

Mineral bioplex supplementation of diets for cows affects colostrum quality and immunoglobulins in calf blood serum*

S. Kinal^{1,3}, A. Rzaša² and A. Korniewicz¹

Wrocław Agricultural University

*¹Department of Animal Nutrition and Feed Quality
Chelmońskiego 38D, 51-639 Wrocław, Poland*

*²Department of Immunology and Veterinary Prevalency
Norwida 31, 50-375 Wrocław, Poland*

ABSTRACT

The aim of the investigations was to assess the influence of supplementation of cow rations with zinc, copper and manganese given in the form of bioplexes during the perinatal period. Colostrum quality and immunoglobulin level in calf serum were evaluated. Total protein and its fractions in colostrum from the first milk as well as in calves' blood serum from the 2nd and 35th day of life were determined. Additionally, the total immunoglobulin index in week 3-4 of life (Ilg_{3-4}) was calculated. All calves were well supplied with colostral lactoimmunoglobulin. The highest level of γ -globulin (12.5 g/L) was found in group III and resulted from the higher level of this fraction in colostrum (93.6 g/L). The value of $Ilg_{3-4} = 0.54$ found in III group confirms that the newborn calves are well protected by colostrum.

KEY WORDS: cows, nutrition, microelements, calves, immunoglobulin, colostrum

INTRODUCTION

Colostrum is the first feed in a calf's life and provides it nutrients and biologically active substances. The most important of these are immunoglobulins, which confer immunity on calves during the postnatal period (Bush and Staley, 1980; Rea et al., 1996). The later efficiency of the humoral and cellular immune systems of calves depends on the amount and quality of colostrum taken by calves at the appropriate time (Abel Francisco and Quigley, 1993; Aldridge et al., 1998). Data from experiments conducted by Ziemiński et al. (2002) and Strusińska et al. (2004) indicated that the use of zinc, copper and manganese chelates in cow nutrition could have a positive effect on colostrum quality.

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³ Corresponding author: e-mail: kinal@zoo.ar.wroc.pl

The aim of this experiment was to assess the effect of adding bioplexes of zinc, copper and manganese to the diets of dry cows on colostrum quality and immunoglobulin level in blood serum of calves.

MATERIAL AND METHODS

The experiment was performed during the perinatal period on 30 dairy cows of Black-and-White breed with 70-90% HF. The average body weight of cows was 650 kg and average milk yield in the last lactation, about 9500 kg. The cows' rations contained silages from maize, barley and sugar beet, brewers' grains, meadow hay (11 kg of DM) and concentrate mixture (2 kg DM). The feeding groups were diversified with respect to the chemical forms of Zn, Cu, and Mn, which were applied as mineral mixtures, given at a dose of 200 g/day/head. The control group (Group I) received a mineral mixture containing Zn, Cu and Mn as sulphates. In group (II) 20% and in group (III), 30% of daily requirements for trace elements was covered by bioplexes. After calving, colostrum and blood samples from the jugular vein of calves were taken. Total protein and its fractions (by paper electrophoresis) were determined in colostrum (using the Benedict reagent) and blood serum (biuret method). Additionally, for calves in week 3-4 of life the total immunoglobulin index was estimated (Ilg_{3-4}) (Nikołajczuk et al., 1994) according to equation:

$$Ilg_{3-4} = \frac{\text{level of serum Ig in 3 - 4th week of life}}{\text{level of serum Ig in 48h of life}}$$

RESULTS

In the 48th h of life, all calves, after completion of intestinal transfer, were well supplied with colostral immunoglobulin (Table 1). The highest γ -globulin level (12.5 g/L) was found in calves from group III. The Ilg_{3-4} calculated for groups I and II points to an inadequate colostrum supply of calves (0.7 and 0.67, respectively). The best Ilg_{3-4} was in calves from group III and equalled 0.54,

TABLE 1
The average Ig level of calves after completed intestinal transfer, in week 3-4 of life, and total immunoglobulin index

Item		Feeding groups		
		I	II	III
48 h of life	$\bar{x} \pm sd$	10.5 \pm 5.6	11.5 \pm 6.4	12.5 \pm 4.4
3-4 th week of life	$\bar{x} \pm sd$	7.4 \pm 2.5	7.7 \pm 2.5	6.8 \pm 0.9
Total immunoglobulin index in week 3-4 of life		0.7	0.67	0.54

this value indicates good supply of calves with colostrum. The highest colostrum level of γ -globulin was in cows from group III, 93.6 g/L, while the colostrum of cows from groups I and II had values that were evidently lower, 48.5 and 54.3 g/L (Table 2), but sufficient for supplying calves with immunoglobulins. The data did not reach statistically significant differences ($P>0.05$).

TABLE 2

Composition proteinogram

Feeding groups		Total protein g/l.	Albumin g/L.	α -globulin g/L.	β -globulin g/L.	γ -globulin g/l.
I	$\bar{x} \pm sd$	70.5 \pm 18.2	2.8 \pm 1.1	13.5 \pm 6.3	6.3 \pm 2.6	48.5 \pm 18.7
II	$x \pm sd$	86.3 \pm 21.2	4.0 \pm 4.6	15.8 \pm 4.5	7.0 \pm 4.4	54.3 \pm 21.8
III	$\bar{x} \pm sd$	128.8 \pm 50.2	5.5 \pm 3.2	23.1 \pm 9.1	14.9 \pm 8.7	93.6 \pm 45.9

DISCUSSION

The level of colostral immunoglobulins in the 48th h of life in calves from group III, 12.5 g/L, could be accepted as satisfactory, although Nikolaajczuk et al. (1994) noted that this index should amount to at least 13.5 g/L. In the opinion of Holloway et al. (2002) and Quigley et al. (2002), the level of Ig in blood serum of calves could be a measure of colostrum quality. The immunoglobulin level in the blood serum of calves from groups I and II on day 23 of life (Table 1) points to their own early immunoglobulin production. This indicates that the passive immunity obtained by them was insufficient (Aldridge et al., 1998). The colostrum from groups I and II (Table 2) was recognized as less valuable, however, the minimal level 40 g/L of γ -globulin, theoretically sufficient for the adequate supply of calves with Ig, was achieved. The obtained data are similar to the results of Abel Francisco and Quigley (1993) who reported an average lactoimmunoglobulin level of 59.0 g/L and, in calf blood serum in the 48th h of life, 11.6 g/L. The level of γ -globulin in colostrum from group III cows came to 93.6 g/L and was satisfactory, but the corresponding Ig level in blood serum was too low (12.5 g/L). For colostrum of a similar quality, Quigley et al. (2001) reported a serum Ig level exceeding 18 g/L.

CONCLUSIONS

After supplementation of Zn, Cu and Mn bioplexes in the perinatal period, all of the calves in the 48th h of life were well supplied with colostral immunoglobulins. Calves from cows that received bioplexes in an amount covering 30% of their requirements had the highest level of γ -globulin. The calculated Ilg_{3-4} 0.54, confirms the good supply of calves with colostrum. Such a relationship was not demonstrated for animals from the remaining groups.

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STRESZCZENIE

Wpływ stosowania biopleksów mikroelementów w żywieniu krów na jakość siary i poziom Ig w surowicy krwi cieląt

Badano wpływ podawania krowom w okresie okołoporodowym Zn, Cu i Mn w formie biopleksów na jakość siary i poziom immunoglobulin w surowicy krwi cieląt. W siarze z pierwszego udoju i surowicy krwi cieląt w 2 i 35 dniu ich życia oznaczono zawartość białka całkowitego i jego frakcje. Wyliczono indeks immunoglobulin całkowitych w 3-4 tygodniu życia cieląt. W 48 godz. życia, po zakończonym transferze jelitowym, cielęta były dobrze zaopatrzone w immunoglobuliny siarowe. Najwyższy poziom γ -globulin (12,5 g/L) stwierdzono u cieląt pochodzących od krów z grupy III, u których poziom γ -globulin w siarze był najwyższy (93,6 g/L). Uzyskany w tej grupie IIgt 3-4-0,54 g/L potwierdza dobre zabezpieczenie noworodków siarą.