

# **USEFULNESS OF CALCIUM-MAGNESIUM PRODUCTS IN PARTURIENT PARESIS IN HF COWS**

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## **Abstract**

The increased milk yield in dairy cattle has made it increasingly difficult to balance accurately the feed ration. This results in energy and mineral deficiencies as well as various homeostasis disorders including calcium and magnesium balance disorders, which in turn lead to metabolic disorders. In our study, we chose to assess the therapeutic efficacy of two most popular products of this type i.e. Glucalvet (Vetoquinol Biowet) and Antiparen-N (Vetoquinol Biowet). The study was conducted on 33 HF cows displaying symptoms of post-parturient paresis that occurred between 2 and 4 day postpartum. The cows were divided into two groups: group A and group B, which were administered Glucalvet and Antiparen-N, respectively. Blood samples were taken twice from the jugular vein of each animal – just before and 24 hours after drug administration. The samples were used to determine serum concentrations of Ca, Mg, P, Cl and glucose. The average body temperature in both groups was slightly below normal and statistically significantly increased 24 hours after the intravenous infusion. The same tendency was observed for the pulse rate. The magnesium levels in the first group improved significantly after drug administration but its level was still lower than the physiological range. In the second group of animals, a slight drop in the Mg level after the Antiparen-N administration. Levels of Ca and P increased in both group of animals after the treatment. The average chloride concentration was similar for both assays. The serum glucose concentration increased significantly in both groups of animals after drug administration. Summing up, the study presented in this paper indicates that Glucalvet and Antiparen-N prove to be useful in the treatment of post-parturient paresis conditioned by Ca and Mg deficiency.

**Key words:** cow, parturient paresis, calcium-magnesium, Glucalvet, Antiparen-N.

## PRZYDATNOŚĆ STOSOWANIA PREPARATÓW WAPNIOWO-MAGNEZOWYCH W ZALEGANIU OKOŁOPORODOWYM KRÓW

### Abstrakt

Wysoka produktywność krów mlecznych sprawia trudności we właściwym zbilansowaniu dawki pokarmowej. Stosowanie nieadekwatnej do potrzeb dawki pokarmowej powoduje wiele zaburzeń w homeostazie ustroju, z których najczęstsze są problemy energetyczne i zaburzenia mineralne, w tym niedobory wapnia i magnezu. Celem badań było określenie skuteczności terapeutycznej dwóch najbardziej popularnych infuzyjnych leków stosowanych w zaburzeniach mineralnych – Glucalvetu i Antiparenu-N. Badania wykonano na 33 krowach rasy HF wykazujących objawy zalegania poporodowego pojawiającego się 2-4 dni po porodzie. Krowom podzielonym na 2 grupy A i B podawano odpowiednio Glucalvet i Antiparen-N. Od wszystkich zwierząt pobrano 2-krotnie krew do badań – tuż przed podaniem leków i 24 h po ich aplikacji. Zwierzęta poddano badaniom klinicznym, natomiast w zakresie parametrów laboratoryjnych oznaczono surowiczy poziom glukozy, wapnia, magnezu, fosforu, chlorków. Średnia temperatura ciała i liczba tętna przed podaniem leków była nieznacznie obniżona, natomiast po aplikacji statystycznie wzrosła. Koncentracja Mg wzrosła istotnie u krów z grupy pierwszej po podaniu leku, ale pozostawała nadal poniżej wartości referencyjnych. W grupie drugiej, po podaniu preparatu Antiparen-N, zaobserwowano nieznaczny spadek poziomu Mg. Stężenie Ca i P wzrosło u wszystkich zwierząt po aplikacji preparatów, natomiast koncentracja chlorków nie uległa zmianom w ciągu badanego okresu. U wszystkich krów zaobserwowano wzrost poziomu glukozy w 24 h po podaniu preparatów. Wyniki wskazują na to, że stosowanie preparatów Glucalvet i Antiparen-N jest skuteczne w leczeniu porażenia poporodowego i niedoborów wapnia i magnezu u krów mlecznych.

Słowa kluczowe: krowy, zaleganie poporodowe, wapń-magnez, Glucalvet, Antiparen-N.

## INTRODUCTION

Higher milk yield in dairy cattle has made it increasingly difficult to balance accurately the feed ration. The result is energy and mineral deficiencies as well as various homeostasis disorders, including calcium and magnesium balance disorders. These disorders in turn lead to metabolic disorders, such as pre-parturient, parturient and post-parturient paresis caused by prolonged calcium deficiencies, spring grass tetany, winter tetany and whole milk tetany of calves caused by reduced magnesium levels (STEC 1985). One of the problems occurring most often in dairy cattle in the perinatal phase is subclinical and clinical hypocalcemia. Apart from typical symptoms, reduced humoral and cellular resistance can be observed. Other symptoms include decreased rumen motor activity and abomasum motor activity and lower feed intake which increases the risk of abomasum displacement (KIMURA et al. 2006, DEGARIS, LEAN 2008). GOFF (2008) points to a decrease in muscle contractility including the teat sphincter muscle.

There are a lot of medicinal products available that are used to remove the symptoms of parturient paresis in cows. They all differ in their composition and therapeutic properties. The study described in the paper are an attempt at assessing the therapeutic efficacy of two most popular products of this type i.e. Glucalvet (Vetoquinol Biowet) and Antiparen-N (Vetoquinol Biowet). Apart from this, changes in the mineral element concentrations, glucose and chloride concentrations were examined in the animals afflicted with post-parturient paresis following intravenous infusion of the products in question.

## MATERIALS AND METHODS

The study was conducted on 33 HF cows displaying symptoms of post-parturient paresis which occurred between 2 and 4 day postpartum. The cows were divided into two groups: group A and group B, which were administered Glucalvet and Antiparen-N respectively. A total of 15 cows received Glucalvet whereas Antiparen-N was administered to 18 cows.

The products used in the treatment are both solutions for intravenous use. Their composition is as follows:

- Glucalvet – hypertonic solution containing: calcium chloride (8.0 g), magnesium chloride (3.0 g), anhydrous glucose (5.0 g), disodium edetate (0.012 g), ferrous sulfate (0.00675 g), copper sulfate (0.0016 g), cobaltous chloride (0.00027 g) and water for injection (up to 100.0 cm<sup>3</sup>);
- Antiparen-N – hypertonic solution containing: calcium chloride (8.0 g), magnesium chloride (1.0 g), sodium chloride (2.0 g), glucose (4.0 g) and water for injection (up to 100.0 cm<sup>3</sup>).

Both products were given in a single administration in accordance with the manufacturer's recommendations, i.e. after warming the solution to body temperature and determining the dose at 1 cm<sup>3</sup> kg<sup>-1</sup> bw. The rate of infusion was around 20-50 cm<sup>3</sup> min<sup>-1</sup>.

All the animals were put under observation, during which the following functions were assessed: appetite and thirst, motor activity, severity of paresis (standing position, sternal recumbent position – animals are conscious, lateral recumbent position – animals are unconscious), body temperature, pulse rate and breathing rate.

Two blood samples were taken from the jugular vein of each animal – the first one directly after the diagnosis and prior to drug administration and the second one 24 hours after drug administration. The samples were used to determine the concentrations of calcium, magnesium, phosphorus, chlorides and glucose in the serum. The assays were done in a Cobas Mira S chemical analyzer (Roche, France).

The results were analyzed statistically with Wilcoxon signed-rank test. The arithmetic average, standard deviation and significance level with the threshold  $p$  value of = 0.05 ( $*p < 0.05$ ,  $**p < 0.01$ ,  $***p < 0.001$ ) were determined.

## RESULTS

Within a few hours following drug administration, noticeable improvement in the general state of health was observed in all group A animals. The cows started to assume standing position, the feed intake increased and the milk yield improved. On the second or third day, the treated animals started to recover to normal health.

Prior to the treatment, the average body temperature in this group was slightly below normal and 24 hours following the intravenous infusion of Glucalvet, a statistically significant increase to 38.8°C was observed. Similarly, the breathing rate rose from 13  $\text{min}^{-1}$  prior to treatment to 17  $\text{min}^{-1}$  following treatment. The same tendency was observed for the pulse rate where a significant increase from 42 to 54 heart beats/minute was noted (Figures 1-3).

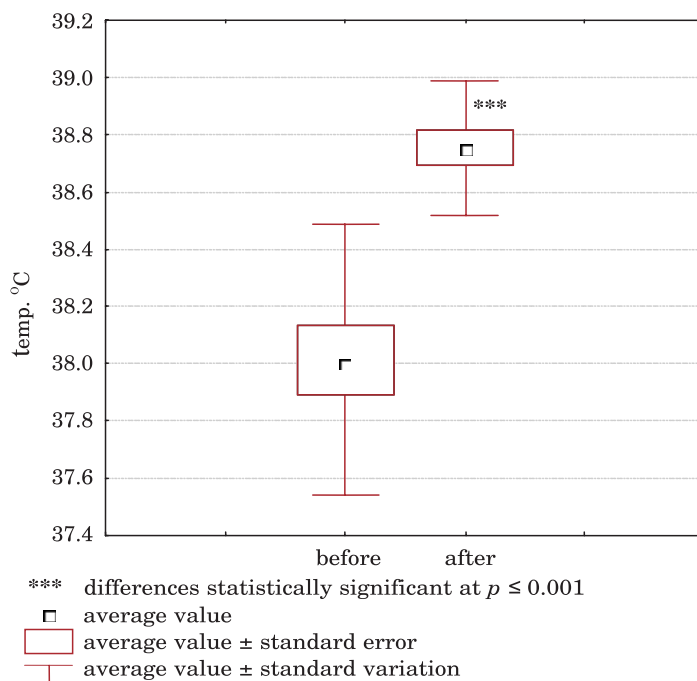


Fig. 1. Body temperature dynamics in cows before and after administration of Glucalvet

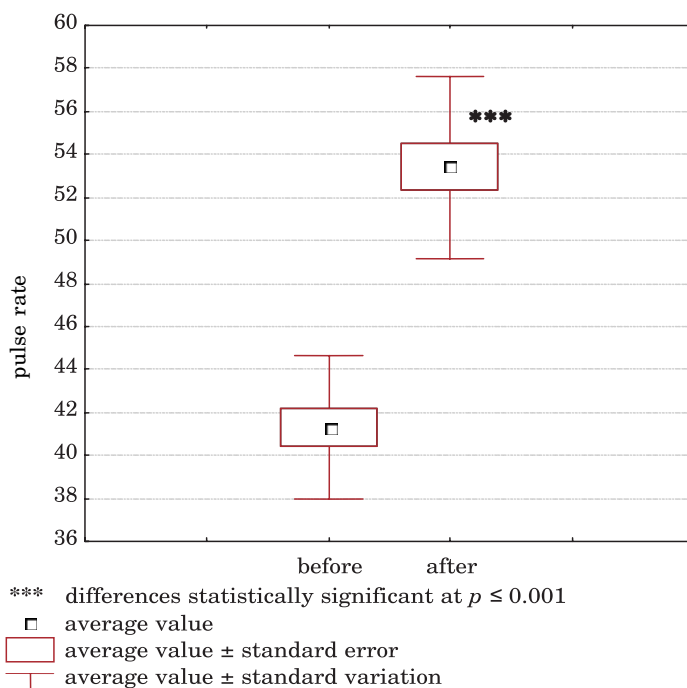


Fig. 2. Pulse rate dynamics in cows before and after administration of Glucalvet

Prior to the administration of Glucalvet, the calcium concentration in blood serum was  $1.33 \text{ mmol dm}^{-3}$ , whereas afterwards it rose to  $1.77 \text{ mmol dm}^{-3}$ . In both cases, the assayed calcium concentration was very low and even after the infusion it failed to achieve the normal physiological value. The phosphorus concentration also increased following the infusion of Glucalvet and achieved the value of  $0.87 \text{ mmol dm}^{-3}$ . This increase was not statistically significant, unlike the calcium concentration increase. The magnesium levels, in turn, improved significantly from  $0.77 \text{ mmol dm}^{-3}$  to  $0.92 \text{ mmol dm}^{-3}$ , i.e. they were at the lower end of the normal physiological range (Table 1).

The average chloride concentration was similar for both assays. It remained within the normal physiological range and was  $100.23 \text{ mmol dm}^{-3}$  following the drug infusion (Table 1).

Similarly, the glucose concentration in blood serum increased significantly from  $1.81 \text{ mmol dm}^{-3}$  to  $3.04 \text{ mmol dm}^{-3}$ . Before the cows were administered Glucalvet, their average glucose concentration was below the normal physiological value but following the drug infusion it was within the physiological range (Table 1).

Similar observations were made in group B. A few hours following the administration of Antiparen-N, noticeable improvement in the general health

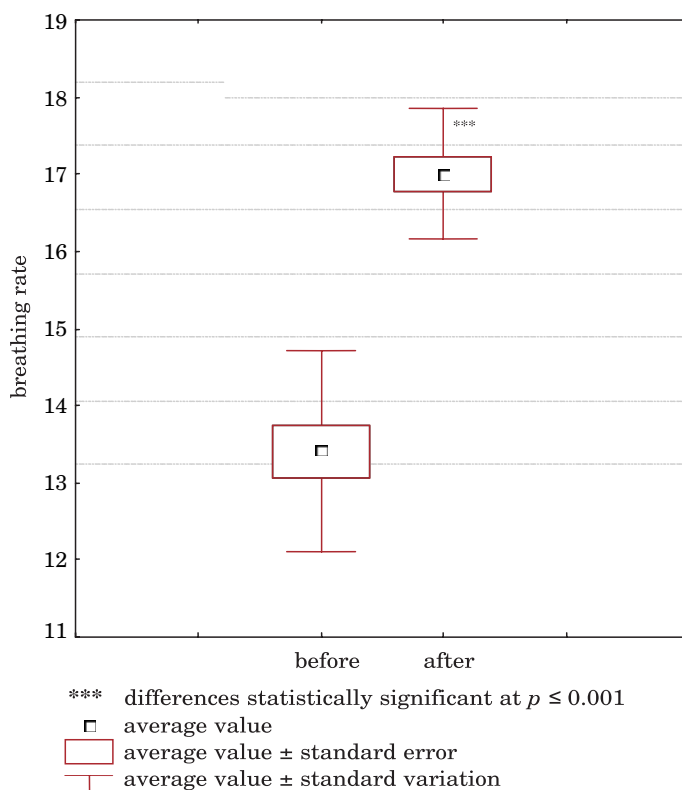


Fig. 3. Breathing rate dynamics in cows before and after administration of Glucalvet

state of the animals was noted. Recovery to the normal condition was observed 2 to 3 days following the infusion. Following treatment with Antiparen-N, the improvement of the clinical indicators such as body temperature, breathing rate and pulse rate was as significant as that observed in the cows treated with Glucalvet (Figures 4-6).

The calcium concentration in these cows prior to treatment was very low i.e.  $1.24 \text{ mmol dm}^{-3}$ , whereas following the treatment, it rose substantially to achieve  $1.77 \text{ mmol dm}^{-3}$ . The phosphorus concentration showed a similar increase from  $0.75 \text{ mmol dm}^{-3}$  to  $1.11 \text{ mmol dm}^{-3}$ . However, in this group a slight drop in the magnesium concentration from  $0.79$  to  $0.74 \text{ mmol dm}^{-3}$  was observed, in contrast to the Glucalvet-treated group. Another similarity between groups B and A was that in both groups the concentration of chlorides remained the same. It was  $101.18 \text{ mmol dm}^{-3}$  following the administration of Antiparen-N. The glucose concentration in turn increased considerably from  $1.51 \text{ mmol dm}^{-3}$  prior to treatment to  $2.43 \text{ mmol dm}^{-3}$  following the Antiparen-N administration. This increase, however, was not as high as that observed in group A animals (Table 1).

Table 1

Average values and standard deviation of calcium, phosphorus, magnesium and chloride concentrations and glucose levels in animals treated with Glucalvet and Antiparen-N

Assay	Ca (mmol dm <sup>-3</sup> )	Pin (mmol dm <sup>-3</sup> )	Mg (mmol dm <sup>-3</sup> )	Cl <sup>-</sup> (mmol dm <sup>-3</sup> )	Glucose (mmol dm <sup>-3</sup> )
Glucalvet					
Before administration	1.33 ± 0.30	0.72 ± 0.58	0.77 ± 0.28	100.25 ± 0.96	1.81 ± 1.13
After administration	1.77* ± 0.59	0.87 ± 0.45	0.92** ± 0.27	100.23 ± 0.83	3.04** ± 0.24
Antiparen-N					
Before administration	1.24 ± 0.44	0.75 ± 0.45	0.79 ± 0.29	100.51 ± 2.32	1.51 ± 0.85
After administration	1.77* ± 0.78	1.11* ± 0.57	0.74 ± 0.22	101.18 ± 3.26	2.43** ± 0.91

\* differences statistically significant at  $p \leq 0.01$

\*\*differences statistically significant at  $p \leq 0.001$

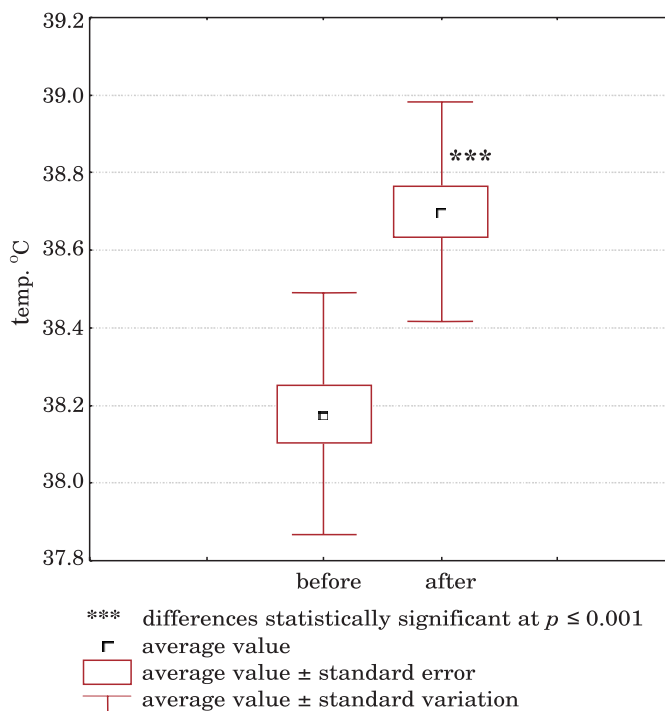


Fig. 4. Body temperature dynamics in cows before and after administration of Antiparen-N

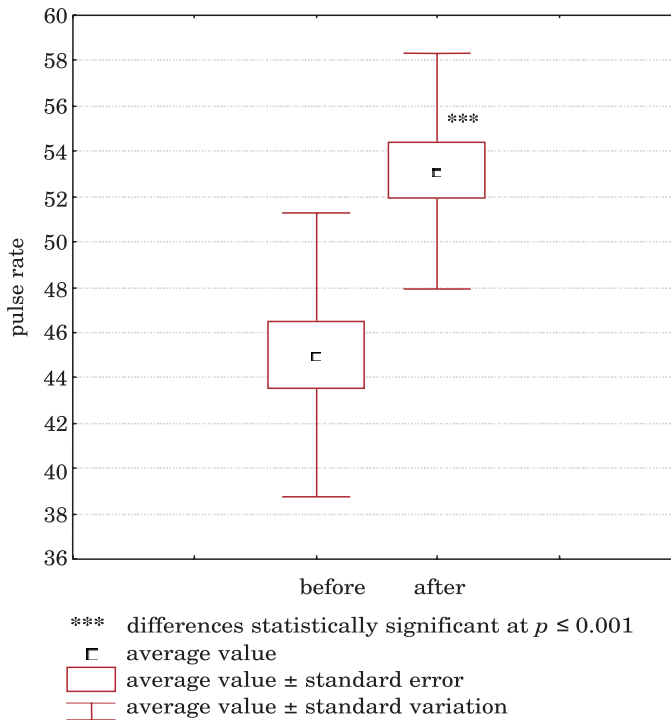


Fig. 5. Pulse rate dynamics in cows before and after administration of Antiparen-N

## DISCUSSION

Based on the clinical data collected during the study, the body temperature of all the animals suffering from parturient paresis was below normal. In both groups, the average temperature was around 38.1°C. Lower body temperature is a characteristic symptom of parturient paresis and is observed in 60% of animals afflicted with this condition (BRAUN et al. 2004). An increase in body temperature observed after the treatment with Glucalvet and Antiparen-N is a symptom of recovery and proves the health benefits of both products. Significantly higher breathing and pulse rates, albeit within the normal physiological range, can also be observed in cows treated with calcium products (HOUE et al. 2001).

The levels of mineral elements (calcium, phosphorus, magnesium) in the blood serum of animals with symptoms of post-parturient paresis from both groups were significantly low. The concentration of these elements was practically half the physiological level. Similar concentrations were observed by GOFF (2007) and LEAN et al. (2006). BRAUN et al. (2006) demonstrated that



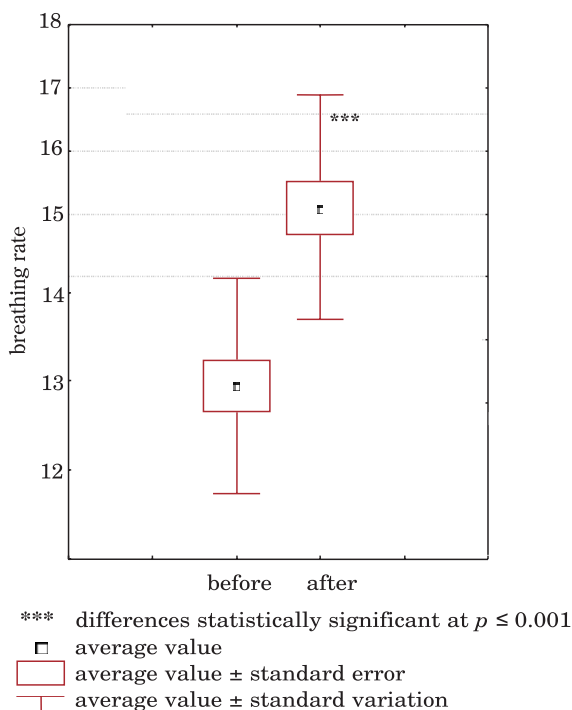


Fig. 6. Breathing rate dynamics in cows before and after administration of Antiparen-N

such drastically low concentrations of calcium and phosphorus in the blood serum can be observed in 90% of cows with post-parturient paresis. Intravenous infusion of Glucalvet and Antiparen-N brought about a significant increase in calcium levels. However, these concentrations were still low and remained below the normal physiological levels. Higher blood serum Ca concentration observed after the infusion of both products is attributed to calcium chloride they contained. However, low Ca levels observed after 24 hours following the administration indicate that the animals were still calcium-deficient. This suggests that Ca re-supplementation might be required. BRAUN et al. (2004) demonstrate that only repeated parenteral administration of calcium products to cows suffering from post-parturient paresis helps to achieve the normal Ca levels in body fluids.

After treatment with either of the products, phosphorus levels were higher although the increase was statistically significant only after the infusion of Antiparen-N. Higher serum concentration of phosphorus in the cows from both groups was probably linked to its greater mobilization from the bones, which in turn brought about an increase of serum concentration. Full investigation of these mechanisms would however require some further studies conducted on more animals.

The magnesium concentrations in the blood serum of cows suffering from post-parturient paresis fall far short of normal levels, which is confirmed by the findings of other authors (ANDRESEN et al. 1999, BEDNAREK et al. 2000). These authors believe that magnesium deficiencies play a prominent role in the development of the condition in question. Hypomagnesaemia has direct effect on calcium metabolism by decreasing the secretion of parathyroid hormone in hypocalcaemia and making tissue receptors less sensitive to parathyroid hormone (RUDE 1998). Additionally, magnesium deficiency causes impairment of intestinal absorption of calcium since Ca absorption is promoted by the active metabolite of vitamin D<sub>3</sub>. This metabolite is formed during hydroxylation, which depends on an appropriate concentration of magnesium ions (GOFF 2008). The data obtained from the present experiment showed a statistically significant increase in the serum concentration of magnesium following the administration of Glucalvet and its slight decrease following the infusion of Antiparen-N. In the first case, the increased magnesium concentrations are due to high Mg supplementation (100 cm<sup>3</sup> of Glucalvet contains 3 g of magnesium chloride). No such increase was observed following the treatment with Antiparen-N, which can be attributed to its lower content in the product. The study conducted by DAUNORASA et al. (2008) demonstrated that intravenous administration of magnesium compounds causes the serum magnesium concentration to rise in the first 2 hours following the administration, after which its levels go down. In the present study, magnesium was assayed 24 hours following supplementation and it appears that after the infusion of both products a temporary increase in the serum magnesium concentration occurred. These increased levels continued to be observed in the blood samples collected later only in the Glucalvet-treated animals because this product is richer in magnesium. BRAUN et al. (2007) demonstrated that even a tiny amount of intravenously infused magnesium significantly increases its serum concentration in cows. Therefore, better results of treatment of parturient paresis are achieved when calcium and magnesium are administered parallel than if only the former is administered (LEAN et al. 2006).

The concentration of chlorides both prior and following the administration of the products was similar in the treated cows. The chloride anion is stable in the body and its levels rarely fluctuate. HORST et al. (1997) found out that feed supplemented with chlorine and sulphur compounds boosted the treatment of parturient paresis and helped to prevent its development. On the other hand, higher concentration of sodium and potassium is one of the factors contributing to the development of this condition. The beneficial mechanism of higher concentrations of chloride ions in the treatment of hypocalcaemia consists in inducing slight ketosis, which promotes calcium and phosphorus mobilization from the bones (GOFF et al. 2007). Both prior and following the administration of the products, the concentration of chlorides in the cows remained within normal physiological limits, which seems

to suggest that in this particular case it did not affect the pathogenesis of parturient paresis.

BEDNAREK et al. (2000) demonstrated that energy deficiencies play a vital role in the pathogenesis and development of parturient paresis. Low glucose levels were also observed in the animals included in the present studies. Glucose concentration rose significantly following the administration of both products. Glucose facilitates the use of macro- and micronutrients by the body and provides extra energy, whose deficiency contributes to the development of metabolic diseases e.g. ketosis. Increased post-partum milk production in cows leads to excessive use of energy reserves. This in turn can cause the limited reserves of magnesium to be depleted and lead to chronic lesions manifested by Mg deficiencies and ketosis. Glucose levels in the cows we studied were decidedly higher following the administration of both products, which indicates that the energy supply was sufficient.

Summing up, the study presented in this paper indicates that Glucalvet and Antiparen-N prove to be useful in the treatment of post-parturient paresis conditioned by Ca and Mg deficiency. Thanks to their complex composition, these products have a beneficial effect on the electrolyte equilibrium and energy metabolism of animals afflicted with this condition.

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