İstanbul Üniv. Vet. Fak. Derg.
40 (1), 76-82, 2014
Araştırma Makalesi

J. Fac. Vet. Med. Istanbul Univ.
40 (1), 76-82, 2014
Research Article

Appraisal of Transfer of a Few Crucial Minerals from Forage to Ruminants: A Case Study in Pakistan

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Geliş Tarihi / Received: 09.01.2013

ABSTRACT

The purpose of this investigation was to evaluate minerals (copper, selenium, zinc and cobalt) concentrations of plants used as forages and samples of blood plasma of cows in suburb of Sargodha, Pakistan to know the mineral deficiency of excesses so that proper monitoring should be managed. Plant species and samples of blood were collected for four months after one month interval, wet digested and processed by AAS (Atomic absorption Spectrophotometer) for metals determination. All the metals except Cu found in excess that the need of livestock, with some irregular trends of elevation or depression during times of intervals. The plant samples contained low amount of Cu than that required for livestock for various metabolic processes pointing to the warranted need of provision of mineral mixture containing higher amount of Cu for maximizing the productive and reproductive potential of animals. The amounts of Cu and Zn were found to be elevated and much more than the requirements of livestock, while the Co, and at some harvesting intervals Se in plasma found marginally and moderately, anyhow the values of these metals in plasma of cows found optimum for the normal requirement. Based on the findings of this study, the animals should be supplemented with green forages to prevent problems of minerals imbalances for maximizing the animal potential at the specific investigated area which will a most pragmatic approach in regard of minerals provision to the livestock.

Key Words: Ruminants, forages, blood plasma, Pakistan

ÖZET

BAZI ÖNEMLİ MİNERALLERİN MERADAN RUMİNANTLARA OLAN TRANSFERLERİNİN DEĞERLENDİRİLMESİ: PAKİSTAN'DAN BİR ÖRNEK

Bu çalışma, Pakistan'ın Sargodha bölgesinde hayvan yemi olarak kullanılan bitkilerdeki mineral konsantrasyonunun (bakır, selenyum, çinko ve kobalt) belirlenmesi, sığırların kan plazma örnekleri ölçülerek herhangi bir mineral yetersizliğinin araştırılması ve bu doğrultuda uygun bir takip sisteminin oluşturulması amacıyla yürütülmüştür. Bitki ve kan örnekleri 4 ay boyunca 1 ay aralıklarla toplandı, metallerin saptanması için yaş yakma yöntemi uygulanarak, atomik absorbsiyon spektrofotometre ile işleme tabi tutuldular. Çalışma süresince Cu dışındaki metallerin düzensiz bir şekilde azalma ya da artma eğilimi gösterdiği ve hayvanların ihtiyacından daha yüksek düzeyde oldukları belirlenmiştir. Hayvanların çeşitli metabolik ihtiyaçları için gerekli olandan daha az Cu ihtiva eden bitki

örnekleri, çeşitli verim parametrelerini maksimize etmek için daha fazla Cu içeren mineral karışımı sağlanmasının gerekli olduğuna işaret etmektedir. Cu ve Zn miktarının arttığı ve hayvanların ihtiyacından oldukça fazla olduğu belirlenmiştir. Co miktarının ve bazı hasat aralıklarında plasma Se düzeyinin az miktarda ve orta düzeyde olduğu saptanmıştır. Yine de bu metallerin sığır plazmasındaki düzeyleri normal gereksinim için optimal düzeyde olduğu belirlenmiştir. Bu çalışmanın bulgularına dayanarak, incelenen özel bir alanda hayvanın potansiyelini maksimize etmek için mineral dengesizliğinden kaynaklanan problemleri önlemek adına hayvanların yeşil yemle beslenmeleri, mineral tedariği açısından pratik bir yaklaşım olacaktır.

Anahtar Kelimeler: Ruminantlar, otlak, kan plazması, Pakistan

Introduction

In Pakistan nearly 30 million herds of livestock depends upon the natural pasture and ruminants contributes about 400 million US$ to national income (Anonymous, 2003). The proper use of forage in the natural pastures is the prime factor to enhance the effect of pastureland on livestock. Both macro and trace elements have a key role for the growth at different stages of both plant and animal live. The mineral concentration of forages varies greatly and is mostly affected by various edaphic and other environmental factors in addition to different stages to the plant growth (Khan et al., 2005, 2010). It has been reported that concentrations of different animals of various ruminants and this concentration not only has a pronounced effect on the palatability of forages, but also badly affect the degree of health production and productivity of farm to the larger extent and various disorders are caused in ruminants because of imbalances of essential minerals in forages (Ganskopp and Bohnert, 2003). In many cases main constraints in the maximization of animal reproduction potential is related to mineral contents of the forages consumed by the livestock in the postures of many regions of Pakistan as the grazing livestock obtain major portion of their forages and mineral nutrients requirements from the pastures (Khan et al., 2009b; Rasool et al., 2005). It is therefore, imperative to know the mineral contents forage mostly sown forage varieties in order to have knowledge of their mineral contents regarding the need of animals in order to formulate the various supplementation regimes after establishing different level in forage consumed by the animals to enhance their productivity at livestock farm. Some other studies in specific area of Southern Punjab Pakistan have been made by Khan et al. (2003; 2006; 2007; 2008; 2010) concluded that both natural and improved pastures were not only marginally deficient in mineral in relation to the requirements of the livestock, but also adversely affecting productivity of livestock. Until now, no information on the mineral concentrations of forages on this specific animal farm, Sargodha, Punjab, Pakistan is available. Therefore, the premier goal of this study to evaluate the status of some essential minerals of commonly sown and improved varieties of forages in relation to cattle pasture allowance of minerals in this animal ranch along with mineral status of blood plasma of cows. The findings will help producers, scientists working in extension services and ranch managerial personnel's for improving and enhancing reproduction potential of ruminants at this rural livestock farm.

Materials and Methods

Study Site

Samples of forage and blood plasma were obtained from the Rural Livestock Farm in Sargodha, Pakistan. The annual rain fall is nearly 180 mm confined to the months of July and August with minimum average temperature 2 ^{0}C and maximum 49 ^{0}C. Pasture comprised of some native and improved varieties of forages available to animals at the farm. Most dominant forage species at the time of sampling included, legumes and grasses in addition to some minor forage species

Sample Collection and Preparation For Analytical Work

Forage: Forage samples were obtained during four months after one month interval from the pasture, each sample comprised of five sub-samples. The samples of forages were taken with a knife, put in plastic bags, dried in

an oven at 65 ^{0}C for 96 hours. Dried forage samples were ground sieved and kept in plastic bags for analysis. Forage samples were prepared for chemical analysis using the processes outlined by Khalili et al. (1993) and Khan et al. (2009a).

Animals: Ten grazing dairy cows (5-6 years old and lactating) were selected for blood sampling. Blood samples were collected four times during the year. Blood samples were taken from the jugular vein into vacutainer tubes allowed clotting for six hours and centrifuge (1500 rpm for 10 min). The blood sera were treated immediately with 10% tricholoroacetic acid (TCA), (1 part serium: 4 part TCA) and centrifuged (for 1500 $_g$ for 10 min). The supernatants were stored at the room temperature until proceed for mineral analysis. Concentrations of copper, zinc, manganese, and cobalt in serum and forage samples were measured by FAAS (Perkin-Elmer). Selenium concentration was determined flourimetrically.

Statistical Analysis

The data thus obtained were subjected to statistical analysis by using Statistical software SPSS to check the significance levels at 0.01, 0.05 and 0.001 following the procedures outlined by Steel and Torrie (1986).

Results

Forages Minerals: Forage Cu ranged from 2.1 to 1.13 mg/Kg across all the sampling intervals (Figure 1a). There was no prominent variation in forage Cu up to the 3 rd sampling period with inconsistent trend of elevation and depression during different samples harvesting intervals. Forage Cu was found to be higher during sampling interval 4th and decrease to the lowest level during sampling interval 3rd. during this survey. Forage Co was found to be above the requirement, throughout the sampling month with exception of 3 rd collection, where its level was slightly lower. It ranged from 10.6 to 3.6 mg/kg across all the sampling months. There was much sampling period effect on Co in forage samples at different sampling times, with trends of elevation and depression in forage Co was also observed (Figure 1b). Se level varied from 0.25-0.15 mg/kg during various sampling intervals with inconsistent pattern of increase or decrease at different sampling time. The higher value of forage Se was observed during harvesting interval 4th and its low level was observed during 2nd sampling interval. And at the last sampling it showed sufficient amount of forage Se for the grazing and lactating animal's requirement (Figure 1c). Although during some sampling periods it improved its status, generally in parallel to the requirements of ruminants. Forage were sufficient in Zn throughout in all seasons (Figure 1d) forage Zn concentrations were highest at period 4th, but lower in the middle of sampling season. Its concentration varied from 92.5 to 58.5 mg/kg among all sampling seasons and all values were higher than the dietary recommended for animals. Forage Zn concentrations for all sampling seasons were not uniform and exhibited inconsistent fluctuations during this investigation.

Plasma Minerals: Mean plasma Cu exhibited inconsistent variation across all sampling months varied from 0.32-0.75 mg/L with maximum level at harvesting period 2nd and minimum level at 4th sampling interval (Figure 2a). Mean plasma Cu concentrations at all sampling season observed were at marginal deficient level during 1st sampling term up to 3rd. It remained sufficient for the requirements of ruminants. Mean plasma Co values were highest at the sampling month 4th and lowest at the month 1st across the sampling season (Figure 2b). Values varied from 0.22 to 0.89 mg/l with all values with some instances at sampling period 1st during sampling season there was severe deficiency. Mean blood plasma Se concentrations were not variable among the sampling months and almost no significant differences were found with non seasonal or sampling period effect. During sampling month 2nd where it was at marginal deficient level, while during other sampling periods the concentrations of plasma Se was much lower pointing to the dire need of supplementation of animals grazing there in. Se concentration increased from 1st to 2nd sampling

months, then it leveled off up to last sampling time (Figure 2c). Blood plasma Zn concentrations ranged from 0.85 to 1.35 among samples harvesting intervals with the higher amount was found at 2nd harvesting period and lower at the 3rd interval of sampling with inconsistent pattern of increase or decrease (Figure 2d).

Discussion

Copper in forages during all harvesting intervals were lesser than the need of 10 mg/kg as described for ruminants (NRC, 1996). However, these values were optimum for those livestock which need Co ranging from 0.10 to 1.0 mg/kg in their diet (NRC, 1996). Se deficient level in forages have already been reported by Khan et al. (2008; 2010) and McDowell and Arthington (2005) and Cuesta et al. (1993) During present investigation all forage samples analyzed for Se showed a marginal deficiency in relation to the requirement livestock as suggested by NRC (1996) for cattle. Cobalt blood plasma values were higher than the above the critical level of 0.25 ug/ml (Khan et al., 2011; McDowell and Conrad, 1977; Underwood, 1981). There is hardly a data in literature related to C study in plasma of grazing animals, but Khan et al, (2006; 2007; 2008; 2009b; 2010) have done preliminary investigation in a semi arid region to evaluate the plasma cobalt status in ruminant in a specific animal ranch in Punjab, Pakistan, and have reported deficient levels of this element in soil, forages and in ruminant grazing livestock. The results of this investigation are in conformity with those reported by Rehman et al. (1998) who described normal range of plasma cobalt while conducting investigation on lactating cows in Sudan. Anyhow, deficiency of this element has been reported in different countries of the world in grazing livestock (Judson and McFarlane, 1998). However, all means levels of this mineral were less than the reference or required value of 0.03 mg/L as suggested by Underwood (1981).

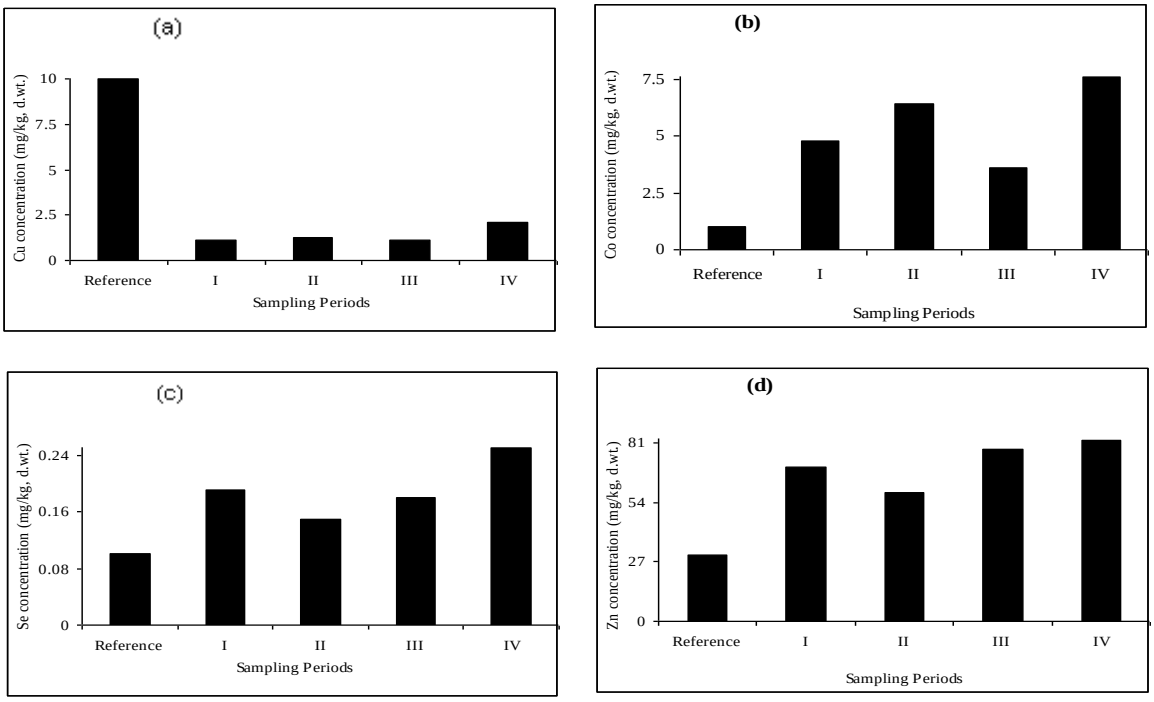

Figure 1a-d. Micromineral contents in dried forages with respect to four different sampling periods [(a) Cu, (b) Co, (c) Se, (d) Zn].

Şekil 1a-d. 4 Farklı örnekleme periyodunda kuru mera otunda mikromineral içerikleri.

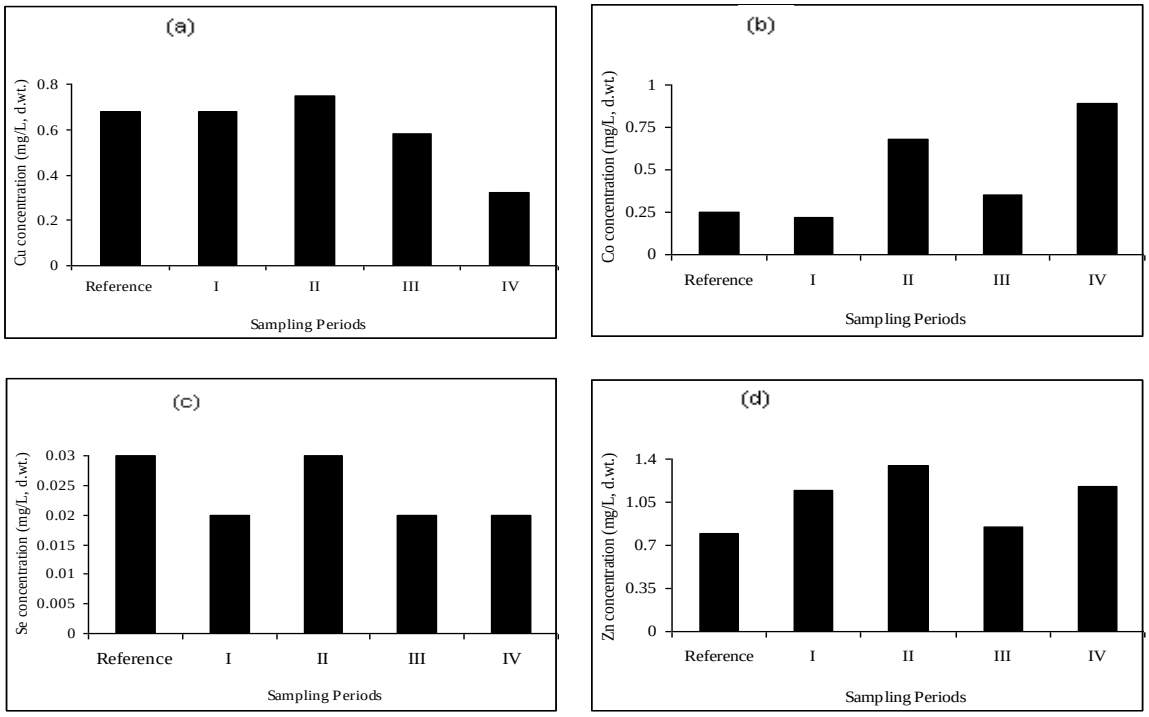

Figure 2a-d Micromineral contents in plasma with respect to four different sampling periods [(a) Cu (b) Co, (c) Se (d) Zn].

Şekil 2a-d Dört farklı örnekleme periyodunda plazmadaki mikromineral içerikleri.

Low levels of plasma Se in different classes of ruminants have previously been found by Khan et al. (2005; 2007; 2009a) in Pakistan, Cuesta et al. (1993) in Florida and Rehman et al. (1998) in western Sudan. It has been found that low level of Se in blood plasma could be related to its intakes, but in our investigation although there was high concentration of forage Se which can't be assumed to be available to the animals in large proportion, but its availability mostly depend on its chemical form and proportion with the other minerals in the diet (Khan et al., 2009a; McDowell, 1985). However, the low levels of plasma Se could not be expected in this study as ruminants were consuming diet with adequate amounts of Se contents, but it suddenly dropped to low level according the critical value established by Underwood (1981) for various types of livestock form. Khan et al. (2005; 2006; 2008) reported similar values of plasma Cu in Pakistan and Rehman et al. (1998) in western Sudan. The low values of plasma Cu in lactating cattle may possible be due to the insufficient amount in forages, found in this investigation as it has previously been reported by Khan et al. (2009b), Mukhtar et al. (1970) and Rehman et al. (1998) that Cu concentrations in soil, forages are strongly correlated. Results of our investigation support the findings of earlier researchers that Cu deficiency in ruminants is wide spread in grazing animals in different regions of the world (Khan et al., 2008; 2010; McDowell, 2003; Tartour, 1975). Although all values showed optimum level for the requirements of livestock, but these were at marginal deficient levels suggesting the need of supplementation as these values, although higher than the reference or required value of 0.80 mg/L (McDowell and Conrad, 1977; Underwood, 1981).The forages Zn values were sufficiently higher than the requirements, but these did not reflect in blood plasma as might be due to

interaction or antagonism of some other mineral elements in the forages in combination with it or in the gastrointestinal tracts of the ruminants (Khan et al., 2008). The low values of plasma Zn have already been reported by Abu Damir et al. (1988) and Rehman et al. (1998) in different regions of Sudan and Khan et al. (2005; 2006; 2007; 2011) in Pakistan while working on blood mineral status of different livestock form. In conclusion low plasma mineral concentrations of some trace minerals in lactating cattle in the central region of Punjab, Pakistan were due to low feed intakes of these minerals and may have contributed to mineral utilization help explain the findings of this study. Further on Se, Zn, Cu and Co levels research is warranty needed on mineral supplementation programs for the improvement of ruminant productivity and production potential in this arid region of Pakistan.

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