Effects of two different prepartum diets on some metabolic traits and productive response in multiparous Holstein cows in early lactation

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ABSTRACT

Twenty-six multiparous Italian Holstein cows were used to compare two feeding strategies for the prepartum period. Cows were allocated to two dietary treatments on the basis of their parity (3.1 ± 1.1) and mature equivalent production (11473 ± 1449 kg). From 20 ± 7 d precalving to the calving day, one group of 13 cows (parity = 3.1 ± 1.0; mature equivalent production = 11473 ± 1606 kg) was fed a Control diet made by mixing a 50:50 as fed combination of the far off dry ration and the lactation diet fed postpartum. The remaining cows (parity = 3.1 ± 1.1; mature equivalent production = 11473 ± 1338 kg) were fed a prepartum diet (Anionic) obtained by supplementing the far off dry ration with energy and protein sources plus calcium chloride. This diet had a lower dietary cation-anion difference than the Control diet (7.35 vs 26.66 meq/100 g DM; P<0.05) and it induced a significant decrease in the cows’ urine pH (7.58 vs 7.95; P<0.01). Cows fed the Anionic diet had the lowest DM intake during the prepartum (12.0 vs 13.4 kg/d; P<0.01), but at parturition they showed a limited drop in plasma Ca reducing the incidence of subclinical hypocalcaemia in comparison with the Control group (8 vs 62%; P<0.01). No differences due to the prepartum diet were observed for the plasma levels of several indicators of hepatic function (aspartate-amino transferase, Y-glutamil transferase, creatin-kinase and bilirubine). After calving, all the cows were co-mingled and fed the same lactation ration and those that had received the Anionic diet during the prepartum showed a significant increase in milk yield with no changes in milk quality. Average production at the peak of lactation was 43.8 kg/d for Control cows while it raised up to 47.8 kg/d (P<0.05) for the animals fed the Anionic diet during the prepartum. This positive result was obtained with a lower loss in cows’ body condition score measured at 30 and 60 days in milk and without any effect on the uterine involution process. The use of the Anionic diet has proven to be an effective alternative to the common practice of feeding close-up diets made by a partial replacement of the far off dry ration with the diet fed to the lactating cows. This strategy should be particularly recommended for dairy herds in which there is a great incidence of metabolic and health problems related to clinical or subclinical hypocalcaemia in the early postpartum.

Key Words: Anionic diets, Prepartum, Hypocalcaemia, Milk yield.
Lo studio ha posto a confronto due diverse strategie alimentari per la fase del preparto utilizzando 26 vacche multipare di razza Frisona Italiana (ordine di parto = 3.1 ± 1.1; equivalente vacca matura = 11473 ± 1449 kg). Le vacche sono state suddivise in due gruppi omogenei sulla base del loro ordine di parto e dell’equivalente vacca matura. A partire da 20 ± 7 d prima del parto, un gruppo di bovine (ordine di parto = 3.1 ± 1.0; equivalente vacca matura = 11473 ± 1606 kg) è stato alimentato con una dieta (Control) ottenuta miscelando una combinazione 50:50 sul peso tal quale della dieta di asciutta e di quella fornita alle bovine in lattazione. L’altro gruppo (ordine di parto = 3.1 ± 1.1; equivalente vacca matura = 11473 ± 1338 kg), invece, è stato alimentato con una dieta (Anionic) isoeenergetica, isoproteica e isofibrosa alla precedente, ottenuta integrando la dieta di asciutta con silomais, crusca, proteine di soia e cloruro di calcio. Questa dieta, che aveva un minore bilancio anioni-cationi di quella di controllo (7.35 vs 26.66 meq/100 g DM; P<0.05), ha indotto una significativa diminuzione del pH urinario nelle bovine (7.58 vs 7.95; P<0.01). Il controllo dell’ingestione durante il pre-parto ha visto un minore consumo di sostanza secca nelle bovine che ricevevano la dieta anionica (12.0 vs 13.4 kg/d; P<0.01). Al parto le bovine alimentate con la stessa dieta hanno però osservato una minore diminuzione del calcio plasmatico riducendo rispetto al gruppo di controllo l’incidenza dei casi di ipocalcemia subclinica (8 vs 65%; P<0.01). La concentrazione ematica di alcuni indicatori della funzionalità epatica come l’aspartato-amino transferasi-AST, la γ-glutamil transferasi-GGT, la creatin-kinasi-CK e la bilirubina totale non ha subito variazioni prima e dopo il parto in funzione della dieta di fine asciutta. Dopo il parto tutte le vacche sono state alimentate con la stessa dieta di lattazione, ma le bovine che nel pre-parto avevano ricevuto la dieta anionica hanno fatto osservare una più elevata produzione di latte, senza variazioni significative nella qualità. La produzione al picco di lattazione del gruppo di bovine della tesi di controllo è stata pari a 43.8 kg/d, mentre le vacche che avevano ricevuto la dieta anionica è salita fino a 47.8 kg/d (P<0.05). A questo positivo risultato produttivo si è aggiunta una minore perdita di condizione corporea dopo 30 e 60 d di lattazione e l’assenza di effetti negativi sul processo di involuzione uterina post-parto. L’utilizzo della dieta anionica nella fase finale dell’asciutta può rappresentare un’efficace alternativa all’impiego della dieta di lattazione in parziale sostituzione della dieta di asciutta, e ciò soprattutto per aziende in cui si verifichi nel post-parto un’elevata incidenza di problemi metabolici e sanitari riconducibili ad una situazione di ipocalcemia clinica o subclinica.

Parole chiave: Diete anioniche, Preparto, Ipocalcemia, Produzione di latte.

Introduction

During the peripartum the dairy cow is characterized by a set of metabolic and endocrine changes to get ready for parturition and the subsequent lactation (Drackley, 1999). A proper nutrition and management of the animal during the late phase of the dry period can improve the ensuing lactation performance. Conversely, an inadequate feeding program may result in inconsistent feed intakes after calving as well as in an increased risk of metabolic diseases during the transition from the dry period to the early lactation (Varga, 2003). Two opposite phenomena can be observed in the pregnant cow during the last 3 weeks of gestation. On one hand, there is a marked increase of the requirements of glucose and metabolizable energy to support fetal growth and mammary tissue development (NRC, 2001). On the other, there is an accelerated decline in feed intake likely driven by a series of endocrine changes (Ingvartsen and Andersen, 2000). This metabolic situation suggests the need to increase the energy density of the diet to offset the negative energy balance before parturition (Rabelo et al., 2003).

A frequent feeding strategy adopted by the dairy farmers to increase the dietary energy density during the prepartum is to feed a diet during the prepartum made by a partial replacement of the far off dry ration with the diet fed to the lactating cows. However, since the lactation diet is rich in cations, like Na and K, this solution may not prevent from the risk of hypocalcaemia induced by the intake of a ration with a high dietary cation-anion difference (DCAD) (Block, 1984). In order to overcome this problem, an alternative feeding solution could be represented by supplementing the far off dry ration with energy and protein sources along with the addition of macromineral anions capable of lowering the DCAD.

In the present study, these two feeding strategies for the prepartum were compared by measur-
ing their effects on the metabolic traits of multiparous Holstein cows and by recording the productive response of the animals in early lactation.

**Material and methods**

*Animals, treatments and management*

The study was carried out at the Pesavento dairy farm, located in Villaverla (VI) Italy. The farm herd consists of 103 Italian Holstein dairy cows (AIA, 2003) and the research considered a group of twenty-six multiparous cows (parity = 3.1 ± 1.1; mature equivalent production = 11473 ± 1449 kg), which calved from the end of September 2003 to the end of January 2004.

According to the expected calving date, these animals were allocated to two dietary treatments based on their parity, and mature equivalent. One group of 13 cows (parity = 3.1 ± 1.0; mature equivalent = 11473 ± 1606 kg) was fed a close-up diet (Control) made by mixing a 50:50 as fed combination of the far off dry ration and the lactation diet fed to the animals postpartum (Table 1). The remaining cows (parity = 3.1 ± 1.1; mature equivalent = 11473 ± 1338 kg) were fed a close-up diet (Anionic) obtained by supplementing the far off dry ration in the mixing wagon with maize silage, wheat bran, soy proteins and calcium chloride as anionic source (Table 1). From the chemical point of view, the two experimental diets were isonitrogenous, isofibrous and isocaloric and differed only in their DCAB (Table 1). The animals of the 2 dietary treatments were housed in separate contiguous individual pens with straw bedded floor and free access to water from 20 ± 7 d pre-calving to the day of calving. The diets were fed as total mixed rations once a day at 09.00 h and the amount of feed offered and the feed residues of each pen were measured daily for 12 consecutive days. Representative samples of the diets were collected every 2 weeks from the manger at the time of feed distribution and they were frozen and stored for subsequent chemical analysis. Following the protocol of a companion study carried out in a commercial dairy farm by Beede et al. (1992), after calving all the cows were co-mingled and fed ad libitum the same lactation ration (Table 1).

*Experimental measurements*

Individual urine samples were collected at approximately 15.00 h by manual stimulation or by using an indwelling Foley catheter on the day before the administration of the experimental diets and after 12 days of the close-up period. The urine sample was taken from mid-stream and its pH was measured within 30 min from the collection. Blood from the jugular vein was collected from each cow into Lithium-Heparinized vacutainer tubes (Becton Dickinson Inson, Meylan Cedex, France) before the feed distribution. The first sample was taken on the day before the administration of the experimental diets (20 ± 7 d pre-calving). A second sample was collected after 15 days of the close-up period, and based on the real calving date of the cows it resulted taken on average 5 ± 3 d before the parturition. Postpartum, two more blood samples were taken at d 5 and d 30.

Samples were centrifuged (3000 rpm for 15 minutes at 4°C) and the plasma was then transferred to the Istituto Zooprofilattico Sperimentale delle Venezie (Legnaro, PD, Italy) and stored at -20°C until the subsequent analysis. Plasma samples were analysed by an indirect potentiometric analyser (Hitachi 911, Roche Boehringer, Mannheim, Germany) for Ca (o-Crysolftalein, Roche BM), non esterified fatty acids - NEFA (enzymatic-colorimetric, Randox) and for a set of metabolites related to the hepatic function like aspartate-amino transferase - AST (IFCC, 37°C), γ-glutamil transferase - GGT (Szasz, 37°C, Roche BM), creatin-kinase - CK (NAC activated, 37°C, Roche BM) and total bilirubine (DPD, Roche BM). Plasma Ca and NEFA were also measured on a further blood sample taken from each cow on the day of calving.

The cow’s body condition score (BCS) was recorded on the day before the administration of the experimental diets and on d 30, d 60 and d 90 postpartum by using the five point scale (from 1 = emaciated to 5 = obese) proposed by Edmonson et al. (1989) for Holstein dairy cows. The incidence of calving-related disorders was also recorded. Individual milk yields were recorded weekly for the first 90 days of lactation by averaging the production of five following days. Milk yield and DIM at the peak of lactation were also recorded for all the
Table 1. Feed composition (% DM) and chemical analysis of the diets given during the far off dry period, the prepartum and the following lactation.

| Ingredients                  | Dry period | Prepartum | Lactation |
|------------------------------|------------|-----------|-----------|
|                              | Control    | Anionic   |           |
| Maize silage                 | 29.3       | 34.8      | 36.7      | 40.3      |
| Meadow hay                   | 36.6       | 24.0      | 22.8      | 11.4      |
| Wheat straw                  | 24.0       | 12.0      | 12.0      | --        |
| Soybean meal                 | 8.8        | 10.7      | 6.0       | 12.6      |
| Maize meal                   | --         | 9.5       | 6.0       | 18.9      |
| Lucerne hay                  | --         | 4.3       | --        | 8.6       |
| Soybean expeller             | --         | 2.4       | 6.3       | 4.8       |
| Wheat bran                   | --         | --        | 7.2       |           |
| Dicalcium phosphate          | 1.2        | 0.8       | 0.9       | 0.4       |
| Sodium bicarbonate           | --         | 0.3       | --        | 0.7       |
| Sodium chloride              | --         | 0.3       | --        | 0.5       |
| Calcium carbonate            | --         | 0.3       | --        | 0.5       |
| Magnesium oxide              | --         | 0.1       | 0.4       | 0.2       |
| Calcium chloride             | --         | --        | 1.0       | --        |
| Trace minerals-vitamins      |            |           |           |           |
| premix¹                      | 0.3        | 0.6       | 0.6       | 0.9       |

Chemical composition:

|                         | Dry period | Prepartum | Lactation |
|-------------------------|------------|-----------|-----------|
| Dry matter %            | 60.1 ± 0.1 | 57.1 ± 0.8 | 56.2 ± 0.6 | 54.1 ± 0.2 |
| Crude protein % DM      | 11.8 ± 0.1 | 12.9 ± 0.3 | 12.8 ± 0.3 | 15.4 ± 0.1 |
| Ether extract %         | 2.3 ± 0.1  | 2.8 ± 0.1  | 3.1 ± 0.1  | 3.3 ± 0.1  |
| Ash                     | 8.2 ± 0.1  | 8.3 ± 0.1  | 8.2 ± 0.1  | 8.4 ± 0.1  |
| Neutral detergent fibre | 55.6 ± 0.7 | 45.2 ± 0.4 | 45.0 ± 0.9 | 34.8 ± 0.5 |
| Nonfibrous carbohydrates | 23.5 ± 0.6 | 30.8 ± 0.8 | 30.9 ± 0.9 | 38.1 ± 1.2 |
| Unité Fouragère Lait /kg DM | 0.67      | 0.79      | 0.79      | 0.91      |
| Dietary cation-anion mEq/100 g DM | --² | 26.66 ± 2.01 | 7.35 ± 1.84 | 29.35 ± 1.32 |

¹ Premix supplied (/kg of DM): 126,300 U of vitamin A; 84,200 U of vitamin D₃; 1580 mg of vitamin E; 10,500 mg of Vitamin PP; 5300 mg of Zn, 2400 mg of Mn, 1600 mg of Fe, 400 mg of Cu, 100 mg of Co; 70 mg of I; 15 mg of Se.
² Not measured.
cows. Individual milk samples were taken from all the cows at the morning and afternoon milking on DIM 20, 50, 80 and 90. Samples were analysed by Milko-scan (Foss Electric, Hillorød, Denmark) for fat and protein content and for the somatic cell count according to the FIL-IDF standard.

Thirty days after calving, all cows were submitted to a rectal palpation to evaluate the degree of uterine involution postpartum by using the following scoring method based on the diameter of the uterine horn: 1 = < 4 cm; 2 = from 4 to <6 cm; 3 = from 6 to < 8 cm; 4 = 8 to <10 cm and 5 = > 10 cm.

Composite samples of the diets collected during the study were analysed for dry matter, crude protein, ether extract, and ash according to AOAC methods (1990). Analysis of neutral detergent fibre of the same samples was carried out according to Van Soest et al. (1991) and the nonfibrous carbohydrates content was calculated as proposed by Mertens (1992). The energy density of the diets was calculated by using the Unité Fouragère Lait values given by INRA (1988) for all the ingredients.

Representative samples of the diets fed during the prepartum and the early lactation were ashed and then analysed for K and Na by inductively coupled plasma spectroscopy, while the content of Cl and S was measured by volumetric titration and ionic chromatography. These minerals were used to calculate the DCAD by adopting the following equation proposed by Horst et al. (1997):

$$\text{DCAD (meq./kg DM) = } \left\{ \frac{([\text{Na}/0.0023] + (K/0.0039)) - ([\text{Cl}/0.00355] + (S/0.0016))]}{\right\}$$

**Statistical analysis**

A one-way ANOVA was performed to test the effect of the prepartum diets on DCAD and urine pH. The intake of the cows during the close-up period was analysed with a linear model that included the effects of the dietary treatment and day of trial. Blood data and body condition score measurements were analysed with a linear model which considered the effects of prepartum diet, cow (diet), week of lactation and the diet x week of lactation interaction. Also in this analysis the significance of the diet effect was tested using cow (diet) as error term. Milk production and DIM at the peak of lactation were analysed by one-way ANOVA to test the effect of the prepartum diet. Milk composition data were processed with a model that considered the effect of prepartum diet and cow (diet) using the repeated measurements option. All this set of analysis was performed without PROC-GLM (SAS, 1989) and Kruskal-Wallis test within PROC NPAR1WAY (SAS, 1989) was performed to analyse the uterine involution and other variables recorded with a score.

**Results**

*Prepartum diets and cows’ intake, urine pH and calving related disorders*

The experimental diets fed during the prepartum period had the same chemical composition but differed for the DCAD (Table 1). In the Anionic diet, the use of calcium chloride as anionic source significantly lowered DCAD in comparison to the Control one (7.35 vs 26.66 meq/100 g DM; P<0.05; SED = 5.90) in which there was significant contribution to the cations concentration from the lactation diet.

The cows used for the study had the same BCS and urine pH when entering into the close-up period (Table 2). The initial value of urine pH did not change during the prepartum in the group of animals fed the Control diet, while it decreased significantly in those fed the Anionic diet despite its lower DM intake measured in the first 12 days of treatment (Table 2).

At calving, there was a single cow with a problem of retained fetal membranes in the Anionic group, while two Control cows had the same reproductive disorder and one Control cow was treated for parturient paresis.

*Metabolic traits in cows*

The administration of a prepartum diet with a low DCAD was capable of limiting the drop in plasma Ca at parturition (Figure 1). Moreover, the same cows showed a lower peak of plasma NEFA at parturition in comparison to the Control ones (Figure 1). For both these parameters the statistical analysis
Table 2. Body condition score and urine pH of multiparous Holstein cows entering the close-up period (20 ± 7 d precalving). Urine pH after 12 days of dietary treatment and average dry matter intake during the same period.

| Prepartum diet       | Control | Anionic | SEM1 |
|----------------------|---------|---------|------|
| Animals n.           | 13      | 13      |      |
| Body condition score | 3.71    | 3.63    | 0.27 |
| Urine pH:            |         |         |      |
| - initial            | 7.93    | 7.87    | 0.36 |
| - 8 day before calving | 7.95A  | 7.58B  | 0.33 |
| Dry matter intake kg/d | 13.4A  | 12.0B  | 0.4  |

1 Standard error of the mean.

Figure 1. Pre- and postpartum plasma calcium (model SEM = 0.14) and non esterified fatty acids – NEFA (model SEM = 0.32) concentrations of multiparous Holstein cows fed the two experimental diets during the close-up period.
showed a significant time of sampling effect (P<0.05).

The experimental diets fed during the close-up period did not affect the pre- and postpartum plasma levels of a set of indicators of hepatic function (Figure 2). The plasma concentration of all these parameters changed according to the day relative to calving and therefore a significant time of sampling effect (P<0.001) was observed for all of them.

**Milk yield, body condition score and uterine involution of cows**

Milk response of cows in early lactation was significantly affected by the prepartum diet. Cows fed the Anionic diet during the close-up period showed a higher milk yield than the Control cows from the 4th wk of lactation onward (Figure 3). The average daily milk production during the first 90 DIM was higher for the cows which received the Anionic diet during the prepartum and the same group of cows showed a higher peak of lactation (Table 3). Conversely, milk fat, protein, and somatic cells count measured on repeated samples taken in early lactation were not affected by the diet fed during the close-up period (Table 3). The calculation of the 3.5% fat corrected milk production by using the average individual milk yield and milk fat data showed similar results between cows fed Control (42.6 kg/d) and Anionic (43.7 kg/d) diets during the prepartum (P = 0.58; model SEM = 5.02).

A significant diet x time of sampling interaction (P<0.05) was observed for the values of the cows’ BCS (Table 4). The two groups of cows entered the close-up period with the same BCS, but the animals fed the Anionic diet showed a reduced loss in body condition during the first 60 DIM. Thirty days after calving, cows fed the Anionic diet prepartum had an average score of 1.6 ± 0.6 for the uterine involution. The score for...
Table 3. Average milk yield and fat corrected milk yield during the first 90 days of lactation, peak of lactation and milk composition of multiparous Holstein cows fed the two experimental diets during the close-up period.

| Prepartum diet | SEM1   |
|----------------|--------|
|                | Control | Anionic |
| Milk yield     | kg/d    | 39.9\*  | 42.1\*  |
| Peak of lactation: |        |        | 3.1     |
| - yield        | kg      | 43.8\*  | 47.8\*  |
| - days in milk |         | 45.8    | 50.6    |
| Milk composition: |      | 18.8    |         |
| - fat          | %       | 3.90    | 3.71    |
| - protein      | "       | 3.15    | 3.12    |
| - somatic cells count | log | 2.53 | 2.15 |

1 Standard error of the mean.

\* P < 0.05; \*\* P < 0.10.

Figure 3. Milk production in early lactation (model SEM = 3.1) of multiparous Holstein cows fed the two experimental diets during the close-up period.
the Control cows was higher 2.1 ± 0.8 but, due to the large variation within group, the difference between diets did not reach the minimum threshold of statistical significance (P<0.18; Kruskal-Wallis X² = 1.8).

Discussion

Consistent with previous studies (Vagnoni and Oetzel, 1998; Moore et al., 2000; Roche et al. 2003b), the administration of the Anionic diet during the close-up period caused a significant drop in the urine pH. This is the consequence of a status of subacute metabolic acidosis induced by the anionic salt which, according to Freeden et al. (1988), should increase the availability of Ca by the mobilization from bone, the enhanced absorption from the gut and a reduced loss through the urine. Roche et al. (2003a) identified a threshold DCAD (< +15mEq/100 g DM), below which blood pH would be reduced and Ca absorption increased. In the present study, the Anionic diet was below this threshold and at parturition (Figure 1), plasma Ca of the cows of this treatment was higher than that of the Control cows confirming the previous results of Block (1984) and Moore et al. (2000).

Joyce et al. (1997) found a similar pattern of blood Ca along with a significant reduction in health disorders by using anionic salts in prepartum diets. The ability of the cow to limit the drop in blood Ca concentration at parturition may reduce the incidence of milk fever and sub-clinical hypocalcaemia in the early postpartum period. According to NRC (2001), sub-clinical hypocalcaemia is observed in cows when blood Ca falls between 9 and 5 mg/dl. Expressing our blood Ca data recorded at parturition with the same unit of measurement, 62% of the Control group cows had a value within this interval in comparison with the single case (8%) observed for the Anionic group (P<0.01; Kruskal-Wallis X² = 8.3).

Cows fed the Anionic diet showed a lower DM intake than Control during the close-up period. This result confirms the low palatability of the anionic salts by cows (Hultens, 1992) and it was consistent with the findings of Tucker et al. (1992) in a previous study on dry pregnant cows. Even Joyce et al. (1997) observed the lowest DM intake feeding a prepartum diet added with anionic salts but, as in the present study, any detrimental effects of the reduced intake were apparently overcome by the improvement in cows’ Ca status.

Plasma levels of several indicators of hepatic function were not affected by the different DCAD of the prepartum diets (Figure 2). This was in agreement with the results of Spanghero (2002),

Table 4. Body condition score at 20 days before and 30, 60 and 90 days after calving of multiparous Holstein cows fed the two experimental diets during the close-up period ( model SEM = 0.19).

| Prepartum diet     | Control       | Anionic       |
|--------------------|---------------|---------------|
| Body condition score | 3.71 ± 0.20   | 3.63 ± 0.33   |
| - 30 days after calving | 3.04 ± 0.31*B | 3.27 ± 0.35*A |
| - 60 days after calving | 3.06 ± 0.34*  | 3.19 ± 0.30*  |
| - 90 days after calving | 3.15 ± 0.28   | 3.29 ± 0.40   |

1 Standard error of the mean.
*A,B: P<0.01; α,β: P<0.10.
who did not observe any significant change for the same parameters in feeding diets with a progressive decrease in DCAD due to supplementation with a compound feed having a high negative cation-anion difference. Regardless of the prepartum diet, the same indicators showed a significant increase post-partum. This trend, also noticed by Bertoni et al. (2000), should be merely considered as the liver response to the metabolic effort faced during the parturition and the onset of lactation.

The positive milk response of the cows which received the Anionic diet during the close-up period was consistent with the results of previous studies carried out under different experimental conditions. Beede et al. (1992), in a large field experiment undertaken in a commercial dairy farm, recorded a +3.61% increase (P<0.01) in the milk yield produced during the next lactation (305 DIM) by cows fed an anionic diet during the late prepartum compared with cows fed a non-acidogenic close-up ration. Like the present study, all these cows were co-mingled and fed the same diet during their lactation. Under more controlled experimental conditions, Block (1984) compared the use of anion vs cation prepartum diets in a two-year switchover design study carried out with 20 dairy cows. An overall increase of 6.8% (P<0.05) in the milk produced in the subsequent lactation was observed when the cows were offered the anion diet. The authors of both studies related the positive productive response to higher plasma Ca levels around parturition, which reduced the incidence of clinical milk fever and sub-clinical hypocalcaemia. This hypothesis could also explain the result of the present study in which, however, further support of the increased production came from the improved energy status observed for the cows of the Anionic group. Despite the lower intake during the close-up period, these animals limited the peak of plasma NEFA at parturition (Figure 1) and they showed a reduced BCS loss in early lactation (Table 4).

Conclusions

The use of a prepartum diet rich in energy but with a low DCAD has been shown to be an effective alternative to the common practice of feeding a close-up diet made by a partial replacement of the far off dry ration with the diet fed to the lactating cows. At parturition, cows fed the Anionic diet limited the drop in plasma Ca reducing the incidence of sub-clinical hypocalcaemia. During the prepartum, the diet added with the anionic salt had the lowest DM intake but the improvement in cows’ Ca status at parturition overcame any detrimental effects of this reduced intake.

A further positive effect of the use of the anionic prepartum diet was observed in early lactation when cows showed a significant increase in milk yield with no detrimental effects on milk composition. This result was obtained with a reduced loss in cows’ BCS and without negative effects on the process of uterine involution.

Based on these results, the choice of a prepartum diet with a low DCAD, like the Anionic one, should be particularly recommended for dairy herd in which there is a great incidence of metabolic and health problems related to a clinical or sub-clinical hypocalcaemia in the early postpartum.

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