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THE EFFECT OF AGE AND HEAT TERM AND DURATION ON MAGNESIUM CONTENT IN MARES' MILK

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INTRODUCTION

Foals spend the first days of their lives with their mothers (CROWELL-DAVIS 1986) and feed only on mares' milk, which is complete food for a young organism, containing all the components necessary for proper growth and development (SASIMOWSKI, BUDZYŃSKI 1988). It is very important to feed the mare properly during that time (MAX 1996). Milk composition changes during lactation (KULISA 1970). The growth rate of foals depends on the changes which could be connected to the physiological state of a mare, including its heat and pregnancy. During the first hours after parturition, the mammary gland produces colostrums, which is richer in dry matter, protein, fat, vitamins and all minerals except calcium (CSAPO-KISS et al. 1995) and phosphorus (GRACE et al. 1999b) but contains less lactose (BOUWMAN, VAN DER SCHEE 1978, KULISA 1980). Mineral elements play a very important role in the development of young organisms, both because of their building properties and also as important components of enzymes catalyzing basic biochemical reactions (ANDERSON 1991). The quantities and proportions of minerals decide about the proper development of horses. But their content in a mare's milk is relatively low. Depressed levels of minerals in milk causes disturbances in bones' and teeth's development and in cell metabolism. A deficit in minerals means that the proportions between elements are not balances, which leads to abnormalities in the assimilation of nutrients in intestines.

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Magnesium, like calcium and phosphorus, is found mainly in bones and teeth (GRACE et al. 1999a), with the remaining amounts present in soft tissues and liquids. In milk magnesium is found as dissolved compounds (75%), colloids and some free ions. Positive correlation was found between magnesium and calcium content (PIJANOWSKI 1984). Magnesium is one of the most important activators of enzymes and its deficit could cause many metabolic diseases (trismus and jerks) (SASIMOWSKI, BUDZYŃSKI 1988).

The aim of this study was to evaluate Arabian mares in terms of their age and heat term and duration in relation to the concentration of magnesium in their milk.

MATERIAL AND METHODS

The research was carried out on 30 mares and 30 foals of Arabian breed. Milk samples were collected from mares to evaluate the magnesium level. The first milking was carried out 2 days after parturition, which was when the milk had already changed from colostrums. (LE BLANC 1990, MCCLURY 1993, TISCHNER et al. 1996). The next samples were collected every 2 days until day 30 after birth. Mares were milked in the afternoon when it was quiet in the stable. Milk samples (about 150 ml) were obtained by hand milking into sterile, plastic bottles with procaine penicillin as a preservative and then the samples were frozen in –20 °C until the chemical analysis. In the next stage the concentration of magnesium was determined. For this purpose all samples were lyophilized in a Labor-Mim 90 apparatus and then mineralized in a mixture of acids (1 part of nitric acid : 1.5 part of perchloric acid). The ash samples were then dissolved in distilled water and analyzed in a Philips PU 9100 apparatus (ANON 1982). Magnesium content was defined in mg/kg of milk.

Afterwards, the mares were divided into three groups according to these factors:

- Mares' age: I group – younger mares to 8 years, II group – mares age from 8 to 12 years, III group – older mares over 12 years of age.
- Heat term: I group – mares with earlier heat on day 4 to 7 after parturition, II group – mares with heat on day 8 to 10 after parturition, III group – mares with later heat on 9 to 30 day after parturition.
- Heat length: I group – mares with shorter heat 1–3 days, II group – mares with heat of 4–7 days; III group – mares with longer heat of 8–12 days.

The results were statistically worked out using computer program Statistica for Windows 5.0. Milk composition was analyzed according to one-factor variance analysis:

$$Y_{ij} = \mu + a_i + e_{ij}$$

μ – mean of the population,
a_i – effect of the factor on milk composition,
e_{ijkl} – random error.

Duncan's test was used to show if there were any statistical differences between the groups.

RESULTS AND DISCUSSION

The average magnesium level in the Arabian mares' milk was 95.86 mg/kg of milk. The mare called Plisa produced milk with the highest average concentration of magnesium (154.15 mg/kg of milk) and Grenlandia's milk was the poorest in Mg (44.83 mg/kg of milk). Magnesium content in milk was significantly positively correlated with the levels of phosphorus, sodium, potassium, zinc, copper and lithium. No negative correlation coefficients were observed in the study (Tab. 1). Figure 1 shows the curve of magnesium concentration in the mares' milk during 30-day-long lactation. The highest level was observed on the 4th day after parturition (118.91 mg/kg of milk), and the lowest – on the 18th day of lactation (84.61 mg/kg of milk). The concentration of magnesium clearly tended to decrease in the first half of the lactation observed, i.e. between day 4 and 12 (Fig. 1).

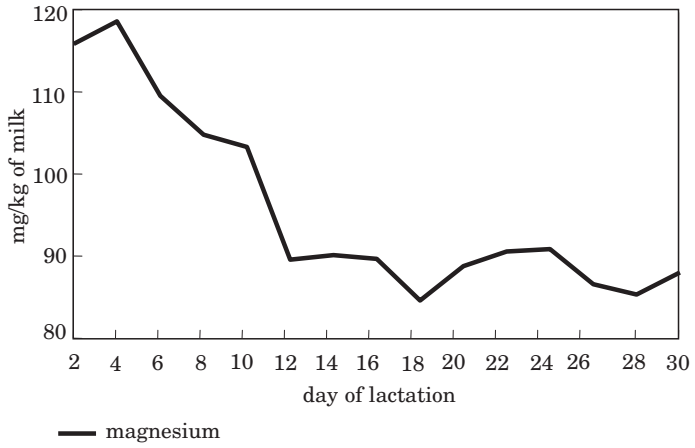

Fig. 1. Magnesium level in Arabian mares' milk during first month of lactation

The older mares produced milk with the highest level of magnesium during the whole lactation period, with only one exception – on the 24th day after parturition younger mares gave milk richer in magnesium. Significant statistical differences were observed in 2, 4 and 12 days between older and other mares (Fig. 2).

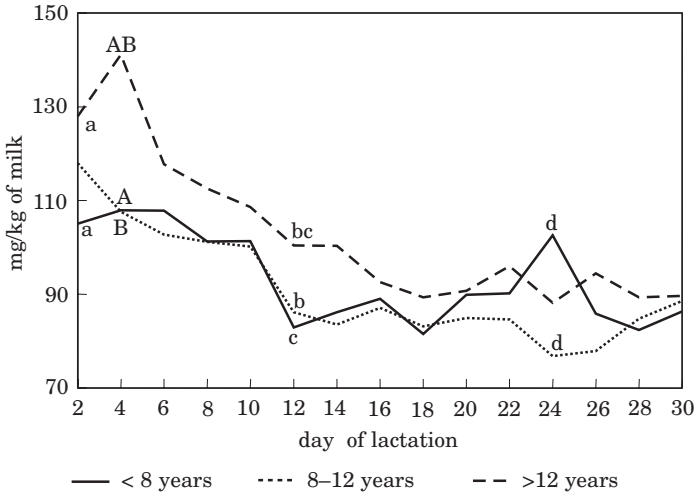

Fig. 2. Magnesium level in Arabian mares' milk during first month of lactation concerning mares' age. Values marked by the same capital letters differ highly significantly (P=0.01), small letters – significantly (P=0.05)

As regards the heat term, mares with earlier heats produced milk with the lowest content of magnesium during whole lactation except day 24, when the Mg level was higher than in milk of the other mares. Significant differences were observed on days 2, 4, 8 and 12 after parturition. The magnesium content was observed to have decreased for the group of mares on heat later than 10 days after parturition (Fig. 3).

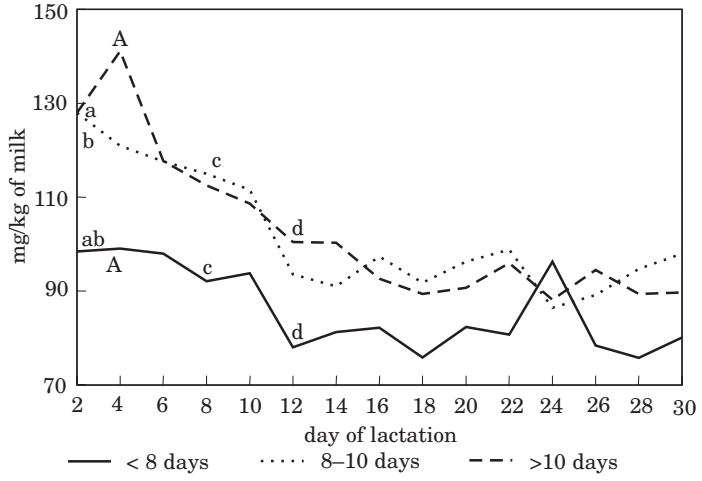

Fig. 3. Magnesium level in Arabian mares' milk during first month of lactation concerning terms of mares' heat. Values marked by the same capital letters differ highly significantly (P=0.01), small letters – significantly (P=0.05)

While analysing the effect of heat duration on the magnesium content in milk it was noticed that mothers with an length of heat (4–7 days) produced milk richer in magnesium than mares with longer heats. Significant differences between these groups were observed on days 6, 8, 18, 20 and 30 after parturition (Fig. 4).

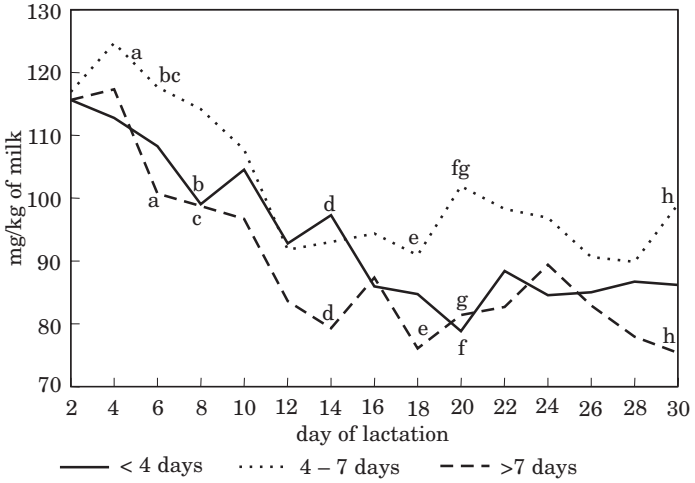

Fig. 4. Magnesium level in Arabian mares' milk during first month of lactation concerning the length of mares' heat. Values marked by the same capital letters differ highly significantly (P=0.01), small letters – significantly (P=0.05)

The environmental conditions have a significant effect on milk composition (KULISA 1970). LONERDALL (2000) in a study concerning women's milk suggested that there was a special mechanism in the mammary gland regulating the level of mineral elements regardless of the mothers' diet. During the first week after parturition it is possible to observe noticeable changes in the concentration of milk components, which is connected to the transformation from colostrums into milk (CSAPO-KISS et al. 1994). On the first day after parturition colostrums differs the most from milk (JOHNSTON et al. 1970, FUENTES GARCIA et al. 1991), being much richer in minerals (OFTEDAL, JENNES 1988).

It is necessary to point that PEAKER et al. (1979), who studied the mammary gland secretion 3 weeks before foaling, stated that sodium and chlorine levels decrease but the concentrations of calcium, phosphorus, magnesium and potassium increase during that time. They also found out that the amounts of calcium in mammary secretion before foaling could be an indicator for assessing the parturition time. Similar conclusions were drawn by LEY (1994) and LISOWSKA at al. (1995). HOWEVER, WALECHLI et al. (1990) suggested that early secretion from the mammary gland before foaling is the most important cause for poor value of the colostrums.

The average level of magnesium in this study was slightly higher than the results obtained by other researchers except HOLMES et al. (1947), who determined 112 mg of magnesium in kg of milk on day 28 of lactation. In the same study, the concentration of magnesium tended to decrease. Similar dependencies were shown by other authors (SONNTAG et al. 1996). GRACE et al. (1999) determined 298 mg of magnesium in kg of milk on the 1st day after parturition and 58 mg of magnesium in kg of milk on the 28th day of lactation. CSAPO-KISS et al. (1994) observed significant decrease in the magnesium content from 140 mg/kg on day 2 to 66 mg/kg on day 45 of lactation in the milk from different breeds, but MARTUZZI et al. (1995) showed 116 mg/kg on day 3 and 88 mg/kg on day 40 after parturition. No correlation coefficients between magnesium and the content other minerals in the mares' milk were found in the present research.

Our results show that the age factor has a significant effect on the magnesium content in the mares' milk. Significantly higher magnesium concentration was determined in the milk from the older mares. Many authors suggested that age is a limiting factor for milk production, especially in mares older than 15 years (SIANYEVA 1954, LEONHARD 1956, ALAGUZHIN 1964, 1974), which is connected to certain morphological changes in the mammary gland (TARASEVICH 1979). These changes probably do not affect the magnesium osmosis in the udder of mares.

The present work demonstrated that the mares' heat term significantly influenced the magnesium content in milk, i.e. mothers with earlier heats (before the 8^{th} day after parturition) produced milk with significantly lower level of magnesium, especially during the first part of 30-day-long lactation. Also mothers with shorter (<4 days) and longer (>7 days) heats gave milk with lower concentration of magnesium with the exception of the 14^{th} day after parturition. Mares characterized by heats with a medium length produced milk with a significantly higher magnesium content, especially on days 6, 8, 18, 20 and 30 of lactation.

CONCLUSIONS

It was found that the magnesium concentration decreased during 30-day-long lactation, especially from the 4^{th} to 12^{th} day after parturition. Older mares produced milk with the significantly higher level of magnesium. Also the heat term influenced magnesium concentration – mares with earlier heat produced milk with the lowest magnesium content. Mares with heats lasting 4 to 7 days produced milk with the highest level of magnesium.

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WPŁYW WIEKU, TERMINU WYSTĄPIENIA I DŁUGOŚCI RUI NA ZAWARTOŚĆ MAGNEZU W MLEKU KLACZY

Słowa kluczowe: klacz, laktacja, magnez,

Abstrakt

Skład mleka klaczy zmienia się podczas laktacji. Od tych zmian zależą tempo wzrostu i rozwoju źrebiąt, natomiast na zmiany te wpływa wiele czynników, m.in. stan fizjologiczny klaczy. Celem pracy było zbadanie wpływu wieku oraz terminu wystąpienia i długości rui na zawartość magnezu w mleku klaczy. Badania prowadzono na 30 klaczach czystej krwi arabskiej.

Stwierdzono, że poziom magnezu obniżał się w ciągu 30-dniowej laktacji, szczególnie w okresie od 4. do 12. dnia po ożrebieniu. W mleku klaczy starszych była istotnie wyższa koncentracja magnezu. Także termin wystąpienia rui oddziaływał na poziom omawianego pierwiastka – klacze z rujami dawały mleko uboższe w magnez. Mleko najzasobniejsze w magnez produkowały klacze, u których ruja trwała średnio 4–7 dni.

THE EFFECT OF AGE AND HEAT TERM AND DURATION ON MAGNESIUM CONTENT IN MARES' MILK

Key word: mare, lactation, magnesium.

Abstract

Milk composition changes during lactation. The growth rate of foals depends on these changes, which could be connected to the physiological state of the mares. The aim of this study was to evaluate the effect of Arabian mares' age and their heat term and length on the magnesium level in the milk. The research was carried out on 30 Arabian mares.

It was confirmed that the magnesium concentration decreased during the 30-days' lactation, especially from the 4^{th} to 12^{th} day after parturition. Older mares produced milk with the significantly higher level of magnesium. Also the heat term influenced Mg concentration – mares with earlier heat produced milk with the lowest magnesium content. Mares which were 4 to 7 days on heat produced milk with the highest level of magnesium.