Determination of Boron Level in Feeds Used in Cattle Nutrition in Regions of Central Anatolia and Mediterranean of Turkey

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Abstract: In this study, samples of forage (alfalfa hay, corn silage, silage of common vetch with triticale, wheat straw), feed ingredient (barley grain, corn grain, wheat grain, wheat bran, corn meal, corn bran, corn gluten meal, cottonseed meal, soybean meal, sunflower meal, dried digestible grain solubilty), and concentrate feed (calf grower feed, heifer feed, dairy cattle feed and beef cattle feed) were collected from various feed mills and dairy cattle farms in the Central Anatolia and Mediterranen Regions of Turkey and analysed to determine their boron levels. Boron concentration ranged from 23.9 to 39.1 ppm in forages. In feed ingredients, concentrations of B varied between 4.1 and 36.4 ppm, with barley grain and soybean meal having the lowest and highest levels, respectively. Average B concentration of concentrate feeds was 20.1 ppm and beef cattle feed and heifer feed had the lowest (12.0 ppm) and highest values (27.9 ppm), respectively.
Keywords: Boron, Forage, Feed ingredient, Concentrate feed

İç Anadolu ve Akdeniz Bölgelerinde Sığırların Beslenmesinde Kullanılan Yemlerin Bor Düzeyinin Belirlenmesi

Özet: Bu çalışmada, İç Anadolu ve Akdeniz Bölgelerinde bulunan bazı yem fabrikaları ve süt sığırı işletmelerinden toplanan kaba yem (yonca kuru otu, mısır silajı, fiğ-tritikale silajı, buğday samanı), yem hammadde (arpa, mısır, buğday, buğday kepeği, mısır özü küspesi, mısır kepeği, mısır gluten unu, pamuk tohumu küspesi, soya fasulyesi küspesi, ayçiçeği tohumu küspesi, kurutulmuş damıtık tahıl) ve karma yem (buzağı büyütme yemi, düve yemi, süt yemi, besi yemi) örneklerinde bor düzeyleri belirlenmiştir. Kaba yemlerde B düzeyi 23.9 - 39.1 ppm arasında değişmiştir. Yem hammaddelerinde B düzeyinin 4.1 – 36.4 ppm arasında olduğu, arpa ile soya fasulyesi küspesinin sırasıyla en düşük ve yüksek düzeylere sahip oldukları saptanmıştır. Karma yemlerde ortalama B düzeyinin 20.1 ppm olduğu ve sığır besi yeminin en düşük (12.0 ppm), düve yeminin en yüksek (27.9 ppm) B düzeylerine sahip oldukları belirlenmiştir.
Anahtar Sözcükler: Bor, Kaba yem, Yem hammaddeleri, Karma yem

INTRODUCTION

Boron (B) has been known to be an essential trace mineral for all higher plants since 1920s (Nielsen, 2008). Numerous studies reported that B effected on cell wall structure, sugar transport, cell wall division, plant hormone regulation, flowering and fruiting (Schmidt et al. 2000). Researches on biochemical roles of B in human and nonruminant animal (e.g. poultry) nutrition have been extended over the past decade (Armstrong et al. 2000). Boron seems to affect bone mineralization and structure (Eren, 2004) and also has a role in the immune system (Armstrong and Spears, 2003). On the other hand, only a limited number of studies have focused on the effect of B on ruminant nutrition, especially cattle nutrition. Also, there has been relatively few number of research involving B level in livestock feeds. The knowledge of the B level in feeds is important for researchers interested with the mineral supplementation or toxicity. Therefore, the objective of this study was to determine B level in certain forages, feed ingredients, and concentrate feeds used cattle nutrition in Turkey.

MATERIAL and METHODS

Feed Samples

Feed samples were collected from various feed mills and dairy cattle farms in the Central Anatolia and Mediterranen Regions of Turkey.

All test feed samples (Table 1) were ground to pass through a 1 mm screen for chemical analysis. The samples except for silages were dried at 105°C for 4 h. The silage samples were dried by a forced-air oven drying at 60°C for 48 h.

Boron Analyses

Boron concentration in feed samples was determined via inductively coupled plasma optical emission spectroccopy (ICP-OES, Varian Liberty II, Varian Inc, Sydney, Australia). Teflon tubes were used in the digestion procedure to avoid possible B contemination from glass. The teflon tubes were acid washed prior to feed digestion (Hunt and Shuler, 1990). Approximately 0.5 g of feed was added to 50 ml teflon tubes and digested in a closed vessel microwave digestion (CEM, MARS5, Matthews, NC) using 10 ml nitric acid and 3 ml hydrogen peroxide. Nitric acid and hydrogen

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peroxide ultra-pure grade were purchased from Merck. Following microwave digestion, samples were brought up to 25 ml using distilled water (Kalra, 1998). All analyses were performed in triplicate.

Table 1. Boron levels in feeds used cattle nutrition (means±standard error)

Feeds	Boron levels (ppm, as fed basis)
Forages	
Alfalfa hay	39.1±0.53
Corn silage	38.6±050
Silage of common vetch with triticale	23.9±0.50
Wheat straw	23.9±1.05
Feed ingredients	
Barley grain	4.1±0.90
Corn grain	22.1±0.60
Wheat grain	28.9±0.50
Wheat bran	27.9±0.80
Corn meal	22.0±0.50
Corn bran	22.7±0.50
Corn gluten meal	9.2±0.50
Cotton seed meal	21.7±0.70
Soybean meal	36.4±0.50
Sunflower meal	29.2±0.80
Dried digestible grain solubility	23.3±1.80
Concentrate feeds	
Calf grower feed	13.5±0.60
Heifer feed	27.9±0.60
Dairy cattle feed	27.1±0.70
Beef cattle feed	12.0±0.70

Statistical Analyses

A descriptive analysis (means and standard error) of the B concentration in feed samples were performed using SAS program package (SAS, 2004).

RESULTS and DISCUSSION

The present study was conducted to determine B concentration in feeds used cattle nutrition. Most of macro and trace mineral concentrations in feeds can be found in reference book such as Nutrient Requirements of Dairy Cattle (2001). However, little information is available on the B concentration in livestock feed ingredient and feeds.

Boron concentration of the forages varied between 23.9 – 39.1 ppm (Table 1). The highest B concentrations was determined alfalfa hay (39.1 ppm) and corn silage (38.6 ppm). It was reported that B concentration was higher during early cereal growth and as plant growth concentrations falling from 7 to 2 ppm (dry matter basis) B in wheat plants (Silanpaa, 1982). In addition, B values tend to be lower in legumes than in grasses and Leach (1983) reported values from 35 to 66 ppm DM in alfalfa (*M. sativa*) grown under subtropical conditions. Similar to this, B concentration of alfalfa was determined 39 ppm in the study.

Boron concentrations in feed ingredients varied within a wide range from 4.1 to 36.4 ppm. Barley grain contained exceptionally low (4.1 ppm) B concentration. The highest B concentrations were determined in soybean meal (36.4 ppm) and sunflower meal (29.2 ppm). Dear and Weir (2004) stated that B concentration in young leaves of sunflower was 35-200 ppm.

It was determined that heifer and dairy cattle concentrate feeds had almost same B concentrations (respectively, 27.9 *vs.* 27.1 ppm). B concentrations in calf grower and beef cattle feeds were 13.5 ppm and 12 ppm, respectively.

The requirement of B for ruminants is unclear. Kabu et al. (2013) suggested that administering sodium borate (30 g/d) positively effected metabolic balance and preventing metabolic disorders such as milk fever and hypomagnesemia during the periparturient period of dairy cattle. Small et al. (1997) reported that dietary B influences the metabolism of Ca, Mg, P and Cu. Unfortunately, it has been not found any document on requirements of ruminants.

Turkey has 72% of the world's B reserves. But, there has been no published study about the B levels in feeds and feed ingredients. The present study could have potential to contribute the present literature regarding B levels in feeding materials of livestock.

REFERENCES

Armstrong, T.A., Spears, J.W. 2003. Effect of boron supplementation of pig diets on the production of tumor necrosis factor-alpha and interferon-gamma. Journal of Animal Science, 81:2552-2561.

Armstrong, T.A., Spears, J.W., Crenshaw, T.D., Nielsen, F.H. 2000. Boron supplementation of a semipurified diet for weanling pigs ımproves feed efficiency and bone strength characteristics and alters plasma lipid metabolites. The Journal of Nutrition, 130: 2575-2589.

Dear, B.S., Weir, R.G. 2004. Boron deficiency in pastures and field crops. Agfact P1.AC.1, 2nd edition.

Eren, M., Uyanık, F., Küçükersan, S. 2004. The influence of dietary boron supplementation on egg quality and serum calcium, inorganic phosphorus, magnesium levels and alkaline phosphatase activity in laying hens. Research in Veterinary Science, 76: 203-210.

Hunt, C.D., Shuler, T.R. 1990. Open vessel, wet ash, low temperature digestion of biological materials for induc- tively coupled argon plasma spectroscopy analysis of boron and other elements. Journal of Micronutrient Analysis, 6: 161–74.

Kalra, Y.P., 1998. Handbook of reference methods for plant analysis. Soil and Plant Analysis Council. Salem, MA 01970 USA.

Kabu, M., Birdane, F.M., Civelek, T., Uyarlar, C. 2013. Affects of boron administration on serum Ca, Mg and P for peripartum cows. Archiv Tierzucht, 56: 1-19.

Leach, G.J. 1983. Influence of rest interval, grazing duration and mowing on the growth, mineral content and utilisation of a lucerne pasture in a sub-tropical environment. Journal of Agricultural Science, Cambridge 101: 169–183.

Nielsen, F. H. 2008. Is boron nutritionally relevant? Nutrition Reviews, 66(4):183–191.

NRC 2001. Nutrient requirements of dairy cattle, 7th review ed. National Academy of Sciences, Washington DC, USA.

SAS, 2004. SAS User's Guide: Statistics, Version 8.0. SAS Inst., Inc., Cary, NC, USA.

Schmidt, A., Heider, B., Schultze-Kraft, R., 2000. Preliminary studies on the influence of boron on forage quality of the pasture legume Desmodium ovalifolium. Faculty of Agronomy University of Zulia (LUZ) 17: 288-294

Silanpaa, M. 1982. Micronutrient and the nutrient status of soils: a global study. Food and Agriculture Organization, Rome, p. 91.

Small, J. A., Charmley, E., Rodd, A. V., Fredeen, A.H. 1997. Serum mineral concentrations in relation to estrus and conception in beef heifers and cows fed conserved forage. Canadian Journal of Animal Science. 77: 55–62.