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E. PAPADOPOULOS (Η. ΠΑΠΑΔΟΠΟΥΛΟΣ), G. C. FTENAKIS (Γ.Χ. ΦΘΕΝΑΚΗΣ)

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## ■ Sarcoptic mange in guanacos: transmission to sheep and goats and treatment with moxidectin

Papadopoulos E.<sup>1</sup>, Fthenakis G.C.<sup>2</sup>

<sup>1</sup>Faculty of Veterinary Medicine, Aristotle University of Thessaloniki, 54124 Thessaloniki, Greece

<sup>2</sup>Veterinary Faculty, University of Thessaly, 43100 Karditsa, Greece

## ■ Σαρκοπτική ψώρα σε γκουανάκο: μετάδοση σε πρόβατα και αίγες και θεραπευτική αγωγή με μοξιδεκτίνη

Παπαδόπουλος Η.<sup>1</sup>, Φθενάκης Γ.Χ.<sup>2</sup>

<sup>1</sup>Κτηνιατρική Σχολή, Αριστοτέλειο Πανεπιστήμιο Θεσσαλονίκης, 54124 Θεσσαλονίκη

<sup>2</sup>Τμήμα Κτηνιατρικής, Πανεπιστήμιο Θεσσαλίας, 43100 Καρδίτσα

**ABSTRACT.** Two guanacos were diagnosed with sarcoptic mange, confirmed by recovery of mites, using standard parasitological techniques, from skin scrapings. Each animal was treated twice, 10 days apart, with moxidectin 1% inj. sol. administered subcutaneously. Dose rate was 0.2 mg/kg bodyweight. After the injections, safety observations were made for local or general adverse reactions. Moreover, clinical examinations were made and skin scrapings were collected and examined. After treatment, neither changes were seen at the site of injection, nor general reactions were recorded. The mange skin lesions had disappeared by 42nd day post-treatment. No mites were recovered 21 d post-treatment. Thereafter, sheep and goats neighbouring the guanacos developed sarcoptic mange, confirmed by clinical findings and recovery of mites. In contrast, horses, donkeys and dogs, also neighbouring the guanacos, did not develop sarcoptic mange. It is concluded that moxidectin can be used for the treatment of sarcoptic mange in guanacos. The findings support a hypothesis that mites may be transmitted easily among ruminants; these are in line with results of *in vitro* studies, indicating that mite strains from ruminants belong to the same cluster.

**Keywords:** goat, guanaco, moxidectin, sarcoptic mange, sheep, transmission, treatment

**ΠΕΡΙΛΗΨΗ.** Έγινε διάγνωση σαρκοπτικής ψώρας σε δύο γκουανάκο (*Lama guanicoe*), αρχικά με βάση τα κλινικά ευρήματα, η οποία επιβεβαιώθηκε με την ανεύρεση ακάρεων *Sarcoptes scabiei* σε ξέσματα δέρματος από τα προσβεβλημένα

Correspondence: G.C. Fthenakis,  
Veterinary Faculty, University of Thessaly, 43100 Karditsa, Greece.  
E-mail: gcf@vet.uth.gr

Αλληλογραφία: Γ.Χ. Φθενάκης,  
Τμήμα Κτηνιατρικής, Πανεπιστήμιο Θεσσαλίας, 43100 Καρδίτσα.  
E-mail: gcf@vet.uth.gr

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ζώα. Θεραπευτικά, χορηγήθηκε μοξιδεκτίνη 1% ενέσιμο διάλυμα, σε δόση 0,2 mg ανά kg σωματικού βάρους, δύο φορές σε μεσοδιάστημα 10 ημερών. Μετά τη χορήγηση, δεν παρατηρήθηκαν συστηματικές φύσεως αντιδράσεις, ούτε αντιδράσεις στο σημείο της ένεσης. Οι δερματικές αλλοιώσεις της ψώρας δεν ήταν εμφανείς κατά την κλινική εξέταση των ζώων την 42η ημέρα μετά τη θεραπευτική αγωγή. Στη συνέχεια, πρόβατα και αίγες, που γειτνιάζαν με τα γκουανάκο, εκδήλωσαν σαρκοπτική ψώρα, η διάγνωση της οποίας βασίστηκε στα κλινικά και τα παρασιτολογικά ευρήματα. Αντίθετα, άλογα, όνοι και σκύλοι, που επίσης γειτνιάζαν με τα γκουανάκο, δεν εκδήλωσαν σαρκοπτική ψώρα. Συμπεραίνεται ότι η μοξιδεκτίνη μπορεί να χρησιμοποιηθεί στη θεραπευτική αγωγή της σαρκοπτικής ψώρας σε γκουανάκο. Επιπλέον, τα ευρήματα υποστηρίζουν την υπόθεση ότι τα ακάρεα *S. scabiei* μπορούν να μεταδοθούν εύκολα μεταξύ μηρυκαστικών ζώων και είναι συμβατά με αποτελέσματα *in vitro* μελετών, τα οποία υποδεικνύουν ότι τα στελέχη του ακάρεος που προκαλούν ψώρα σε μηρυκαστικά, ανήκουν στην ίδια ομάδα.

**Αέξεις ευρετηρίασης:** αίγες, γκουανάκο, θεραπευτική αγωγή, μετάδοση, μοξιδεκτίνη, πρόβατα, σαρκοπτική ψώρα

## INTRODUCTION

Injectable macrocyclic lactones are considered to be effective for the treatment of sarcoptic mange. However, drugs of that family are licenced for use only in some animal species: cattle, sheep and pigs. Nevertheless, the disease also affects other animal species, for which no registered ectoparasiticides are available. Therefore, clinicians rely on published evidence (clinical trials, case reports) for valid information in order to control the disease in such animal species.

Numbers of guanacos (*Lama guanicoe*), along with those of llamas, alpacas and vicunas, are currently increasing in Europe and North America. These animals are used for fibre production, as pets or for breeding. Although their commercial value is increasing, leading to requirements for increased standards of veterinary care (Anderson and Whitehead, 2009), there is limited information in the scientific literature regarding treatment of specific diseases, including sarcoptic mange, of these animals (Ballweber, 2009; Lusat et al., 2009).

In this paper, we detail the therapeutic approach to sarcoptic mange in two guanacos and we present evidence of transmission of the causative agent to neighbouring sheep and goats.

## MATERIALS AND METHODS

### Description of the farm and clinical findings in the guanacos

The case described occurred in a hobby animal farm located in the outskirts of Thessaloniki, Northern Greece. The farm contained 12 sheep, 6 goats, 4

dogs, 4 pony horses, 2 donkeys and 2 guanacos, all maintained as pets. Although no direct mixing of the various animal species was practiced, the paddocks where the guanacos were maintained, adjoined those of the sheep and goats, of the horses and donkeys and of the dogs. Paddocks were separated by wooden fences. The guanacos (one male, one female) were the most recent introductions into the farm, where no history of sarcoptic mange had ever been reported.

Within one month after their import from Germany, both guanacos showed crusty and hyperkeratotic skin lesions located in the neck and shoulders, the outer surface of the thighs and the thoracic region surfaces, coupled with intense pruritus. A tentative diagnosis of sarcoptic mange was considered.

### Parasitological examinations of samples from the guanacos

Skin scrapings were collected from the part of the lesions bordering healthy issue; scrapings from four sites were collected from each animal and, approximately, 1 to 2 cm<sup>2</sup> of each site were scraped. A scalpel blade was dipped into glycerine, a skin fold was pinched between the forefinger and the thumb and whilst holding the blade at right angle to the skin, scrape was carried out until blood seeped from the abrasion. Scrapings from each animal were transferred into a Petri dish containing some damp cotton wool. Samples were examined within 2 h of collection.

Each sample was moistened with approximately 5 ml 5% KOH and heated until hair and epidermal scales were dissolved and cooled down. The mixture was transferred to a tube and was centrifuged at 10 g



for 10 min. The sediment was transferred to slides, for microscopic examination. Only presence or absence of mites was recorded; no counts were made. Identification of mites was made by using the criteria of Bowman (2008).

Further skin scrapings were collected from each animal, 21 d (D32) and 42 d (D53) after the second moxidectin injection, as detailed herebelow.

### Treatment of the guanacos

Each guanaco was treated twice, 10 days apart (on D0 and on D11), with moxidectin 1% inj. sol. (CYDECTIN; Pfizer, New York, USA), administered subcutaneously at the right side of the neck. Dose rate was 0.2 mg/kg bodyweight.

Subsequently to treatment (at 3 hours, 8 hours and 24 hours post-treatment; D0 and D1), the site of injection was palpated in both animals and compared to that of the contralateral side, in order to assess possible changes (e.g. swellings). At each of the above time-points, both animals were also observed to record any general adverse reactions; observations were carried out for 15 min to permit a reliable assessment.

### Clinical findings, parasitological examinations and treatment of other animals in the farm

On D32, mild skin lesions characteristic of sarcoptic mange were observed in 4 sheep and 2 goats. Lesions were scored '1' or '2' on the '0'-'4' scale described by Papadopoulos and Fthenakis (1999). At that time and contrary to veterinary advice, the farmer did not accept sampling for parasitological examination, neither did he perform any treatment to the animals.

On D53, skin lesions were observed in all (12) sheep and in 4 of the 6 goats. Lesions were scored '1' to '4' for sheep and '1' to '3' for goats on the above scale. At that time, skin scrapings were collected from four sheep and three (2 affected and 1 clinically healthy) goats for parasitological examination, as detailed above.

At that time, all other animals neighbouring to the guanacos (pony horses, donkeys, dogs) in the farm were also clinically examined for skin lesions and no abnormalities were found. Moreover, a skin scraping was collected from each of these animals.

All sheep and goats were treated twice, 10 days apart (on D56 and on D67), with moxidectin 1% inj. sol., administered subcutaneously. Dose rate was 0.2 mg/kg bodyweight. Horses, donkeys and dogs were left untreated.

Further clinical examinations were performed in the sheep and goats 21 d (D88), 42 d (D109) and 77 d (D144) after the second moxidectin injection. On D88 and D109, skin scrapings were collected from the four sheep and three goats, same as above. Finally and also on each of these occasions, all other animals in the farm were clinically examined and sampled (skin scrapings).

## RESULTS

Before treatment, mites were recovered from all four samples collected from each guanaco. All mites were identified as *Sarcoptes scabiei*, confirming the clinical diagnosis of sarcoptic mange.

After treatment, no changes were seen at the site of injection of any of the two guanacos. Moreover, no general reactions were recorded. Skin lesions (crusts, hyperkeratosis) were milder on D32 and had disappeared on D53. No mites were recovered from the two animals in any of the two post-treatment samplings (D32, D53). *Sarcoptes scabiei* was also recovered from skin scrapings of all clinically affected sheep and goats, but not from those of the clinically healthy goat. Skin lesions were milder on D109 and had disappeared on D144.

In no occasion, were any of the other animals (pony horses, donkeys, dogs) found to have clinical signs characteristic of sarcoptic mange. Moreover, in no case mites were recovered from scrapings collected from these animals.

## DISCUSSION

### Treatment of sarcoptic mange in guanacos

Sarcoptic mange is reported to be the most important disease in South American camelids, accounting for 95% of production losses by these animals (Ballweber, 2009). The disease is caused by *Sarcoptes scabiei* var. *aucheniae* (Bravo and Fowler, 2001; Ballweber, 2009).

To the best of our knowledge, no reports are available in the literature regarding treatment of sarcop-

tic mange in guanacos. Moreover, no reports could be found regarding use of moxidectin in that animal species. In related animal species (llamas, *Lama glama*; alpacas, *Vicugna pacos*), other macrocyclic lactones had been successfully used for treatment of the disease (Geurden et al., 2003; Leroy et al., 2003; Twomey et al., 2008).

It was decided to use moxidectin, because of its confirmed efficacy against the disease in cattle and sheep, species in the same order (Artiodactyla) as the guanacos. A dose rate of 0.2 mg/kg bodyweight has been selected on the basis of its efficacy in sheep (Fthenakis et al., 2000). The increased safety of the drug in adult mammals has also been taken into account. For safety considerations, however, the two animals were monitored at regular intervals post-treatment.

No adverse reactions were recorded following administration of the drug, confirming the safety of the product. Moreover, animals were effectively cured, as confirmed by failure to recover mites (21 d post-treatment) and subsidence of the clinical signs (42 d post-treatment).

Albeit veterinary advice, the animal owner did not disinfect the wooden fences surrounding the paddock, where the animals lived. Sarcoptic animals use fences for scratching, at which point, mites are transferred thereon and subsequently can infest other animals nearing on the same fences. In treatment protocols of sarcoptic mange in sheep, such disinfection is required for the effective cure of the disease (Papadopoulos and Fthenakis, 1999; Plant and Lewis, 2011). Nevertheless, the guanacos were not re-infested and were fully cured. As mites can survive in woods for up to 21 days (Wall and Shearer, 2001), one can propose that the persistent efficacy of moxidectin (equivalent to at least 21 days) protected the animals from potential re-infestation. As a comparison, it is mentioned that in sheep the persistent efficacy of moxidectin against *Sarcoptes scabiei* has been found to be between 25 to 32 days (Papadopoulos et al., 2000).

All the above findings support the use of moxidectin for treatment of sarcoptic mange in guanacos.

### **Transmission of sarcoptic mange from guanacos to other animal species**

The wooden fence between the guanacos and the sheep and goats could have been the likely source of

infestation for the latter two animal species. Likely, infestation took place as sheep and goats approached that fence. The disease spread quickly among these animals, especially as the farmer refused to carry out a timely treatment course of sheep and goats. Prevalence of the disease increased from 0% on D11 to 33% (sheep and goats) on D32 to 100% (sheep) and 67% (goats) on D53. Severity of the lesions also increased during that period. Moxidectin was used for effective treatment of the disease (Fthenakis et al., 2000).

There is some controversy whether there is one or several species of *S. scabiei*, as strains recovered from different animal species are morphologically similar (Arlian et al., 1984). Direct evidence has been provided by the experimental work of Arlian and others (1984) that varieties of *S. scabiei* may not be host-specific. For example, attempts to transfer *S. scabiei* var. *suis* from pigs to rabbits and dogs were unsuccessful (Arlian et al., 1984). On the other hand, *S. scabiei* from goats was successfully transmitted from those animals to sheep (Ibrahim and Abu-Samra, 1987). Concurrent infestation of guanacos and sheep by sarcoptic mange, but not specific cross-infection between these animal species, has previously been reported in the past (Rojas et al., 1993). Anecdotal evidence from South America (Alvarado et al., 1966) suggests that sarcoptic mange could have been transmitted from South American camelids to sheep brought in there by Europeans in the 18th century. Moreover, Menzano and others (2008) provided evidence of transmission of the disease from chamoises (*Rupicapra rupicapra*) to roe deers (*Capreolus capreolus*). In recent research, carried out using molecular markers specific to *Sarcoptes* mites, it was found that mite populations from wild animals clustered into different groups; populations from ruminants consisted one of these groups (Rasero et al., 2010).

In furtherance to the present findings, where sarcoptic mange did not appear to be transmitted from the guanacos to the horses, the donkeys and the dogs in the hobby farm, it is worth mentioning that under the sheep/goat farming conditions prevailing in Greece (Gelasakis et al., 2010), where donkeys and dogs may co-exist with small ruminants in the same farm (Arsenos et al., 2010), prevalence of sarcoptic mange in sheep and goats is high, whilst the disease is virtually non-existent in the other animal species (Charalambidis, 2003).



### Concluding remarks

Moxidectin was found to be effective for the treatment of sarcoptic mange in guanacos, at a dose rate of 0.2 mg/kg bodyweight. No adverse reactions were observed in the treated animals. The disease was transmitted to sheep and goats, at close contact with the

guanacos, but not to horses, donkeys and dogs. The findings support a hypothesis that mites may be transmitted easily among ruminants. These findings are in line with results of *in vitro* studies, indicating that mite strains from ruminants belong to the same cluster. One may thus infer that these strains may infect these animal species, but not non-ruminant species. ■

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