bendir hún til að ýmsar tegundir þessara frumdýra séu ýmist ekki til í landinu, tíðni þeirra sé lág eða að þau finnist aðeins í saur í skamman tíma.

Ögður hafa ekki fundist í hundum á Íslandi.

Nokkrar bandormategundir hafa fundist í hundum á Íslandi. Þó egg þeirra hafi ekki fundist með þessari aðferð er sennilega hæpið að draga miklar ályktanir af því um tíðni sumra þeirra. Niðurstöðurnar eru þó samhljóða öðrum vísbendingum um að bandormategundum og bandormum í hundum hafi fækkað verulega í landinu.

Þráðormurinn *T. canis* virðist vera algengur en hann er eini þráðormurinn sem hefur fundist í innlendum hundum.

Niðurstöðurnar eru einnig bornar saman við rannsóknir á sníkjudýrum í meltingarvegi hunda sem fluttir hafa verið til landsins á undanförnum árum og voru í einangrunarstöð þegar sýni voru tekin. Samanburðurinn bendir til að margar tegundir þarmasníkjudýra í hundum hafi borist til landsins í aldanna rás en hafi ekki náð að verða landlægar á Íslandi eða að tíðni þeirra sé lág.

INTRODUCTION

The objective of the study presented here was to gather information on the occurrence of intestinal protozoans and helminths in the dog (*Canis familaris*) population in Iceland at present and compare the results with earlier findings.

The first dogs in Iceland were probably imported during the settlement of the country in the 8th and 9th century and during the following centuries dogs have occasionally been imported. Gradually, through the ages the so called Icelandic sheepdog became dominant in the country. In 1865 the number of dogs in Iceland was estimated to be 15 000–20 000 (Krabbe, 1865). During the last decades foreign breeds have been showing up in Iceland and today most of the common foreign dog races can be found in the country. The dog population is now estimated to be 5000–10 000 dogs, thereof approx. 2000–3000 in the Reykjavík urban area.

The present study is the first study on the occurrence of intestinal protozoa of the dog population in Iceland but previously two systematic studies have been carried out on the prevalence of intestinal helminths of the population.

The first study was performed in 1863 when autopsies were carried out on 100 dogs, from various parts of the country, and their intestines were searched for helminths. The following parasites were found: *Dipylidium caninum, Diphyllobothrium* sp., *Echinococcus granulosus*, *Mesocestoides canislagopodis, Multiceps multiceps, Taenia hydatigena* and *Toxocara canis* (Krabbe, 1865).

The fight against echinococcosis started already in 1864. From the beginning it involved the education of the public on the life cycle of *Echinococcus granulosus*; since 1869 a legislation that all cysts and infected slaughter offal should be destroyed and since 1890 a legislation requiring annual treatment of all dogs in Iceland with anticestodals (Beard, 1973; Pálsson, 1984).

The second systematic search for intestinal helminth parasites of dogs was carried out during the years 1950–60. Autopsies were carried out on 200 dogs, mainly from the Reykjavík area, and their intestines were examined for tapeworms. The studies revealed only *Dipylidium caninum* and *Taenia hydatigena* (Pálsson *et al.*, 1971). Since then *Diphyllobothrium* sp. has occasionally been found

in dogs (Eydal, 1992) and *Toxocara canis* has been observed from time to time.

Import of dogs has been prohibited or restricted since 1909. However, in 1989 the ban was lifted conditionally, subject to a period of quarantine. During 1989–1993 the faeces of 133 dogs in quarantine, mainly from countries in Northern-Europe and USA, were studied using the formalin-ethylacetate concentration method and searched for protozoan cysts and helminth eggs. The following parasites were found: *Giardia* sp., *Hammondia heydorni*, *Isospora canis*, *I. rivolta*, *Sarcocystis* sp., *Toxascaris leonina*, *Toxocara canis* and *Trichuris vulpis* (Richter *et al.*, 1993). Since 1993, using the same method, *Strongyloides* sp., *Ancylostoma caninum* and *Capillaria aerophila* have also been found in imported dogs in quarantine (Richter *et al.*, unpublished data). (While in quarantine all dogs are treated twice against helminths after examination and against *Giardia* when it is found).

MATERIALS AND METHODS

Faecal samples were collected from altogether 115 dogs in two districts, Reykjavík and Breiðdalsvík, in Iceland in 1996 (Figure 1). The dogs were of several different breeds, of both sexes, and of varying age.

Figure 1. Sites where faecal samples were collected.
1. mynd. Staðir þar sem saursýnum var safnað.

The Reykjavík area

In the Reykjavík urban area in SW-Iceland a faecal sample was collected from 103 dogs during February–May as follows:

- From 25 dogs (13 bitches and 12 males), aged 2–12 months.
- From 39 dogs (20 bitches and 19 males) over 1 year of age.
- From 8 bitches with litters.
- From 31, 5–6 weeks old puppies from the eight litters (3–4 puppies from each litter).

Table 1 shows when the dogs in the study (except for the bitches and their puppies) received their last anthelminthic treatment. The puppies had not received any treatment when the samples were taken.

In the 22 cases when the anthelminticum used was known, Drontal plus® (praziquantelum, pyrantelum and febantelum) was administered to 14 (64%) of the dogs, Panacur® (fenbebdazolum) to 7 (31%) and Vermox® (mebendazolum) to 1 (5%).

All the dogs were pets. Most of them were allowed to be outdoors or exercised daily and went occasionally to areas frequented by other dogs.

The Breiðdalsvík area

In the rural area Breiðdalsvík in E-Iceland a faecal sample was collected from 12 dogs during April–May as follows:

- From 4 dogs (3 bitches and 1 dog), 2–12 months of age.
- From 8 dogs (6 bitches and 2 dogs) over 1 year of age.

Table 2 shows when the dogs in the study received their last anthelminthic treatment.

In all cases the anthelminticum Drontal® was used.

All the dogs from Breiðdalsvík were free roaming farm dogs.

In order to detect protozoan cysts and helminth eggs in the faeces the formalin-ethylacetate concentration method was used (Allen and Ridley, 1970; Young *et al.*, 1979).

Table 1. The number and percentage of dogs (except for the bitches and their puppies) of different age groups in the Reykjavík area and information on their anthelmintic treatment.
1. tafla. Fjöldi og hlutfall hunda (tíkur og hvolpar þeirra undanskilin) á mismunandi aldri á Reykjavíkursvæðinu og upplýsingar um meðhöndlun þeirra með ormalyfjum.

Last anthelmintic treatment *Síðasta ormalyfjagjöf*	Dogs 2–12 months *Hundar 2–12 mánaða*	Dogs over 1 year of age *Hundar eldri en eins árs*	Total *Alls*
0–3 months ago *Fyrir 0–3 mánuðum*	9 (36%)	9 (23%)	18 (28%)
3–6 months ago *Fyrir 3–6 mánuðum*	2 (8%)	11 (28%)	13 (20%)
6 months or more *Meira en 6 mánuðum*	0 (0%)	9 (23%)	9 (14%)
No information *Engar upplýsingar*	14 (56%)	10 (26%)	24 (38%)
Total *Alls*	25 (100%)	39 (100%)	64 (100%)

Table 2. The number and percentage of dogs of different age groups in the Breiðdalsvík area and information on their anthelmintic treatment.
2. tafla. Fjöldi og hlutfall hunda á mismunandi aldri á Breiðdalsvíkursvæðinu og upplýsingar um meðhöndlun þeirra með ormalyfjum.

Last anthelmintic treatment *Síðasta ormalyfjagjöf*	Dogs 2–12 months *Hundar 2–12 mánaða*	Dogs over 1 year of age *Hundar eldri en eins árs*	Total *Alls*
0–3 months ago *Fyrir 0–3 mánuðum*	1 (25%)	4 (50%)	5 (42%)
3 months or more *Meira en 3 mánuðir*	0 (0%)	4 (50%)	4 (33%)
No treatment *Engin ormalyfjagjöf*	3 (75%)	0 (0%)	3 (25%)
Total *Alls*	4 (100%)	8 (100%)	12 (100%)

A drop of the sediment was placed on a microscope slide, stained with iodine and covered by a 22×22 mm coverslip. The whole area under the coverslip was examined under a microscope at a magnification of 125×. Then, approx. 1/3 of the area was studied at a magnification of 500×. Each of the two authors examined separate drops from each sample.

Furthermore, a part of the formalin-ethyl-acetate concentrated sediment from each of the faecal samples of all dogs, 1 year of age or younger (60 altogether), was put on a microscope slide and stained using a modified Ziehl-Neelsen method (Henriksen and Pohlens, 1981). The sediment was then examined under a microscope at a magnification of 500× for the specific detection of *Cryptosporidium*.

RESULTS

No protozoan cysts, trematode eggs or cestode eggs were detected.

Eggs of the nematode *Toxocara canis* were

found in faecal samples from 6 puppies from two litters and from one 3 months old puppy, all from the Reykjavík area.

DISCUSSION AND CONCLUSIONS

During the past centuries most of the common parasites of dogs have probably reached Iceland several times. This is indicated by an earlier study, using the same method as in the present study on the faeces of 133 dogs in a quarantine in Iceland, imported from Europe and USA during 1989–1993. Eight species of intestinal parasites were found (Richter *et al.*, 1993). Since 1993 three more species have been found in dogs in quarantine (Richter *et al.*, unpublished data). Consequently, the question arises which species have become endemic and what their prevalence is?

Among the factors which can reduce the probability of dog parasites becoming endemic is the fact that Iceland lies in the cold-temperate zone; the number of dogs is small compared with the size of the country; the people have been well informed about the dangers of echinococcosis; during the last century it has been fairly well controlled that all dogs receive an annual treatment with anticestodals (and in recent years new broad spectrum anthelmintics) and measures are taken to ensure that slaughteroffal is inaccessible for dogs and foxes. Furthermore, treating puppies with anthelmintics has become an increasingly common practice during the last decades.

Among the factors which can increase the probability of parasites of dogs becoming endemic is that wild arctic foxes (*Alopex lagopus*) are present in most parts of the country and that domestic cats (*Felis domesticus*) are common pets. Both these species can sustain populations of some of the parasites.

Protozoa

The present study is the first comprehensive search for intestinal protozoans in the native dog population in Iceland. Surprisingly, no protozoa were found. This is rather remarkable since the studies on 133 dogs being imported during 1989–1993 revealed five protozoan species: *Giardia* sp. (prevalence 3%), *Hammondia heydorni* (0.75%), *Isospora canis* (0.75%), *I. rivolta* (1.5%) and *Sarcocystis* sp. (0.75%) (Richter *et al.*,1993). Therefore, it seems that these species have not succeeded in becoming endemic in Iceland or that their prevalence is so low that they were not detected in the present study.

In a search for *Cryptosporidium* sp. in 27 animal species in Iceland, using the same method as in the present study, the faeces of 9 puppies were examined but all were negative (Skírnisson *et al.*, 1993b). Even though *Cryptosporidium* sp. was not found in the puppies in that study, and not in the puppies in the present study, it is assumed that *Cryptosporidium* is present in puppies in Iceland, since this parasite is rather common in several other of the mammalian species in Iceland (Skírnisson *et al.*, 1993b).

Furthermore, a coccidian has been reported from arctic foxes in Iceland (Skírnisson *et al.*, 1993a), *Giardia* sp. has been reported in the native cat population (Ágústsson and Richter, 1993; Smáradóttir and Skírnisson, 1996) and *Sarcocystis* has frequently been observed in sheep.

Trematoda

Trematodes have never been reported from dogs in Iceland but the search for these has been rather limited. None were reported in the systematic search for intestinal helminths in dogs that was performed in 1863 (Krabbe, 1865) and no trematode eggs were found in the present study.

It should be mentioned that *Cryptocotyle lingua*, *Plagiorchis elegans*, *Brachylaemus* sp., *Tristriata* sp. and *Spelotrema* sp. have been found in arctic foxes in Iceland (Skírnisson *et al.*, 1993a) and some of these species might occur in rural dogs.

Cestoda

As previously mentioned two surveys have

been made on intestinal cestodes of dogs in Iceland. The prevalence of the cestodes found by Krabbe in 1863 in dogs from various parts of Iceland were as follows: *Dipylidium caninum* (prevalence 57%), *Diphyllobothrium* sp. (5%), *Echinococcus granulosus* (28%), *Mesocestoides canislagopodis* (21%), *Multiceps multiceps* (18%) and *Taenia hydatigena* (75%) (Krabbe, 1865). The prevalence of cestodes in the study of Pálsson *et al.* in the Reykjavík urban area during 1950–1960 were as follows: *Dipylidium caninum* (1%) and *Taenia hydatigena* (5.5%) (Pálsson *et al.*, 1971).

Since then *Diphyllobothrium* sp. has been found occasionally in dogs (Eydal, 1992).

Search for *E. granulosus* cysticerci in humans (Dungal, 1957) and for *E. granulosus*, *T. hydatigena* and *M. multiceps* cysticerci in sheep (Pálsson *et al.*, 1953; Pálsson *et al.*, 1971; Pálsson, 1984) has revealed a drastic decline in these cysticerci during the last century.

In the present study no cestode eggs were found. However, the authors feel that the method used in this study may not be very reliable for the detection of those cestode species which pass their eggs in proglottids in the faeces (this applies to all of the above mentioned species, except *Diphyllobothrium* sp.). Consequently, no conclusions are drawn here concerning the prevalence of cestodes in the dog population in Iceland at present. However, this study certainly does not contradict the above mentioned results which indicate that the number of tapeworm species and the prevalence of the tapeworms in dogs in Iceland has diminished drastically since 1863. The main reason for that decline is probably the earlier mentioned fight against echinococcosis.

In the 1980's, *Taenia ovis* cysticerci were occasionally found in sheep in Iceland (Richter *et al.*, 1984, 1985, 1987) but have not been observed since 1992. Adult worms were never found in dogs.

Furthermore, autopsies on arctic foxes caught in 1986–7 revealed *Mesocestoides canislagopodis*, *Schistocephalus solidus* and *Diphyllobothrium dendriticum* (Skírnisson *et al.*, 1993a) and *M. canislagopodis* has been reported from domestic cats (Ágústsson and Richter, 1993). These species could therefore be expected to occur, at least in rural dogs.

Nematoda

Toxocara canis is the only nematode species which has been found in native dogs in Iceland.

In 1863, the prevalence of *T. canis* found in the intestines of dogs in Iceland was 2% (Krabbe, 1865). These numbers provide limited information on the real prevalence of this nematode in the dog population. A much higher proportion of the dogs has probably had second stage larvae living dormant in their tissues. These larvae are then mobilised in the bitches during pregnancy and migrate to the fetus, giving rise to pre-natal infection.

Since 1863, no systematic examinations have been conducted on nematode infections of dogs in Iceland, but from time to time adult *T. canis* have been found in Icelandic dogs. Even though no eggs of *T. canis* were found in adult dogs in the present study, the finding of *T. canis* eggs in puppies, in two out of eight litters, indicates that this parasite is common in Iceland.

It is rather surprising that only *T. canis* was found in the present study. The earlier mentioned studies on the dogs being imported through a quarantine during 1989–1993 revealed three species of nematodes: *Toxascaris leonina* (prevalence 2.25%), *Toxocara canis* (7.5%) and *Trichuris vulpis* (1.5%) (Richter *et al.*,1993) and since 1993 *Strongyloides* sp., *Ancylostoma caninum* and *Capillaria aerophila* have also been found in imported dogs in the same quarantine.

Furthermore, autopsies on arctic foxes caught in 1986–7 in Iceland, revealed *Capillaria aerophila*, *Toxascaris leonina*, *Toxo-*

cara canis and *Uncinaria stenocephala* (Skírnisson *et al.*, 1993a) and *T. leonina* has been reported from cats (Ágústsson and Richter, 1993; Smáradóttir and Skírnisson, 1996). These species could therefore be expected to occur in dogs in Iceland.

General

It is debatable how representative the present study is for dogs in the country as a whole. In the Reykjavík urban area a relatively representative sample from the pet dog population was studied. Regarding farm dogs, however, faecal samples from only a very limited number of dogs from the Breiðdalsvík rural area were examined, and none from puppies. Consequently, the results can only to a very limited degree be considered representative for the free-roaming farm dogs in the country.

The compulsory annual anthelmintic treatment of dogs in Iceland usually takes place during early winter. A study in the fall would possibly have revealed more helminths.

Still, this study indicates that several intestinal parasite species of dogs have not been able to establish themselves in Iceland or their prevalence is rather low. The study also indicates that the nematode *Toxocara canis* is common in Iceland.

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