A comparison of faecal egg counts and body condition scores in young Peruvian alpacas

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I declare that all the work in this project is my own, I am grateful for the help of those specified below
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Abstract:
This Study looked at the parasite burdens of young alpacas in the region of Nuñoa, Peru. This was performed using a McMaster faecal egg count. The results were then compared to the body condition score and weight of the animals. Any possible effect of sex or breed was also measured. Very low burdens were detected in these animals, which were solely nematodirus species as identified by morphological identification. No significant relationship was demonstrated between body condition, weight, breed and sex with faecal egg counts.
**Introduction:**

Alpacas (*Vicugna pacos*) are a species of domesticated South American camelids found throughout the Andes. They are primarily kept for their fibre but are also used for meat production. There are two breeds of alpaca the Huacaya and the Suri, the difference between them is the nature of their fleeces. (British Alpaca Society, 2014). There are approximately 3 million alpacas in Peru and they are routinely reared over 4000m above sea level where production of other livestock is extremely unprofitable. Therefore the alpaca is of enormous importance to the rural economies of Peru where it is often the only viable industry (Fernández-Baca, 1977). Numbers of Alpacas are also increasing in countries outside of South America particularly the United states of America, Australia and the UK (Inca Alpaca, 2014).

Gastrointestinal parasites are a leading health concern affecting camelids worldwide and can have a serious effect on the productivity of the animals (Windsor, 1992). In one study in Peru there was a marked increase in live weights and fleece weight of animals which received anti-parasitic treatment with Ivermectin (Windsor, 1992). This demonstrates the potential for intestinal parasites to cause poor productivity and ill health, leading to economic losses.

The presence of anthelmintic resistance is widely documented particularly in sheep and goats. It has also been demonstrated in alpacas in the United States (Galvan, 2012). As a result it is important to consider the extent of infection in order to manage alpaca herds correctly and reduce the potential risks of incurring resistance.

**Aims:**

The aim of this project is to investigate the extent of gastrointestinal nematode infection in the alpacas of the Nuñoa region of Peru. Then to compare this to their body condition scores to determine if the parasitism is having a demonstrable effect.

**Methods:**

Samples were taken from 82 alpacas located upon the altiplano in the Nuñoa region of Peru. From each animal a faecal sample was taken, a body condition score noted, a weight measured, as well as the breed and sex being noted.
The faecal samples were analysed using a series of McMaster techniques on each individual sample.

**Nuñoa:** Nuñoa is a region of Peru on the slopes of the eastern Andes at approximately 4000m above sea level. The region has the highest alpaca density on the altiplano (Nuñoa Project, 2015).

**The alpacas:** All of the animals that were sampled were born in the first few months of 2014 and as a result were between 4 and 6 months of age. The sample is a mixture of the two breeds, split 55% Suri to 45% Huacaya. There is a mixture of the two alpaca breeds in the sample. There is also a near even split of males (47.6%) to females (52.4%).

**Weight Measurements:** Each animal that was sampled was weighed using a weigh sling. This is an accurate method of weighing the animals as long as the procedure is carried out uniformly each time. However because there are no accurate records of when the crias were born any differences in weight may be related to age rather than the impact of parasites. This makes comparisons of weights and any inferences from them inaccurate.

**Body Condition Scoring:** These were noted for each animal sampled. The method used was that described by Pennsylvania state College of Agricultural sciences. It is similar to the method described for sheep and goats and involves observation and palpation of bony structures, especially the dorsal spinous processes and transverse processes (Pennsylvania State college of agricultural sciences, 2014). See appendix 1 for an explanatory illustration.

**Faecal Samples:** The analysis of the faecal samples was conducted using a series of McMaster techniques on individual samples. The McMaster technique is described in Appendix 2. The reason for these repeats is to improve the level of detection. A standard McMaster technique only gives a detection level of 50 eggs per gram (Food and Agriculture Organisation, 1994). By performing it three times on the same sample it lowers it to a detection rate of 12.5 eggs per gram. Sucrose was used over salt for practical reasons, as it was easier to acquire in Nuñoa. This may have influenced the counts and the parasites that were detected. This is considered in the discussion section of this report.
Results:

Of the 82 animals sampled, 7 of them demonstrated positive faecal egg counts. The positive counts ranged from 12.5epg up to 37.5epg. The eggs were identified as belonging to *Nematodirus* species as shown in figure 1. Statistical analysis was performed to see if there were significant differences in the body condition scores and weights of animals with positive and negative faecal egg counts. Analysis was also performed to see if either sex or breed were overrepresented. The statistics were completed using the Minitab 17™ statistical program.

\[
\frac{7}{82} = 0.085
\]

There is evidence of an extremely low nematodirus burden in these animals with a prevalence of 8.5%

**Body condition scores** –

P value = 0.111
The results were divided into two groups, animals with a BCS ≤ 2 and animals with a BCS ≥ 3. Positives and negatives were then compared to see if lower body condition scores were associated with positive faecal egg counts. A Fishers exact t-test was then conducted to give a p value. The P value was greater than 0.05. Therefore the presence of positive or negative counts does not produce statistically significant differences in body condition score.

**Weights** –

P value = 0.217
Range: 10.8 - 30kg
The weights were compared using a 2 sample t-test. An individual value plot is shown as figure2. No statistically significant differences in weights were identified between the groups with positive and negative faecal egg counts.
**Sex -**  
\[ P = 0.709 \]  
The positive and negative cohort were compared to see if either sex was overrepresented. They were compared using a Fishers exact t-test. There was no significant difference in the occurrence of parasite infection between the sexes.

**Breed -**  
\[ P = 1.000 \]  
The positive and negative cohorts were also compared to see if either breed was overrepresented, again with a Fishers exact t-test. There was no significant difference in the extent of parasitism identified between breeds.

A more complete breakdown of the statistics can be found in appendix 3
Discussion

On comparing the two groups, the FEC positive and negative animals, there was found to be no statistically significant differences between the number of males to females or huacayas to suris with positive counts. There was also no statistically significant change in the number of animals with body condition scores ≤2 or ≥3 with positive or negative counts. There was no statistically significant difference between the mean weights of the animals with positive or negative counts. This study suggested that the parasite burdens were not having any demonstrable effect on the alpacas.

The comparison of weights is, in this case, flawed. There were no accurate records kept which could accurately give the age of the animals involved. Only that the animals had been born at the start of 2014 giving an age range of 4-6 months. This means that the differences in weight could be attributed to differences in age, as well as other potential factors. There was a range of 10.8 - 30kg in the negative animals alone. If a more accurate relationship between weight and parasite burden was desired then a study with more accurate age records would be required.

The use of sucrose in the flotation solution could potentially have affected the nature of the results. In a paper by Professor Cebra it was found that McMaster flotation using a solution of sodium chloride was far more successful at detecting *Nematodirus* eggs, finding more than twice as many positive counts. However it also proved less efficacious for detecting *Strongyle* and *Trichuris* eggs (Cebra, 2008). With this in mind it is possible that animals with positive counts may have been missed due to the use of sucrose. The method used was chosen for practical purposes related to the working conditions. It was however adequate for demonstrating the presence of gastrointestinal parasitism. If a more accurate quantification of the parasitism was desired then a different technique may prove more accurate. This would involve using a technique such as the Modified Stolls, this requires a centrifuge which was not available at the time.

The parasite eggs discovered were morphologically identified as those belonging to *Nematodirus* species. There are a number of *Nematodirus* spp. that have been identified in South American camelids these are *N. lamae*, *N. spathiger*, *N. lanceolatus*, *N. filicolis* and *N. battus*. *N. lamae* is the only one of these that is specific to South American camelids (SENASA, 2011). No evidence of other parasites was found in the Peruvian alpacas. According to Argentinian
government figures the incidence of *Nematodirus* in guanacos in northern Chile was found to be 19% with a similar incidence of *Trichuris* spp but only a 5.5% incidence of *Trichostrongyles* (Zapata, 2006). This situation is very similar to that of alpacas in southern Peru in terms of climactic and environmental conditions. Although the incidence described by Zapata is higher than recorded in this study, this can perhaps be attributed to the differences in existence between the domesticated alpaca and the wild guanaco. The European situation however is markedly different. Far higher prevalences are recorded in Europe with *Trichostrongyles* making up the vast majority. A study in Switzerland described a prevalence of 87% for *Trichostrongyles*, 63% for *Nematodirus battus* and 53% for other *Nematodirus* species (Kohler, 2006). This suggests that a difference in the local ecology must affect the prevalence of these parasites. The local temperatures and humidity are likely to be very different between Europe and the altiplano. The conditions during July when this study was performed are cold and dry with an average temperature of 2.4°C and lows of -10.8°C with an average of 5mm of precipitation (Climate-data.org, n.d.). The fact that *Nematodirus* was found but no other parasite perhaps suggests that *Nematodirus* species are more resilient to the extremely low temperatures found on the altiplano. Studies have shown that *Nematodirus* eggs are able to withstand wide variations in temperature with survival at temperatures as low as -50°C being reported. This has led to the suggestion that *Nematodirus* could have an arctic origin (Morgan, 2008). For hatching and development temperatures around 0°C followed by a rise to around 10°C are necessary but the eggs would survive easily on the pastures of the altiplano even in the coldest periods. Other nematode species are more susceptible to variations in temperatures and dessication (The University of Sydney, 2003). Perhaps explaining why no other parasite species were detected during this study.

When discussing nematode burdens and control in any species it is important to consider the importance of anthelmintic resistance. Anthelmintic resistance has been well documented in cattle, sheep and horses (Waller, 1997) (Kaplan, 2002). It has also been described in alpacas and llamas in the US, Canada, Australia and Belgium (Galvan, 2012) (Rose-Ann M. Gillespie, 2010) (Jabbar, 2013) (Sarre, 2012). This demonstrates how important adequate control of gastrointestinal nematodes whilst minimising the risk and emergence of resistance in alpaca populations. Knowing and understanding the extent and type of nematode infection in these animals is an important first step in their effective and sustainable control.
Conclusion

This study discovered a very low parasite burden in the young alpacas of Nuñoa. This was not unexpected given the very extensive management systems and subsequent low stocking densities of the alpacas. This combined with the environmental conditions on the altiplano combine to ensure very low burdens. This is useful to compare to the European scenario where it is warmer and wetter and stocking densities tend to be higher. It also suggested no statistically significant relationship between parasite burdens and weight or body condition score. Nor did it show any effect of sex or breed. The differences between the UK and Peru are important to consider in the future management of alpacas to try and tackle health and productivity problems and focus on anthelmintic resistance.

Bibliography


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*ruminants* (p. section 3.4). Nairobi: ILRAD. Retrieved from [http://www.fao.org/wairdocs/ilri/x5492e/x5492e05.htm](http://www.fao.org/wairdocs/ilri/x5492e/x5492e05.htm)


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<th>Animal Description</th>
<th>Score</th>
<th>Frontal Profile</th>
<th>Paralumbar Fossa</th>
<th>Spinous to Transverse Process</th>
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<td></td>
<td></td>
<td></td>
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- **Score**: Represents the degree of body condition.
- **Frontal Profile**: Describes the appearance of the body from the front.
- **Paralumbar Fossa**: Describes the area around the lumbar region.
- **Spinous to Transverse Process**: Describes the transition area from spinous processes to transverse processes.

**Appendix 1**
Appendix 2

McMaster Faecal egg count technique:

1. Weigh out 2 grams of faeces into a beaker.
2. Break up the faecal pellets and add 28ml of flotation solution to the faeces to make a slurry.
3. Draw about 1 ml faecal suspension from the upper layers of the slurry into your syringe.
4. Load one side of counting chamber carefully to avoid producing bubbles – each chamber holds about .15 ml of slurry and repeat sampling and loading procedure for second side of chamber.
5. Let preparation stand a minimum of 5 min (examine it at least by 20 min.)
6. Place chamber on microscope and examine with 10 X objective (Adjust the focus until you can see grid lines clearly and then refine your focus to the air bubble layer).
7. Count eggs in both sides of chamber- each chamber or grid has six sections. Do not count eggs outside the grid
8. Repeat the procedure another two times on the same slurry
9. Multiply the count by 12.5 to give the eggs per gram

(Cornell University, 2015)

The repeated counting of the same slurry brings the egg detection level up to 12.5epg as opposed to the standard 50epg of a regular McMaster test.
Appendix 3

Male and female comparison –

Test and CI for Two Proportions

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<th>N</th>
<th>Sample p</th>
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Difference = p (1) - p (2)
Estimate for difference:  0.0285714
95% CI for difference:  (-0.0927122, 0.149855)
Test for difference = 0 (vs ≠ 0):  Z = 0.46  P-Value = 0.644

* NOTE * The normal approximation may be inaccurate for small samples.
Fisher’s exact test: P-Value = 0.709

Huacaya suri comparison –

Test and CI for Two Proportions

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<tr>
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Estimate for difference:  0.000607903
95% CI for difference:  (-0.121725, 0.122941)
Test for difference = 0 (vs ≠ 0):  Z = 0.01  P-Value = 0.992

* NOTE * The normal approximation may be inaccurate for small samples.
Fisher’s exact test: P-Value = 1.000

BCS comparison –

Test and CI for Two Proportions

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<tr>
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Difference = p (1) - p (2)
Estimate for difference:  0.110699
95% CI for difference:  (-0.0235937, 0.244991)
Test for difference = 0 (vs ≠ 0):  Z = 1.62  P-Value = 0.106

* NOTE * The normal approximation may be inaccurate for small samples.
Fisher’s exact test: P-Value = 0.111
Weight comparison –

**Two-Sample T-Test and CI**

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<th>Mean</th>
<th>StDev</th>
<th>SE Mean</th>
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<td>17.93</td>
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<td>2</td>
<td>75</td>
<td>19.87</td>
<td>4.45</td>
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Difference = μ (1) - μ (2)

Estimate for difference: -1.94

95% CI for difference: (-5.32, 1.44)

T-Test of difference = 0 (vs ≠): T-Value = -1.36  P-Value = 0.217  DF = 7

Comparison of cria body weights between FEC positive and negative animal