Effect of Management System on Serum Copper Level and Haematology of Jabal Akhdar Breed Goats in two Sites in Al Jabal Al Akhdar Region of Oman

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ABSTRACT: Blood samples were collected from randomly selected healthy Jabal Akhdar breed goats reared in two sites in the Jabal Akhdar region of Oman. Seven males and 65 female goats, age range 2 months to 4 years, raised in Shnoot Al-Dar village were kept under a semi-intensive system (SIS) and 2 males and 18 females, age range 4 months to 5 years, raised in Al-Ala’lana village and kept under free range system (FRS) were studied. Serum Cu and haematological values were measured. There were no significant (p>0.05) effects of age, sex or serum copper levels on the haematology of goats, so data was pooled and only the effects of the management system on serum Cu and haematology were analysed. There were highly significant (p<0.001) differences between the two systems in all parameters studied. FRS goats were higher than SIS goats in mean values (± SE) of serum Cu (mg/l) 0.60 ± 0.07 vs 0.48 ± 0.33, red blood cells (RBC) (X10¹²/L) value 15.03 ± 0.42 vs 14.97 ± 0.25, mean cell volume (MCV) (fl) 21 ± 21 vs 19.57 ± 0.19, and haematocrit (HCT) (%) value 31.84 ± 0.59 vs 29.6 ± 0.35. SIS values were higher than FRS in haemoglobin (Hb) (g/dl) 9.34 ± 0.16 vs 9.26 ± 0.27, mean cell haemoglobin (MCH) (pg) 6.21 ± 0.05 vs 6.16 ± 0.08 and mean cell haemoglobin concentration (MCHC) (g/dl) 31.96 ± 0.38 vs 29.05 ± 0.64. Therefore, it is evident that the management system can affect the copper serum levels and haematology of the Jabal Akhdar breed goats in the Jabal Akhdar region of Oman.

Keywords: Haematology; Serum copper; Copper deficiency; Oman; Jabal Akhdar; Goats

اثر نظام الرعاية على مستوى عنصر النحاس في مصل ومكونات الدم في نوع ماعز الجبل الأخضر في موقعي منطقة الجبل الأخضر بسلطنة عمان

الملخص: جمعت عينات من الدم من نوع ماعز الجبل الأخضر لدى ماشية جيدة، تم اختيارها عشوائيا، من مواقع في منطقة الجبل الأخضر بسلطنة عمان. تضمنت الدراسة عدد 7 ذكور و35 أنثى بأعمار تراوحت بين 3 أشهر إلى 5 سنوات، وتربت في قرية شنوت الدار بالنظام شبه المغلق (SIS)، وعدد 2 ذكور و18 أنثى بأعمار تراوحت بين 4 أشهر إلى 5 سنوات، في قرية العلّانا بالنظام المفتوح (FRS). تم قياس كل من نسبة عنصر النحاس في مصل وقيم مكونات الدم. لم يظهر هناك تأثيرات ذات دلالة إحصائية لكل من العمر، الجنس، أو مستوى عنصر النحاس في المصل على قيم مكونات الدم، وذلك يدل على أن نظام الرعاية يمكن أن يؤثر على مستوى عنصر النحاس في نوع ماعز الجبل الأخضر، وأن نظام الرعية المفتوح يوفر على مستوى عنصر النحاس في مصل وقيم مكونات الدم في نوع ماعز الجبل الأخضر بسلطنة عمان، وأن نظام الرعية المغلقة يمكن أن يؤثر على مستوى عنصر النحاس في نوع ماعز الجبل الأخضر من حيث مشكلة نقص عنصر النحاس في أمصال الماعز العماني.

الكلمات المفتاحية: مكونات الدم،نحاس مصل،نحاس مصل ماعز الجبل،الجبل الأخضر،نحاس مصل،نحاس مصل ماعز الجبل الأخضر.
1. Introduction

Haematological values are useful in assessing animal health and provide vital information on the physiological, nutritional and pathological status of an animal. These values are affected by several factors such as age, breed, sex, management systems [1-3], diet [4], rumen impaction [5] and parasitism [6].

Copper is an essential trace element which is associated with clinical and biochemical disorders. Copper deficiency is an endemic problem in Oman where low tissue, plasma or serum values have been reported in livestock by many workers [7-9]. Goats comprise a very important source of meat and income to villagers in Oman. Jabal Akhdar goats, a large body size goat, comprise 20% of the total goat population of 854,060 in Oman, as reported by Mahgoub et al [10]. They are named after the region they inhabit, the Jabal Akhdar. The Jabal Akhdar, Jebel Akhdar or Al Jabal Al Akhdar, is a part of the Al Hajar Mountain range in Oman, which extends about 300 km northwest to southeast, between 50 – 100 km inland from the Gulf of Oman coast. The range is mostly desert, with the higher altitudes receiving around 300 mm (12 in) of precipitation annually, which is moist enough to allow the growth of shrubs and trees and to support agriculture. This gives the mountains their ‘green’ name [11]. Goats are generally kept in medium to large herds of about 1-50 [10]. Villagers either leave their goats to graze all day on a free range management system, in which they browse on Acacia shrubs and other trees, or they feed them on seasonal indigenous range grass, Rhodes grass hay, by-products and household leftovers [10]. This work was intended to investigate the effect of the management system on serum copper and serum copper of goats in the Jabal Akhdar region of Oman.


Blood samples were collected from the jugular vein from randomly selected, apparently healthy, Jabal Akhdar breed goats, reared in two different sites in the Jabal Akhdar region of Oman. A total of 72 goats, 7 males and 65 females, age range 2 months to 4 years, raised in Shnoot Al Dar village (GPS: N 23’ 06.930 E 057’ 39.507 Elevation: 2289 meters above sea level (masl)) kept under the semi-intensive system (SIS) and 20 goats, 2 males and 18 females, age range 4 months to 5 years, raised in Al Al'a'lanana village (GPS: N 23’ 06.903 E 057’ 34.647 Elevation: 2172 masl) kept under the free range system (FRS) were included in the study. Serum was collected from blood in situ, separated in vials and kept at a cool temperature, moved to the lab and then frozen. Serum copper values were detected using Atomic Absorption Spectrophotometry. For haematology, blood was collected in EDTA vacuum tubes, kept at a cool temperature, moved to the lab and then analyzed immediately. Haematological parameters were obtained from these fresh samples using a CELL-DYN 3700 automated blood analyzer (Abbott Laboratory, Diagnostic Division, Abbott Park, IL 60064, USA). Parameters studied included the following: Red blood cells (RBC), Packed cell volume (PCV), Haemoglobin concentration (Hb), Mean cell volume (MCV), Mean cell haemoglobin concentration (MCHC) and Mean cell haemoglobin (MCH).

3. Statistical Analysis

Means were compared to study the effects of the management systems, age, sex and serum copper levels on these values using Type III general linear model statistical analysis using the SPSS computer package. There were no effects of age, sex or serum copper levels on haematological values; so data were pooled and only the effect of the management system on serum copper (mg/l) and haematological values were studied. A serum copper concentration \( \leq 0.59 \text{ mg/l} \) was considered as low and \( \geq 0.60 \text{ mg/l} \) was considered as normal.

4. Results and Discussion

4.1 Serum copper

The effect of the management system on serum copper level is presented in Table 1. FRS mean serum copper (mg/l) was significantly (p<0.001) higher than mean values for SIS.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Free range System</th>
<th>Semi-intensive System</th>
<th>Significance</th>
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</thead>
<tbody>
<tr>
<td>Serum copper (mg/l)</td>
<td>0.60 ± 0.07</td>
<td>0.48 ± 0.33</td>
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<tr>
<td>RBC (x 10^{12}/l)</td>
<td>15.03 ± 0.48</td>
<td>14.97 ± 0.25</td>
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<td>MCV (fl)</td>
<td>21.00 ± 0.21</td>
<td>19.57 ± 0.19</td>
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<td>PCV (%)</td>
<td>31.84 ± 0.59</td>
<td>29.6 ± 0.35</td>
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<tr>
<td>Hb (g/dl)</td>
<td>9.26 ± 0.27</td>
<td>9.34 ± 0.17</td>
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<td>MCH (pg)</td>
<td>6.16 ± 0.08</td>
<td>6.21 ± 0.05</td>
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<tr>
<td>MCHC (g/dl)</td>
<td>29.07 ± 0.06</td>
<td>31.96 ± 0.38</td>
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the SIS, especially on the serum Cu levels and RBC, MCV and PCV values. Although a proportion of goats had serum Cu levels within the subclinical and deficient range, it can be concluded that the FRS has the potential to provide for a reduction in Cu deficiency as well as higher haematological values of RBC, MCV and PCV. Further studies are needed to support these findings and to find proper supplementation methods to help to totally alleviate Cu deficiency and to improve the haematology and health status of Jabal Akhdar grazing goats in Oman.

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