

Estimation of Serum Copper Concentrations in Sheep and Goats Infected with Gastrointestinal Parasites in Mosul City, Iraq

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Doi: <https://doi.org/10.37940/AJVS.2019.12.2.8>

Abstract

The objective of the present study was to determine serum copper concentrations in sheep and goats infected with different gastrointestinal parasites. A total of 60 sheep and 30 goats were obtained from different areas in Mosul city and examined in the Veterinary Teaching Hospital, University of Mosul. Fecal and blood samples were collected from each animal. Animals infected with gastrointestinal parasites were diagnosed by detecting parasite eggs in fecal samples. Copper concentrations and hematological values were compared between infected and non-infected animals. Different gastrointestinal parasites were diagnosed include; *Chabertia ovina*, *Cooperia* spp., *Haemonchus contortus*, *Marshallagia marshalli*, *Nematodirus* spp., *Oesophagostomum* spp., *Ostertagia ostertagia*, *Strongylus* spp. and *Trichostrongylus* spp. in both single and mixed infection types. Infected sheep and goats suffered from different clinical signs such as emaciation, poor wool or hair, trembling, pale mucous membrane, loss of appetite, and diarrhea. Infected animals showed significantly ($p \leq 0.05$) lower serum copper concentrations compared to non-infected animals. Moreover, hematological parameters (RBC, Hb, PCV, MCH, MCV, and MCHC) were lower compared to non-infected animals. In conclusion, gastrointestinal parasitic infection in sheep and goats can decrease serum copper concentrations and blood parameters in infected animals, thereby exacerbating clinical signs.

Keywords: Copper, Gastrointestinal parasites, Goats, Sheep, Trembling

تقدير تركيز النحاس في مصل الأغنام والماعز المصابة بالطفيليات المعوية في مدينة الموصل ، العراق

هدفت الدراسة الحالية إلى تحديد تركيز النحاس في مصل الأغنام والماعز المصابة بالطفيليات المعوية. تم الحصول على ما مجموعه 60 من الأغنام و 30 من الماعز من مناطق مختلفة في مدينة الموصل وتم فحصها في المستشفى البيطري التعليمي بجامعة الموصل. تم جمع عينات البراز والدم من كل حيوان. وتم تشخيص الحيوانات المصابة بالطفيليات المعوية عن طريق الكشف عن بيض الطفيليات في عينات البراز. وتمت مقارنة مستويات النحاس والقيم الدموية بين الحيوانات المصابة وغير المصابة. وتم تشخيص الطفيليات المعوية المختلفة بما في ذلك (*Chabertia ovina*, *Cooperia* spp., *Haemonchus contortus*, *Marshallagia marshalli*, *Nematodirus* spp., *Oesophagostomum* spp., *Ostertagia ostertagia*, *Strongylus* spp. and *Trichostrongylus* spp.) في كل من أنواع العدوى المفردة والمختلطة. عانت الأغنام والماعز المصابة من علامات سريرية مختلفة مثل الهزال ، وسوء الصوف أو الشعر ، وشحوب الأغشية المخاطية ، وفقدان الشهية ، والإسهال. أظهرت الحيوانات المصابة مستويات أقل بكثير من النحاس في الدم مقارنة بالحيوانات غير المصابة. علاوة على ذلك ، كانت الصفات الدموية أقل مقارنة بالحيوانات غير المصابة. يمكن ان نستنتج أن الإصابة بالطفيليات المعوية في الأغنام والماعز تؤدي الى انخفاض مستويات النحاس و الصفات الدم في الحيوانات المصابة ، مما يؤدي الى تفاقم العلامات السريرية.

Introduction

Intestinal parasite infection can reduce animal growth and cause severe economic losses to livestock industry, particularly in tropical and subtropical areas (1). In addition to several

environmental and epidemiological factors that influence the susceptibility to the parasitic infection, outdoor rearing of sheep and goats provides a suitable environment for direct or indirect transmission of infection (2).

Gastrointestinal parasite infections, particularly with roundworms, cause different clinical signs and symptoms of illness including body weight loss, ascites, diarrhea, and low production. Biochemically, roundworm infection in sheep and goats decreases copper absorption resulting in decline of copper concentration in serum (3)

Copper plays an important role in regulating the mechanisms of different enzymes, particularly metabolic enzymes (4). Copper deficiency may cause dysfunction in reproductive, digestive, nervous, immune performance, and cardiovascular systems (5,6). Therefore, copper deficiency results in several clinical signs including anemia, diarrhea, poor wool production, and trembling (7). Trembling is considered one of the most clinical signs that appear due to copper deficiency. It can be primary; due to lack low concentration of copper in the animal food, or secondary; due to the reduction of copper absorption (8).

Gastrointestinal parasitic infection is widespread in sheep and goats in Mosul city, Iraq. The aim of the present study was to estimate serum copper concentration and blood parameters in sheep and goats infected with gastrointestinal worms in Mosul city, Iraq.

Materials and method

Ethical approval

This study was subjected to ethical examination at the College of Veterinary Medicine, University of Mosul and was approved.

Animals of study

A total of 60 sheep and 30 goats (> 1-year-old) brought to the Veterinary Teaching Hospital, the University of Mosul from different areas in Mosul city were used in this study. The animals were divided into two groups: (group-1) infected with gastrointestinal parasites; including 40 sheep and 20 goats, and (group-2) free from gastrointestinal parasites and clinically normal animals; including 10 sheep and 10 goats. All

animals were clinically examined for changes in appetite, body condition, mucous membranes color, wool (or hair) health, trembling, and fecal consistency.

Study samples

Fecal and blood samples were collected from each animal. Fecal samples were collected from the rectum directly, placed in small plastic containers, and transferred to the laboratory within 24 hours for the examination. Blood samples (7 ml/animal) were collected from the jugular vein; 2 ml kept in EDTA tubes, and 5 ml used for serum collection. Serum samples were stored at -20 °C.

Laboratory examination

Fecal samples were examined using both direct and flotation methods to detect presence of gastrointestinal parasites eggs, while EDTA blood samples were used to determine blood parameters values, including Red Blood Cells Count (RBC), hemoglobin (Hb), Packed Cell Volume (PCV), Mean Corpuscular Hemoglobin (MCH), Mean Corpuscular Volume (MCV) and Mean Corpuscular Hemoglobin Concentration (MCHC). Whereas serum samples were used to estimate copper concentration using a commercial kit (BIOLABO, France) and spectrophotometer.

Statistical analysis

The differences in copper concentrations and blood parameters between infected and non-infected animals were tested using t-test at a concentration of ($p \leq 0.05$). Statistical analysis was performed using SPSS version 12.

Results and Discussion

In the present study, sheep and goats were infected with different gastrointestinal parasites (Table 1). The predominant of infection type in both sheep and goats were single infection; i.e., infection with one type of parasite (Table 2). Infected sheep and goats suffered from different clinical signs including emaciation, poor wool (or

hair), trembling, pale mucous membrane, loss of appetite, and diarrhea (Table 3). In addition, copper concentrations, RBC, Hb, PCV, MCH,

MCV, and MCHC were significantly lower ($p \leq 0.05$) in infected sheep and goats, compared to non-infected animals (Table 4).

Table 1. Gastrointestinal worms diagnosed through detection of parasites eggs in the fecal samples which collected from sheep and goats in Mosul city, Iraq

Gastrointestinal worm	Sheep (n = 40)		Goats (n =20)	
	Number	%	Number	%
<i>Chabertia ovina</i>	2	5	3	15
<i>Cooperia</i> spp.	-	-	1	5
<i>Haemonchus contortus</i>	12	30	8	40
<i>Marshallagia marshalli</i>	8	20	2	10
<i>Nematodirus</i> spp.	8	20	-	-
<i>Oesophagostomum</i> spp.	-	-	2	10
<i>Ostertagia ostertagi</i>	4	10	2	10
<i>Strongylus</i> spp.	2	5	-	-
<i>Trichostrongylus</i> spp.	4	10	2	10

Table 2. Types of gastrointestinal parasite infection (single and mixed) in studied sheep and goats

Types of infection	Sheep (n = 40)		Goats (n =20)	
	Number	%	Number	%
Single infection	24	60	16	80
Mixed infection	16	40	4	20
Total	40	100	20	100

Table 3. Clinical signs observed in sheep and goats infected with gastrointestinal parasites

Types of infection	Sheep (n = 40)		Goats (n =20)	
	Number	%	Number	%
Emaciation	2	5	2	10
Poor wool (or hair)	16	40	9	45
Trembling	6	15	2	10
Pale mucous membrane	14	35	9	45
Loss of appetite	8	20	6	30
Diarrhea	6	15	3	15

Table 4. Serum copper concentration and hematological values in sheep and goats infected with gastrointestinal parasites compared to non-infected animals

	Sheep (n = 40)		Goats (n =20)	
	Infected	Non-infected	Infected	Non-infected
Cu ($\mu\text{g/dL}$)	59.08 $\pm$ 7.47 _b	100.5 $\pm$ 12.7 _a	25.85 $\pm$ 3.17 _b	125.04 $\pm$ 13.51 _a
Hb (g/dL)	6.31 $\pm$ 0.17 _b	10.88 $\pm$ 0.42 _a	6.56 $\pm$ 0.17 _b	10.98 $\pm$ 0.54 _a
PCV (%)	24.01 $\pm$ 0.82 _b	34.58 $\pm$ 0.84 _a	23.33 $\pm$ 0.75 _b	33.26 $\pm$ 0.86 _a
RBC ($10^6/\mu\text{L}$)	5.61 $\pm$ 0.20 _b	11.52 $\pm$ 0.48 _a	6.23 $\pm$ 0.22 _b	11.67 $\pm$ 0.35 _a
MCH (pg)	9.60 $\pm$ 0.55 _b	11.62 $\pm$ 0.60 _a	10.73 $\pm$ 0.41 _b	9.50 $\pm$ 0.65 _a
MCV (fL)	30.49 $\pm$ 1.53 _b	43.99 $\pm$ 2.21 _a	28.60 $\pm$ 0.66 _b	38.32 $\pm$ 1.77 _a
MCHC (g/dL)	26.89 $\pm$ 1.18 _b	31.69 $\pm$ 1.60 _a	28.53 $\pm$ 1.01 _b	33.26 $\pm$ 1.96 _a

Different superscript letters in the same row indicate significant differences ($p \leq 0.05$).

Discussion

Infected sheep and goats exhibited several clinical signs including emaciation, poor wool or hair, trembling, pale mucous membrane, loss of appetite, and diarrhea. These signs are attributed to different digestive disturbances that occur due to parasitic infection. For instance, *Haemonchus contortus* has oral suckers that can cause damage to the abomasal mucous membrane leading to anemia, hypoproteinemia, and vitamin deficiency. Furthermore, *Ostertagia ostertagi* can damage the glandular cells of the abomasum causing fatal diarrhea (8). On the other hand, other parasites (e.g., *Trichostrongylus* spp. and *Nematodirus* spp.) can cause damage to the intestinal mucosa leading to severe inflammation resulting in diarrhea, loss of appetite, and emaciation(9,2,10).

Infected animals showed low concentrations of copper in the serum, compared to non-infected animals. In the present study, copper deficiency can be considered secondary due to malabsorption in infected animals. Decreased copper concentrations in infected animals might exacerbate the clinical signs indicated in the infected animals, particularly

poor wool or hair, and trembling. Copper is a cofactor for tyrosinase that stimulates synthesis of tyrosine to melamine; an important pigment for wool and hair color (11). In addition, trembling is potentially attributed to decrease in copper concentrations in infected animals. In other studies, sheep and goats exhibited trembling due to lack of copper in their feed (12). Copper deficiency can result in musculoskeletal system imbalance and partial paralysis (3).

In the current study, infected animals suffered from low hematological parameters including RBC, Hb, PCV, MCV, MCH, and MCHC, compared to non-infected animals. Although parasitic infection results in anemia due to decrease in blood parameters, low copper concentrations can also contribute to the anemia. The decrease in RBC, Hb, and PCV were indicated in animals with copper deficiency (13). Copper is important to RBC formation; as copper is found in transferase enzyme that transfers iron from the intestine and liver to bone marrow for Hb formation (11).

Conclusion

It is concluded that the infection with gastrointestinal worms in sheep and goats can cause decrease in serum copper concentrations, which exacerbate clinical signs and decrease hematological parameter values in infected animals.

Acknowledgments

This study was supported by the College of Veterinary Medicine, University of Mosul, Mosul, Iraq.

Authors' contributions

All authors contributed equally to this paper.

Conflict of interest

The authors declare that they have no conflict of interest.

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