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EFFECT OF PRE-PARTUM DIETARY CATION-ANION DIFFERENCE LEVEL ON PHYSIOLOGICAL PERFORMANCE OF DAIRY COW

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SUMMARY

This investigation aimed to study the effect of dietary cation: anion difference (DCAD) on some physiological parameters in dairy cow, including blood serum and urine concentration of mineral elements, acid-base balance, calcium homeostasis, and health status. This experiment began before the expected due date (21 days) and continued until calving and insemination for the next pregnancy. Twenty multiparous cows in second and third parity were targeted as experimental animals. Animals were divided according to the parity to four groups, five cows each. Animals were housed in four separate open areas provided with water sinks and shades. All animals were fed on a basal diet without (G1) or with different DCAD, including +90,0, -90 and -150 mEq/kg of DM, in G1, G2, G3, and G4, respectively, During the postpartum period, cows in all groups were fed on diet with DCAD of + 200 mEq/kg DM) anionic salt. Results indicated that serum calcium concentration increased significantly (p<0.05) with decreasing DCAD. With positive DCAD (+90 mEq/kg DM), serum calcium concentration was 6.5968 mg/dl, increased significantly to 7.2095 mg/dl with zero DCAD. When DCAD decreased to -90 or -150 /mEq/kg DM), serum calcium concentration increased to 7.7263 and 7.9486 mg/dl with anionic salts, respectively with no significant differences. The urinary calcium concentration had the same trend of blood calcium concentration. Total Serum phosphorus concentration decreased significantly (p < 0.05) with decreasing DCAD, the highest serum phosphorus concentration was recorded for G1 (5.11 mg/dl), and the lowest was obtained with G4 (4.67 mg/dl). The urinary pH decreased from 2.009 for G1 to 1.808 for G4. Moreover, DCAD level affects significantly urinary magnesium, urea and creatinine, while serum magnesium, total protein, albumin, globulin, AST and ALT weren't affected significantly by treatment. Data indicated that there was a significant interaction between treatment and time before and after parturition effects on Beta **hydroxyl Butyric Acid** (BHBA) concentration. The data also showed that the thyroid hormone (T4) was unaffected by the therapy, and as expected, progesterone levels dropped sharply during delivery and kept dropping until 14 days postpartum.

It could be concluded that the dairy cattle breeders adjust DCAD at transition period to -150 /mEq/kg DM pre-partum and to +200 /mEq/kg DM post-partum.

Keywords: *Pre-partum; DCAD; Hypocalcaemia and Physiological parameters.*

INTRODUCTION

The transition period is the most critical time due to significant metabolic stress, endocrine changes, and reduced immunological function. Dairy cows need to be observed during the first 15 days in milk (DIM) in order to detect and treat any illness indications early in the subclinical stage. Clinical and subclinical hypocalcaemia (SCH), clinical and subclinical ketosis (hyperketonemia), and fatty liver are among the metabolic conditions that have been documented during the transition period. The objective of the present study was to investigate the effect of pre-partum DCAD (Dietary Cation - Anion Difference) level, on plasma and urine concentration of mineral elements, acid-base balance, and calcium homeostasis and health status in dairy cows.

Per-parturient cows experience notable changes in both energy and protein flux around the time of calving, as well as major changes in the dynamics of mineral elements (Horst *et al*., 1997). According to Hansen *et al*. (2003), preventing hypocalcaemia, which lowers dry matter intake and raises the risk of metabolic diseases, is a crucial part of cows' mineral metabolism (Curtis *et al*., 1983). Chan *et al*. (2005)

and Hu *et al*. (2007) published that, from the time of calving until roughly 50 days after giving birth, lactating dairy cows may benefit from dietary cation: anion difference (DCAD) manipulation. Rodriguez *et al.* (2016) reported that the dairy cows ruminants' low DCAD levels in pre- and postpartum meals affected the concentrations of mineral components in the serum and urine, calcium homeostasis, acid-base balance, DMI, milk activate parathyroid hormone receptors, lower the pH of bodily fluids, which affects the production, and health of dairy cows.

Providing anionic products is one way to achieve a negative DCAD (<6.0), which could signal metabolic over-acidification and that the cow is at the limit of compensatory mechanisms (Cunningham, 2002; Goff, 2018; Melendez *et al.,* 2022b). The authors *sta*te that low DCAD levels decreased the pH of bodily fluids, activate parathyroid hormone receptors and ultimately help dairy cows release calcium reabsorption from their bones. The adverse impacts of excessive negative DCAD have also been corroborated by a recent study (Beck *et al.*, 2022). Thus, a quick and inexpensive field technique to check the degree of metabolic acidification in pre-partum cows fed anionic diets is to measure the urine pH (Goff, 2018; Lean *et al*., 2019; Wilkens *et al*., 2020), whereas, urine pH will change during 48–72 hours after dietary DCAD changes (Goff, 2014). According to Charbonneau *et al*., (2006), it's interesting to note that cows with urine pH values near 7.0 are less likely to develop clinical hypocalcaemia. As a result, it is possible to prevent milk fever in Holstein cows by ensuring that their urine pH remains within the mild metabolic acidosis range (6.0 - 6.8) prior to giving birth (Charbonneau et al., 2006; Goff, 2014; Melendez and Poock, 2017).According to, feeding low DCAD for three to four weeks prior to calving had positive impacts on calcium metabolism, systemic acid-base status, pre-partum health, and postpartum productive performance. However, it became out that giving periparturient dairy cows negative DCAD improved their blood calcium levels and the amount of milk they produced after giving birth (Block, 1984; Beede *et al*., 1992; Moore *et al*., 2000).

The high demand for calcium at the start of lactation puts the animal's ability to maintain calcium homeostasis to the test, which is why hypocalcaemia is a special issue in recently calved cows (Goff, 2008). Other diseases are more likely to affect cows with hypocalcaemia. Whereas, hypocalcaemia is linked to early metritis, retained placenta, dystocia, and prolapsed uterus, according to Grohn *et al*. (1989) and DeGaris and Lean (2008). Through its effects on the animal's acid-base balance and calcium metabolism, which are frequently "broken" in dairy cows, dietary cation-anion differences have an impact on the health and production of animals (Sanchez, 2003).

Despite a steady decline in the incidence of its clinical form, milk fever, over the past few years (5.9 % in 1996 to 2.5 % in 2014) (USDA, 2018), some herds continue to experience incidences exceeding 5% (Venjakob *et al*., 2021). Furthermore, 50–80% of dairy cows may be impacted by the high prevalence of sub-clinical hypocalcaemia (SCH), which is defined as total serum Ca (tCa) and ionized serum Ca (iCa) concentrations of <2.15 and <1.0 mmol/L, respectively (Goff, 2018; Couto Serrenho *et al*., 2021c) (Reinhardt *et al*., 2011; Caixeta *et al*., 2015; Tsiamadis *et al.,* 2016).

Over time, this metabolic status has changed. The first two days after calving were when SCH used to occur most frequently (Reinhardt *et al*., 2011; Rodríguez *et al.,* 2017). However, in recent years, SCH cases have been documented past two days after giving birth (Neves *et al.,* 2018; McArt and Neves 2020). In confined dairy cattle, the prevalence was 18.6% at 7–8 days after giving birth (Tsiamadis *et al*., 2021), and in southern hemisphere dairy cows, it ranged from 21.7 to 42.3% at 7 days after giving birth (iCa 1.0 mmol/L) (Melendez *et al.,* 2022). Additionally, SCH contributes to substantial financial losses (Liang *et al.*, 2017) and is a risk factor for various periparturient disorders (McArt *et al.,* 2012; Overton *et al.,* 2017; Neves *et al*., 2018; McArt and Neves, 2020).

Dairy farmers must thus find an effective way to prevent SCH in order to ensure a good lactation period and minimize financial losses. Utilizing anionic chemicals (chlorides and sulfates) in the feed to change the dietary cation-anion difference (DCAD) and cause a mild metabolic acidosis is one of the many ways to prevent hypocalcaemia (Goff, 2014 and 2018). The ideal DCAD needed to prevent the onset of clinical hypocalcaemia, however, has been hotly contested.

DCAD's possible impact on nursing dairy cows has also been investigated; the findings suggest a possible acid-base regulatory link between DCAD and production (Sanchez and Beede, 1994; Hu and Murphy, 2004). Early lactation milk production was higher in cows fed a higher DCAD level, according to current developments in mineral nutrition (Sanchez, 2003; Hu and Murphy, 2004; Hu et al., 2007a). Tucker *et al,* (1988) found that early lactation cows fed a diet of +200 DCAD had a 9% higher milk output and an 11% increase in dry matter intake (DMI).

With the knowledge currently available, producers and nutritionists could use dietary supplements of anionic salts to reduce the harmful effects of sub-clinical hypocalcaemia (SCH), prevent milk fever, and increase the lactation performance of cattle. The physiological adaptations in the cow and calf may be affected negatively by excessive anionic salts, hence such a nutritional intervention should be controlled. To regulate and avoid clinical hypocalcaemia and lower the incidence of SCH, a moderate metabolic state with a urine pH between 6.0 and 7.0 appears to be enough. It has been shown that a more severe acidotic state is neither beneficial nor harmful to the cow and probably her progeny. Research that clarifies the pathophysiological processes via which very low negative DCAD diets affect cows that produce milk productivity and health, as well as the impacts of such diets on the performance and health of offspring, is desperately needed. Thyroid hormones are essential for the differentiation, growth and proper metabolism of the cells. They have a significant impact on the regulation of the mammary gland, lactopoesis (Capuco *et al*. 2001., Huszenicza *et al*. 2002), Bharti *et al*., (2015) noted that thyroid hormones regulate the activity of sodium potassium pumps in most of the tissues Serum thyroid hormone (T4) concentrations gradually increase during late gestation, decrease approximately 50 percent at calving, and then begin to increase (Kunz *et a*l., 1985; Pethes *et al*., 1985). These hormonal responses are designed to increase energy mobilization, reduce basal metabolic rate, and partition nutrients to the mammary gland. They are involved in the initiation and stimulation of ovarian activity – in steroidogenesis in the follicles. In cows exhibiting postpartum negative energy balance, lower concentrations of T4 hormones was noted. Low levels of these hormones were observed during the first three months of lactation, due to the fact that the concentration of T4 is negatively correlated with milk productivity (Jorritsma *et al*. 2003, Klimienė *et al*. 2008, and Djoković *et al*. 2010, 2014, and 2015).T4 concentration also remained at a higher level in multiparous cows compared to primparous cows.

Progesterone is one of the most significant hormones that is mainly engaged in receptor coordination of female reproductive processes, including the start and maintenance of pregnancy (De Amicis *et al.* 2012). Therefore, pregnancy maintenance and uterine preparation are among P4 functional characteristics (Blavy *et al*. 2016), and a low progesterone level is responsible for embryo loss as recorded in aborted cases of dairy cows (Amin,Omran *et al*. 2023). Pre-partum levels of T4 (thyroxin) are generally high, while progesterone (P4) is high for pregnancy maintenance, then rapidly declines at parturition to facilitate calving and lactation onset. Postpartum, P4 levels rise again for a short period to support fertility and pregnancy maintenance.

Progesterone is produced in cows by the corpus luteum, adrenal glands and placenta. Its purpose is primarily to maintain pregnancy. Progesterone is involved in the development of the mammary gland and the onset of lactation (Convey 1973, Kindahl *et al*. 2002, 2004). Many of the hormonal changes during the peripartum period are to prepare the cow for the substantial increase in energy needs postpartum (Ehrhardt *et al*., 2016). The decrease in the concentration of progesterone before calving is necessary for uterine contractions, contributes to the onset of lactation, allows mammary epithelial to respond to lactogenic complex (glucocorticoids and ACTH) (Bernal 2001, Mastorakos and Ilias 2003, Kindahl *et al*. 2004). Decrease in the concentration of progesterone at the end of pregnancy in cows is associated with cortisol-induced fetal enzyme activity – 17α-hydroxylase and C17–20 lyase – which catalyze the conversion of progesterone to androgens, which in turn is converted to estrogen. In addition, 2–3 days before calving luteolysis is also observed (Bernal 2001, Mastorakos and Ilias 2003, Kindahl *et al*. 2004).

Kindahl *et al*. (2004), reported that postpartum increase in the concentration of progesterone in cows is observed after the first ovulation. Cernescu *et al.* (2010). According to Corah *et al*. (1974) a significant increase in progesterone levels was observed in postpartum beef cows, 3–5 days before the first heat,because off luteinization of maturing follicles, and/or progesterone synthesis in the adrenal glands. According to Stevenson and Britt (1979), lower concentration of progesterone was noted during the first estrous cycle in cows after calving in comparison to later cycles – which in turn may result in a shorter first estrous cycle.

The objectives of the present study were to investigate the effect of pre-partum dietary cation: anion difference level, and the effect of different levels on serum and urine concentration of mineral elements, acid-base balance, and calcium homeostasis and health status in dairy cows.

MATERIALS AND METHODS

Animals, diets, and experimental design:

In northern Egypt (Delta) private farm, where this study was carried out, dietary treatments started before to the anticipated date of delivery and continued until the calf was born and insemination for the subsequent pregnancy took place, or roughly three weeks prior to the event and two months following the birth. Dairy cows in the latter stages of pregnancy were used for the study.

For sampling, 20 multiparous cows in second and third partition from the farm in northern Egypt (Delta) were chosen. Four groups, each consisting of five cows, were formed based on the animals' parity. The animals were kept in four distinct open spaces, each with shade and as in for water. The animals were fed before, during, and after the trial. At feeding time, the animals were tied to receive berseem (*Medicago sativa*) individually. Each group received a basal diet that included 30 kg of berseem, 6 kg of concentrate feed mixture (CFM), 6 kg of rice straw, and 75 g of soybean meal (SBM) as a carrier for anionic salts per day per day. Rice straw and concentrate feed combination in accordance with NRC (2001). All animals were fed on diet and the following additives:

Treatment (G1): Control group received (+90) anionic salts which were added to other groups.

Treatment (G2): Received (0 gm) anionic salt to achieve DCAD equal zero mEq /Kg DM. Composition of anionic salts are shown in Table (2).

Treatment (G3): Received (-90 gm) anionic salt.

Treatment (G4): Received (-150 gm) anionic salt.

During the post-partum period use (+ 200 gm) anionic salt for all groups.

Ingredients of concentrate feed mixture are shown in Table (1) and Anionic salt composition of feedstuffs are shown in Table (2).

Table (1): Ingredients of the experimental concentrate feed mixture.

Ingredient:	(kg/ton)
Yellow corn	450
Sunflower	75
Bran	150
Glut feed	100
Molasses	30
Soybean meal 44%	100
Protected soy	50
Sodium chloride	8
Limestone	30
Di calcium phosphate	12
Nutritive Value:	
TDN (%)	73
Protein (%)	16

Table (2): Anionic salt composition.

Components	(g)
Magnesium sulfate	100
Ammonium sulfate	150
Ammonium chloride	250
Soybean meal (carrier)	500
Total	1000

Samples:

Feed samples:

All feed items had representative samples collected prior to, throughout, and following the experiment. For each feedstuff's three samples were frozen and combined until analysis.

Blood samples:

Blood samples were withdrawn from Jugular vein three hours after feeding weekly starting at 0 day of treatments pre- and post-partum up to the third month of milking.

Samples were centrifuged immediately 3000 rpm for10min and Serum was separated and frozen. Blood samples were used for determination of pH, creatinine, Ca, P, and Mg. Remaining blood samples were centrifuged at 1200×g at 4°C for 20 min to separate the serum for the analysis of minerals and creatinine. The pH of whole blood was determined by using an electronic pH meter (Riviera), Na, were estimated on flame photometer after digestion. Creatinine level in serum was analyzed by Span diagnostics kits using modified Jaffe's Reaction (Junge *et al*., 2004).

Moreover, BHBA was estimated due to its importance which comes in that it is one of side effects of milk fever (hypocalcaemia) is higher ketone bodies concentration. BHBA is one of these ketone bodies.

Urine samples:

Urine samples were collected by gently stroking a cow just under her vulva. This motion sends a signal to the brain to urinate. Urine temperature and pH were measured directly after collection. Samples were collected weekly pre and postpartum up to third month of milking. Samples were then kept frozen until the time of chemical analysis.

A sample of urine, from midstream, was collected in a 30-ml container. Within 30 min of collection, pH was measured, and 15 ml of sample was frozen for mineral and creatinine analysis. Urinary Ca, P, Na, mg and Cl were expressed as ratios to creatinine concentration to overcome variations in urine volume among animals (Roche *et al.,* 2002). Creatinine in urine was analyzed by Span diagnostics kits using modified Jaffe's Reaction (Junge *et al*., 2004) however mineral content in urine was analyzed by using atomic absorption spectrophotometer.

Rumen samples:

Rumen samples were collected using stomach tube (esophageal tube) once after one week of treatments three hours after feeding. Samples were filtered through four layers of cheesecloth's and Two drops of formaldehyde were added to the sample in order to stop microbial growth then samples were kept frozen.

Fecal samples:

Fecal samples were grabbed from the rectum of experimental animals three executive days one week after treatment beginning. Samples were frozen. The three samples of each animal were composited before analysis.

Chemical analysis:

Feed analysis:

Feed samples were analyzed for proximate analysis according to AOAC (2006) and fiber fractions were determined according to Goering and Van Soest (1970) modified by Van Soest *et al*., (1991). Digestibility was determined using two internal markers Acid Detergent Lignin (ADL) and Acid Insoluble Ash (AIA).

pH in urine:

pH was measured using portable pH meter (ADWA model AD11).

Minerals analysis:

Minerals samples in Feedstuffs analysis were carried out according to Tucker et al. (1988).

Minerals in blood and urine:

Calcium: colorimetric Method were determined according to Gindler (1972).
Phosphorus: colorimetric Method were determined according to El-Merzabani *et al*., (1977).
Magnesium: colorimetric Method were determined according to Staugaitis and Rutkauskienė (2010).

Kidney function, urea nitrogen concentration and creatinine:

Urease was determined by Berthelot method according to Fawcett and Scott (1960). Creatinine was analyzed using colorimetric method according to Schirmeister *et al*. (1964).

Liver Enzymes:

Activity of aminotransferases including aspartate aminotransferase (AST) and alanine aminotransferase (ALT) was determined by chemical kits purchased from Salucea (Dutch technology in life science.

Total protein, albumin and globulin:

They were determined by colorimetric method according to Dumas *et al*. (1971).

Hormones analysis (Progesterone & T4):

Kits were purchased from Sigma Aldrich (St. Louis, Mo, USA).

Statistical analysis:

Data were analyzed using the MIXED procedure of statistical software package SPSS version 19(SPSS for windows, V19.0; SPSS Inc., Chicago, IL, USA).

Complete random block design was used. Twenty animal's parity was used as Blocks throw four treatments groups. All the obtained data were statistically analyzed using the General Linear Model Program of SAS (2000). Statistical models were as the follows:

- For Blood and Urine: $Y_{ijk} = \mu + tr_i + ti_j + (tr_i x\ ti_j) + e_{ijk}$
  Where Y_{ijk}, is the dependent valuable; μ is the overall mean. tr_i; is the effect of treatment; ti_j, is the effect of time (before, during parturition and after), $tr_i x\ ti_j$ is the effect of interaction between treatment and time; e_{ijk}, is the residual error.
- Duncan's new multiple range test (Duncan, 1955) was used to determine the significant differences among treatments.

RESULTS

Effect of DCAD on mineral concentration:

Statistical analyses showed no significant effect of the interaction between treatments and sampling time on mineral concentration.

Calcium concentration:

Serum calcium concentration:

The effect of DCAD on pre and postpartum serum calcium concentration is shown in Table 3. Results indicated that serum calcium concentration increased significantly ($p<0.05$) with decreasing DCAD. With positive DCAD (+90 mEq/kgDM), serum calcium concentration was 6.5968 mg/dl, increased significantly to 7.210 mg/dl with zero DCAD. When DCAD decreased to -90 or -150 /mEq/kg DM), serum calcium concentration increased to 7.726 and 7.949 mg/dl with anionic salts, respectively without significant differences between G3 and G4. Serum calcium concentration on 7 days prepartum (7.5202 mg/dl) didn't differ significantly from that on 7 days postpartum (7.66365 mg/dl). However, calcium concentration at calving was lower significantly (6.9274 mg/dl) than those pre- and post-partum.

Table (3): Effect of pre partum (DCAD) on serum calcium concentration (mg/dl).

Group	Serum calcium (mg/dl)			
	Before (-7 d)	Zero (calving)	After (+7d)	Overall mean
G1	5.985	6.396	7.413	6.597[b]
G2	7.379	6.619	7.631	7.210[c]
G3	8.424	7.033	7.726	7.726[a]
G4	8.296	7.664	7.885	7.949[a]
Overall mean	7.520[a]	6.927[b]	7.664[a]	-

a,b, and: Means with different superscripts differ significantly (P< 0.05).
Before (-7d): 7 days before the expected delivery date. After (+7d): 7 days after the expected delivery date. Zero: actual day of delivery. G1: Control group received (+90) anionic salts. G2: Received (0 gm) anionic salt. G3: Received (-90 gm) anionic Salt. G4: Received (-150 gm) anionic salt.

Urine calcium concentration:

Data in Table 4 showed that the concentration of urinary calcium (mg/dl) as affected by DCAD pre and post-partum. Data showed that urinary calcium concentration had the same trend of blood calcium concentration. Urinary calcium concentration increased with decreasing DCAD level from 0.961 mg/dl for +90 mEq/kg DM up to 2.070 mg/dl for -150mEq/kg DM. However, there was significant difference $p < 0.05$ between G3 and G4. Urinary Calcium concentration showed the same trend of blood calcium concentration before, during and after (1.555, 1.494, 1.541 mg/dl) parturition.

Table (4): Effect of pre partum (DCAD) level on urinary calcium concentration (mg/dl).

Group	Urinary calcium (mg/dl)			
	Before (-7d)	Zero (calving)	After (+7d)	Overall mean
G1	1.008	0.883	0.992	0.961[d]
G2	1.152	1.082	1.142	1.125[c]
G3	1.971	1.958	1.961	1.964[b]
G4	2.093	2.048	2.067	2.070[a]
Overall mean	1.555[a]	1.494[b]	1.541[a]	

a,b, andc: Means with different superscripts differ significantly (P< 0.05).

Before (-7d): 7 days before the expected delivery date. After (+7d): 7 days after the expected delivery date. Zero: actual day of delivery. G1: Control group received (+90) anionic salts. G2: Received (0 gm) anionic salt. G3: Received (-90 gm) anionic Salt. G4: Received (-150 gm) anionic salt.

Magnesium concentration:

Serum magnesium concentration:

Results of pre and post-partum serum magnesium concentration (mg/dl) as affected by DCAD level are shown in table (5). Data showed that there were no significant differences ($p < 0.05$) among groups as it ranged between 2.080 mg/dl for +90 mEq/kg DM, DCAD level and 1.679mg/dl for –150 mEq/Kg DM DCAD level. However, values tended to decrease with decreasing DCAD level. Also, blood magnesium concentration had no significant differences before, during and after parturition.

Data in table (6) showed the effect of DCAD on pre and post-partum urinary magnesium concentration (mg/dl).

Table (5): Effect of pre partum (DCAD) level on serum magnesium concentration (mg/dl).

Group	Serum magnesium (mg/dl).			
	Before (-7d)	Zero (calving)	After (+7d)	Overall mean
G1	2.216	2.059	1.964	2.080
G2	2.090	1.646	1.646	1.795
G3	1.995	1.551	2.059	1.869
G4	1.710	1.615	1.710	1.679
Overall mean	2.003	1.718	1.845	

a,b, andc: Means with different superscripts differ significantly ($P< 0.05$).
Before (-7d): 7 days before the expected delivery date. After (+7d): 7 days after the expected delivery date. Zero: actual day of delivery. G1: Control group received (+90) anionic salts. G2: Received (0 gm) anionic salt. G3: Received (-90 gm) anionic Salt. G4: Received (-150 gm) anionic salt.

Urine magnesium concentration:

Result indicated that urinary magnesium increased with decreasing DCAD level. Values were 2.578 mg/dl for animals fed diets with DCAD + 90 mEq/kg DM and 3.982 mg/dl for DCAD level -150 mEq/kg DM. However, there were not significant between G3 and G4. Urinary magnesium concentration didn't differ significantly before, during and after parturition.

Table (6): Effect of pre partum (DCAD) level urinary magnesium concentration (mg/dl).

Group	Urinary magnesium (mg/dl)			
	Before (-7d)	Zero (calving)	After (+7d)	Overall mean
G1	2.577	2.518	2.641	2.578^{c}
G2	2.914	3.147	2.888	2.983^{b}
G3	3.907	3.883	3.926	3.905^{a}
G4	3.981	3.981	3.987	3.982^{a}
Overall mean	3.345	3.382	3.361	

a,b, andc: Means with different superscripts differ significantly ($P< 0.05$).
Before (-7d): 7 days before the expected delivery date. After (+7d): 7 days after the expected delivery date. Zero: actual day of delivery. G1: Control group received (+90) anionic salts. G2: Received (0 gm) anionic salt. G3: Received (-90 gm) anionic Salt. G4: Received (-150 gm) anionic salt.

Phosphorus concentration:

Serum phosphorus concentration:

Data in Table (7) showed the effect of DCAD level on pre and post-partum serum phosphorus concentration. Result indicated that serum phosphorus concentration decreased with decreasing DCAD level. The highest serum phosphorus concentration was recorded 5.11 mg/dl for group (1) and the lowest was obtained with group (4)4.67mg/dl. Also, serum phosphorus concentration decreased significantly ($p < 0.05$), 7 days after parturition 4.71 mg/dl, when compared with 5.07 mg/dl 7 days before parturition.

Table (7): Effect of pre partum (DCAD) level on serum phosphorus concentration (mg/dl).

Group	Serum phosphorus (mg/dl)			
	Before (-7d)	Zero (calving)	After (+7d)	Overall mean
G1	5.38	5.36	4.60	5.11 [a]
G2	5.08	5.21	4.90	5.06 [ab]
G3	5.08	5.02	4.41	4.84 [bc]
G4	4.74	4.33	4.93	4.67 [c]
Overall mean	5.07 [a]	4.98 [ab]	4.71 [b]	

a,b, andc: Means with different superscripts differ significantly (P< 0.05).
Before (-7d): 7 days before the expected delivery date. After (+7d): 7 days after the expected delivery date. Zero: actual day of delivery. G1: Control group received (+90) anionic salts. G2: Received (0 gm) anionic salt. G3: Received (-90 gm) anionic Salt. G4: Received (-150 gm) anionic salt.

Urinary phosphorus concentration:

Results of effect of DCAD on pre and post-partum urinary phosphorus concentration (mg/dl) are shown in table (8). Data in the table indicated that urinary phosphorus concentration was lower for DCAD level of -150 mEq/kg DM than +90 mEq/Kg DM or zero DCAD level. However, there were no significant differences neither between G1 and G2 nor G3 and G4. Urinary phosphorus concentrations were not affected by time before or after parturition.

Table (8): Effect of pre partum (DCAD) level on urinary phosphorus concentration (mg/dl).

Group	Urinary phosphorus (mg/dl)			
	Before (-7d)	Zero (calving)	After (+7d)	Overall mean
G1	0.071	0.083	0.075	0.076 [a]
G2	0.061	0.083	0.075	0.073 [a]
G3	0.061	0.047	0.041	0.049 [b]
G4	0.062	0.049	0.052	0.055 [b]
Overall mean	0.064	0.066	0.061	

a,b, andc: Means with different superscripts differ significantly (P< 0.05).
Before (-7d): 7 days before the expected delivery date. After (+7d): 7 days after the expected delivery date. Zero: actual day of delivery. G1: Control group received (+90) anionic salts. G2: Received (0 gm) anionic salt. G3: Received (-90 gm) anionic Salt. G4: Received (-150 gm) anionic salt.

Urinary pH value:

Data in Table (9) showed the effect of DCAD on pre and post-partum urinary PH. results indicated that urinary PH decreased from 2.009 for G1 to 1.808 in G4. However, there were no significant differences between G1 and G2 (2.009 and 1.993, respectively), while decreased significantly in G3 (1.870) than in G1 and G2. However, G 4 (1.808) decreased significantly when compared with G3. Urinary PH did not differ significantly before and after parturition 1.917 and 1.924, respectively.

Table (9): Effect of pre partum (DCAD) level on urinary pH value.

Group	Urinary pH value			
	Before (-7d)	Zero (calving)	After (+7d)	Overall mean
G1	2.000	2.028	2.723	2.009 [a]
G2	2.007	1.992	1.980	1.993 [a]
G3	1.854	1.885	1.871	1.870 [b]
G4	1.807	1.771	1.845	1.808 [c]
Overall mean	1.917	1.919	1.924	

a,b, andc: Means with different superscripts differ significantly (P< 0.05).
Before (-7d): 7 days before the expected delivery date. After (+7d): 7 days after the expected delivery date. Zero: actual day of delivery. G1: Control group received (+90) anionic salts. G2: Received (0 gm) anionic salt. G3: Received (-90 gm) anionic Salt. G4: Received (-150 gm) anionic salt.

Blood parameters:

Total protein concentration:

Data in Table (10) showed no significant effect of neither treatments nor time before and after parturition on total blood protein concentration. With the overall mean of serum total protein, (6.362 g/dl). Serum albumin concentration in table (11) showed no effect neither for treatment nor for time before and after parturition on serum albumin concentration. With the overall mean of serum albumin concentration, (3.166 g/dl). Also, Serum Globulin concentration in table (12) showed no effect neither for treatment nor for time before and after parturition on serum Globulin concentration. With the overall mean of serum Globulin concentration, (3.29g/dl).

Table (10): Effect of pre partum (DCAD) level on serum total protein concentration (g/dl).

Group	Serum total protein (g/dl)			
	Before (-7d)	Zero (calving)	After (+7d)	Overall mean
G1	6.681	6.080	6.270	6.344
G2	6.491	5.859	6.206	6.185
G3	6.239	6.270	6.809	6.439
G4	6.524	6.460	6.460	6.481
Overall mean	6.484	6.167	6.436	6.362

a,b, andc: Means with different superscripts differ significantly (P< 0.05).
Before (-7d): 7 days before the expected delivery date. After (+7d): 7 days after the expected delivery date. Zero: actual day of delivery. G1: Control group received (+90) anionic salts. G2: Received (0 gm) anionic salt. G3: Received (-90 gm) anionic Salt. G4: Received (-150 gm) anionic salt.

Table (11): Effect of pre partum (DCAD) level on serum albumin concentration (g/dl).

Group	Serum albumin (g/dl).			
	Before (-7d)	Zero (calving)	After (+7d)	Overall mean
G1	3.166	3.104	3.199	3.156
G2	2.976	3.199	3.104	3.093
G3	3.040	3.230	3.356	3.209
G4	3.420	3.166	3.040	3.209
Overall mean	3.175	3.175	3.151	

a,b, andc: Means with different superscripts differ significantly (P< 0.05).
Before (-7d): 7 days before the expected delivery date. After (+7d): 7 days after the expected delivery date. Zero: actual day of delivery. G1: Control group received (+90) anionic salts. G2: Received (0 gm) anionic salt. G3: Received (-90 gm) anionic Salt. G4: Received (-150 gm) anionic salt.

Table (12): Effect of pre partum (DCAD) level on serum globulin concentration (g/dl).

Group	Serum Globulin (g/dl)			
	Before (-7d)	Zero (calving)	After (+7d)	Overall mean
G1	3.515	2.97635	3.07135	3.1882
G2	3.515	2.66	3.10365	3.0932
G3	3.19865	3.67365	3.45135	3.4409
G4	3.10365	3.29365	3.42	3.2718
Overall mean	3.3326	3.15115	3.26135	

a,b, andc: Means with different superscripts differ significantly (P< 0.05).
Before (-7d): 7 days before the expected delivery date. After (+7d): 7 days after the expected delivery date. Zero: actual day of delivery. G1: Control group received (+90) anionic salts. G2: Received (0 gm) anionic salt. G3: Received (-90 gm) anionic Salt. G4: Received (-150 gm) anionic salt.

Activity of hepatic enzymes:

ALT activity:

Data in Table (13) showed the effect of DCAD pre and post-partum on ALT activity. Results indicated that changing DCAD levels from +90 meq/kg DM to zero or -150 mEq/kg DM did not affect significantly the enzyme activity. Also, ALT activity tended to increase from 18.478 Iu/L at 7 days before parturition to 20.892 Iu/L at parturition. However, ALT activity at 7 days post-partum was not significantly different

(20.061 Iu/L) when compared with pre and during parturition. Data in Table (14) showed the effect of DCAD pre and post-partum on AST Activity. Results indicated that changing DCAD levels from +90 meq/kg DM to zero or -150 mEq/kg DM did not affect significantly AST activity. Also, AST activity decreased significantly from 44.871 IU/L at 7days before parturition to 42.592 IU/L on the day of parturition and continued to decrease significantly ($p < 0.05$) to 40.397 IU/L at 7 days after parturition.

Table (13): Effect of pre- partum (DCAD) level on serum ALT activity (IU/L).

Group	Serum ALT activity (IU/L)			
	Before (-7d)	Zero (calving)	After (+7d)	Overall mean
G1	17.606	21.344	20.995	19.981
G2	18.715	18.620	19.729	19.021
G3	18.335	21.629	19.950	19.971
G4	19.254	21.976	19.570	20.266
Overall mean	18.478 ^{b}	20.892 ^{a}	20.061 ^{ab}	

a,b, andc: Means with different superscripts differ significantly (P< 0.05).
Before (-7d): 7 days before the expected delivery date. After (+7d): 7 days after the expected delivery date. Zero: actual day of delivery. G1: Control group received (+90) anionic salts. G2: Received (0 gm) anionic salt. G3: Received (-90 gm) anionic Salt. G4: Received (-150 gm) anionic salt.

Table (14): Effect of pre partum (DCAD) level on serum AST activity (IU/L).

Group	Serum AST activity (IU/L)			
	Before (-7d)	Zero (calving)	After (+7d)	Overall mean
G1	47.376	41.511	39.526	42.804
G2	47.136	44.425	40.440	44.001
G3	41.589	42.720	41.760	42.023
G4	43.382	41.712	39.861	41.652
Overall mean	44.871 ^{a}	42.592 ^{b}	40.397 ^{c}	

a,b, andc: Means with different superscripts differ significantly (P< 0.05).
Before (-7d): 7 days before the expected delivery date. After (+7d): 7 days after the expected delivery date. Zero: actual day of delivery. G1: Control group received (+90) anionic salts. G2: Received (0 gm) anionic salt. G3: Received (-90 gm) anionic Salt. G4: Received (-150 gm) anionic salt.

Kidney function markers:

Urea concentrations:

Values of pre and post-partum urea concentration were affected by DCAD level are shown in Table (15). Results indicated that serum Urea concentration increased with decreasing DCAD level from 28.357mg/dl to 33.098mg/dl for Group 1, 4 respectively. Urea concentration was lowest significantly for group 2 (24.221 mg/dl) and intermediate for group 3 (30.121mg/dl). Serum urea concentration was not affected by time before and after parturition.

Creatinine concentration:

Table (16) showed effect of DCAD on pre and post-partum serum creatinine concentration. Result indicated that serum creatinine concentration recorded the highest value for group 4 (1.367mg/dl) and lowest value for group 2 (1.117mg/dl) and intermediate values for group1and 3(1.238mg/dl) and (1.184 mg/dl), respectively. With significant differences among all groups. Time before, during and after parturition did not affect serum creatinine concentration significantly.

Table (15): Effect of pre partum (DCAD) level on serum urea concentration (mg/dl).

Group	Serum urea (mg/dl)			
	Before (-7d)	Zero (calving)	After (+7d)	Overall mean
G1	25.161	28.701	30.268	28.357 ^{b}
G2	26.821	22.591	23.249	24.221 ^{c}
G3	32.399	32.900	25.067	30.121 ^{b}
G4	32.524	34.341	32.430	33.098 ^{a}
Overall mean	29.226	29.634	27.989	

a,b, andc: Means with different superscripts differ significantly (P< 0.05).

Before (-7d): 7 days before the expected delivery date. After (+7d): 7 days after the expected delivery date. Zero: actual day of delivery. G1: Control group received (+90) anionic salts. G2: Received (0 gm) anionic salt. G3: Received (-90 gm) anionic Salt. G4: Received (-150 gm) anionic salt.

Table (16): Effect of pre partum (DCAD) level on serum creatinine concentration (mg/dl).

Group	Serum creatinine (mg/dl)			
	Before (-7d)	Zero (calving)	After (+7d)	Overall mean
G1	1.171	1.315	1.229	1.238 [b]
G2	1.107	1.123	1.123	1.117 [d]
G3	1.241	1.190	1.120	1.184 [c]
G4	1.507	1.178	1.418	1.367 [a]
Overall mean	1.257	1.202	1.222	

a,b, andc: Means with different superscripts differ significantly (P< 0.05).
Before (-7d): 7 days before the expected delivery date. After (+7d): 7 days after the expected delivery date. Zero: actual day of delivery. G1: Control group received (+90) anionic salts. G2: Received (0 gm) anionic salt. G3: Received (-90 gm) anionic Salt. G4: Received (-150 gm) anionic salt.

Beta hydroxyl butyric acid:

Statistical analyses showed significant interaction effect between treatments and time of parturition on BHBA blood concentration. Data in table (17) showed the effect of DCAD on pre and post-partum serum BHBA concentration. Data indicated that there was a significant interaction between treatment and time before and after parturition on BHBA concentration reflecting interaction in the following observation:

1. At 7 days before parturition there were no significant differences among groups.
2. On the day of parturition group 1 had the highest BHBA concentration 8.496 mg/dl) followed by group G2and G3 (7.356 &7.384 mg/dl), respectively and the lowest was for group G4. With no significant difference between group G2 and G3.
3. At 7 days after parturition group G3 and G4 showed the lowest BHBA concentration with no significant difference between them. Group G2 had significantly higher BHBA concentration than group G3 and G4, while Group 1 had the highest BHBA concentration (9.500 mg/dl).

Table (17): Effect of pre partum (DCAD) level on serum BHBA concentration (mg/dl).

Group	Serum BHBA (mg/dl)			
	Before (-7d)	Zero (calving)	After (+7d)	Overall mean
G1	5.900	8.496	9.500	7.965
G2	5.330	7.356	8.904	7.197
G3	5.716	7.384	7.935	7.012
G4	5.387	6.764	7.717	6.651
Overall mean	5.604 [c]	7.500 [b]	8.514 [a]	

a,b, andc: Means with different superscripts differ significantly (P< 0.05).
Before (-7d): 7 days before the expected delivery date. After (+7d): 7 days after the expected delivery date. Zero: actual day of delivery. G1: Control group received (+90) anionic salts. G2: Received (0 gm) anionic salt. G3: Received (-90 gm) anionic Salt. G4: Received (-150 gm) anionic salt.

Effect of DCAD on Thyroxin (T4):

Data in Table (18) showed the results of effect of DCAD on pre and post-partum serum T4 concentration µg/dl. Results indicated that T4 was slightly significantly less 3.411 for group 4 than group 2 & 3. (3.648 & 3.664 µg/dl) respectively. However, Group 1 did not differ significantly neither than group 2 and 3 nor group 4. Thyroxin Hormone increased significantly from (2.344 µg/dl) on parturition day to (4.865µg/dl) 14 days after parturition.

Effect of DCAD on Progesterone:

Results of table (19) indicated that progesterone decreased dramatically at parturition where it was 1.592 ng/dl (7 days pre-partum) to 0.276 ng/dl at parturition and 0.454 ng/dl (7 days post-partum).

Table (18): Effect of pre partum (DCAD) level on serum T4 concentration (µg/dl).

Group	serum T4 (µg/dl)				
	Before (-7d)	Zero(calving)	After (+7d)	After(+14d)	Overall mean
G1	2.667	2.613	4.697	4.246	3.556 [ab]
G2	2.917	2.075	4.465	5.135	3.648 [a]
G3	2.870	2.519	4.474	4.794	3.664 [a]
G4	2.522	2.171	4.120	4.832	3.411 [b]
Overallmean	2.744 [c]	2.344 [d]	4.327 [b]	4.865[a]	

a,b, andc: Means with different superscripts differ significantly (P< 0.05).
Before (-7d): 7 days before the expected delivery date. After (+7d): 7 days after the expected delivery date: After (+14d):14 days after the expected delivery date. Zero: actual day of delivery. G1: Control group received (+90) anionic salts. G2: Received (0 gm) anionic salt. G3: Received (-90 gm) anionic Salt. G4: Received (-150 gm) anionic salt.

Table (19): Effect of pre partum (DCAD) level on serum Progesterone concentration (µg/dl).

Group	serum Progesterone (µg/dl)				
	Before (-7d)	Zero(calving)	After (+7d)	After(+14d)	Overall mean
G1	1.477	0.034	0.540	0.46269	0.706[a]
G2	1.571	0.158	0.245	0.19109	0.541[b]
G3	1.617	0.301	0.498	0.3007	0.679[a]
G4	1.704	0.304	0.531	0.43359	0.743[a]
Overallmean	1.592[a]	0.276[d]	0.454[b]	0.347[c]	

a,b, andc: Means with different superscripts differ significantly (P< 0.05).
Before (-7d): 7 days before the expected delivery date. After (+7d): 7 days after the expected delivery date: After (+14d): 14 days after the expected delivery date. Zero: actual day of delivery. G1: Control group received (+90) anionic salts. G2: Received (0 gm) anionic salt. G3: Received (-90 gm) anionic Salt. G4: Received (-150 gm) anionic salt.

DISCUSSION

The present study highlighted the effect of negative pre-partum DCAD level on some blood and urine parameters that associated with animal performance.

Results indicated that decreasing DCAD level to -150 mg/dl increasing serum Ca concentrate to7.52 and 7.66 pre and postpartum, respectively. These results were in agreement with Melendez *et al.* (2022b) and Neves *et al.* (2018). In contrast to present findings, other researchers (Tucker *et al*., 1988a; Hu and Murphy 2004; Hu *et al*., 2007), this may be due to lower DCAD levels than those used in the present study.

Urinary calcium concentration showed the same trend of blood calcium concentration before, during and after parturition. These findings were consistent with Melendez *et al* (2022b) and Horst *et al*. (1994) who reported, in previous studies, blood tCa within 24 h of parturition was not associated with metritis risk (Neves *et al*., 2018). A recent meta-analysis demonstrated a reduction in metritis by lowering the DCAD before calving (Lean *et al*., 2019). However, in the present study, no effects of treatment were detected on metritis. This is in agreement with results from Martinez *et al*. (2018), who found that lowering DCAD had no effect on metritis. However, tCa measured repeatedly to reveal associations between SCH and or metritis for both multiparous and primiparous cows. This supports the conclusions of Beede (1992); Martinez *et al*. (2012); Rodríguezes *et al.* (2017); Neves *et al*. (2018); Reinhardt *et al*. (2011); Caixeta *et al*. (2015); Tsiamadis *et al*. (2016) who stated that Results of this study indicated that effected by DCAD level to increasing serum Magnesium concentrate to 2.003 and 1.845mg/dl, pre and postpartum, respectively.

The level of phosphorus is important in preventing and diagnosing milk fever, Data showed that there were no significant differences ($p < 0.05$) among groups where it ranged between 2.080 mg/dl for +90 mEq/kg DM, DCAD level and 1.679 mg/dl for –150 mEq/kg DM DCAD level. However, values tended to decrease with decreasing DCAD level. On the other hand, blood magnesium concentration had no significant differences before, during and after parturition. These results were in agreement with Sanchez (2003), Hu and Murphy (2004), Hu et al. (2007a), Horst et al. (1994), and Horst (1997).

Result indicated that serum phosphorus concentration decreased with decreasing DCAD level the highest serum phosphorus concentration was recorded 5.11 mg/dl and the lowest was obtained with group (4)4.67 mg/dl. Also, serum phosphorus concentration decreased significantly $p < 0.05$. 7 days after parturition 4.71 mg/dl when compared with 5.07 mg/dl, 7 days before parturition. These findings agreed with Block (1984) and Horst et al. (1997), who observed similar results.

Effect of DCAD on pre and post-partum urinary phosphorus concentration (mg/dl) was lower for DCAD level of -150 mEq/kg DM than +90 mEq/kg DM or zero DCAD level. However, there were no significant differences neither between G1 and G2 nor G3 and G4) and urinary phosphorus concentrations were not affected by time before or after parturition. These results are in agreement with Cunningham, (2002), Goff (2018), and Melendez *et al*. (2022b).

Urine pH was very responsive to changes in DCAD. Increased urinary pH may be attributed to greater blood HCO3 and declining urine net acid excretion, implying that the acid load of lactating cows decreased dramatically as DCAD increased. These results agreed with Goff (2018), Lean et al. (2019), Wilkens et al. (2020), Charbonneau *et al*. (2006), Goff (2014), Melendez and Poock (2017), and DeGaris (2008). These results appear to contradict those of Tucker *et aI*. (1991), who demonstrated significant effect of increasing DCAD on blood pH and HC03 concentration.

The present value of serum total protein, Albumin and Globulin are within the normal range and in good agreement with the values obtained by Sanchez (1994).

The present activity of serum ALT and AST are within the normal range and in good agreement with those obtained by Sanchez (1994) and DeGaris *et al*. (2008).

Results indicated that serum creatinine concentration recorded the highest value for group (4)1.367mg/dl and lowest value for group 2 (1.117mg/dl) and intermediate values for G1 and G3 (1.238 and (1.184 mg/dl), respectively with significant differences among all groups. Time before, during and after parturition did not affect serum creatinine concentration significantly. These findings were consistent with data indicated that there was a significant interaction between treatment and time before and after parturition effects on BHBA concentration The results were also similar to Horst *et al*. (1994) and Block (1984). Moreover, calcemia has been negatively correlated with blood non esterified fatty acid (Martinez *et al*., 2014) and BHBA concentrations, and liver fat content Lean *et al*. (2019) did not find differences in postpartum BHBA when evaluating the effects of acidogenic diets.

The present value of serum T4 are with in normal range and in agreement with those obteained by Jorritsma *et al.* 2003, Klimienė *et al*. 2008, and Djoković *et al*. 2010, 2014, and 2015.Thyroxin Hormone increased significantly from (2.344 µg/dl) on parturition day to (4.865µg/dl) 14 days after parturition, These results are in agreement with those found by (Cernescu *et al.* 2010). who demonstrated that the total serum T4 of late pregnant buffaloes markedly decreased in comparison with that of 8–9 month of pregnancy (P< 0·001). Another point of view is that, Ketosis, often associated with the negative energy balance (NEB) at parturition, can lead to decreased thyroid hormone levels (T4) and disrupt reproductive function. T4 concentration also remained at a higher level in multiparous cows compared to primparous cows. The authors bind the fact with the observed metabolic problems in multiparous cows.

During the pre-partum phase (late pregnancy), T4 and progesterone levels remain high, with progesterone levels fluctuating but remaining consistently high in the last weeks of gestation, while T4 levels also rise. Following birth, both estradiol and progesterone levels experience a sharp decline within hours due to the expulsion of the placenta. This rapid drop in progesterone is linked to a heightened risk of postpartum mood disorders, though these hormonal shifts are complex and influenced by various factors including individual variations and other neurohormonal and psychosocial factors.

It is noted from Table (19) that serum progesterone level indicated that progesterone decreased dramatically at parturition where it was 1.592 ng/dl (7days pre-partum) to 0.276 ng/dl at parturition and 0.454 ng/dl (7 days post-partum), The serum progesterone level in the last 7d of pregnancy was higher p<0.01 than three weeks postpartum, progesterone decreased in zero calving and postpartum by 72.3% These results are in agreement and Similarly with,(Bernal 2001, Mastorakos and Ilias 2003, Kindahl et al. 2004). Moreover, these findings were consistent with Sangsritavong *et al*., (2002), who reported a rapid decline of P4 occurring immediately after parturition. This apparent discrepancy might be explained by the fact that this study ascribed the sudden and disruptive onset of milk production to the 0‑60 d period. In an earlier study by (Carroll *et al.,* 1988; Barton *et al.,* 1996 and Jorritsma *et al.,* 2003) who recorded that, Excess dietary (crude protein) CP may inhibit fertility in some cases by lower serum progesterone concentrations.

In this result of the study show that many of the hormonal changes during the peripartum period are essential to prepare the cow for the substantial increase in energy needs postpartum (Ehrhardt *et al*., 2016).

CONCLUSION

The results of this study concluded that there is an effect of pre- partum DCAD on mineral elements, acid-base balance, pH balance, calcium homeostasis and physiological performance of dairy cows. As a result, it advised dairy cattle producers to modify the DCAD level during the transition period to -150 before and +200 after giving birth.

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تأثير أختلاف مستوي الكاتيونات والأنيونات الغذائية قي فترة ماقبل الولادة على الأداء الفسيولوجي للأبقار الحلابة

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تهدف هذه الدراسه الي دراسه تاثير فرق الكاتيونات و الانيونات الغذائية علي بعض المعايير الفسيولوجيه في الابقار الحلابة ، بما في ذلك تركيز العناصر المعدنيه في مصل الدم والبول، التوازن الحمضي، اتزان الكالسيوم و الحاله الصحيه، بدات هذه التجربه قبل الموعد المتوقع للولادة ب21 يوم وأستمرت حتي الولاده و التلقيح للحمل التالي . تم استهداف عشرين بقره متعددة الولاده في الموسم الثاني و الثالث كحيوانات تجريبية، وتم تقسيم الحيوانات و فقا للولاده الي أربعه مجموعات، كل مجموعه تحتوي علي خمس ابقار و تم ايواء الحيوانات في مناطق منفصله مزوده بأحواض مياه ومناطق مظللة، تم تغذيه جميع المجموعات بنظام غذائى اساسي مع أضافات الأملاح الأنيونية بما في ذلك +90 ، 0 ، - 90 ، -150 مللي مكافئ /كجم مادة جافه من المادة الجافة في المجموعة الأولى، الثانية ، الثالثة والرابعة على الترتيب ، وخلال فترة ما بعد الولاده تم تغذيه الابقار في جميع المجموعات بنظام غذائي يحتوى على فرق الكاتيونات والانيونات الغذائية (DCAD) بمقدار + 200 مللي مكافئ/كجم مادة جافة من الاملاح الانيونيه ' اشارت النتائج الي ان تركيز الكالسيوم في المصل زاد بشكل معنوي(اقل من 0.05) مع انخفاض ال (DCAD) الايجابى(+90 مللي مكافئ) كان تركيز الكالسبوم في المصل 6.5968 ملغم/ديسلتر وزاد بشكل كبير الى 7.2095 ملغم /ديسلتر مع صفر (DCAD) و عندما انخفض (DCAD) الى -90 أو -150 مللي مكافئ / كجم زادت تركيزات الكالسيوم في المصل الي 7.7263 و 7.9486 ملغم/ديسلتر مع الاملاح الانيونيه ، على التوالى دون فروق ذات دلاله أحصائيه. كان تركيز الكالسيوم في البول له نفس اتجاه تركيز الكالسيوم في الدم. انخفض تركيز الفوسفور في مصل الدم بشكل معنوى (اقل من 0.05) مع انخفاض ال(DCAD) وسجل أعلي تركيز للفوسفور في مصل الدم للمجموعه (1) 5.11 ملغم/ديسلتر وادنى تركيز للمجموعه (4)4.67 ملغم/ديسلتر، انخفض الرقم الهيدروجين للبول من 2.009 للمجموعه (1) الى 1.808 للمجموعه(4).

بالاضافة الى ان المعاملة أثرت بشكل معنوى على مقاييس الماغنسيوم في البول ، اليوريا والكرياتينين ، بينما لم تتأثر معنويا مقاييس الماغنسيوم في المصل ، البروتينات الكلية ، الألبيومين ، الجلوبيولين و انزيمات الكبد AST & ALT ، وأيضا أشارت النتائج لوجود تداخل معنوي بين المعاملة ووقت الولادة علي تركيز البيتا هيدروكسي بيوتريك ، كما أشارت النتائج أيضا الي أنه لم يكون هنالك تاثير للمعاملة علي هرمون الغدة الدرقية (T4)، كما أنخفض مستوى هرمون البروجسترون بشكل كبير عند الولادة وأستمر في الانخفاض حتي 14 يوم بعد الولادة وهو الوضع الطبيعي .

لذلك يمكن الاستنتاج ان مربي الابقار الحلوب يجب عليهم تعديل ال(DCAD) في فتره الانتقال الى -150 مللي مكافئ/كجم مادة جافة قبل الولاده و +200 مللي مكافئ / كجم مادة جافة بعد الولاده .

الكلمات المفتاحية: *قبل الولادة، فرق الكاتيونات والأملاح الانيونية الغذائية، نقص كالسيوم الدم، المقاييس الفسيولوجية.*