Skin lesions in alpacas and llamas with low zinc and copper status - a preliminary report

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Short communication

Skin lesions in alpacas and llamas with low zinc and copper status – a preliminary report

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South American camelids kept as zoo or farm animals often display skin lesions, the aetiology of which remains unresolved. Mostly, only a few individuals in a herd are affected. The empirical treatment consists of oral doses of zinc (Zn), and lesions usually improve over two to three months. It is unclear whether the syndrome is a Zn deficiency or a disorder that responds to supra-physiological systemic Zn concentrations (Rosychuk, 1994). Although it has been mentioned that males and animals of dark fleece colour might be more susceptible (Fowler, 1989; Rosychuk, 1994), no systematic evaluation of factors that predispose animals to the condition has been published.

A breeding herd of 13 llamas, 17 huacaya alpacas and 18 suri alpacas from a German farm was fed a diet of ad libitum hay and approximately 0.5 kg of a cameld feed per animal per day. Females and males of each species were kept in separate groups, and some males were kept individually. Except for one alpaca, the females had either given birth to a cria the same year or were considered pregnant by the owner. The animals received a regular prophylactic ivermectin treatment. Dry, scaly skin lesions were noted in 12 animals (25%; Table 1) on the bridge of the nose and the ears. Skin scrapings from four animals were investigated microscopically, but no signs of ectoparasites were detected.

Of eight hair samples cultured for fungi, six were negative, and from two, dermatophytes were isolated. Measured Zn and copper (Cu) contents of the hay and the commercial camelid feed were 15.8 and 51.3 mg Zn per kg dry matter, and 3.4 and 9.8 mg Cu per kg dry matter, respectively.

Two initial serum samples revealed a Zn content of 0.20 μg/mL and a Cu content of 0.51 μg/mL, respectively. After a tentative diagnosis of Zn deficiency, one suri alpaca was given an oral supplementation of 4 g of Zn methionine per day and its skin lesions improved over a course of three weeks. At this point, all animals of the herd were bled, and serum samples stored for later analysis. It was recommended that the owner of the herd should change to another commercial feed with higher mineral (especially higher Zn) content.

Serum samples were analysed for Cu and Zn by inductively coupled plasma emission spectrometry (ICP-AES; Schramel, 1983). ANOVA was performed with species/breed (llama, huacaya, and suri), gender, fleece colour (white or non-white) as independent factors to test for differences concerning serum mineral concentrations. Post hoc tests (Dunn–Sidak) served to evaluate pair-wise differences. The potential influence of species/breed (llama, huacaya, and suri), gender, fleece colour (white or non-white) and serum minerals on the occurrence of skin lesions (yes/no) was evaluated using logistic regression.

In the entire herd, the average serum Zn and Cu levels were 0.17 ± 0.03 and 0.49 ± 0.08 μg/mL for
Table 1
Distribution of fleece colours and average (SD) serum zinc (Zn) and copper (Cu) levels in a herd of South American camelids in relation to the occurrence of skin lesions

<table>
<thead>
<tr>
<th></th>
<th>White (n)</th>
<th>Coloured (n)</th>
<th>Mean serum Zn (µg/mL)</th>
<th>SD</th>
<th>Mean serum Cu (µg/mL)</th>
<th>SD</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Huacaya alpaca</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>4</td>
<td>2</td>
<td>0.17</td>
<td>0.03</td>
<td>0.45</td>
<td>0.03</td>
</tr>
<tr>
<td>Female with skin lesions</td>
<td>1</td>
<td>1</td>
<td>0.18</td>
<td>0.02</td>
<td>0.45</td>
<td>0.06</td>
</tr>
<tr>
<td>Female without skin lesions</td>
<td>7</td>
<td>2</td>
<td>0.17</td>
<td>0.03</td>
<td>0.53</td>
<td>0.13</td>
</tr>
<tr>
<td><strong>Suri alpaca</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>2</td>
<td>1</td>
<td>0.15</td>
<td>0.02</td>
<td>0.51</td>
<td>0.06</td>
</tr>
<tr>
<td>Female with skin lesions</td>
<td>0</td>
<td>8</td>
<td>0.17</td>
<td>0.03</td>
<td>0.50</td>
<td>0.05</td>
</tr>
<tr>
<td>Female without skin lesions</td>
<td>2</td>
<td>5</td>
<td>0.16</td>
<td>0.03</td>
<td>0.47</td>
<td>0.06</td>
</tr>
<tr>
<td><strong>Llama</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>0</td>
<td>3</td>
<td>0.18</td>
<td>0.01</td>
<td>0.50</td>
<td>0.19</td>
</tr>
<tr>
<td>Female with skin lesions</td>
<td>1</td>
<td>1</td>
<td>0.21</td>
<td>0.02</td>
<td>0.51</td>
<td>0.07</td>
</tr>
<tr>
<td>Female without skin lesions</td>
<td>3</td>
<td>5</td>
<td>0.24</td>
<td>0.06</td>
<td>0.30</td>
<td>0.13</td>
</tr>
</tbody>
</table>

Note that no male animals were affected by skin lesions.

Alpacas and 0.22 ± 0.05 and 0.38 ± 0.16 µg/mL for llamas, respectively (Table 1). No influence of gender, fleece colour or alpaca breed on circulating mineral levels (Cu content: \( p \) (gender) = 0.0540, \( p \) (colour) = 0.861; Zn content: \( p \) (gender) = 0.161, \( p \) (colour) = 0.466) was evident. There were significant differences in the mineral content between llamas and alpaca breeds for both the Cu levels (ANOVA \( p = 0.016 \), \( p \) (huacaya–suri) = 0.998, \( p \) (llama–huacaya) = 0.025, \( p \) (llama–suri) = 0.027) and the Zn levels (ANOVA \( p < 0.001 \), \( p \) (huacaya–suri) = 0.884, \( p \) (llama–huacaya) = 0.001, \( p \) (llama–suri) < 0.001), with llamas displaying higher Zn (0.22 ± 0.05 versus 0.17 ± 0.03 µg/mL in both huacaya and suri alpacas, respectively) and lower Cu (0.38 ± 0.16 versus 0.49 ± 0.10 µg/mL in huacaya and 0.49 ± 0.07 µg/mL in suri alpacas) levels. Only female animals were affected with skin lesions. A strong relationship between the breed- and colour variables was found (chi-square (exact), \( p = 0.009 \)); therefore, two different approaches were performed by including either species/breed or colour as an independent variable. In both approaches, gender had a significant influence (\( p = 0.007 \) and \( p = 0.003 \), respectively), and circulating mineral concentrations did not have any influence (Zn: \( p = 0.830 \) and \( p = 0.687 \); Cu: \( p = 0.219 \) and \( p = 0.126 \), respectively). In the approach that included species/breed, no influence of this parameter was obvious (\( p = 0.105 \)). In the approach including fleece colour, colour had a significant influence (\( p = 0.023 \)) on the occurrence of skin lesions, with non-white animals being more affected.

In domestic sheep, serum levels of 0.20–0.40 µg Zn and 0.10–0.70 µg Cu per mL serum can indicate a deficiency (Puls, 1994). For llamas, Johnson (1989) proposed 0.30–0.50 µg Zn and 0.40–0.70 µg Cu per mL serum as a “normal” reference range “on an appropriate diet”. Even if this lower reference range is taken into account, the animals in the present study had notably low serum Zn and, at least in case of the unaffected female llamas, Cu levels. Given these comparative data, the absence of other potential pathogens, and the recovery of one animal receiving a high dose of mineral supplementation, it was concluded that the skin lesions observed in this herd were comparable to Zn-responsive skin lesions reported in South American camelids (Fowler, 1989; Rosychuk, 1994). However, it was not possible to distinguish between animals with and without skin lesions on the basis of blood mineral levels, suggesting that other predisposing factors must play a role. The low Zn and Cu levels in this herd can be explained by the low content of these minerals in their diet. For ruminants, the minimum dietary Zn and Cu concentrations necessary to meet requirements are 40–50 mg Zn and 8 mg Cu per kg dry matter (Kent and Wiener, 1999). Although the camelid feed of this herd contained appropriate amounts of these minerals, its mineral levels were not high enough to balance the low contents contained in the staple diet item, the grass hay.

South American camelids are adapted to very low quality diets (San Martin and Bryant, 1989). In this respect, they are similar to yaks (Bos grunniens) and musk oxen (Ovibos moschatus), which also live on low quality diets (Staaland and Olesen, 1992; Li and Wiener, 1995). These species have all been demonstrated to digest low quality forage more efficiently than domestic ruminants (llamas: Hintz et al., 1973; yaks: Richmond et al., 1977; musk oxen: Adamczewski et al., 1994). Free-ranging South American camelids (Espinoza et al., 1982; San Martin and Bryant, 1989; Karsh et al., 1998), yaks (Liu et al., 1995) and musk oxen (Blakley et al., 2000) have been shown to have low Cu, and when Zn was investigated, low Zn concentrations as well in body tissues, as compared to domestic ruminants. In captive animals, low Cu levels and Cu deficiency has been reported for South American camelids (Palmer et al., 1980; Smith, 1989; Morgan, 1992; Hastings and Gascoyne, 1992; Johnson, 1994; Bechert and Smith, 1996; Andrews and Cox, 1997; Smith et al., 1998), yaks (Clauss and Dierenfeld, 1999; Flach et al., 2003) and musk oxen (Blakley et al., 1998). Low circulating Zn levels have been observed in South American camelids.
American camelids (Rosychuk, 1994; Bechert and Smith, 1996; Smith et al., 1998), and in yaks with skin lesions (Dierenfeld, personal communication). Sheep, South American camels, yaks and musk oxen all produce a fleece, and wool from semi-domesticated individuals is harvested by humans. Wool production imposes a high demand for minerals (Grace and Clark, 1991; Neathery et al., 1972; White et al., 1994).

Different breeds of sheep have differences in Cu and Zn metabolism (e.g., Van der Schee et al., 1983). Our analysis on the occurrence of skin lesions between two different alpaca breeds could not clarify whether such breed differences occur in South American camels as well, due to the uneven distribution of fleece colours and breeds in our sample. As eight of 15 female suri alpacas but only two of 11 female huacaya alpacas were affected, further investigation of a particular susceptibility of suri alpacas seems warranted. There are indications, in humans, that coloured hair contains more Zn and Cu than white hair (Aulerich et al., 1982; Dorea and Pereira, 1983; Laitinen et al., 1988; Allegri et al., 1990; Sturaro et al., 1994; Bertazzo et al., 1996). In the llamas and alpacas we investigated, white animals were significantly less affected by skin lesions than coloured animals, thus statistically confirming the observation shared by Fowler (1989) and Rosychuk (1994) that coloured animals are more susceptible to skin lesions. It could be suspected that a coloured fleece, with higher mineral contents, exerts higher demands on mineral metabolism, making such animals more susceptible to deficiency syndromes. In different animal species, pregnancy leads to a decrease in body Zn and Cu levels of the mother animal (Dreosti et al., 1968; Gooneratne and Christensen, 1986; Lee et al., 1993; Rombach et al., 2003), due to the increasing mineral requirements of the growing foetus. In herds of animals with a marginal mineral supply, therefore, deficiencies are most likely to clinically affect breeding females first (Dierenfeld et al., 1988) as in our study, which is in contrast to the impression of Rosychuk (1994) that male llamas appear to be over-represented in Zn-responsive dermatitis cases.

Further studies, potentially involving both serum and hair samples, and different dietary supplementation regimes, are needed to evaluate fully the impact of mineral deficiencies and predisposing factors on the skin health of South American camelids.

References


