

REDUCING METABOLIC DAIRY COWS DISEASES INCIDENCE BY USING ANIONIC SALTS

Bogdan M.^{1)*}, M. I. Bențea²⁾, A. Șara²⁾

¹Alltech Biotechnology Romania, Dr. Dimitrie Brândză Street No. 18, Sector 6, 60102 Bucharest, Romania; ²University of Agricultural Sciences and Veterinary Medicine Cluj-Napoca, Faculty of Animal Science and Biotechnologies, Mănăștur St., No.3-5, 400372 Cluj-Napoca, Romania

*Corresponding author: mariusbogdanmv@yahoo.com

Abstract. The present research has followed the effects of the product Calving Care on the incidence of postpartum metabolic disorders in dairy cows, under intensive farming conditions. The research has been conducted at two dairy farms in Romania, on two groups of Holstein Friesian cows, consisting of ten cows each, in Close-up group. Experimental group 1(E), consisting of 10 cows, was administered 300g/cow/day of Calving Care anionic salt mixed in the Total Mixed Ration (TMR) 21 before calving. Control group 2(C), also consisting of 10 cows, was administered a similar structured TMR to the one administered to group 1, but without Calving Care. Both groups had the urine pH level determined before the beginning of the experiment, 48 hours after the experiment begun and again half way through the duration of the experiment. After calving some data have been determined for both groups: serum calcium and the incidence of postpartum metabolic disorders - hypocalcaemia, retained placenta, ketosis and left displaced abomasum (LDA). Using Calving Care anionic salt complex in group 1(E) generated a reduction urine pH from 8,3 to 6,4 within 48 hours, meaning 22,89%, and 6,5 ten days after the beginning of the experiment, meaning a 21,68% reduction. The mean urine pH level recorded for group 2(C) was 8,4 at the beginning of the experiment, 8,3 after 48 hours and 8,3 in the tenth day testing. Regarding the serum calcium level, all the cows in group 1(E) fell within the normal limits - 100%, whereas in case of group 2(C) 37,5% of the cows had the serum calcium level below normal limits, and 62,5% had the serum calcium level within physiological limits.

Keywords: dry cows, Close-up, Dietary Cation-Anion Difference (DCAD), anionic salts, urine pH, serum calcium

INTRODUCTION

Numerous researches have been conducted worldwide regarding the influence of anionic salts on the incidence of postpartum metabolic disorders in cows. The principle upon all of this research is based on that the maintaining parathormone (PTH) activity during the dry period takes place under mild metabolic acidosis induced by a negative dietary cation-anion difference (DCAD) (Block, 1984). Obtaining negative DCAD in dry cow diets has been the object of study for many researchers: Block, 1984; Block, 1994; Byers, 1994; Horst et al, 1994; Horst et al., 1997; Joyce et ca., 1997; Oetzel, 1993; Oetzel et al., 1999; Seymour et al. 1992; Tauriainen et al. 1998.

An experiment conducted by Razzaghi et al. (2012) proves the effect of anionic salts on dietary cation-anion difference, on the incidence of postpartum metabolic disorders and on the productive and reproductive performance of cows during the lactation subsequent to the treatment. The experiment was conducted over a 21 days period before calving and 63 days postpartum. Close-up group was divided in two groups of 12 Holstein Friesian cows each, with the same TMR. The experimental group received in addition 210g anionic salts /cow/day, which generated a DCAD of -10mEq/100g dry matter. The anionic salts consisted of equal parts NH₄Cl, CaCl₂, MgSO₄, CaSO₄ (52,5 g each). The control group received a

TMR containing only 27g of anionic salts /cow/day, having a cation-anion difference of +10 mEq/100g dry matter. After calving the cows in each group were further separated in two more sub-groups of 6 cows each: 6+6 cows from the antepartum experimental group on the one hand, and 6+6 cows from the antepartum control group on the other. One sub-group from each group received a diet having a cation-anion difference of +20 mEq/100g dry matter, whilst the other two sub-groups received a diet having a cation-anion difference of +40 mEq/100g dry matter.

The experiment highlighted major differences in the incidence of metabolic disorders between the group that received anionic salts in Close-up and had a negative cation-anion difference of -10mEq/100g dry matter and the control group who's DCAD was +10 mEq/100g dry matter in Close-up. While the experimental group was diagnosed with only one case of mastitis out of 12 calvings (8,3%), regardless of the DCAD level after calving, the control group had a higher incidence of disorders, presenting out of 12 calvings 4 cases of hypocalcaemia (33,3%), 4 cases of retained placenta (33,3%), 7 cases of mastitis (58,3%), distributed almost equally between the sub-groups that received a DCAD of +20 mEq/100g dry matter or +40 mEq/100g dry matter subsequent to calving. This proves that the reduction of dietary cation-anion difference during Close-up period using anionic salts has a direct and decisive influence on the incidence of postpartum metabolic disorders, regardless the level of cation-anion difference obtained in postpartum feeding, thus confirming similar results obtained by Goff in 2008, Joyce et. al in 1997 and Hu et al. in 2007.

The aim of this research was to reducing postpartum metabolic diseases incidence in dairy cows by using the anionic salt.

MATERIALS AND METHODS

Calving Care is the anionic salt (CaCl_2 and MgCl_2) designed by Alltech Biotechnology Company for postpartum metabolic disorders limitation in dairy cows. The product contains calcium chloride and magnesium chloride and DCAD value is -9.366,16 mEq/kg. This value, along with the fact that the salts are coated, make this product applicable in doses of up to 300 g/cow/day without affecting total mixed ratio's (TMR) palatability.

The experiment was conducted between 22.03.2016 - 30.04.2016 (40 days), comparative in two farms, as follows: Carmolact Farm in Sieu-Odorhei, Bistrita-Nasaud county, on a group of 10 Holstein Friesian cows, named Experimental group 1 (group 1(E)), that received Calving Care mixed in the TMR during Close-up period (21 days before calving), and the Lacto Agrar Farm in Vaidei, Hunedoara county, on a group of 10 Holstein Friesian cows, named Control group 2 (group 2(C)) that was not administered Calving Care.

The cows in the two study groups were kept in similar microclimates, according to the intensive farming system. The TMR structure was similar for both groups, nutrient levels ranged within the requirements for dry cows (National Research Council, 2001), with the exception of the cation-anion difference (DCAD) induced by Calving Care in the experimental group (table 1).

During the experiment three key indicators have been monitored for both groups: urine pH in Close up, serum calcium level after calving and postpartum metabolic diseases incidence: hypocalcaemia, retained placenta, ketosis and displacement of the abomasum were monitored.

Table 1.

Nutritional parameters of Close-up diets formulated for the two groups

Analysis	Group 1(E)	Group 2(C)	Requirements Close-up	
			With anionic salts	No anionic salts
Dry Matter (DM), kg	12,89	12,61	11-13,5	11-13,5
NEL, mcal/kg	1,34	1,36	max. 1,44	max. 1,44
Crude Protein, %DM	13,66	13,97	13-15	13-15
NDF, %DM	41,68	42,62	min. 33	min. 33
ADF, %DM	26,69	27,29	min. 21	min. 21
Calcium, %DM	1,64	0,46	1,40-1,60	0,45-0,55
Phosphorus, %DM	0,40	0,31	0,35-0,4	0,30-0,35
Magnesium, %DM	0,64	0,27	0,28-0,32	0,22-0,24
Sodium, %DM	0,16	0,19	0,10-0,12	0,10-0,12
Potassium, %DM	0,54	0,65	0,50-0,65	0,50-0,65
Chloride, %DM	0,99	0,18	0,70-0,80	0,20-0,24
Sulfur, %DM	0,16	0,16	0,35-0,40	0,19-0,21
DCAD, mEq/100 g DM	- 17,08	+ 9,86	-10 la -20	-10 la -20

RESULTS AND DISCUSSIONS

The mean values and fluctuation of urine pH in Close-up cows are presented in table 2.

Table 2.

Mean values and fluctuation of urine pH in dry cows

Date	Group 2(C) n=10		Group 1(E) Calving Care n=10	
	X ± SX	V%	X ± SX	V %
22.03.2016	8,40 ± 0,071	2,69	8,27 ± 0,072	2,74
24.03.2016	8,29 ± 0,074	2,81	6,42 ± 0,065***	3,18
01.04.2016	8,26 ± 0,065	2,50	6,49 ± 0,090***	4,39

n- no of samples

***p < 0.001 very significant differences

p>0,05 not significant differences

At the beginning of the experiment the urine pH level of the two groups was determined assuming that, for similar feed parameters, environment and physiological status, similar pH should be observed. Thus, during the first determination, an average pH of 8,4 for the control group and 8,27 for the experimental group was recorded, normal values

considering that the feed rations of both groups had positive cation-anion differences (DCAD). Once Calving Care was introduced in the experimental group diet, DCAD value was reduced to -17,08 mEq/100g dry matter, which rapidly led to a significant decrease in urine pH. Upon a first analysis of this parameter, conducted 48 hours after the beginning of the experiment, the pH of the control group was almost unaltered, with a recorded mean value of 8,29 , while in the case of the experimental group the pH mean value had decreased to 6,42.

A significant difference (± 0.065) may be noted between the experimental group and the control group, thus confirming the causal relationship between the DCAD reduction and the decrease of urine pH. This is confirmed by measurements conducted ten days after the beginning of the experiment, which highlight a constant pH of 8,26 for the control group, and a significant difference of $\pm 0,09$ for the experimental group, where the mean pH value was 6,49.

DCAD reducing from +9,86 mEq/100g dry matter to -17,08 mEq/100g dry matter by using 300g Calving Care /cow/day has been reflected by a lower urine pH level in experimental group compared to the control group. In order to prove that the parathormone activity is related to a slightly acidic systemic pH, the serum calcium level in the fresh cows was further determined (table 3).

Table 3.

Mean values and fluctuation of serum calcium (mg/dl) within the first 11 days postpartum

Group 2(C) n=10		Group 1(E) Calving Care 300 g/cap/zi n=10	
X \pm SX	V%	X \pm SX	V %
8,402 \pm 0,273	10,27	8,90 \pm 0,361	12,82
8,402 \pm 0,273	10,27	9,304 \pm 0,293	8,89
n=10 8,183 \pm 0,271	9,38	n=10 9,304 \pm 0,293*	8,89

n- no of samples

*p < 0.05 significant differences

p > 0,05 not significant differences

Thus, the mean value of the serum calcium level of the control group was 8,183 mg/dl, with a 37,5% incidence of hypocalcaemia within the group. In experimental group, the mean serum calcium level was 9,304 mg/dl, none of the cows having the serum calcium level below the limit. These values are comparable with the ones obtained by Beede et al. (1992) and Razzaghi et al. (2012).

Using in experimental group 1(E) 300g Calving Care/cow/day in TMR for cows during the last 21 days of gestation leads to a reduction in the incidence of retained placenta by 60%, hypocalcaemia by 66,67%, ketosis by 75% and the displacement of the abomasum by 40% within the group, as compared to control group 2(C) that were not administered Calving Care treatment during the Close-up period (table 5).

Table 5.

Comparative metabolic diseases incidence between experimental group 1(E) subjected to Calving Care treatment, and control group 2(C) without Calving Care treatment

Interval	01.04.16-30.04.16	01.04.16-30.04.16	
	Control group 2(C) Calving Care 0 g/cow/day	Experimental group 1(E) Calving Care 300 g/cow/day	Reduction
Retained placenta	13,61%	6,70%	-60,00%
Hypocalcaemia	6,12%	2,50%	-66,67%
Ketosis	5,44%	1,70%	-75,00%
Displaced abomasum	3,40%	2,50%	-40,00%

CONCLUSIONS

1. Reformulating diets for dry cows with anionic salt Calving Care, led to a significant reduction of the Dietary Cation-Anion Difference (DCAD) from +9,86 mEq/100g dry matter to -17,08 mEq/100g dry matter.

2. Reduction of DCAD by introducing Calving Care in diets was reflected within 48 hours by the reduction of the urine pH level from 8,27 to 6,42, and to 6,49 respectively after 10 days from the beginning of the experiment, while the urine pH of the control group that did not receive Calving Care, was relatively unmodified: 8,4 at the beginning of the experiment, 8,29 after 48 hours and 8,26 after 10 days of experiment.

3. Better parathormone activity at lower pH, has been proven by the fact that in experimental group the average serum calcium level was 9,304 mg/dl per group, whereas the control group had an average serum calcium level of 8,183 mg/dl.

4. Reducing DCAD and urine pH and maintaining calcium level above the critical 8,4 mg/dl value in experimental group, led in clinical terms to a decrease by 60% retained placenta, 66,67% hypocalcaemia, 75% ketosis and 40% left displaced abomasum, as compared to the control group.

5. Based on these experiments it may be concluded that, using anionic salts Calving Care during Close-up period, parathormone functionality can be maintained at optimal capacity, such that after calving it is capable of controlling serum calcium level and consequently to reduce metabolic diseases incidence.

REFERENCES

1. Beede, D. K., D. C. A. Risco, G. A. Donovan, C. Wang, L. F. Archbald, W. K. Sanchez, 1992, Nutritional management of the late pregnant dry cow with particular reference to dietary cation-anion difference and calcium supplementation. 24th Annual Convention American Association Bovine Practitioners.
2. Block E., 1984, Manipulating dietary anions and cations for prepartum dairy cows to reduce incidence of milk fever. Journal of Dairy Science, 67: 2939-2948.

3. Block E., 1994, Manipulation of dietary cation difference on nutritionally related production diseases, productivity, and metabolic responses of dairy cows. *Journal of Dairy Science*. 77: 1437-1450.
4. Byers D. I., 1994, Management considerations for successful use of anionic salts in dairy-cow diets. *Practice Veterinary Food Animal*, 16: 237-242.
5. Goff J. P., 2008, The monitoring, prevention and treatment of milk fever and subclinical hypocalcaemia in dairy cows. *The Veterinary Journal*, 5: 53
6. Heinrichs A. J., A. V. Ishler, 1996, Feeding and managing dry cows. Pennsylvania State University, College of Agricultural Science – Cooperative Extension Circular 372
7. Horst R. L., J. P. Goff, T. A. Reinhardt, 1994, Calcium and Vitamin D metabolism in the dairy cow. *Journal of Dairy Science*, 77: 1936–1951.
8. Horst R. L., J. P. Goff, T. A. Reinhardt, D. R. Buxton, 1997, Strategies for preventing milk fever in dairy cattle. *Journal of Dairy Science*, 80: 1269–1280.
9. Hu W., M. R. Murphy, P. D. Constable, E. Block, 2007, Dietary cation-anion difference effects on performance and acid-base status of dairy cows postpartum. *Journal of Dairy Science*, 90:3367–3375.
10. Joyce P. W., W. K. Sanchez, J. P. Goff, 1997, Effect of anionic salts in prepartum diets based on alfalfa. *Journal of Dairy Science*, 80: 2866-2875.
11. NRC - National Research Council, 2001, Nutrient requirements of dairy cattle, 7th ed., Nutrient requirements of domestic animals. National Academy Press, Washington, DC.
12. Oetzel G. R., 1993, Use of anionic salts for prevention of milk fever in dairy cattle. *Veterinary Clinics of North America: Food Animal Practice*, 15: 1138-1146.
13. Oetzel G. R., K. V. Nordlund, E. F. Garrett, 1999, Effect of ruminal pH and stage of lactation on ruminal lactate concentrations in dairy cows. *Journal of Dairy Science*. Supple.1, 82:38
14. Razzaghi A, H. Aliarabi, M. M. Tabatabaei, A. A. Saki, R. Valizadeh, P. Zamani, 2012, Effect of dietary cation-anion difference during prepartum and postpartum periods on performance, blood and urine minerals status of holstein dairy cow. *Asian-Australasian Journal of Animal Sciences*, 25(4): 486-495
15. Seymour W. M., J. E. Nocek, J. Siciliano-Jones, J. E. English, 1992, Effect of feeding an anionic diet pre-partum on blood, health, reproductive and productive parameters in Holstein cows. *Journal of Dairy Science*, 75: 297.
16. Tauriainen S., S. Sankari, S. Pyörälä, L. Syrjälä-Qvist, 1998, Effect of anionic salts in concentrate mixture and calcium intake on some blood and urine minerals, acid-base balance and feed intake of dry pregnant cows on grass silage based feeding. *Agricultural Food Science Finland*, 7: 523-533.