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Influence of Prepartum and Postpartum Dietary Cation-Anion Difference (Dcad) On Milk Production and Some Physiological Parameters of Dairy Shami Goats

Mohamed M. Ghidan [1], Sherein H. Mohamed [1], Ahmed M. Salama [2], Ahmed S. M. Soliman [1], and Abdelkarim I. El-Sayed [1]
[1]Department of Animal Production, Faculty of Agriculture, Benha University. Egypt.
[2] Animal Production Research Institute (APRI), Agriculture Research Center, Dokki, Giza, Egypt.
Corresponding author: moghidany@icloud.com

Abstract

Fifteen dairy Shami goats (5 per group) were fed three different DCAD levels, (T1) control group contain a high DCAD level feeding positive DCAD diet (+215 mEq/kg DM), (T2) fed (zero DCAD) and (T3) fed a low DCAD level feeding negative DCAD (–150 mEq/Kg DM). Feeding positive DCAD diet (T1) resulted in higher (P <0.05) plasma pH than dairy Shami goats fed the negative dietary DCAD. Plasma calcium, phosphorus and Magnesium concentration increased significantly (P <0.05) with decreasing DCAD level. The highest significant (P < 0.05) plasma calcium, phosphorus and Magnesium level was recorded for group (3) (-150 mEq/kg DM) and the lowest was obtained with group (1) (+215 mEq/Kg DM). Plasma parathyroid hormone (PTH) concentration decreased significantly (P < 0.05) with decreasing DCAD. The lower DCAD value was recorded with negative DCAD and increased significantly with (zero DCAD), While, the higher were recorded with positive DCAD group. The negative DCAD fed to group (T3) showed significantly (P<0.05) the highest milk yield followed by group (T2) fed (Zero DCAD), while the control group (T1) positive DCAD had the lowest milk yield. Anionic salts didn't affect milk total solid (TS), Ash, Moisture and solid not fat (SNF), However milk protein and fat were increased in treatment (3) when compared with other treatments. The group (T1) fed positive DCAD (+215 mEq/Kg DM) showed significantly (P<0.05) the highest somatic cell count and lactose followed by group (T2) fed (zero DCAD), while, negative DCAD (-150/mEq/Kg DM) fed group (T3) had the lowest. Based on the study, Lowering DCAD beyond (-150) mEq/kg DM improves the lactation performance and some physiological parameters of dairy Shami goats.

Keywords: Dietary Cation-anion difference; DCAD**;** Minerals concentration; Shami goats**.**

Introduction

Ration formulations based on an animal's physiological stage are critical for maximizing productive and reproductive animal performance. Milk output may be increased by giving a balanced diet. Dietary cation-anion differential (DCAD mmol/kg DM) is the difference in mill moles of main cations (Na+ and K+) and major anions (Cl- and S2-) per kg DM in the diet. (**Yang *et al.*, 2021 and Nguyen *et al.*, 2020**). The pH of normal blood is slightly alkaline because the cations slightly exceed the anions (**Goff, 2018**). Herbivores with diets high in forages that are usually high in K+ and Ca2+ and comparatively low in anions such as Cl-, SO4 2-, and PO4 3- have slightly higher blood pH than non-herbivores, putting ruminants in a status of compensated metabolic alkalosis with no adverse health hazards. In this stage, the kidneys keep alkalosis from becoming fatal by excreting excess K+ in the urine. The increased cation content of the urine results in the usual alkaline urine of cattle fed K-rich forages (**Goff, 2018**).

This metabolic alkalosis is increased when dairy cows are fed cation-rich diets. Importantly, metabolic alkalosis affects the cow's ability to maintain calcium homeostasis after parturition (**Wilkens *et al.*, 2020**), as well as its ability to synthesis vitamin D in its active form 1,25-dihydroxyvitamin D (**Goff, 2018**). As a result, dietary supplementation of anions during the pre-partum period has been employed as a successful strategy to maintain calcium homeostasis (**Wilkens *et al.*, 2020**), by converting the typical alkaotic condition to a moderate acidotic state (**Goff, 2018**). This mild metabolic acidosis is associated with increased sensitivity of parathyroid hormone receptor sites in kidney and bone (**Goff, 2018**), resulting in increased mobilization of Ca reserves from bone, Ca reabsorption from kidney, and absorption from the intestine, resulting in higher circulating Ca concentrations. As a result, the inclusion of anionic chemicals in pre-partum diets has become a popular prevention method for treating hypocalcemia in dairy cows. Reduced DCAD during the last 3-4 weeks before parturition will protect dairy cows against clinical hypocalcemia (**Melendez and Risco, 2016 and Goff, 2018**). Diets rich in sulphates and chlorides result in a DCAD higher in anions (negative DCAD) and, as a result, lower the risk of hypocalcemia (**Goff, 2018**). As more anions are supplied, the level of H+ in bodily fluids, including blood, rises as pH decreases, resulting in metabolic acidosis. As a result of these changes, the kidneys lower K+ and Na+ excretion and urine pH as compensatory strategies. As a result, assessing urine pH in pre-partum cows given anionic diets provides a quick and low-cost field approach for determining the extent of metabolic acidification (**Wilkens *et al*., 2020**). As a reason, the current study was carried out to investigate the influence of ionic minerals on milk production and other physiological parameters of dairy Shami goats.

Materials and Methods

Experimental animals:

Fifteen late pregnant Shami goats (3 to 4 weeks before parturition), on their first to third season were divided randomly into three groups (n=5 per each). The treatments were started three weeks before the expected date of parturition and ended on the day of parturition. While the transactions were recorded milk for seven weeks after birth). This study was conducted during the period from December 2021 to March 2022. Milk and blood samples were analyzed in the food analysis laboratory of the Faculty of Veterinary Medicine, Benha University, Egypt.

Management:

The Shami goats were kept in three semi-open areas with water troughs and umbrellas, with temperatures ranging from 18 to 23 ° C. and natural ventilation. These animals were fed daily dietary pellets purchased from the (beladi) company. Goat's requirements' were calculated According to **NRC (2007).** In all rations, the concentrate to roughage ratio was exactly 50:50 on a DM basis. During the day, clean drinking water was given. Tables 1 and 2 show the formula and chemical composition of experimental diets Feeding was changed every two weeks based on pregnancy stages and milk production.

Table 1. Feed ingredients of the complete feed mixture formula (CFM)

Ingredient	%
Yellow corn	32
Soybean meal (48%)	10
Wheat bran	14
Rice bran	14
Glutofeed (20%)	5
Peanut hulls	9
Sugar beet pulp	9
Calcium carbonate	2
Sodium chloride (NaCl)	1
Molasses	4
Total (%)	100

Table 2. Chemical composition of complete feed mixture for goats (%, dry matter (DM) basis).

Nutrient	CFM % on DM basis
Dry matter	93.21
Organic matter	92.18
Ether extract	4.39
Crude protein	13.44
Nitrogen free extract	61.95
Crude fiber	12.40
Ash	7.82
Na	0.25
K	1.04
Cl	0.28
S	0.13
DCAD (mEq / Kg)	+215

All Shami goats in the three groups were fed on the basal diet (complete feed mixture) and the following additives:

T1: The control group received basal diet (complete feed mixture) + yellow corn without anionic salts.

(Corn powder was used as a carrier for the anionic salts added to the other groups).

T2: Received basal diet + 24.5 g (corn powder + anionic salt) to achieve DCAD equal zero mEq /Kg DM. composition of anionic salts as shown in table 3.

T3: Received basal diet + 42 g (corn powder + anionic salt) to achieve a DCAD equal to -150 mEq/kg DM.

DCAD was calculated according to the following equation **(Tucker *et al.*, 1992):**

DCAD mEq /Kg DM:

{(Na mEq/Kg DM + K mEq/Kg DM)} – {(Cl mEq/Kg DM + S mEq/Kg DM)}.

Calculation of element mEq/Kg DM of the diet

$$\frac{1000}{\text{molecular weight of elements/valence}} \times \text{\% of elements in dry matter}$$

While % of elements in dry matter showed in Table 2 which can be used to calculate the previous equation.

DCAD calculating in complete feed mixture dry matter:

DCAD= (Na + K) − (Cl + S)

= (0.25*435+1.04*256) – (0.28*282+0.13*624) = 215 mEq/kg DM

Table 3. Anionic salts composition

Components	Weight	DCAD value
Magnesium sulfate, g	250	4149 mEq / 250 g.
Ammonium chloride, g	250	4667 mEq / 250 g.
Corn (carrier), g	500	15 mEq/ 500 g.
Total, g	1000	8831 mEq / 1000 g

Samples:

Feed samples:

Representative samples from feedstuffs before, throughout, and after the trial period were taken, and were examined for proximate analysis According to **A. O. A. C. (2006).**

Milk Samples:

Every day, milk production was recorded. At the end of the seven-week milking period, a milk sample was obtained. Dairy cows were milked by hand twice a day, between 7 a.m. and 7 p.m. to establish the composition of the milk; five goats from each experimental group were sampled. The Bentley 150 Infrared Milk Analyzer (Bentley Instruments, Chaska, MN, USA) was used to test milk samples for total solids, fat, protein, and lactose using **A. O. A. C. (1995)** methods. SNF (Solids-Not-Fat) was computed by removing fat from total solids. Milk ash content was evaluated after 8 hours of heating in a muffle boiler at 550°C. Individual does' average yields of each milk component were computed by multiplying milk yield by component content.

Minerals analysis:

According to **Tucker *et al.* (1988)**, mineral analyses of feedstuffs and blood were performed using a Flame Atomic Absorption Spectrophotometer (AAS). The digest, blanks, and standard solutions were aspirated, and their mineral contents were analyzed. According to the instrument manual, the device has an auto sampler, digital absorbance readout, and a concentration readout that can operate in the situations described below.

Quantitative determination of the tested elements:

Phosphorus, calcium, and magnesium absorbency were automatically measured on the digital scale, and their concentrations were calculated using the following formula:

$$\mathbf{C} = \frac{\mathbf{R \times V1}}{\mathbf{V2}}$$

Where, **C=** Concentration of the element "ppm" (mg/Kg), **R=** Reading of digital scale of AAS, **V1=** volume of diluted solution, **V2=** volume of water sample, **N. B.** The concentration of each element in the blank solution was also calculated and subtracted from each analyzed sample.

Table 4. Estimated elements:

Condition	Ca	P	Mg
Lamp wave length (nm)	422.7	213.6	**285.2**
Lamp current (mA)	4	10	**4**
Slit width (nm)	0.7	0.2	**0.5**
Used gas	**AC/A***	**AC/A***	**AC/A***

*AC/A= Acetylene/ Air

Blood samples:

Blood samples were taken from Jugular vein three hours after feeding on a weekly basis beginning on the first day of treatment and continuing until the third week of milking. The samples were immediately centrifuged at 3500 rpm for 20 minutes to separate and freeze the plasma.

Determination of blood pH value (Pearson, 2006):

An electrical pH meter was used to rapidly determine the pH of the blood (Bye model 6020, USA). pH meter calibration using two buffer solutions with known pH (alkaline pH 7.01, acidic pH 4.01). As a result, after adjusting the temperature correction system, the pH electrode was rinsed with neutralized water and then injected into the blood sample.

Determination of parathyroid hormone (PTH):

The quantities of parathyroid hormone in plasma were measured using an ELISA kit (No. 18, Keyuan Road, DaXing Industry Zone, Beijing, China).

Statistical analysis:

SAS (2013) was utilized to do statistical analysis utilizing the general linear model approach. One-way analysis was the design that was employed. For mean comparison, **Duncan's multiple tests (1955)** were used. The static model that was used: $Y_{ij} = \mu + T_i + e_{ij}$, Where: Y_{ij} = Individual observation, μ = overall mean, T_i = effect of treatment e_{ij} = random error

Results and Discussion:

Effect of dietary cation- anion differences (DCAD) on plasma pH value:

Results of pre and postpartum plasma pH value as affected by DCAD level are shown in Table 5. Data showed that there were significant differences (p< 0.05) among groups and values of pH value tended to decrease with decreasing DCAD level. The increased of plasma pH at high DCAD level (+215 mEq/Kg DM) may be due to decreased concentrations of H+ and increased HCO3- concentration. The pH of normal blood is slightly alkaline because the cations slightly exceed the anions (**Goff, 2018**). Herbivores having diets high in forages that are normally high in K+ and Ca2+ and comparatively low in anions such as Cl_, SO4 2_, and PO4 3 have somewhat higher blood pH than non-herbivores, putting ruminants in a status of compensated metabolic alkalosis with no adverse health impacts. In this stage, the kidneys keep alkalosis from becoming dangerous by excreting excess K+ in the urine as more anions are fed, the concentration of H+ in body fluids, including blood, is increased, and pH is reduced, which leads to metabolic acidosis. In response to these changes, the kidneys reduce the excretion of Na+ and K+ and reduce urine pH as compensatory mechanisms. Therefore, the evaluation of plasma pH in pre-partum cows fed anionic diets is a rapid and low-cost field method to screen the level of metabolic acidification (**Wilkens *et al.* 2020**).

Table 5. Effects of dietary cation- anion differences on plasma pH value in dairy goat's experimental groups:

Group	DCAD value (mEq/kg DM)	Plasma pH value at:				
		-15 day pre-partum	-7 day pre-partum	+7 day post-partum	+15 day post-partum	+21 day post-partum
T1	+215	7.46[a]	7.46[a]	7.46[a]	7.46[a]	7.46[a]
T2	0	7.39[b]	7.39[b]	7.39[b]	7.39[b]	7.39[b]
T3	-150	7.36[c]	7.36[c]	7.36[c]	7.36[c]	7.36[c]
±SE		0.008	0.014	0.015	0.016	0.018

a,b,c: means with different letters differ significantly (P< 0.05).
T1: The control group received basal diet (complete feed mixture) + yellow corn without anionic salts.
T2: Received basal diet (complete feed mixture) + 24.5 g (corn powder + anionic salt) to achieve DCAD equal zero mEq /Kg DM.
T3:_Received basal diet (complete feed mixture) + 42 g (corn powder + anionic salt) to achieve a DCAD equal to (-150) mEq/kg DM.

Effect of dietary cation- anion differences (DCAD) on plasma calcium level (mg/dL):

Results in Table 6 show that plasma calcium level increased significantly (P < 0.05) with decreasing DCAD. The lower value was recorded with positive DCAD +215 mEq/Kg DM group, and increased significantly with zero DCAD, While, the higher plasma calcium level with decreased DCAD to -150 mEq/Kg DM.

Table 6. Effects of dietary cation- anion differences on plasma calcium level (mg/dL) in dairy goat's experimental groups

Group	DCAD value (mEq/kg DM)	plasma calcium (mg/dL) at:				
		-15 day pre-partum	-7 day pre-partum	+7 day post-partum	+15 day post-partum	+21 day post-partum
T1	+215	8.06[c]	8.11[c]	8.14[c]	7.97[c]	8.17[c]
T2	0	8.25[b]	8.31[b]	8.35[b]	8.16[b]	8.39[b]
T3	-150	8.82[a]	8.91[a]	8.96[a]	8.77[a]	8.99[a]
±SE		0.029	0.033	0.035	0.033	0.034

a,b,c: means with different letters differ significantly (P< 0.05).
T1: The control group received basal diet (complete feed mixture) + yellow corn without anionic salts.
T2: Received basal diet (complete feed mixture) + 24.5 g (corn powder + anionic salt) to achieve DCAD equal zero mEq /Kg DM.
T3:_Received basal diet (complete feed mixture) + 42 g (corn powder + anionic salt) to achieve a DCAD equal to (-150) mEq/kg DM.

Decreased DCAD in the final 3-4 weeks before parturition protects dairy cows from clinical hypocalcemia (**Goff, 2018**). Diets high in Cl and S result in a DCAD higher in anions (negative DCAD), lowering the incidence of hypocalcemia (**Goff, 2018**). As a result, vitamin D activity is increased, and bone Ca reabsorption is boosted (**Goff, 2018**). As a result, pre-partum anion supplementation has been used as an effective method to reestablish calcium hemostasis (**wilkens *et al*, 2020**), by changing the normal alkaotic situation to a mild acidotic one (**Goff, 2018**). This moderate metabolic acidosis is linked to enhanced sensitivity of parathyroid hormone receptors in bone and kidney, resulting in greater mobilization of calcium stores from the bones (**Goff, 2018**).

Effect of dietary cation- anion differences (DCAD) on plasma phosphorus level (mg/dL)

DATA in Table 7 shows the effect of DCAD level on pre and post-partum plasma phosphorus level. Results indicated that plasma phosphorus level increased with decreasing DCAD level. The highest significantly ($P < 0.05$) plasma phosphorus level was recorded for group 3 of -150 mEq/kg DM and the lowest was obtained with group 1 +215 mEq/Kg DM.

The current study's findings agreed with those of **Shahzad *et al* (2011)**. Yet the current study's findings contradicted those of **Roche *et al* (2017)** who reported that increasing plasma P levels while DCAD in the diet was increased. DCAD had no influence on plasma Phosphorus level by time before or after parturition, according to **West *et al.* (1992)** and **Tucker *et al*. (1988).**

Table 7. Effects of dietary cation- anion differences on plasma phosphorus level (mg/dL) in dairy goat's experimental groups.

Group	DCAD value (mEq/kg DM)	plasma phosphorus (mg/dL) at:				
		-15 day pre-partum	-7 day pre-partum	+7 day post-partum	+15 day post-partum	+21 day post-partum
T1	+215	5.78[c]	5.84[c]	5.86[c]	5.70[c]	5.92[c]
T2	0	5.89[b]	5.96[b]	5.99[b]	5.82[b]	6.03[b]
T3	-150	6.07[a]	6.13[a]	6.18[a]	5.97[a]	6.20[a]
±SE		0.024	0.024	0.024	0.025	0.024

a,b,c: means with different letters differ significantly (P< 0.05).
T1: The control group received basal diet (complete feed mixture) + yellow corn without anionic salts.
T2: Received basal diet (complete feed mixture) + 24.5 g (corn powder + anionic salt) to achieve DCAD equal zero mEq /Kg DM.
T3:_Received basal diet (complete feed mixture) + 42 g (corn powder + anionic salt) to achieve a DCAD equal to - 150 mEq/kg DM.

Effect of dietary cation- anion differences (DCAD) on plasma Magnesium level (mg/dL)

Results of pre and post-partum plasma Magnesium level (mg/dL) as affected by DCAD level are shown in Table 8. Results indicate that plasma Magnesium level increased significantly ($p < 0.05$) with decreasing DCAD. The lower value was recorded with positive DCAD +215 mEq/Kg DM group, and increased significantly with zero DCAD. While the higher plasma Magnesium level with decreased DCAD to -150/mEq/Kg DM, Obtained results are in agreement with those found by **Jackson *et al.* (1992)** who reported that there were a linear decrease in Mg level as the DCAD levels increased. And the Results of this study were in contrast with **Ganjkhanlou *et al.* (2010) and Shahzad *et al.* (2011)** who stated that plasma Mg remained unaffected by DCAD levels.

Table 8. Effects of dietary cation- anion differences on plasma Magnesium level (mg/dL) in dairy goat's experimental groups

Group	DCAD value (mEq/kg DM)	plasma Magnesium (mg/dL) at:				
		-15 day pre-partum	-7 day pre-partum	+7 day post-partum	+15 day post-partum	+21 day post-partum
T1	+215	1.25[c]	1.28[c]	1.32[c]	1.19[c]	1.37[c]
T2	0	1.35[b]	1.42[b]	1.48[b]	1.34[b]	1.50[b]
T3	-150	1.50[a]	1.58[a]	1.65[a]	1.51[a]	1.71[a]
±SE		0.02	0.024	0.024	0.024	0.025

a,b,c: means with different letters differ significantly (P< 0.05).
T1: The control group received basal diet (complete feed mixture) + yellow corn without anionic salts.
T2: Received basal diet (complete feed mixture) + 24.5 g (corn powder + anionic salt) to achieve DCAD equal zero mEq /Kg DM.
T3:_Received basal diet (complete feed mixture) + 42 g (corn powder + anionic salt) to achieve a DCAD equal to - 150 mEq/kg DM.

Effect of dietary cation- anion differences (DCAD) on plasma PTH (mg/dL)

Results of pre and post-partum plasma PTH (mg/dL**)** as affected by DCAD level are shown in Table 9. Data show that there were significant differences (P< 0.05) among groups. Results indicated that plasma PTH (mg/dL) decreased significantly (P < 0.05) with decreasing DCAD. The lower value was recorded with negative DCAD -150/mEq/Kg DM, and increased significantly with zero DCAD, While, the higher plasma PTH (mg/dL) was recorded with positive DCAD +215 mEq/Kg DM group.

Regulating intestinal Ca and P absorption, mobilizing mineral from bone, and increasing renal Ca reabsorption (**Bronner, 1987**) PTH modulates a cascade of metabolic reactions, including the hydroxylation and subsequent activation of 25-hydroxyvitamin D3 to 1,25-dihydroxyvitamin D3 (**Fraser and Kodicek, 1973**) by directly acting on the 1-hydroxylase gene CYP27B1 (**Brenza and DeLuca, 2000**). Also, transition dairy cows given 25-hydroxyvitamin D3 and a diet with a negative DCAD saw a rise in iCa levels (**Rodney *et al.*, 2018**). Blood iCa levels rise around calving in dairy cows with a metabolic acidosis brought on by acidogenic diets (**Charbonneau *et al.*, 2006**), which may alter PTH release and, in turn, the activity of the enzyme 1-hydroxylase that produces 1, 25-dihydroxyvitamin D3 (**Fraser and Kodicek, 1970**). In response to exogenous PTH, feeding acidogenic diets elevated blood levels of 1, 25-dihydroxyvitamin D3 and tCa (**Goff *et al*. 2014**).

Table 9. Effects of dietary cation- anion differences on plasma PTH (mg/dL) in dairy goat's experimental groups

Group	DCAD value (mEq/kg DM)	plasma PTH (mg/dL) at:				
		-15 day pre-partum	-7 day pre-partum	+7 day post-partum	+15 day post-partum	+21 day post-partum
T1	+215	42.94[a]	42.44[a]	42.04[a]	44.20[a]	41.64[a]
T2	0	40.22[b]	39.78[b]	39.54[b]	42.12[b]	39.46[b]
T3	-150	38.10[c]	37.30[c]	37.02[c]	39.64[c]	36.78[c]
±SE		0.352	0.382	0.401	0.338	0.413

a,b,c: means with different letters differ significantly (P< 0.05).
T1: The control group received basal diet (complete feed mixture) + yellow corn without anionic salts.
T2: Received basal diet (complete feed mixture) + 24.5 g (corn powder + anionic salt) to achieve DCAD equal zero mEq /Kg DM.
T3:_Received basal diet (complete feed mixture) + 42 g (corn powder + anionic salt) to achieve a DCAD equal to -150 mEq/kg DM.

Effect of dietary cation-anion differences (DCAD) on Milk production

Weekly milk yield of experimental goats as shown in Table10 revealed that negative DCAD group 3 had significantly (P<0.05) higher weekly milk yield. The negative DCAD -150/mEq/Kg DM fed group 3 showed significantly (P<0.05) the highest milk yield followed by group 2 which fed zero DCAD, while the control group 1 positive DCAD +215 mEq/Kg DM had the lowest milk yield. The improved milk production as result of decreasing the DCAD level supplementation could be reflecting the dry matter intake through the transitional period. On contrary, In a meta-analysis, **Hu *et al.* (2007)** shown that raising DCAD improved acid-base balance, which resulted in enhanced DMI, milk production, and milk fat yield. According to **Hu and Murphy (2004**), milk output was best at 340 mEq/kg of DM DCAD, 4.0% FCM production was greatest at 490 mEq/kg of DM DCAD, and DMI was greatest at 400 mEq/kg of DM DCAD. **Sanchez and Beede (1996)** proposed that a DCAD (Na + K - Cl) concentration of 380 mEq/kg of DM optimized both milk production and DMI. Although multiple researches have looked at how different DCAD concentrations affect production, the ideal DCAD concentration for maximum dairy FE is unclear. Some studies, however, have indicated that there may be substantial interactions impacting milk output and DMI response to DCAD with varying Na:K ratios in the diet (**Sanchez *et al.*, 1997**).

Table 10: Effects of dietary cation- anion differences on Milk production in dairy Shami goat's experimental groups

Item	Milk production (g/ day)			±SE
	T1	T2	T3	
Week 2	313.6[c]	382.8[b]	427.2[a]	0.88
Week 3	372.6[c]	442.8[b]	533.4[a]	1.05
Week 4	374.0[c]	448.8[b]	524.0[a]	1.53
Week 5	495.6[c]	515.0[b]	572.0[a]	1.54
Week 6	290.2[c]	319.8[b]	338.0[a]	1.27
Week 7	205.0[c]	294.8[b]	391.0[a]	1.83

a,b,c: means with different letters differ significantly (P< 0.05).
T1: The control group received basal diet (complete feed mixture) + yellow corn without anionic salts (DCAD equal + 215).
T2: Received basal diet (complete feed mixture) + 24.5 g (corn powder + anionic salt) to achieve DCAD equal zero mEq /Kg DM.
T3:_Received basal diet (complete feed mixture) + 42 g (corn powder + anionic salt) to achieve a DCAD equal to (-150) mEq/kg DM.

Effect of dietary cation- anion differences (DCAD) on Milk composition

Data in Table 10 present the effect of treatments on milk composition. Results indicated that anionic salts didn't affect milk total solid (TS), Ash, Moisture and solid not fat (SNF), However milk protein and fat were increased in treatment 3 (DCAD -150) when compared with other treatments. The group 1 fed positive DCAD +215 mEq/Kg DM showed the highest (P<0.05) somatic cell count and lactose followed by group 2 fed zero DCAD, while, negative DCAD -150/mEq/Kg DM fed group 3 had the lowest. Some previous research suggested that milk yield and milk composition were not affected by cation source and that the most important influence on production responses is the overall DCAD concentration (**Hu and Kung, 2009**).

Table 10. Effects of dietary cation- anion differences on Milk composition in dairy goat's experimental groups.

Item	Experimental rations			±SE
	T1	T2	T3	
Protein	3.33^{c}	3.49^{b}	3.64^{a}	**0.045**
Fat	3.62^{b}	3.80^{a}	3.91^{a}	**0.052**
TS	13.40	13.56	13.66	**0.126**
Lactose	4.85^{a}	4.65^{b}	4.46^{c}	**0.042**
Ash	1.46	1.42	1.36	**0.043**
Moisture	86.60	86.44	86.34	**0.126**
SCC	267.6^{a}	194.0^{b}	121.0^{c}	**3.433**
SNF	**9.77**	**9.75**	**9.74**	**0.084**

a,b,c: means with different letters differ significantly (P< 0.05).
T1: The control group received basal diet (complete feed mixture) + yellow corn without anionic salts (DCAD equal +215).
T2: Received basal diet (complete feed mixture) + 24.5 g (corn powder + anionic salt) to achieve DCAD equal zero mEq /Kg DM.
T3:_Received basal diet (complete feed mixture) + 42 g (corn powder + anionic salt) to achieve a DCAD equal to (-150) mEq/kg DM.

Conclusion

Based on the study, we suggest that lowering DCAD beyond (-150) mEq/kg DM improves the lactation performance and some physiological parameters of dairy Shami goats.

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تأثير اختلاف الكاتيوني-الأنيوني (DCAD) قبل الولادة وما بعد الولادة على إنتاج اللبن وبعض المقاييس الفسيولوجية في الماعز الشامي الحلاب

محمد محمود غيضان[1] ، شيرين حمدي محمد[1] ، أحمد محمد سلامة[2] ، أحمد سليمان محمود سليمان [1] ، عبد الكريم إبراهيم السيد[1]

[1] قسم الإنتاج الحيواني بكلية الزراعة – جامعة بنها.

[2] معهد بحوث الإنتاج الحيواني (APRI) ، مركز البحوث الزراعية.

Corresponding author: moghidany@icloud.com

تم تغذية خمسة عشر ماعز شامي حلابة (5 لكل مجموعة) بثلاثة مستويات مختلفة من DCAD، وتحتوي المجموعة الكنترول (T1) على نظام غذائي إيجابي DCAD عالي التغذية بمستوى (DCAD +215 مللي مكافئ / كجم مادة جافة) ، و المجموعة الثانيه T2 تم معادلتها بنسبه DCAD لتكون (صفر DCAD مللي مكافئ / كجم مادة جافة)، و المجموعة الثالثه (T3)) تم تغذيتها علي DCAD منخفضة المستوى لتصبح DCAD سلبية (–150 DCAD مللي مكافئ/ كجم مادة جافة). نتج عن تغذية نظام DCAD الإيجابي للمجموعه الاولي (T1) درجة حموضة أعلى (P <0.05) في البلازما للماعز الشامي المغذاة على نظام DCAD سلبي. بينما زاد مستوي الكالسيوم والفوسفور والماغنيسيوم في البلازما معنويا (P <0.05) مع انخفاض مستوى DCAD. تم أيضا تسجيل أعلى معنويه (p <0.05) من مستوي الكالسيوم والفوسفور والماغنيسيوم للمجموعة الثالثه T3 (–150 مللي مكافئ / كجم مادة جافة)، و كان أقل تركيز مع المجموعة الاولي T1 (+215 مللي مكافئ / كجم مادة جافة). بينما انخفض تركيز هرمون PTH في البلازما معنويا (P <0.05) مع انخفاض DCAD. و تم تسجيل القيمة الأقل مع DCAD السالب والتي زادت بشكل ملحوظ مع (صفر DCAD) ، بينما سجلت أعلى مع مجموعة DCAD الإيجابية. أظهرت مجموعة DCAD السالبة للمجموعة الثالثه T3 معنوياً (P <0.05) أعلى إنتاجيا للبن تليها المجموعة الثانيه T2 (صفر DCAD) ، بينما كانت المجموعة الكنترول T1 إيجابية DCAD أقل إنتاجية للبن. هذا و لم تؤثر الأملاح الأنيونية على المواد الصلبه الكلية (TS) في اللبن ، والرماد ، والرطوبة ، والمواد الصلبه الغير دهنيه (SNF) ، ومع ذلك فقد زادت بروتينات ودهون اللبن في المعاملة الثالثه (T3) بالمقارنة مع المعاملات الأخرى. أظهرت المجموعة الاولي (T1) التي تم تغذيتها بـ DCAD إيجابيًا (+215 مللي مكافئ / كجم مادة جافة) معنويًا (P <0.05) أعلى في عدد الخلايا الجسدية واللاكتوز متبوعًا بالمجموعة الثانيه (T2) المغذاة علي (صفر DCAD)، بينما سجلت المجموعة الثالثه (T3) المغذاة (–150 مللي مكافئ / كجم مادة جافة) القيم الأقل .