JIDC | THE JOURNAL OF INFECTION IN DEVELOPING COUNTRIES

Original Article

Outbreak of diarrhea among preweaning alpacas (*Vicugna pacos*) in the southern Peruvian highland

Miguel Rojas[1], Alberto Manchego[2], Camila B. Rocha[1], Luz Alba Fornells[1], Raquel C. Silva[1], Gabriella S. Mendes[1], Helver G. Dias[1], Nieves Sandoval[3], Danilo Pezo[4], Norma Santos[1]

[1] *Instituto de Microbiologia Paulo de Góes, Universidade Federal do Rio de Janeiro, Rio de Janeiro, Brazil*
[2] *Laboratorio de Microbiologia y Parasitologia, Facultad de Medicina Veterinaria, Universidad Nacional Mayor de San Marcos, (FMV/UNMSM), Lima, Peru*
[3] *Laboratorio de Histología, Embriología y Patología Veterinaria, Universidad Nacional Mayor de San Marcos, (FMV/UNMSM), Lima, Peru*
[4] *Instituto Veterinario de Investigaciones Tropicales y de Altura (IVITA), Cuzco, Peru*

Abstract

Introduction: Infections, particularly diarrheal infections, are a major cause of neonatal death in South American camelids. The aim of this study was to identify the pathogens that could have caused the recent diarrhea outbreak among the alpacas in Silli, Cusco, located in the southern Peruvian highland.

Methodology: Spleen, kidney, and intestine tissue along with fecal and intestinal lavage samples were obtained from 50 one- to five-week-old alpacas and analyzed for the presence of parasites, bacteria, and viruses.

Results: Laboratory testing of the 50 crias included in this study revealed that 80% were infected with *Eimeria* spp., 40% with coronavirus, 34% with *E. coli*, 32% with rotavirus, 22% with *Clostridium* spp., and 20% with *Cryptosporidium* spp. Of these 50 alpaca crias, 20 presented with a single infection (19 positive for *Eimeria* spp. and 1 positive for rotavirus). Co-infections with up to four pathogens occurred in 60% of the samples. The significance of such infections is not clear, but it is noteworthy that the animals suffering from necrotic and/or hemorrhagic enteritis presented with quadruple infections. It is likely that co-infections increase the severity of the disease.

Conclusions: These data show that multiple pathogens circulate among young alpaca crias and could be associated with diarrheal disease in these animals. The findings from this study warrant the provision of subsidies for future assessment of the potential economic impact of these infections on the productivity of the Peruvian alpaca industry.

Key words: alpacas; bacteria; diarrhea; Peru; protozoa; virus.

J Infect Dev Ctries 2016; 10(3):269-274. doi:10.3855/jidc.7398

(Received 08 July 2015 – Accepted 15 October 2015)

Introduction

Alpacas (*Vicugna pacos*) are a domesticated species of camelids indigenous to the Andean region of South America. Peru has the largest alpaca herd in South America and the world (4–4.5 million alpacas) [1]. The largest proportion of these alpacas lives in the southern Peruvian highland, which represents one of the nation's most important regions of economic activity [2]. Commercialization of alpaca breeding is also growing outside South America, particularly in Australia, the United States, and the United Kingdom [3,4].

According to the National Congress of South American Camelids, the primary source of income for at least 1.5 million people living in the highlands of the Peruvian Andes is the breeding of South American domestic camelids [5]. Inhabitants of the Andean highlands raise alpacas for food and fiber, and the feces of these animals are used as fuel for cooking food and as fertilizer. Peru produces an average of about 3.5 million kg of alpaca fiber annually, which represents 90% of total world production [6]. Cusco is the second-most important center for alpaca breeding in Peru. Almost 90% of the alpaca population in this region is generated and cared for by small producers, who have inadequate health management training due to their extreme poverty [1,2,7]. The breeding of alpacas in this environment is characterized by low productivity, reduced fertility rates, and high neonatal losses that are not always included in the analysis of industrial productivity and in health records [1].

During the first week of February 2010, the Tropical and High-Altitude Veterinary Research

Institute of the National University of San Marcos, Peru, was notified of a diarrhea outbreak that resulted in high rates of morbidity and mortality among neonatal alpacas in Silli, Cusco. Silli is home to approximately 790 alpacas. On average, 100 animals are born in Silli each year, and the mortality rates for neonatal and adult alpacas are about 18% and 7%, respectively. In Silli, 101 families depend on the flocks of farm alpacas for subsistence. Loss of crias due to infection imposes a major economic burden on this population.

Alpacas are regarded as very resilient animals. However, several diseases, the prevalence of which depends mainly on the climate and management conditions, can endanger neonatal crias and ultimately limit productivity [3,7-9]. A six-year study of neonatal crias from communal herds in Puno Department, the largest alpaca-producing area in Peru, determined that enteric disorders (especially enterotoxemia) were responsible for 44% of the mortalities [10]. Diarrhea is an important disease in alpacas, and it is the most common cause of morbidity during the preweaning period, affecting about 23% of crias [8,9,11]. The most significant infectious pathogens causing diarrhea in alpacas are Coccidia (affecting crias 21–60 days of age), *Cryptosporidium* spp. (affecting crias 7–45 days of age), *Giardia* spp. (affecting crias 7–120 days of age), *Salmonella* spp. (affecting crias at any age), *Escherichia coli* (affecting crias younger than 7 days of age), rotavirus (affecting crias at any age), and coronavirus (affecting crias 10–150 days of age) [8,9,11]. *Clostridium* spp. have also been detected in diarrheic alpacas younger than 6 months of age [1,9]. Identification of the infectious agent involved in the disease is important for proper treatment. Bacterial infections may require antibiotic administration [8,9], while antiparasitic drugs have been effective in treating giardiasis and coccidiosis in alpacas [4,9,12]. Treatment for viral diarrhea is mainly supportive. Nevertheless, it is important to rule out viral diarrhea and, if necessary, treat other pathogens that may be concurrently involved in the disease pathogenesis [8,9].

Despite the importance of these animals to the Peruvian economy, studies examining the frequency of enteric infections (especially viral infections) among these herds are scarce. A better understanding of the epidemiology of enteric infections is essential for the development of preventive measures. Therefore, the aim of this study was to identify the pathogens that could have caused the recent diarrhea outbreak among the alpacas in Silli, Cusco, located in the southern Peruvian highland.

Methodology

Spleen, kidney, and intestine tissue along with fecal and intestinal lavage samples were obtained from 50 preweaning (one- to five-week-old) alpacas suffering from dehydrating diarrhea during an outbreak that occurred between January and February 2010. The alpacas were from an Andean alpaca herd in Silli, Cusco, Peru, approximately 4,000 meters above sea level. The animals were subjected to postmortem examination at the Laboratory of Histology, Embryology and Veterinary Pathology, Universidad Nacional Mayor de San Marcos, Peru.

Bacteriological and parasitological analyses were performed in the Laboratory of Microbiology and Parasitology, Faculty of Veterinary Medicine, Universidad Nacional Mayor de San Marcos, Peru. Virological analyses were carried out in the Institute of Microbiology Prof. Paulo de Goes, Federal University of Rio de Janeiro, Brazil. Samples of spleen, kidney, and intestine obtained during the necropsy procedure were streaked onto MacConkey agar plates (Oxoid Limited, Hampshire, UK) and thioglycollate broth (Oxoid Limited) for *E. coli* and *Clostridium* ssp. isolation, respectively. Fecal samples were collected from the rectum, and the McMaster flotation procedure and light microscopy were used to identify *Eimeria* spp. oocysts [13]. Smears of intestinal tissue stained with the modified Ziehl-Neelsen technique were examined for *Cryptosporidium* spp. [14]. Intestinal lavage samples were obtained during necropsy by thoroughly washing the intestines with warm water and were then used for viral detection. The same samples were taken from all of the animals tested. The lavage samples were diluted in 10% v/v sterile phosphate-buffered saline and clarified by low speed centrifugation (2,500×g) for five minutes. Total RNA was extracted from 300 µL supernatant using a kit according to the manufacturer's instructions (Applied Biosystems/Ambion, Austin, USA). Viral RNA detection was performed by conventional reverse transcription polymerase chain reaction (RT-PCR). All primers were synthesized by IDT (Integrated DNA Technologies, Coralville, USA). Reactions were performed in a Veriti 96-well thermocycler (Applied Biosystems, Foster City, USA). Rotavirus detection was done using a set of conserved primers that amplify a conserved region (379 base pairs [bp]) of the VP6-encoding gene present in rotavirus strains belonging to species A (RVA) [15]. Coronavirus was detected by using a set of conserved primers that amplify a 251 bp fragment of the polymerase gene present in all coronavirus strains [16]. The RT-PCR products were separated by 1.2% (w/v) agarose gel

electrophoresis, stained with ethidium bromide, and visualized under UV light [17]. A 100 bp DNA ladder (Fermentas/Thermo Fischer Scientific, Waltham, Massachusetts, USA) was used to determine molecular size.

Results

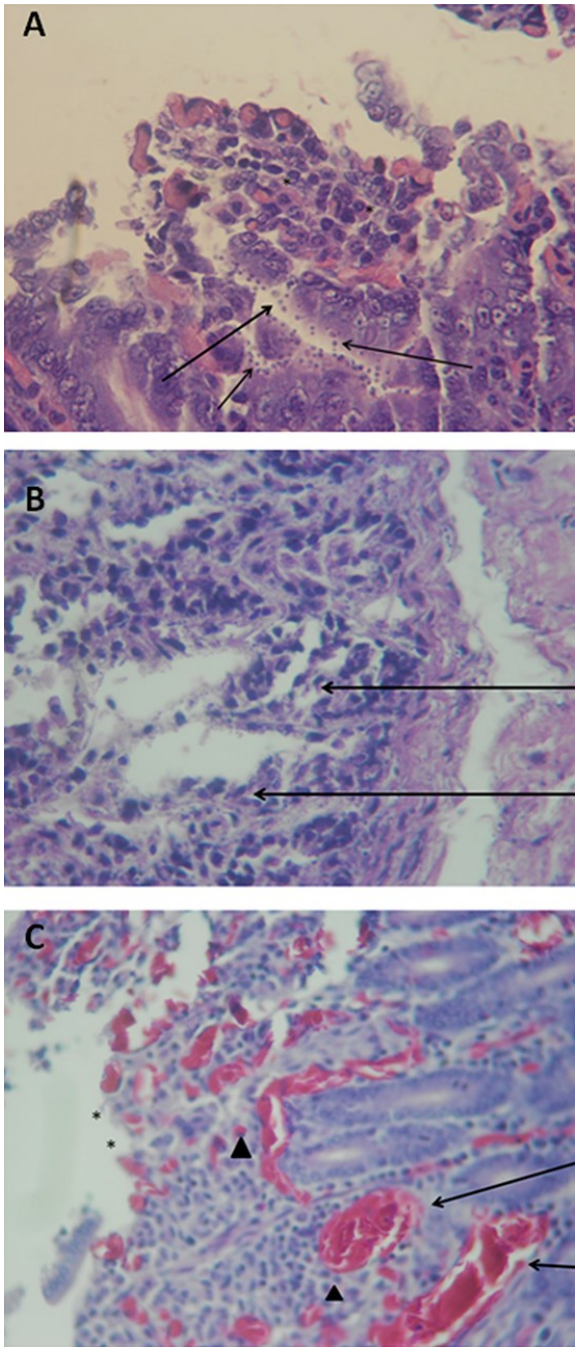
On physical examination, the alpacas were prostrate; the body condition scoring (BCS) was determined to evaluate the animals' fat stores and long-term energy balance; the sick alpacas were given a BCS of 3/10, which means that they had no visible or palpable fat or muscle between skin and bones and extreme loss of muscle [18]. The alpacas exhibited cachexia, dehydration of varying severity, and fever (Figure 1A). The alpaca fibers and ocular, labial, vulvar, and penile mucus membranes were dull and pale (Figure 1B), and capillary refill times were more than four seconds. In the most severe cases, the animals exhibited hypothermia (6 animals). Most animals (27/50) presented with profuse, foul-smelling, watery, mostly greenish feces, whereas the others (23/50) presented with grayish or yellowish feces. Of the 50 affected animals, 6 died and 44 were euthanized to prevent the spread of infection to other alpacas.

The 6 dead animals were examined by gross necropsy (macroscopic examination of the animal), which revealed marked muscle wasting and loss of body fat. All of the mesenteric lymph nodes were enlarged and dark red. The intestinal contents contained gas and were watery, yellowish, and mixed with mucus (Figure 1C). Their livers had areas of infarction in the caudate lobe. The lungs had signs consistent with pneumonia. Necropsy of the 44 euthanized animals revealed intestinal congestion, inflammation, and watery feces, findings consistent with all 6 of the dead alpacas. Samples of spleen, kidney, intestine, intestinal lavage, and feces were submitted for laboratory investigation.

Histopathological examination of intestinal specimens revealed that most of the animals (44/50) demonstrated catarrhal enteritis (Figure 2A), while only 4 animals presented with necrotic enteritis (Figure 2B), and 2 presented with hemorrhagic necrotic enteritis (Figure 2C). Those animals with necrotic and/or hemorrhagic enteritis presented with multiple infections consisting of rotavirus + coronavirus + *Eimeria* spp. + *Clostridium* spp. (4 crias) or coronavirus + *Eimeria* spp. + *E. coli* + *Clostridium* spp. (2 crias). Laboratory testing of the 50 crias included in this study revealed that 80% were infected with *Eimeria* spp., 40% with coronavirus, 34% with *E. coli*, 32% with rotavirus, 22% with *Clostridium* spp., and 20% with *Cryptosporidium* spp. Co-infections with up to four pathogens occurred in 60% of the animals and included the following pathogens: *Eimeria* spp., *Cryptosporidium* spp., *Clostridium* spp., coronavirus, rotavirus, and *E. coli* (Figure 3). Of the 20 alpacas with

Figure 1. Gross appearance of diarrheic alpacas. **A:** Prostrate animal showing muscle wasting, cachexia, and dull fiber; **B:** Pale mucus membranes and corneal opacity; **C:** Representative gross necropsy of a diarrheic alpaca. The intestinal contents were watery, yellowish, and mixed with mucus.

Figure 2. Histopathology of intestinal tissue from diarrheic alpacas. Modified Ziehl-Neelsen. Magnification × 400. **A:** Jejunum of a 15-day-old alpaca with catarrhal enteritis. Villous epithelium shows developmental stages of *Cryptosporidium* spp. (arrows). Epithelial cells have sloughed into the intestinal lumen, leaving the lamina propria of villi with congested blood vessels exposed. Mononuclear cells (macrophages/monocytes and lymphocytes) are present in the subepithelium (*). **B:** Jejunum of a 15-day-old alpaca showing early stage necrotic enteritis. Karyorrhexis and karyolysis of crypt cells and villous epithelium are present (arrows). **C:** Ileum of a 7-day-old alpaca with hemorrhagic necrotic enteritis. Loss of the villous epithelium has left the lamina propria (*) exposed. Dilated blood vessels (→), inflammatory cells, and extravasations of red blood cells (◀) are also present.



single infections, 19 tested positive for *Eimeria* spp., and 1 tested positive for rotavirus (Table 1).

Discussion

The purpose of this study was to investigate a diarrhea outbreak among Peruvian alpacas that occurred in Silli, Cusco, using histopathological and microbiological methods. We found that the majority of the 50 crias (80%) affected by the diarrhea outbreak tested positive for *Eimeria* spp., and nearly half (47.5%) of these animals had no dual infection. Coccidiosis in camelids is caused by several different species belonging to the genus *Eimeria* [1,8,9,11,19]. It is the main diarrheal pathogen reported in Peruvian camelids and is regarded as the most common cause of death in alpacas younger than 4 months of age [20-22]. Similar to our findings, previous necropsies of diarrheic crias infected with *Eimeria* have revealed intestines distended by gas, reddened areas affecting primarily the jejunum and ileum, and enlarged mesenteric lymph nodes [20-22]. Congestion has been found in other internal organs, including the kidneys, thymus, liver, and lungs. In another study, histopathological findings in the alpaca intestine ranged from moderate catarrhal enteritis to severe necrotic enteritis and locally extensive hemorrhagic and necrotic enteritis [21].

Cryptosporidium has been detected in diarrheic alpacas [11,23-25] and has been recognized as diarrhea-causing pathogen in preweaning crias younger than 3 weeks of age. Subclinical infection with *Cryptosporidium* has also been reported in alpacas [26]. In Peru, one study detected *Cryptosporidium* in 4.4% of fecal samples (n = 274) collected from 12 herds in Puno

Figure 3. Photomicrograph of a section of jejunum from a 21-day-old alpaca infected with *Eimeria* spp. Modified Ziehl-Neelsen. Magnification × 1000. Note the numerous stages of parasite development.

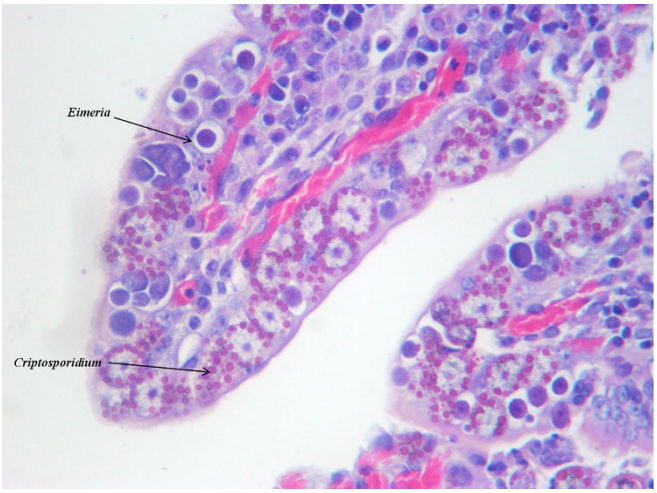


Table 1. Parasites, bacteria, and viruses detected in alpaca crias.

Pathogen	Number of samples
Eimeria spp.	19
RVA	1
Eimeria spp. + CoV	1
RVA + *E. coli*	5
CoV + *Cryptosporidium* spp.	1
Eimeria spp. + CoV + *Clostridium* spp.	4
CoV + *Cryptosporidium* spp. + *E. coli*	3
Eimeria spp. + CoV + *E. coli*	2
Eimeria spp. + CoV + *Cryptosporidium* spp.	2
Eimeria spp. + RVA + *E. coli*	1
Eimeria spp. + RVA + CoV + *Clostridium* spp.	4
Eimeria spp. + RVA + *Cryptosporidium* spp. + *E. coli*	3
Eimeria spp. + CoV + *E. coli* + *Clostridium* spp.	2
Eimeria spp. + RVA + CoV + *Cryptosporidium* spp.	1
Eimeria spp. + RVA + *E. coli* + *Clostridium* spp.	1

RVA: rotavirus species A; CoV: coronavirus

and Cusco [27]. However, in that study it was not possible to establish an association between *Cryptosporidium* and diarrhea, because it was also detected among non-diarrheic animals. The age of the animals in that study was greater than 5 weeks. In the present study, we detected *Cryptosporidium* in 20% of diarrheic crias 1–5 weeks of age, but co-infection with other pathogens known to cause enteric disease in camelids was present in all cases, making it difficult to determine the role of *Cryptosporidium* in the illness.

Previous studies have shown that *Clostridium perfringens* and *E. coli* can cause enterotoxemia in Peruvian alpacas [1,28]. We detected one or the other of these bacterial species in 25 of 50 crias. In 3 cases, both bacterial species were present; however, all of those 25 animals also presented with co-infections by other pathogens.

Both coronavirus and rotavirus have been identified as diarrheal pathogens in neonatal alpacas [1,8,9,11,19,29]. In a study conducted in Oregon, USA [11], coronavirus was the most common diarrhea-causing pathogen in llama and alpaca crias younger than 31 days of age. Another study detected rotavirus and coronavirus in 16% and 23%, respectively, of 14 alpacas from the Centro Experimental de La Raya, Universidad Nacional de San Antonio Abad del Cusco, Peru [29]. In that study, virus detection was performed using immunochromatographic tests. By contrast, we used a more sensitive molecular amplification method (RT-PCR) that detected rotavirus and coronavirus in a larger percentage of alpacas (32% and 40%, respectively). One alpaca was positive for only rotavirus, whereas the others presented with multiple pathogens such as *Eimeria* spp., *E. coli*., *Clostridium* spp., and coronavirus (Table 1). Coronavirus was only detected in co-infected animals.

Conclusions

Data presented in this report demonstrate that multiple pathogens co-circulate among young alpaca crias in Peru. Alone or in combination, it is likely that these pathogens could be associated with diarrhea. We observed a high rate of mixed infections (60%). We found a high number of triple and quadruple infections as well. The significance of such infections is not clear, but it is noteworthy that the animals suffering from necrotic and/or hemorrhagic enteritis presented with quadruple infections. It is likely that co-infections increase the severity of the disease. Future work will incorporate assessments of the potential economic impact of these infections on the productivity of the Peruvian alpaca industry.

Acknowledgements

We thank Soluza dos Santos Gonçalves for technical assistance. This study was supported in part by the Conselho Nacional de Desenvolvimento Científico e Tecnológico (CNPq) grant numbers 471063/2012-6 and 303864/2014-1, the Coordenação de Aperfeiçoamento de Pessoal de Nível Superior (CAPES), and the Fundação Carlos Chagas de Amparo à Pesquisa do Estado do Rio de Janeiro (FAPERJ) grant numbers E-26/103.113/2011 and E-26/201.374/2014, Brazil.

.

References

1. Rosadio RA, Maturrano LH, Pérez DJ, Luna LE (2012) El complejo entérico neonatal en alpacas andinas [Neonatal enteric complex in Andean alpacas]. Rev Inv Vet Perú 23: 261-271.
2. MINAG (Ministério de Agricultura y Riego, Perú) (2015) http://www.minag.gob.pe/portal/sector-

agrario/pecuaria/situacion-de-las-actividades-de-crianza-y-produccion/cam%C3%A9lidos-sudamericanos. Accessed January 29, 2015.
3. Sharpe MS, Lord LK, Wittum TE, Anderson DE (2009) Pre-weaning morbidity and mortality of llamas and alpacas. Aust Vet J 87: 56-60.
4. Thomas SM, Morgan ER (2013) Effect on performance of weanling alpacas following treatments against gastro-intestinal parasites. Vet Parasitol 198: 244-249.
5. CONACS (Consejo Nacional de Camélidos Sudamericanos) [the National Congress of South American Camelids] (2005) Estrategia Nacional de Desarrollo: Los camélideos domésticos em El Perú [National Development Strategy: Domestic camelids in Peru]. Available: http://tarwi.lamolina.edu.pe/~emellisho/zootecnia_archivos/Estrategia%20Nacional%20Camelidos%20Domesticos.pdf. Spanish. Accessed 9 February 2015.
6. Tuckwell C (1994) The Peruvian Alpaca Industry, A study tour report for RIRDC, Barton, ACT. Rural Industries Research and Development Corporation. Research paper/RIRDC; 1321-2656; No. 94/8.
7. Schmid S, Lehmann B, Kreuzer M, Gomez C, Gerwig C (2006) The value chain of alpaca fiber in Peru, an economic analysis. Master's thesis. Swiss Federal Institute of Technology Zurich. Switzerland. Available: http://tarwi.lamolina.edu.pe/~cgomez/Diplomarbeit%20_Endfassung_Tesis%20_2006.pdf. Accessed 9 February 2015.
8. Whitehead CE (2009) Neonatal Diseases in Llamas and Alpacas. Vet Clin Food Anim 25: 367-384.
9. Whitehead CE, Anderson DE (2006) Neonatal diarrhea in llamas and alpacas. Small Rumin Res 61: 207-215.
10. Ameghino E, Demartini J (1991) Mortalidad de crıas de alpacas [Mortality of alpacas crias]. Boletín de Divulgación del Instituto Veterinario de Investigaciones Tropicales y de Altura (IVITA). Lima: National University of San Marcos. 71-80.
11. Cebra CK, Mattson DE, Baker RJ, Sonn RJ, Dearing PL (2003) Potential pathogens in feces from unweaned llamas and alpacas with diarrhea. J Am Vet Med Assoc 223: 1806-1808.
12. Windsor RH, Teran M, Windsor RS (1992) Effects of parasitic infestation on the productivity of alpacas (*Lama pacos*). Trop Anim Health Prod 24: 57-62.
13. Cebra CK, Stang BV (2008) Comparison of methods to detect gastrointestinal parasites in llamas and alpacas. J Am Vet Med Assoc 232: 733-741.
14. Henriksen SA, Pohlenz JF (1981) Staining of cryptosporidia by a modified Ziehl-Neelsen technique. Acta Vet Scand 22: 594-596.
15. Iturriza-Gómara M, Wong C, Blome S, Desselberger U, Gray J (2002) Molecular characterization of VP6 genes of human rotavirus isolates: correlation of genogroups with subgroups and evidence of independent segregation. J Virol 76: 6596-6601.
16. Moës E, Vijgen L, Keyaerts E, Zlateva, K, Li S, Maes P, Pyrc K, Berkhout B, van der Hoek L, Van Ranst M (2005) A novel pancoronavirus RT-PCR assay: frequent detection of human coronavirus NL63 in children hospitalized with respiratory tract infections in Belgium. BMC Infect Dis 5: 6.
17. Gouvea V, Glass RI, Woods, P, Taniguchi K, Clark HF, Forrester B, Fang ZY (1990) Polymerase chain reaction amplification and typing of rotavirus nucleic acid from stool specimens. J Clin Microbiol 28: 276-282.
18. Camelid Community Standards of Care Working Group (2015) Recommended practices in caring for llamas & alpacas. Available: https://icinfo.org/sites/camelid-sta.osumc.edu/files/documents/Practices2005FINAL.pdf. Accessed 6 February 2015.
19. Cebra CK, Valentine BA, Schlipf JW Jr, Bildfell RJ, McKenzie E, Waitt LH, Heidel JR, Cooper BJ, Löhr CV, Bird KE, Saulez MN, Firshman AM (2007) *Eimeria macusaniensis* infection in 15 llamas and 34 alpacas. J Am Vet Med Assoc 230: 94-100.
20. Palacios CA, Perales RA, Chavera AE, Lopez MT, Braga, WU, Moro, M 2006, *Eimeria macusaniensis* and *Eimeria ivitaensis* co-infection in fatal cases of diarrhoea in young alpacas (Lama pacos) in Peru. Vet Rec 158: 344-345.
21. Rosadio R, Londoñe P, Pérez D, Castillo H, Véliz A, Llanco L, Yaya K, Maturrano L (2010) *Eimeria macusaniensis* associated lesions in neonate alpacas dying from enterotoxemia. Vet Parasitol 168: 116-120.
22. Rosadio RH, Ameghino EF (1994) Coccidial infections in neonatal Peruvian alpacas. Vet Rec 135: 459-460.
23. Starkey SR, Johnson AL, Ziegler PE, Mohammed, HO (2007) An outbreak of cryptosporidiosis among alpaca crias and their human caregivers. Am Vet Med Assoc 68: 1562-1567.
24. Waitt LH, Cebra CK, Firshman AM, McKenzie EC, Schlipf JW Jr (2008) Cryptosporidiosis in 20 alpaca crias. Am Vet Med Assoc 233: 294-298.
25. Wessels J, Wessels M, Featherstone C, Pike R (2013) Cryptosporidiosis in eight-month-old weaned alpacas. Vet Rec 173: 426-427.
26. Twomey DF, Barlow AM, Bell S, Chalmers RM, Elwin K, Giles M, Higgins RJ, Robinson G, Stringer RM (2008) Cryptosporidiosis in two alpaca (*Lama pacos*) holdings in the South-West of England. Vet J 175: 419-422.
27. Gómez-Couso H, Ortega-Mora LM, Aguado-Martínez A, Rosadio-Alcántara R, Maturrano-Hernández L, Luna-Espinoza L, Zanabria-Huisa V, Pedraza-Díaz S (2012) Presence and molecular characterisation of Giardia and Cryptosporidium in alpacas (*Vicugna pacos*) from Peru. Vet Parasitol 187: 414-420.
28. Morales S, Paredes D, Pezo D (2007) Asociación de rotavirus y *Escherichia coli* fimbriada como agentes causales de infecciones entéricas en alpacas neonatas [Association between fimbriated *Escherichia coli* and rotavirus as causative agents of enteric infections in newborn alpacas]. Rev Inv Vet Perú 18150-18153.
29. López WP, Chamorro ML, Garmendia AEB (2011) Detección rápida de rotavirus y coronavirus en crías de Alpaca (*Vicugna pacos*) con diarrea en la región del Cusco, Perú [Rapid detection of rotavirus and coronavirus in alpaca crias (*Vicugna Pacos*) with diarrhea in the Cusco region, Peru]. Rev Inv Vet Perú 22: 407-411.

Corresponding author

Norma Santos, Prof, PhD.
Departamento de Virologia, Instituto de Microbiologia,
Universidade Federal do Rio de Janeiro, Cidade Universitária
CCS – Bl. I, Ilha do Fundão, Rio de Janeiro – RJ, 21.941-902,
Brazil
Phone: +55 21 2560-8344
Fax: +55 21 2560-8028
E-mail: nsantos@micro.ufrj.br

Conflict of interests: No conflict of interests is declared.