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Influence of the Field Type (Mountain and Plain) on the Cupric Status of Lambs

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***Abstract*—**The study realized on alive lambs in two different areas mountain and plain in Batna region, aims to demonstrate the possible effect of field type on cupric status of lambs, through evaluation of copper contents in the chain: soil – plant – animal by atomic absorption spectrophotometry. This comparative study also allowed the investigation of the influence of the age and the season. The results obtained show that contents of copper in the soil, forage in the same way as in the plasma of lambs are higher in the plain than in the mountainous area; however, the difference is significant only between the values of feed.

***Keywords*—**Copper, Forage, Lambs, Plasma copper.

I. Introduction

TRACE elements are minerals present in very small amounts in living organisms. The copper is an ore naturally occurring in the environment.

It is absolutely essential for the normal healthy growth and reproduction of all higher plants and animals [1]. Thus copper (Cu) is an essential trace element for many biological processes of plants and animals. It is required for normal iron metabolism, synthesis of elastin and collagen, melanin production, and integrity of the central nervous system. It also is essential in keratin (wool) production. Copper is one of the key trace minerals required for an effective immune response [2]. It is an essential nutrient as well as a toxicant under practical feeding conditions. Grazing ruminants are most likely to suffer from Cu deficiency. With the exception of P, Cu is the most common mineral deficiency for grazing ruminants in the world [3], [4].

It has a capital importance in the maintenance of biological processes but its bioavailability is compromised by its precariousness and fragility of biodynamic of its passage through soil-plant-animal chain. Among the ruminants the sheep is the most reactive species with copper as well in its defect (enzootic ataxia of lambs) as in its excess (haemolytic jaundice).

Indeed cattle and goats are less susceptible to copper toxicity than sheep [5]. Young ruminants are more susceptible to copper toxicosis than older animals during relatively short-term exposure periods [6].

Mineral status in general and especially cupric in sheep is little studied in Algeria; this is why we chose to realize this work in one of its cities known by its reliefs consisting of mountains and plains as well as the importance of its ovine breeding. The main sought objectives were to determine and to follow the evolution of plasma copper concentrations in lambs of the study area, to evaluate the contribution of copper by an analysis of soil and feed paths. This comparative study allowed moreover the investigation of the influence of some factors such as the age and the season.

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II. Materials and Methods

A. Study Area

The study was realized in two separate areas from the wilaya of Batna located in the Aures massif which is an extension to the east of the great whole mountain range of the Saharan Atlas and it is bounded on the north by the wilaya of Setif, Mila, Oum Bouaghi, to the east by the provinces of Kenchela, Tbessa to the west by the province of M'sila and south by the wilaya of Biskra. The study region is characterized by its semi-arid climate marked by hot, dry summers and cool winters with very erratic rainfall and its extensive sheep breeding. The first (A) is a mountainous region "Arris" with very broken relief located at the south-east of the wilaya, and the second (B) is a plain which is east of the same area it bears the name of Ouyoun El Assafer.

B. Study Animals

The study carried on lambs of local breed "Ouled Djellal", it is among the main local breeds with well defined standard in Algeria, and it is the numerically most important and economically the most interesting. Its represents more than 60% of the national sheep flock known for its rustic character butcher vocation [7] and its adaptation to pasture land [8]. Twelve lambs in each of the two areas were used. For the lambs of each area three age groups were established. The first one includes the lambs whose age is between 2 to 3 months, the second the lambs between 3 and 4 months and the third those between 4 and 6 months.

C. Sampling and Analytical Methods

Samples of soil, forage and blood were collected each season (over a period of one year).

1. Soil

To assess the levels of copper and zinc soil samples from the surface horizon (0-30cm) were made using an auger at both sites A and B.

The samples were dried in an oven at a temperature of 80°C for 48 hours. After cooling the samples are ground in a porcelain mortar to reduce them in fine particles, and then

sieved with a mesh sieve of 60µm [9]. The mortar used was cleaned thoroughly and dried after each grinding to avoid contamination.

The copper extraction in soil was achieved using aqua regia (aqua regia: mixture of pure nitric and hydrochloric acids in proportions 1: 3) [10].

2. Forage

The fresh samples were dried at 60-80°C for 48 hours in an oven ventilated (Memmert brand) in order to prepare them for proper conservation and facilitate grinding. Various plants were finely ground in a micro mill (brand K. Janke and Kunkle IKA-Labortechnik) through a 1mm mesh sieve [11]. This is a procedure that allows the extraction of the majority of the minerals. It is based on the oxidizing properties of acids: nitric (HNO3) and perchloric (HClO4).The copper extraction in plant was conducted through a "wet digestion" [12].

3. Blood

Samples for analysis were taken every season (in both zones). Blood tests are performed at the jugular vein in Vacutainer tubes with lithium héparinate.

Blood samples were processed on a sample of 1ml diluted to 1/5. Proteins are precipitated from plasma according to the procedure recommended by Lamand [13].

The determination of copper concentration in the extract of soil forages and blood was performed by atomic absorption spectrophotometer equipped with flame burner (Shimadzu AA 6800).

D.Statistical Analysis

The results obtained were subjected to statistical analysis by Student't-test (t test) carried out on the software Statitcf. The Excel software was used for the calculation of mean and standard deviation.

III. Results and Discussion

The cupric contents in the soil were 17.11 ± 0.22 ppm and 21.01 ± 0.36 ppm, for respectively, the areas A and B. Copper levels determined in the soil are close to the average values reported by some authors [14]-[16]. However, our results are lower than the value set by the World Health Organization: 30 mg/kg [17]. Comparing the values of the two targeted areas shows that the levels in the plain (B) are slightly higher than those of the mountainous area (A).

This could be related to soil parent materials, that is to say, the geochemical background. Indeed, it is well known that natural levels of metals in the environment vary from one region to another depending on the geochemical background [18] whose the level varies depending on the climate, vegetation and geological environment [19]. Furthermore, the concentration of trace metals in soils are generally associated with mother material; pedogenic sources, and are influenced by anthropogenic activities such as industrial and agricultural activities [20]. It may also be due to the degradation which undergoes soils in the mountainous region which involves losses in nutritive elements.

Table I shows the seasonal variations of copper contents in forages of areas A and B. These results are below the bibliographic values reported by Blood and Henderson (11 ppm) [21]. The comparison between the two areas reveals that the values are constantly higher in area B (Fig. 1). These differences are significant (P <0.05) in autumn, and highly significant (P <0.01) in winter, spring and summer.

TABLE I
SEASONAL VARIATIONS IN COPPER CONTENT OF FORAGES (PPM)

Season	Area A	Area B
Winter	6.60 ± 2.23	9.58 ± 3.06
Spring	6.84 ± 2.26	10.70 ± 4.07
Summer	6.62 ± 2.05	9.66 ± 3.23
Autumn	7.05 ± 2.40	10.49 ± 3.89

These values are low in the mountainous region (A) and get closer to the limit of deficiency recommended by some researchers which is 7 ppm in all ruminants [22], but on the other hand they are close to the average values of the copper contents determined in native plants of a mountainous region in Norway (6 ppm) [23] and those found in pastures of central Punjab for farm livestock (6.48 - 6.90 ppm) [24] ; while in the plain (B), these values are identical to those recommended by Jarrige [25], for the ruminants.

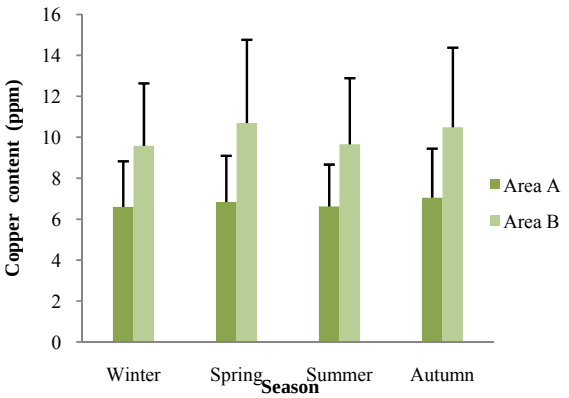

Fig. 1 Seasonal variations in copper content of forages (ppm)

TABLE II
SEASONAL VARIATIONS OF PLASMA COPPER (µg / 100 ml) OF LAMBS

		2 to 3 months	3 to 4 months	4 to 6 months
Area A	Winter	69.38 ± 2.14	78.53 ± 3.01	79.45 ± 7.57
	Spring	77.89 ± 5.76	86.63 ± 7.92	90.99 ± 12.50
	Summer	72.18 ± 7.14	81.44 ± 3.35	83.30 ± 6.12
	Autumn	75.83 ± 3.95	86.97 ± 6.45	88.19 ± 12.03
Area B	Winter	72.90 ± 6.65	80.77 ± 7.43	85.93 ± 11.68
	Spring	81.40 ± 13.77	94.58 ± 16.94	97.70 ± 16.01
	Summer	76.33 ± 22.18	85.34 ± 12.74	88.31 ± 15.77
	Autumn	80.33 ± 11.33	89.25 ± 15.33	93.80 ± 9.44

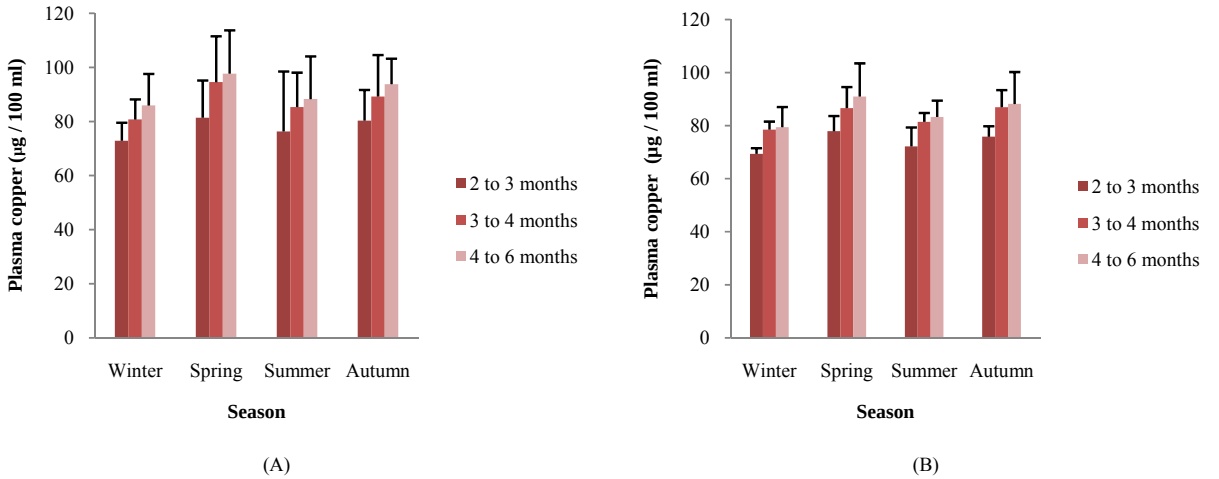

Fig. 2 (A) Seasonal variations of plasma copper (µg / 100 ml) in lambs of area A (B) Seasonal variations of plasma copper (µg / 100 ml) in lambs of area B

Seasonal variations of plasma copper in lambs are reported in Table II. The results show that the plasma copper of lambs of the two areas A and B experienced continuous improvement with age (Fig. 2); these results are in agreement with those of Maach which followed the spontaneous evolution of the plasma copper of lambs according to age, and found that it increases with advancing age of the lamb [26]. The increase of cupremy values with age could be considered as a physiological response to increased copper requirement of the young animal following an intense growth [27]. Thus during the growth the trace element requirements of the animals increase [28].

The values are higher in spring, autumn compared to winter and summer. The fact that the lambs of the two areas A and B have high average cupremy values in spring and autumn compared to winter and summer could be related to the elevated levels of copper taken from forage of the two areas in spring and autumn compared with other seasons.

We note that the results for the three age groups and for the two areas are generally in the range of normal values in sheep plasma copper cited by Blood and Henderson (70-130µg /100ml) [21]. The comparison of the concentrations of the plasma copper of the lambs shows a valuable difference in favour of animals living in the zone B. This could be explained by the relative wealth in copper of fodder paths of the plain.

IV. Conclusion

It appears from the study that cupric values of fodder produced in the hilly area studied are very close to those of the lower limit of dietary recommendations and may predispose to be an area of ovine enzootic ataxia.

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