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Study of Serum Biochemical Values and Mineral Contents of Tissues in Guizhou Black Goat

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Abstract: Reference values were established for hematological and serum biochemical constituents in Guizhou black goats in China. The contents of mineral elements in the blood, hair and liver of Guizhou black goats were measured. All values are reported for the first time for Guizhou black goats in China. Most hematological and serum biochemical values were similar to those of cattle, sheep and camels. The liver contained the highest concentrations of copper and iron. The concentrations of cobalt, zinc, manganese and molybdenum in wool were within the reference range for other ruminants. The mean iron, copper and selenium concentrations in the liver were significantly higher than those in other ruminants.

Key words: Guizhou black goats, minerals, hematological, thyroxine, enzymes

INTRODUCTION

The Guizhou black goat is vital to the production system of the south west China karst mountain area. Animals provide meat, wool and hides for local people. However, there are not data on mineral element and the normal hematological and serum biochemical values. This study was designed to define reference hematological and serum biochemical values and concentrations of mineral element in the Guizhou black goats.

Study area: Researchers conducted the study in the Bijie City of Guizhou Province, China. It is located at 26°31'-27°56'N latitude and 103°31'-104°55'E longitude at an average elevation of 2200 m above sea level. The annual precipitation is 962 mm. The average atmospheric temperature is 10-12°C. The grassland vegetations are mainly Puccinellia (*Chinampoensis ohuji*) Siberian Nitraria (*Nitraria sibirica* Pall) floriated astragalus (*Astragalus floridus*) poly-branched astragals (*A. polycladus*) falcate whin (*Oxytropis falcate*) Ewenki automomous banner (*Elymus nutans*) common leymus (*Leymus secalinus*) and june grass (*Koeleria cristata*). Most of the plants are herbaceous and are good food resources for animals.

MATERIALS AND METHODS

Animals: The 20 Guizhou black goats, 10 females and 10 males selected for the study. All the animals were healthy with no clinical signs of disease.

Sampling: All the samples were taken in May 2012. Blood samples each of 15 mL were obtained from the jugular vein of all Guizhou black goats using 1% sodium heparin as anticoagulant and stored at 4°C for hematological examination and at -20°C for analysis of mineral elements. Serum samples for biochemical values were taken without anticoagulant and were refrigerated until they arrived at the laboratory after <5 h when the serum was separated by centrifugation and stored frozen in plastic vials until the laboratory determinations could be made. Hair was taken from the neck of all the animals, washed and degreased as described by Salmela *et al*. (1981) and kept in a desiccator over silica gel until analyzed. Liver biopsies were also sampled by a trained technician using techniques previously described (Arthington and Corah, 1995). The liver samples were dried at 80°C for 48 h, ground, passed through a 0.5 mm sieve and stored in a desiccator over silica gel.

Hematological and biochemical examination: Hemoglobin (Hb), Packed Cell Volume (PCV) and Red Blood Cell (RBC) count were determined using an automated hematology analyzer (SF-3000, Sysmex-Toa Medical Electronics, Kobe, Japan). The serum content of Ceruloplasmin (Cp), Lactate Dehydrogenase (LDH), Aspartate Aminotransferase (AST), Alanine Aminotransferase (ALT), Alkaline Phosphatase (AKP), γ-Glutamyl Transferase (γ-GT), Creatinine (Crt), Cholesterol (Chol), Blood Urea Nitrogen (BUN), Sodium (Na), Potassium (K), Magnesium (Mg),

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Calcium (Ca), Inorganic Phosphorus (IP), Neutrophils, Lymphocytes, Eosinophils, Basophils, Monocytes were determined on an automatic analyser (SF-1, Shanghai Medical Apparatus and Instruments Factory, Shanghai, China) using commercial test kits (Nanjing Medicine University Biochemical Co., Nanjing, China). Quality control serum (Shanghai Biochemical Co., Shanghai) was used to validate the blood biochemistry data. Serum protein electrophoretic studies were performed on cellulose acetate using the EA-4 electrophoresis apparatus (Shanghai Medical Apparatus and Instruments Factory) (Shi, 1990). Serum triiodothyronine (T_3), thyroxine (T_4) and Parathyroid Hormone (PTH) concentrations were determined by Radioimmunoassay (RIA) on a γ-counter (γ-Autocounter, Xian 262 Factory, Shanxi, China) using commercial test kits (Tianjing Medicine Biochemical Co., Tianjing, China). All the serum biochemical values were measured at room temperature.

Analysis of trace elements: Copper (Cu), Molybdenum (Mo), Iron (Fe), Zinc (Zn), Cobalt (Co), Manganese (Mn) and Selenium (Se) were determined by atomic Absorption Spectrophotometry (AAS) (AA-640, Shimadzu Co., Ltd. Tokyo, Japan). Sulphur (S) was determined by nephelometry (Wen *et al*., 1983). The accuracy of the analytical values was checked by reference to certified values of elements in the National Bureau of Standards (NBS, Washington, USA) Standard Reference Material, bovine liver SRM1577a.

Statistical analyses: The data are presented as means±standard deviation. The differences were assessed by Student's t-test. Experiment data were analyzed by using a Statistical Package (SPSS Version for Windows; SPSS, Chicago, Illinois, USA).

RESULTS AND DISCUSSION

Table 1-3 summarize the hematological and biochemical values in the sera from the Guizhou black goat. The concentrations of mineral elements in the blood, hair and tissues are given in Table 4. The liver contained the highest concentrations of Cu, Fe, Mo, Mn, Zn, Co and Se.

All hematological values are reported for the first time for Guizhou black goats in China. The hematological results for Guizhou black goats were within the reference ranges for other ruminants including cattle, sheep and camels (Abdelgadir *et al*., 1984; Shi, 1990; Shen, 2011) with the exception of the Hb concentration which was significantly ($p<0.01$) less than the value for other ruminants (Shi, 1990; Shen, 2009).

Table 1: Mean hematological values in Guizhou black goats

Items	Males	Females	Ranges
RBC (10^{12} L^{-1})	12.90±3.10	13.30±2.60	6.53-14.98
Hb (g L^{-1})	102.60±23.0	107.80±26.0	77.8-156.7
PCV (%)	34.40±3.70	32.20±4.20	21.5-43.6
Neutrophils (%)	53.30±3.60	52.90±3.70	35.6-69.7
Lymphocytes (%)	32.60±6.30	30.80±6.37	22.1-39.1
Eosinophils (%)	8.12±1.27	6.32±1.98	2.9-16.2
Basophils (%)	0.57±0.15	0.45±0.15	0.13-0.89
Monocytes (%)	0.61±0.23	0.73±0.32	0.12±1.38

Table 2: Serum biochemical values in Guizhou black goats

Items	Males	Females	Ranges
Cp (mg L^{-1})	53.3±11.9	51.7±12.5	29.2-73.7
LDH (μmols^{-1}/L)	3.71±0.37	3.67±0.57	1.72-4.37
AKP (IU L^{-1})	256±62	278±71	191-683
AST (IU L^{-1})	36.7±11.9	37.8±8.7	21.6-47.3
ALT (IU L^{-1})	12.7±3.7	13.7±3.9	7.9-18.7
γ-GT (IU L^{-1})	17.3±3.4	15.8±4.5	12.2-25.3
BUN (mmol L^{-1})	5.68±1.31	6.52±2.56	3.56-9.87
Crt (μmol L^{-1})	307±87	316±77	122-436
Chol (mmol L^{-1})	2.65±0.37	2.78±0.31	1.53-4.11
K (mmol L^{-1})	3.73±0.31	4.12±0.57	2.51-6.13
Na (mmol L^{-1})	129±39	122±31	63-198
Ca (mmol L^{-1})	2.17±0.19	2.26±0.23	1.31-3.13
IP (mmol L^{-1})	1.73±0.31	1.68±0.29	0.97-2.56
Mg (mmol L^{-1})	0.91±0.17	0.83±0.29	0.18-1.79

Table 3: Concentration of parathyroid hormone, triiodothronone and thyroxine in serum

Items	Males	Females	Ranges
PTH (ng L^{-1})	123.2±25.30	125.7±31.80	67.7-137.1
T_3 (nmol L^{-1})	1.83±0.37	1.79±0.36	1.55-2.17
T_4 (nmol L^{-1})	53.7±18.10	52.9±13.20	37.7-66.70

Table 4: Concentrations of mineral element in blood, wool and liver of Guizhou black goats

Elements	Liver	Blood	Wool
Se (μg g^{-1})	1.12±0.72	0.053±0.05	0.23±0.03
Fe (μg g^{-1})	2387±837	371±83	278±57
Zn (μg g^{-1})	417±38	15.8±3.9	129±17
Cu (μg g^{-1})	112±22	0.74±0.17	5.37±1.53
Mn (μg g^{-1})	5.11±0.83	0.41±0.11	4.39±1.16
Mo (μg g^{-1})	5.27±2.11	0.51±0.13	0.38±0.11
Co (μg g^{-1})	1.27±0.31	0.73±0.21	1.12±0.26
S (mmol L^{-1})	65±12	37.3±7.1	223±61

All biochemical values are reported for the first time for Guizhou black goats in China. Most of these values were similar to the reference values for cattle (Shi, 1990), sheep (Shen, 2011) and camels (Abdelgadir *et al*., 1984; Bengoumi *et al*., 1999). Essential trace elements are integral components of certain enzymes and of other biologically important compounds that have major physiological and biochemical roles. For example, Se in glutathione peroxidase, Cu and Zn in superoxide dismutase, Fe in hemoglobin and Co in vitamin B_{12}. It is well known that dromedaries have some physiological peculiarities in trace element metabolism due to their adaptation to arid conditions and poor feeding resources (Faye and Bengoumi, 1994). Researchers think that the Guizhou black goats have some physiological peculiarities in trace element metabolism may be due to geographic

(altitude, latitude, climate) and dietary factors. In the present study because it is easier to obtain whole blood than serum, the concentrations of mineral elements were determined for whole blood. The concentration of Zn in whole blood was significantly higher ($p<0.01$) in Guizhou black goats than in dairy cattle (10.91±3.86 mg L^{-1}) (Bengoumi *et al*., 1999) in the same area. The concentration of Se in whole blood was significantly lower ($p<0.01$) in Guizhou black goats than in goats (0.088±0.036 μg g^{-1}) (Shen, 2011) in the same area. The concentrations of the other elements in the blood were within the reference ranges for cattle and goats (Shen, 2011; Youde and Huaitao, 2001).

The reference values for the concentrations of mineral elements in the liver and hair of Guizhou black goats were the first such reports in China. The concentrations of Co, Zn, Mn, S and Mo in the liver and hair were within the reference ranges for camels (Faye and Bengoumi, 1994; Faye *et al*., 1992), cattle (Georgievaskii *et al*., 1982) and sheep (Shen *et al*., 2006) while the mean iron and Cu concentrations in the liver were significantly higher than those in other ruminants ($p<0.01$). In the present study, concentrations of Se in liver and hair were higher ($p<0.01$) than those in goats (the content of selenium are 3.16±1.12 and 0.363±0.072 μg g^{-1} for liver and hair, respectively) (Shen, 2011) in the same area.

CONCLUSION

The hematological and serum biochemical values and mineral contents in the tissues of domestic animals may vary according to geographic (altitude, latitude, climate) and dietary factors. Too little information is available to permit conclusions on the effects of these factors on Guizhou black goat in China. Further studies will also be needed to the effects of diet, regional differences, season of year and the reproductive and physiological status of the animal.

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