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Short communication

PRELIMINARY DATA ON NEMATODE INFECTIONS IN GUINEA PIGS IN THE PROVINCE OF CAJABAMBA (CAJAMARCA, PERU)

K. TACILLA[1], J. ROJAS-MONCADA[1], T. TORREL[1], W. QUISPE[1] & L. VARGAS-ROCHA[1,2]

[1]Laboratorio de Parasitología Veterinaria y Enfermedades Parasitarias, Facultad de Ciencias Veterinarias, Universidad Nacional de Cajamarca, Cajamarca, Perú;
[2]Círculo de Estudios e Investigación en Ciencias Veterinarias - CEICIVET, Facultad de Ciencias Veterinarias, Universidad Nacional de Cajamarca, Cajamarca, Perú

Summary

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In the absence of local studies, the current study was conducted in four villages located in the province of Cajabamba (Cajamarca, Peru) to demonstrate and determine the point prevalence of enteric nematodes in guinea pigs (*Cavia porcellus*) raised in a family-commercial breeding system. A total of 384 faecal samples were collected from guinea pigs and processed using the Sheather Sugar method. The eggs of *P. uncinata*, *Trichuris* spp., and *Capillaria* spp. were identified in guinea pigs from all four villages, resulting in an overall prevalence of 66.15±4.73%. Among the villages, the highest prevalence was observed in Naranjos, with a prevalence of 78.16±8.68% (68 out of 87 guinea pigs). This was followed by Malcas with a prevalence of 67.24±8.54% (78 out of 116 guinea pigs), Ogosgón-Paucamonte with a prevalence of 64.08±9.27% (66 out of 103 guinea pigs), and La Esperanza with a prevalence of 53.85±11.06% (42 out of 78 guinea pigs). Furthermore, it was found that 66.54±5.80% of guinea pigs had a single nematode, 28.35±5.54% had two nematodes, and 5.12±2.71% had three nematodes. Thus, the presence of enteric nematodes in guinea pigs raised in a family-commercial breeding system from four villages in the Cajabamba district was established.

Key words: *Cavia porcellus*, breeding, parasite, parasite association, prevalence

Guinea pig (*Cavia porcellus*), a mammal rodent native to the Andean region of South America, has undergone global dispersion (Lammers *et al*., 2009). However, this species is susceptible to parasitic diseases, which can be transmitted either directly or indirectly by other animals. Such diseases may arise from species-specific parasites like *Paraspidodera uncinata* (García *et al*., 2013; Meutchieye *et al*., 2017), or from parasites originating in other domestic animals that have adapted due to the guinea pig's introduction in diverse locations and increased interactions with other species (Kouam *et al*., 2015; Payne *et al*., 2015).

Helminths in guinea pigs developed gradual symptoms, which are often overlooked by breeders due to the animals appearing clinically healthy. However, unlike severe coccidiosis, which typically leads to mortality in guinea pigs of all age groups, severe infections by helminths can result in death usually among young animals. Moreover, adult animals experience a gradual decline in productivity, output, and increased susceptibility to other diseases, consequently impacting the economic viability of procedures of producers due to resulting losses (García *et al*., 2013; Huamán *et al*., 2020). Ectoparasites exert a significant detrimental effect on the health of guinea pigs. Infestations by the fly *Cordylobia anthropophaga* and the flea *Pulex* sp, even in mild cases, result in severe symptoms in guinea pigs (Kouam *et al*., 2015).

Cajabamba, located in the Peruvian region of Cajamarca, is renowned as the province with the highest production of guinea pigs, followed by Cajamarca, Chota, San Marcos, and Cutervo. At the national level, Cajamarca stands as the primary producer of guinea pigs, with a population of over 2.4 million individuals. It is closely followed by other regions such as Cusco, Ancash, Apurimac, Junin, Lima, La Libertad, Ayacucho, Arequipa, and Lambayeque (SENASA, 2019).

However, producers tend to prioritise the productivity aspect and bacterial infectious diseases, often underestimating the impact of helminth infections on this species. In this province, guinea pigs of the Peru breed prevail, raised in ponds within a family-commercial production system. Over 80% of producers do not receive technical assistance, and between 1 and 5 guinea pigs die per week, per producer, primarily due to salmonellosis (Ortiz-Oblitas *et al*., 2021). Neglecting helminth infections may be a significant contribution factor to the decline productivity.

Paraspidodera uncinata generally does not exhibit clinical signs, however, in high parasite loads, it can cause weight loss and diarrhoea. It can even lead to haemorrhagic typhlitis and submucosal capillary ectasia during the migration process through the intestinal mucosa (Coman *et al*., 2009). The migration of *Trichinella spiralis* through the intestinal wall in guinea pig infections induces precise and highly predictable alterations in the intrinsic propulsive behaviour of the small intestine (Alizadeh et al., 1987). The larvae of *Baylisascaris procyonis*, during their migration process within the guinea pig's body, can cause damage and inflammation that manifest as torticollis, ataxia, anorexia, opisthotonos, stupor, and hyperexcitability (Van Andel *et al*., 1995). Within the mammalian host, *Fasciola hepatica* causes extensive tissue damage due to the migration of immature forms through the liver, eliciting an immunological response that leads to fibrosis in order to repair the damage. Furthermore, adult parasites feed on blood nutrients, disrupting the normal physiology of the animal (Lalor *et al*., 2021).

Therefore, the objective of this study is to shed light on the prevailing issue of enteric nematode parasite in guinea pigs raised for family-commercial purposes within four villages of the aforementioned province. The study aims to demonstrate the presence of nematodes and subsequently implement appropriate therapeutic and prophylactic measures.

The study was conducted in four villages within the Condebamba district (La

Esperanza, Malcas, Los Naranjos, and Ogosgón-Paucamonte) in the province of Cajabamba, Cajamarca region, Peru (Fig. 1). Condebamba is located at an elevation of 2829 meters above sea level, with coordinates of –7.57417 S and –78.07 W. The area features a semi-arid climate, with precipitation occurring during the summer while the winters are dry. The district experiences an average annual temperature of 14 °C and an average annual precipitation of 520 mm. The residents of this district rely on extensive agriculture, cultivating crops such as corn, cassava, legumes, guava, oranges, limes, lemons, bananas, and others. Additionally, they engage in extensive livestock farming, primarily raising guinea pigs, but also rearing creole chickens, ducks, sheep, goats, pigs, creole cattle, horses, and so on.

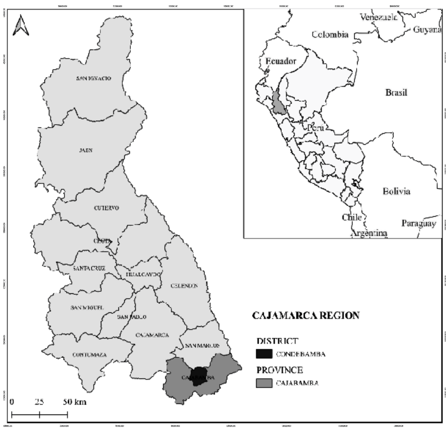

Fig. 1. Location of the study area.

The feeding of guinea pigs consisted of a diverse range of forages, including alfalfa, rye grass, and locally sourced grains such as corn and wheat. The guinea pigs were primarily raised in ground ponds segregated by rudimentary materials, as well as in cages constructed with wooden and metal mesh. Additionally, guinea pigs were observed freely roaming on the ground (Fig. 2). The waste produced by guinea pigs was directly utilised as organic fertilizer for the pastures used to sustain their feed.

As this was an initial local study aiming to encompass a larger sample, the sample size was determined using an unknown population, 50% favourable proportion, 95% confidence level, and 5% precision (Wang & Ji, 2020). A sample size of 384 guinea pig faecal samples was estimated. Guinea pigs older than three months were included, regardless of breed, lineage, type, or sex. The number of samples per farm was calculated proportionally based on the guinea pig population in each location.

For sample collection, individual guinea pigs were isolated overnight in cardboard boxes containing 100 g of Cajamarca ecotype rye grass (*Lolium multiflorum*). After twelve hours, approximately 20 g of faeces were collected from each guinea pig and placed in properly labeled polyethylene bags (8×12 cm). The samples were then transferred to an expanded polystyrene box containing cooling gels and transported to the Laboratory of Veterinary Parasitology and Parasitic Diseases at the National University of Cajamarca.

The samples were processed using the Sheather Sugar method (Sheather, 1923). The samples mixed with a saturated sugar solution were centrifuged at 3000 rpm for 3 minutes, and a drop was taken from the upper part of the tubes using a Pasteur pipette and placed on a microscope slide, which was then covered with a cover slide. Observation was conducted under an optical microscope at 400× magnification, and each parasite egg was identified based on its morphological characteristics. The eggs of *Paraspidodera uncinata* have a thick shell and an ellipsoidal appearan-

Fig. 2. Types of guinea pig husbandry in the four villages of the Condebamba district. A. Naranjos: guinea pigs raised in ground ponds constructed with local materials. B. Ogosgón-Paucamonte: guinea pigs raised in wooden cages with metal mesh. C. Malcas: guinea pigs raised in ground ponds. D. La Esperanza: guinea pigs raised in individual cages on the ground.

ce. The eggs of *Trichuris* spp. are barrel-shaped, with a thick shell and a pair of polar "plugs" at each end. The eggs of *Capillaria* spp. have two flat polar prominences and a striated shell (Lora *et al*., 2007; Gálvez *et al*., 2022).The results were organised in spreadsheets, and point prevalence was calculated with a 95% confidence interval. Using SPSS Statistics 27.0.1 software, the overall prevalence of parasites, as well as the prevalence of each parasite genus among and within the four villages, was initially analysed using the Kruskal-Wallis nonparametric test. In cases where significant differences were found, the Mann-Whitney U test was employed. Using the same methodology, the association among parasite presentations was examined.

Eggs of *P. uncinata*, *Trichuris* spp., and *Capillaria* spp. were observed (Fig. 3). A total prevalence of 66.15±4.73% was found for guinea pigs infected with nematodes. A higher presence of nematode eggs was observed in Naranjos (78.16±8.68%), followed by Malcas (67.24±8.54%), Ogosgón-Paucamonte (64.08±9.27%), and La Esperanza (53.85±11.06%) (Table 1).

The prevalence of *P. uncinata* (31.51±4.65%) was similar to that of *Trichuris* spp. (31.51±4.65%), while *Capillaria* spp. showed the lowest prevalence (27.08±4.44%) (Table 1). Among the 254 positive guinea pigs, 66.54± 5.80% were parasitised by a single nematode, 28.35±5.54% by two nematodes, and 5.12±2.71% by three nematodes (Table 2).

The results are consistent with those of other authors who found *P. uncinata* to be the most common parasitic nematode in guinea pigs. This nematode has been predominantly found alongside *Trichuris* spp., and *Capillaria* spp. (Huamán *et al*., 2020; Gálvez *et al*., 2022). Its high presence may be attributed to it being a specific parasite of neotropical hystricomorph rodents such as the guinea pig (Rossin *et al*., 2004).

In a study conducted on guinea pigs in a family-commercial farming setting in a region of the central highlands of Peru (Junín), 262 faecal samples were analysed, and 82.8±4.6% tested positive for gastrointestinal nematodes. *P. uncinata*, *Capillaria* spp., *Trichostrongylus axei*, and *Trichuris* spp. were identified. Addi-

Fig. 3. Eggs of the nematodes observed: *Paraspidodera uncinata* (a), *Trichuris* spp. (b) and *Capillaria* spp. (c); ×400.

Table 1. Prevalence of enteric nematodes in guinea pigs from four villages of Condebamba district (Cajamarca, Peru)

Village	Nº guinea pigs	Prevalence (%) ± CI95%			
		General	*P. uncinata*	*Trichuris* spp.	*Capillaria* spp.
La Esperanza	78	53.85±11.06^{a}	24.36±9.53^{xy}	26.92±9.84^{xy}	15.38±8.01^{xy}
Malcas	116	67.24±8.54^{ab}	35.34±8.70^{xy}	31.90±8.48^{xy}	28.45±8.21^{xyz}
Naranjos	87	78.16±8.68^{ab}	37.93±10.20^{xy}	32.18±9.82^{xy}	37.93±10.20^{xy}
Ogosgón-Paucamonte	103	64.08±9.27^{a}	27.18±8.59^{xy}	33.98±9.15^{xy}	25.24±8.39^{xyz}
Total	384	66.15±4.73	31.51±4.65	31.51±4.65	27.08±4.44

a,b, and x,y,z: Different letters indicate significant differences between rows and columns (Kruskal-Wallis + Mann-Whitney U *Post hoc*, $P < 0.05$).

Table 2. Parasite association in guinea pigs reared in family-commercial type farms in four villages of Condebamba (Cajabamba, Peru)

Nematode	Prevalence ± CI95%			
	Individual		Cumulated	Total
One nematode				
Paraspidodera uncinata	73/254	28.74±5.57[a]	169/254	66.54±5.80[x]
Trichuris spp.	56/254	22.05±5.10[a]		
Capillaria spp.	40/254	15.75±4.48[a]		
Two nematodes				
Paraspidodera uncinata + *Trichuris* spp.	18/254	7.09±3.16[a]	72/254	28.35±5.54[y]
Paraspidodera uncinata + *Capillaria* spp.	17/254	6.69±3.07[a]		
Trichuris spp. + *Capillaria* spp.	37/254	14.57±2.71[b]		
Three nematodes				
Paraspidodera uncinata + *Trichuris* spp. + *Capillaria* spp.	13/254	5.12±2.71	13/254	5.12±2.71[z]
Total	254/384		66.15±4.73	

a,b, and x,y,z: different superscript letters indicate significant differences between rows (Kruskal-Wallis + Mann-Whitney U *Post hoc*, P < 0.05).

tionally, the occurrence of a single parasite per guinea pig was 50.4%, the occurrence of two parasites was 30.2%, and the occurrence of three parasites was 1.9%, which is lower than the findings of the present study (Ríos *et al*., 2020). Similarly, lower prevalences have also been reported. In a study conducted in Ancash (Peru) with 100 faecal samples from guinea pigs in a family-commercial breeding system, 89% tested positive for parasites. Similarly, the presence of a single parasite was 55.1%, the combination of two parasites (most frequently *P. uncinata* and *Trichuris* spp.) was 39.3%, and the occurrence of three parasites in a single guinea pig (*P. uncinata*, *Trichuris* spp., and *Capillaria* spp.) reached 5.6% (García *et al*., 2013). Despite numerical differences or similarities, all the regions where these studies were conducted are located in the Peruvian highlands, under conditions of feeding with fresh forage.

In the Cajamarca region, there have been few published studies on the presence of parasites in guinea pigs, despite it being a region with high production of these animals. In research conducted in the city of Cajamarca, a frequency of 76% of nematodes was found in 100 guinea pigs analyzed during necropsy, with a higher presence of *P. uncinata* (74%), followed by *Capillaria* spp. (18%), and finally *Trichuris* spp. (14%) (Gálvez *et al*., 2022). The difference with the obtained results is not alarming, which would lead us to postulate that guinea pigs in Cajamarca are highly parasitised due to lack of interest or unawareness on the part of producers, institutions, and veterinary professionals.

Generally, guinea pig farms in the Peruvian highlands are of the family-commercial type and are fed green for ages such as *Medicago sativa*, *Lolium multiflorum*, and *Trifolium pratense* (Mamani *et al*., 2015). They are also fed with kitchen vegetable waste, a condition that could favour direct reinfection of parasites through ingestion of eggs attached to forages since the animals are raised in ground ponds or cages. Additionally, the coprophagic behaviour of some guinea pigs is one of the most important reasons that allows the perpetuation of the biological cycle of parasites (Franz *et al*., 2011).

The animals are easily reinfected, especially in favourable environmental conditions, as demonstrated in a study where guinea pigs raised outdoors showed a *P. uncinata* prevalence of 40%, compared to 10% in conventionally raised guinea pigs (Pinto *et al*., 2002). The high presence of parasites in the present study could be favoured by the breeding system, such as ground pits that hinder deep cleaning, and the nature of the materials used, which limit the application of various disinfection methods. Dust accumulation and cracks in the ground could favour the camouflage of nematode eggs. Another important factor to consider is the use of untreated guinea pig waste (food scraps, feces, and slurry) as organic fertilizer for the feed used to feed the animals themselves. This practice would favour the biological cycle of parasites, as they would have sufficient time to develop, become infective, and be ingested along with the feed.

The owners' lack of awareness of the presence of parasites in guinea pigs could also be a factor that has contributed to the high prevalence of nematodes. Additionally, to reduce costs, they do not use antiparasitic products. It should be noted that there is also no dissemination or variety of specific veterinary products for guinea pigs in the local market, so in some places in Cajamarca, products such as ivermectin intended for other species like cattle are used, leading to therapeutic failures (Rojas-Moncada *et al*., 2023).

In conclusion, the presence of enteric nematodes was demonstrated in guinea pigs from four villages in the province of Cajabamba. Technical advice is recommended for the implementation of therapeutic and prophylactic biosecurity measures, mainly the establishment or reformulation of health calendars, periodic cleaning, drying of pastures and forages, improvement of family breeding facilities, and primarily treatment and proper management of guinea pig waste before its use as organic fertilizer.

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Correspondence:

Luis Vargas-Rocha,
Facultad de Ciencias Veterinarias,
Universidad Nacional de Cajamarca,
Cajamarca, Perú
tel: +51 939 513 028
e-mail: lvargasr17_1@unc.edu.pe
https://orcid.org/0000-0002-8571-6416