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THE INFLUENCE OF IMMUNOGLOBULIN STATUS ON HEALTH STATUS AND GROWTH PERFORMANCE IN CALVES TO THE AGE OF 24 WEEKS

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ABSTRACT

The aim of the research was to study the influence of immune status on health status and changing of heart girth with age in calves. Seventy one dairy calves from birth to the age of 24 weeks were studied and their health status was monitored. The blood samples were taken once a week, till the age of 6 weeks and later on at the age of 8, 12, 16, 20 and 24 weeks. In blood samples the concentration of IgG was measured with quantitative ELISA test. At each bleeding, the heart girth was measured. The average IgG concentration in the 1st week of age was 26.15 ± 15.18 g/L. The calves were divided in two groups; in the 1st group there were calves with IgG concentration in the 1st week below average value, in the 2nd one were calves with IgG concentration above average. Statistically significant differences between groups were established at the age of one ($P < 0.001$), two ($P = 0.044$), five ($P = 0.001$), eight ($P = 0.017$) and sixteen weeks ($P = 0.029$). The percentage of diseased calves was significantly higher in group 1 regarding to group 2. The heart girths between groups did not differ significantly. In the research it was established that the differences between groups in IgG level remained to the end of research period and more calves diseased in the low IgG group.

Key words: cattle / calves / health status / immunoglobulins / heart girth

VPLIV IMUNOGLOBULINSKEGA STATUSA NA ZDRAVSTVENO STANJE IN RAST TELET DO STAROSTI 24 TEDNOV

IZVLEČEK

V raziskavi smo preučevali povezanost med imunskim statusom, zdravstvenim stanjem in spreminjanjem prsnega obsega pri teletih. V raziskavo je bilo vključenih 71 telet črno-bele pasme. V preiskovanem obdobju od rojstva do starosti 24 tednov smo spremljali zdravstveno stanje telet. Teletom smo odvzeli vzorce krvi enkrat tedensko do starosti 6 tednov ter pri starosti 8, 12, 16, 20 in 24 tednov. V vzorcih smo merili koncentracijo IgG s kvantitativnim ELISA testom. Ob vsakem odvzemu krvi smo teletom izmerili prsni obseg. V prvem tednu življenja je bila povprečna koncentracija IgG v serumu telet 26,15 ± 15,18 g/L. Teleta smo razdelili v dve skupini: v prvi skupini so bila teleta, ki so imela pri prvem odvzemu nižjo koncentracijo IgG od omenjene povprečne vrednosti, v drugi skupini pa tista, ki so imela koncentracijo IgG nad povprečjem. Statistično značilne razlike med skupinama smo ugotovili pri starosti enega tedna ($P < 0,001$), dveh ($P = 0,044$), petih ($P = 0,001$), osmih ($P = 0,017$) in šestnajstih tednov ($P = 0,029$). V preiskovanem obdobju je bil delež obolelih telet v prvi skupini značilno večji kot v drugi. Večjih razlik v prsnih obsegih med skupinama nismo ugotovili. Ugotovili smo, da so razlike med skupinama v povprečni koncentraciji IgG ostale do konca preiskovanega obdobja ter da je v skupini z nižjim nivojem IgG zbolelo več telet.

Ključne besede: govedo / teleta / zdravstveno stanje / imunoglobulini / prsni obseg

INTRODUCTION

The newborn calves receive antibodies via passive immunisation with colostrum intake. The calves, which are insufficiently provided with colostrum or received colostrum with low Ig concentration, are growing slower and are more prone to disease or to die as well supplied calves (Nocek *et al*., 1984; Quigley *et al*., 1995). The most cases of disease occur in first weeks of life; in younger calves there is higher incidence of diarrhoea and in older calves of respiratory diseases (Maach *et al*., 1992; Svensson *et al*., 2003). The incidence of disease differs between herds (Svensson and Liberg, 2006; Losinger and Heinrichs, 1996). In different studies the relation between immune status and incidence of disease was established (Schmidt *et al*., 1982; Quigley *et al*., 1995; Virtala *et al*., 1999). In some researches this relation was not confirmed (Rea *et al*., 1996; Sivula *et al*., 1996). Better relation between Ig level and disease incidence was established in studies, where incidence of disease was high and Ig level of calves was low, as in studies where morbidity and mortality were low. The incidence of disease depends from calves' resistance and from exposure to pathogens (Garry *et al*., 1993; Hancock, 1985). Therefore good passive immunity of calves is more important in bad breeding conditions. Diseases have a negative influence on growth of calves (Caldow *et al*., 1988). In 18 American herds the influence of disease on growth, of calves to the age of 3 months was researched. Each week when the calf had pneumonia, the weight gain was lower for 0.8 kg, umbilical inflammation for 2.5 kg and failure of passive transfer for 2.1 kg. Lower weight gain were established only in respiratory diseases, which needed treatment, if all cases which were found by the owner were considered, the influence on weight gain was not significant (Virtala *et al*., 1996). Some researchers did not ascertain the influence of disease on weight gain, but the cases of disease were mild (Franklin *et al*., 1998; Sivula *et al*., 1996).

The aim of the research was to investigate the dynamics of IgG concentration through the first 24 weeks of life in calves with different IgG level in 1st week of life. Further the influence of immune status on health status and changing of heart girth with age in calves was studied.

MATERIAL AND METHODS

Seventy one dairy calves from two farms were included in the research. After calving, the calves got 1 to 1.5 liter colostrum from their mother. The calves were drinking mothers' colostrum three times daily for first four days, later they received milk two times daily. After 10 days of age, they had free access to starter and hay. They were weaned at the age of 16 weeks. In the research period, from birth to the age of 24 weeks, the health status was monitored. Blood samples from the calves were taken from vena *jugularis* in evacuated tubes. They were taken once weekly till the age of 6 weeks, later on at the age of 8, 12, 16, 20 and 24 weeks. In blood serum samples the concentrations of IgG were measured with quantitative ELISA (Bovine IgG ELISA Quantitation Kit, Bethyl laboratories, UK). At each bleeding the heart girth was measured, because the weighting was impossible to perform. The heart girth was measured on calf in standing position behind the fore legs. The calves were divided in two groups regarding to IgG concentration in the 1st week; in 1st group (n = 33) were calves with IgG concentration below average value, in 2nd (n = 38) were calves with IgG concentration above average concentration. The data were processed with the statistical program SPSS (Ver 15). The data of both groups were compared with the t test. The incidence of disease between groups was compared with the χ^2 test.

RESULTS

The average concentration of IgG in calves' serum in the 1st week was 26.15 ± 15.18 g/L. The dynamics of IgG concentration in both groups was studied through the research period (Fig. 1).

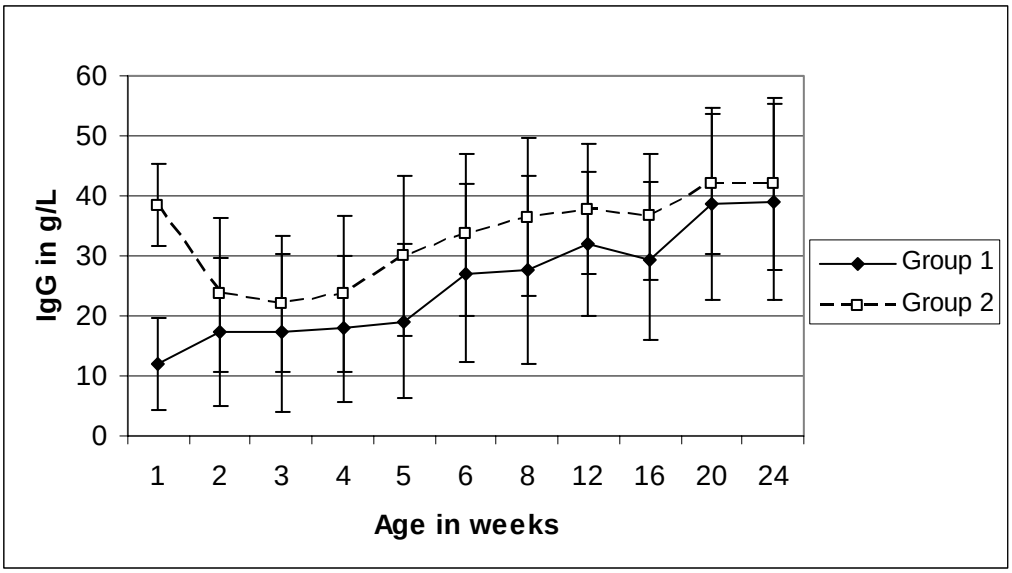

Figure 1. The dynamics of IgG concentration with age in both groups of calves.

The average IgG concentration between groups differs most significantly in the 1st week of life, later on the differences were smaller but they remain to the end of investigated period (Fig. 1). Statistically significant differences between groups were established at the age of one ($P < 0.001$), two ($P = 0.044$), five ($P = 0.001$), eight ($P = 0.017$) and sixteen weeks ($P = 0.029$).

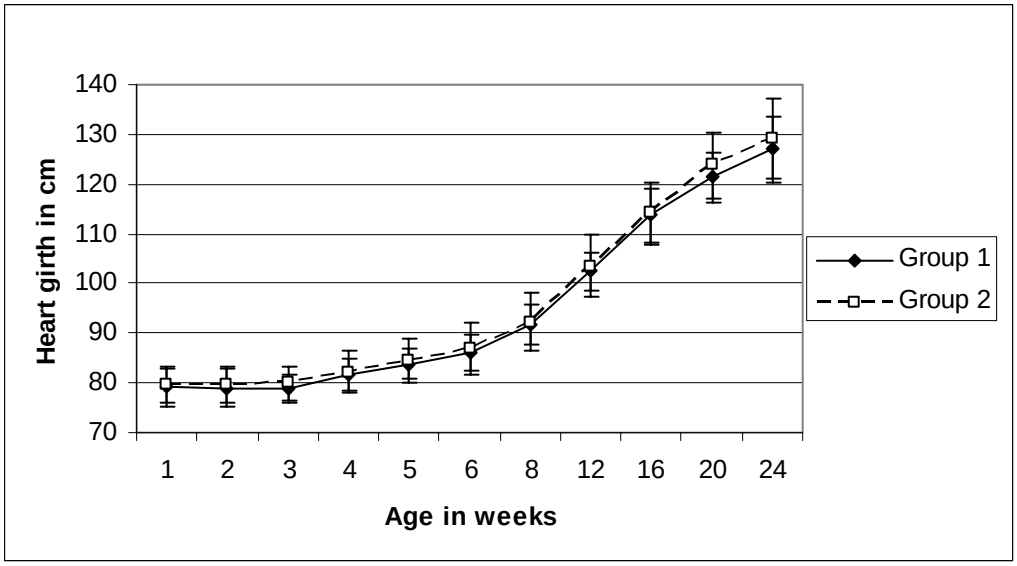

Figure 2. The heart girth in calves of both groups regarding to the age.

In the research period 33 (46.48%) calves got ill at least once. In group 1 diseased 19 calves what represent 57.57% of calves from this group. In group 2 disease was established in 14

calves, what is 36.84% calves from the group. The parts of diseased calves differ significantly between groups ($P < 0.005$). In first three weeks of life (average age 14 days) the most frequent disease was diarrhoea, later (average age 32 days) mostly respiratory diseases were observed. The duration of disease was short, in most cases 2–3 days, except in three calves which died later and in one calf which was chronically ill.

The heart girths were measured, the comparison between groups is presented in Fig. 2.

The heart girths of calves almost did not change in first three weeks of life. Later they increased slowly with the age. Significant variations between groups were not established. The significant difference was established only in one calf which was treated more times and its heart girth almost did not change with age.

DISCUSSION

After first week of age IgG level in calves with high IgG concentration decreased and in those with low IgG increased. After 3rd week it increased slowly with age (Fig. 1). Devery *et al*. (1979) established that the calves are able to produce own antibodies (0.84 g of IgG1/day) already in first three weeks of life. Rea *et al*. (1996) measured average concentration of IgG1 13.84 g/L in calves in 1st week which is similar to our results in calves from group 1. Erhard *et al*. (1999) measured the highest IgG1 concentration (9.3 g/L) 12 hours after first colostrum intake and the lowest concentration of IgG1 (4.9 g/L) at the age of 28 days, later on it increased to the 77th day (9.0 g/L). In research from Hammon *et al.* (2002) the IgG concentration decreased from 2nd to the 21st day of age, what is in accordance with our results. Burton *et al*. (1989) established the lowest IgG level at the age of 4 weeks it was 12.13 g/L what less as measured in our study is. Panivivat *et al*. (2004) measured lower average IgG concentration as established in our study, the first day after birth they measured 9.58 g/L and at the age of 6 weeks the IgG concentration was 12.39 g/L. They concluded that low IgG concentration could be the reason for higher incidence of diarrhoea and lower weight gain as was expected.

The differences in IgG concentration between both groups of calves remained till the end of the research period (Fig. 1). Similar was found also by other authors. Rajala and Castren (1995) compared calves with very low Ig concentration (below 10 g/L) at the age of 24 hours and those with high (45 g/L) and established different dynamics with age. In calves with very low Ig the concentration increased from 2nd to the 12th week of age and in those with high Ig the concentration decreased to the 12th week. But the Ig level of calves with low Ig did not reach the level of those with high Ig concentration on the 1st day. Other authors also found that the calves with low concentration of Ig in 1st week had lower Ig concentration in later weeks regarding to those with high concentration of Ig at the beginning. The dynamics of concentrations in both groups showed some central tendency but the differences did not equalize completely (Hancock, 1985; Burton *et al*., 1989). The findings from our research and from others indicate, that calves have different ability to produce IgG.

By comparison of diseases in both groups, different percentage of calves which got ill in the research period was established. More diseases were established in the group with lower IgG level. The relation between concentration of Ig and incidence of diseases was ascertained also by other authors. Schmidt *et al*. (1982) found a half lower concentration of IgG two hours after colostrum intake in calves which got ill in period from birth till the 3rd month, in comparison to healthy ones. Quigley *et al*. (1995) found the relation between concentration of IgG and IgM in calves serum and incidence of diarrhoea in calves. Results from Virtala *et al.* (1999) indicate that concentration of IgG in calves' serum after colostrum intake between 8–13 g/L is significant predictive factor for pneumonia. Caldow *et al*. (1988) divided calves in three groups regarding to IgG level (above 9 g/L – high; 5 – 8 g/L – middle; below 5 g/L – low) and they did not found

any significant relation with incidence of disease. They claim that the significant relation between Ig level and incidence of disease was found in herds with relative high morbidity and mortality of calves and that published data indicate the passive immunity is less important in herds with low morbidity. In other study the immune status of calves from herds with high and low morbidity was compared and no statistically significant difference was found. But in herds with high morbidity the part of calves with very low Ig concentration was bigger (Hancock, 1985).

The growth performance of calves was monitored with measuring of heart girth. Heinrichs *et al*. (1992) performed measurements on big number of Holstein Friesian heifers from birth to the age of 821 days and established good correlation between body weight and heart girth ($R^2 > 0.9$). Therefore we think that variations in growth between calves can be assessed with measuring of heart girth because all calves were of the same breed. The average heart girth was bigger in 1st week as was established in dairy calves in Swedish study where it was 74.0 ± 3.8 cm at birth (Lunborg *et al*., 2003) and it was consistent with measurements of Selim *et al*. (1995). The average heart girth of calves in our research almost did not increase until the 4th week, later it started to increase slowly (Fig. 2). The findings are attributed to relatively small amount of milk offered to the calves and because in first weeks the consummation of starter and hay was small. Hammon *et al*. (2002) compared weight gain between calves which got milk *ad libitum* and those fed with restricted amount, in the first ones the weight gain was better in 1st week but after 28th day there were no difference in weight gain between groups. In Swedish research performed on dairy calves from birth to the age of 56 days the heart girths increased between 0.18–0.33 cm/day which means 400–700 g/day (Svensson and Liberg, 2006). The growth rate of calves was better in smaller than in bigger groups. The heart girths of calves in our research almost did not differ between groups. Selim *et al*. (1995) and Sivula *et al*. (1996) also found no relation between concentration of Ig in calves after birth and later growth performance. Very slow increase of heart girth was established in one calf in our study which was more times treated in research period; similar was established by others (Blum *et al*., 1996). Caldow *et al*. (1988) compared growth of calves to the age of 12 weeks and found significantly lower growth rate in treated regarding to healthy calves. Similar established Virtala *et al*. (1996) but when all respiratory diseases, which were observed by owner, were considered the influence on growth was not significant. In study of Franklin *et al*. (1998) the influence of diarrhoea on weight gain in 2–3 weeks old calves was not established, but the cases of diarrhoea were mild and they were successfully treated only with electrolyte solution and milk. In our research the calves were ill only short time and most of them did not need antimicrobial therapy therefore the disease had no significant influence on growth.

CONCLUSIONS

In the research we established that variations between groups in average IgG concentration remained until the end of the investigated period. In the group with lower IgG level the percentage of diseased calves was higher. The diseases were of short duration and therefore had no influence on the dynamics of heart girth with age.

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