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Urea and salt as supplementary diet for crossbreed milk cows

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ABSTRACT. This study aimed to evaluate the use of supplementary feed with different percentages of urea and mineral salt for crossbred milk cows. Ten animals were used, mean body weight 480 kg ± 9,7, distributed in a 5 x 5 double Latin square, with treatments of supplements with different urea and mineral salt percentages, namely, 10:10; 10:20; 20:10 and 20:20, completed to 100% with corn meal. Data underwent statistical analysis by SAS at 0.05 significance level. The use of supplements increased ($p < 0.05$) the total dry matter (DM) intake of diet. The increase in the level of urea in the supplement decreased DM intake of supplement. The use of supplements increased ($p < 0.05$) DM digestibility. The treatments with presence of supplement showed higher ($p < 0.05$) milk production. Supplemented diets may be used to correct nutritional deficiencies of sugar cane, with higher intake, digestibility and milk production. Treatments with 20% urea in the composition of the supplement caused a lower DM consumption with the same performance in the animals. The above-mentioned treatments had the best efficiency.

Keywords: cattle nutrition, supplementation, milk production.

Ureia e sal mineral em suplementos para vacas mestiças leiteiras

RESUMO. Esse estudo teve como objetivo avaliar o uso de suplementos, com diferentes proporções de ureia e sal mineral, na alimentação de vacas mestiças leiteiras. Foram utilizados dez animais, com peso corporal médio de 480 kg ± 9,7, distribuídas em dois quadrados latinos 5 x 5, com tratamentos de suplementos com diferentes porcentagens de ureia e sal mineral, sendo: 10:10; 10:20; 20:10, 20:20 e 0:100, completados para 100% com fubá de milho. Os dados foram analisados utilizando-se o programa SAS, adotando-se um nível de significância de 0,05. O uso de suplemento aumentou ($p < 0,05$) o consumo de matéria seca (MS) total da dieta. O aumento do teor de ureia no suplemento diminuiu o consumo de MS de suplemento. O uso de suplemento aumentou ($p < 0,05$) a digestibilidade da MS. Os tratamentos com presença de suplemento proporcionaram maior ($p < 0,05$) produção de leite. Os suplementos podem ser usados para corrigir deficiências nutricionais, resultando em maior consumo, digestibilidade e produção de leite. Os suplementos com 20% de ureia em sua composição resultaram em menor consumo com mesmo desempenho dos animais, podendo-se concluir que esses tratamentos apresentaram melhor eficiência de utilização.

Palavras-chave: nutrição de bovinos, suplementação, produção de leite.

Introduction

The sugar cane (*Saccharum* spp.) is a plant featuring high production potential, well-accepted by animals, low costs per unit of dry mass and great availability during periods of scanty pasture (Mendonça et al., 2004; Prado et al., 2011). Due to the above characteristics, sugar cane is often used as roughage, supplementary to pasture, for cattle. However, sugar cane has several nutritional limitations mainly due to its low protein rates and slow fiber degradation. In fact, they are limiting factors for microbial growth and the fermentation activity in the rumen, with a decrease in the intake of dry matter and subsequent lack of nutrients.

Since animal production mainly depends on consumption and nutrition rates of available feed, the correction of deficiencies is mandatory to minimize liabilities in milk production and the employment of multiple feed supplements is a possible solution.

Although several research works on the supplementation of beef cattle have been published, the theme has not been thoroughly discussed with regard to milk cows. The usual recommendation is a concentrate with 20-24% crude protein at the ratio

of 1 kg for three kg of milk produced. However, supplementation response depends on the quantity and composition of the supplemented concentrate and on the interaction between the latter and the roughage, coupled to the animals' genetic capacity (Bargo et al., 2003).

Milk production by diet-supplemented cows is represented by a curvilinear regression due to the increase in concentrate supplementation (Bargo et al., 2003; Lana et al., 2007; Sairanen et al., 2006). Further, the ingredients that make up the concentrate are generally expensive, with an increase in feed costs (Lana et al., 2005; Pimentel et al., 2006; Vilela et al., 2006). Therefore, the rational supply of the concentrate is relevant to make supplemented feed economically feasible

Urea and salt in the formulation of supplemented diets may be used to limit intake by fractioning the consumption of the supplementary diet. The above produces a more constant ingestion of nutrients during the day, even with a small amount of supplemented feed. Further, the supply of urea optimizes the intake of forager plants and increases the voluntary consumption of dry matter due to the improvement in rumen fermentation.

Current analysis evaluates the effect of different levels of urea and mineral salt in supplemented feed to correct nutritional deficiencies of sugar cane in the feed of crossbred Holstein-Gir cows during lactation.

Material and methods

Current experiment was conducted on the Fazenda Bela Vista of the Universidade Federal de Viçosa (UFV), in the district of Cachoeirinha, Viçosa, Minas Gerais State, Brazil, between September and November 2012.

Ten crossbred Holstein-Gir cows, mean initial body weight 480 kg ± 9.7, were used, between the third and fifth lactation, after production peak and with mean milk production of 8 kg day^{-1}. The animals were distributed in a 5 x 5 double latin square design, with four treatments of supplementary feed and different urea and mineral salt percentages, namely, 10:10; 10:20; 20:10 and 20:20, completed to 100% with corn meal. The fifth treatment was composed of mineral salt only, as Table 1 shows.

The cows were kept in individual 24 m^2 pens, with cement floor, tile-covered trough with roughage, water trough, and an additional tough for supplemented feed.

The 70-day experiment was divided into five periods, with fourteen days each, the first seven days for diet adaptation and the last seven days to collect data and samples.

Table 1. Percentage composition of treatments based on natural matter.

Ingredients (%)	Treatments				
	10:10	10:20	20:10	20:20	0:100
Urea[1]	10	10	20	20	-
Mineral salt[2]	10	20	10	20	100
Corn[3]	80	70	70	60	-

[1]Commercial urea for cattle, with the addition of ammonium sulfate (AS), at 9:1 (urea:AS); [2]commercial mineral supplement: calcium (15.6%); phosphorus (5.1%); sulfur (2.0%); magnesium (3.3%); sodium (9.3%); potassium (2.82%); cobalt (0.003%); copper (0.040%); chromium (0.001%); iron (0.2%); iodine (0.004%); manganese (0.135%); selenium (0.002%); fluor (0.051%); zinc (0.170%); vitamin A (135.000 U.I); vitamin D3 (68.000 U.I.); vitamin E (450 U.I.). Solubility of iron at 95%; [3]feed processed as meal.

Besides the treatments provided *ad libitum*, the animals received 1.6 kg of supplemented concentrate based on corn and soybean meal per day, with approximately 24% of crude protein in the dry matter, divided into two portions and provided during the morning and evening milking. Sugar cane, variety RB 867515, was harvested manually and ground by machine into particles with mean size between 3 and 5 mm, and provided in two daily portions *ad libitum* at 8h00 am and 3h00 pm. Table 2 shows the chemical composition of the feed.

Table 2. Chemical composition of sugar cane, supplement and concentrate.

Item	Sugar cane	10:10	10:20	20:10	20:20	Concentrate[1]
DM[2]	21.75	89.03	90.02	90.06	91.04	85.23
OM[3]	95.78	90.33	81.54	90.41	81.62	94.49
CP[3]	4.05	35.04	34.19	62.37	61.56	24.19
EE[3]	2.72	2.49	2.18	2.18	1.87	2.49
NDFap[3]	60.51	11.33	9.91	9.91	8.50	10.43
NFC[3]	28.50	59.65	53.45	52.32	46.11	57.38

[1]60% corn meal; 40% soy meal; [2] % of natural matter; [3] % of dry matter; DM: dry matter; OM: organic matter; CP: crude protein; EE: ether extract; NDFap: neutral detergent fiber corrected for ashes and protein; NFC: non-fiber carbohydrates.

Voluntary intake was calculated by feed provided between the 7th and 14th day of each experimental period, by individual daily weighing and sampling of the feed provided and the surplus of supplements and of sugar cane. Feed offer was daily adjusted to provide approximately 10% surplus based on natural material. The samples were stored in plastic bags and frozen (-20°C) for later processing.

The animals were weighed on the 7th and 14th day of each experimental period, after the morning milking, to measure the weight variation of each animal in each period.

Coefficients of digestibility were estimated by collecting the feces directly from the animal's rectum in three consecutive days (12th, 13th and 14th), following distribution: 12th day - 8h, 13th day - 12h and 14th day - 16h. Samples were conditioned in plastic bags and frozen (-20°C) for later drying, grinding and chemical analysis.

Samples of feed, food surplus and feces were thawed and dried partially in a forced-air buffer

(60°C / 72 hours) for laboratory analysis. They were processed in a Wiley mill with a 2 mm mesh sieve and a certain amount was stored for further analysis for indigestible neutral detergent fiber (iNDF). The other amount was reprocessed in a 1 mm mesh sieve for the other analyses. Samples of feed, surplus and feces were prepared for each animal and each period, based on the weight of air-dried samples, and stored in plastic bags.

Rates of dry matter (DM) were calculated by INCT–CA G-003/1 method; matter (MM) was calculated by INCT–CA M-001/1 method; crude protein (CP) was calculated by INCT–CA N-001/1 method; neutral detergent fiber (NDF) was calculated by INCT–CA F-001/1 method and corrections for protein and ashes (NDFap) were respectively calculated by INCT–CA N-004/1 and INCT–CA M-002/1 methods; ether extract (EE) was calculated by INCT-CA G-004/01 method, following Detmann et al. (2012), for feed, surplus and feces samples

Non-fiber carbohydrate rates (NFC) were assessed following Detmann and Valadares Filho (2010), due to urea in the diets:

$$NFC = 100 - [(\%CP - \%CP\ urea + \%\ urea) + \%EE + \%MM + \%FDNap]$$

where:

NFC = non-fiber carbohydrates (g kg^{-1});

CP = crude protein (g kg^{-1});

NDFap = neutral detergent fiber for ashes and protein (g kg^{-1});

EE = ether extract (g kg^{-1});

MM = mineral matter (g kg^{-1}).

Indigestible neutral detergent fiber (iNDF) was the internal index to calculate fecal excretion. Feed and feces samples, which were dried and ground in a 2 mm sieve, were conditioned in F57 bags (Ankom®), in triplicate, with 20 mg of DM cm^{-2} at the surface. The bags were incubated in the rumen of a cross-breed calf to which was provided a mixed diet during 288 hours (Detmann et al., 2010). After incubation the bags were washed in running water till it was totally clear. The bags with the samples underwent extraction with neutral detergent (Mertens, 2002) during 1 hours, after which iNDF was evaluated.

The concentration of the diet's digestible energy (DE) was calculated by multiplying the digestible fraction of each calorie component by its energetic rate (NRC, 2001), according to equation:

$$DE = 5.6 \times dCP + 9.4 \times dEE + 4.2 \times NDFapd + 4.2 \times dNFC$$

where:

DE = concentration of digestible energy (Mcal kg^{-1});

dCP = concentration of digestible crude protein (kg kg^{-1});

dEE = concentration of digestible ether extract (kg kg^{-1});

dNFC = concentration of digestible non-fiber carbohydrates (kg kg^{-1});

FDNapd = concentration of neutral detergent fiber corrected for ashes and digestible protein (kg kg^{-1}).

Milk production was reported between the 7^{th} and 14^{th} day of each experimental period. The cows were mechanically milked twice a day at 6h00 am and 2h00 pm. Milk samples were collected on the second milking of the day before the last and the first milking of the last day of each period respectively, at the proportion 1/3 and 2/3. Samples were prepared for each animal; they were conditioned in plastic flasks with the preservative Bronopol® for the analysis of protein, fat, lactose, total dry extract, somatic cell count and total bacteria count, at the Laboratory of Milk Quality Analysis of the School of Veterinary of the UFMG, Belo Horizonte, Minas Gerais State, Brazil, following methodology by International Dairy Federation.

Corrected milk production (CMP) with fat rate at 3.5% was calculated following Sklan et al. (1992), by the following equation:

$$CMP = (0.432 + 0.1625 \times \%\ milk\ fat) \times milk\ production\ in\ kg\ day^{-1}.$$

Urination was stimulated by massage on the vulva and urine spot samples were collected four hours after the morning feed on the 11^{th} day of each experimental period. The urine was filtered by a triple-layer gauze and 10 mL aliquots were retrieved and immediately diluted in 40 mL sulfuric acid at 0.036 N to avoid the bacterial destruction of purine derivatives and precipitation of uric acid. The aliquots were stored at -15°C for later analyses of urea, allantoin, uric acid and creatinine.

Creatinine, uric acid and urea amounts were measured by automatic biochemical analyzer. Total urine volume was estimated by dividing the daily urine excretion of creatinine by the concentration of creatinine in the urine. Daily urine excretion of creatinine was calculated as from 24.05 mg creatinine per kg of body weight (Chizzotti et al., 2008). Further, allantoin in urine and milk was analyzed by the calorimetric method described by Young and Conway (1942).

Total excretion of purine derivatives (TP) was calculated by the sum of allantoin and uric acid excreted in the urine and by the amount of allantoin secreted in the milk. Absorbed purines (AP) were measured by TP excretion with the following equation:

$$AP = (TP - 0.385 \times PV^{0.75}) / 0.85$$

where:

0.85 is the retrieval of absorbed purines as derivatives of purines;

$0.385 \times PV^{0.75}$ is the endogenous contribution for purine excretion (Verbic et al., 1990).

Synthesis of microbial nitrogenated compounds in the rumen (Nmic) was calculated as a function of AP by equation:

$$Nmic = (70 \times AP) / (0.83 \times 0.116 \times 1000)$$

where 70 is N contents in purines;

0.83 is the digestibility of microbial purines;

0.116 is the ratio N-purine:total N in the bacteria (Chen & Gomes, 1995).

Blood samples, collected on the 14th day of the experimental period, were retrieved by puncturing the coccygeal vein and placed in test tubes with gel separator. Samples were immediately centrifuged at 4,000 rpm for 20 minutes. The blood serum obtained was stored in Eppendorf tubes and frozen at -20°C for later analysis of urea.

N-ureic concentration in the serum (NUS) was obtained with serum urea concentration multiplied by 0.466, the nitrogen rate in the urea.

Data underwent statistical analysis by MIXED procedure of Statistical Analysis System (SAS, 2004) at 0.05 significance level.

Results and discussion

There was an increase ($p < 0.05$) in the daily consumption of DM of sugar cane, total DM and all constituents of DM when diets with the supplements 10:10; 10:20; 20:10 and 20:20 were compared to control (0:100) (Table 3). It is the result of the addition effect between the supplement and the sugar cane, which may be related to the increase of the amount of nutrients in the rumen, especially CP, triggering a greater development and activity of rumen microorganisms (Broderick, 2003). Corroborating results in current assay, Pimentel et al. (2006) and Perez De La Ossa et al. (2013) registered an increase in the intake of DM when the concentrate was included in the diet of lactating cross-bred cows.

Increase in urea rates in the supplemented diet decreased DM intake of the supplement, total DM, OM and NFC (Table 3) but failed to affect the sugar cane's DMC. Increase in mineral salt in the supplement did not significantly affect DM consumption. Result confirmed that urea was more efficient in the control of supplement intake when compared to mineral salt, since it decrease the DM of the supplement from an average of 2.30 to 1.25 kg.

Table 3. Consumption of DM (kg day^{-1}) of feed and diet constituents due to the different proportions of urea and mineral salt in the supplement.

Item	Urea: Mineral salt					MSE	P			
	10:10	10:20	20:10	20:20	0:100		SU	UR	SM	U*S
Sugar cane	5.36	5.64	5.65	5.85	4.85	0.14	0.001	0.097	0.111	0.785
Supplement	2.30	2.29	1.29	1.21	0.23	0.13	0.001	0.001	0.646	0.758
Urea	0.23	0.23	0.26	0.24	0.00	0.02	0.001	0.046	0.400	0.489
Mineral salt	0.23	0.46	0.13	0.24	0.23	0.02	0.266	0.001	0.001	0.069
Concentrate	1.32	1.32	1.32	1.32	1.32	-	-	-	-	-
Total	8.98	9.24	8.25	8.36	6.40	0.24	0.001	0.001	0.290	0.674
OM	8.43	8.48	7.79	7.81	5.88	0.23	0.001	0.001	0.846	0.954
CP	1.34	1.33	1.35	1.30	0.53	0.05	0.001	0.752	0.357	0.512
EE	0.23	0.23	0.22	0.22	0.17	0.01	0.001	0.051	0.947	0.614
FDNap	3.70	3.83	3.76	3.84	3.20	0.11	0.001	0.669	0.227	0.779
NFC	3.60	3.53	2.95	2.90	2.02	0.13	0.001	0.001	0.444	0.885

DM: dry matter; OM: organic matter; CP: crude protein; EE: ether extract; NDFap: insoluble neutral detergent fiber corrected for ashes and protein; NFC: non-fiber carbohydrates; MSE: mean standard error; SU: supplemented diets x non supplemented; UR: diets with 10% urea x diets with 20%; SM: diets with 10% mineral salt x diets with 20%; U*S: effect of the interaction between urea and mineral salt.

When compared to control (0:100), the supplements 10:10; 10:20; 20:10 and 20:20 increased ($p < 0.05$) the digestibility of DM, OM, CB and NFC and consequently the intake of TDN and DE (Table 4). The above showed the positive effect of the supplements in consumption and in DM digestibility, or rather, the better performance of the diet-supplemented animals.

The above results were expected due to the greater digestibility rates of the supplement compared to sugar cane and, as previously reported, to a possible improvement in the development of rumen microorganisms.

Table 4. Digestibility of dry matter (DDM) and its constituents and total digestible nutrient (TDN) and digestible energy (DE, Mcal kg^{-1}) rates as a function of different urea and mineral salt in the supplement.

Item	Urea: Mineral salt					MSE	P			
	10:10	10:20	20:10	20:20	0:100		SU	UR	SM	U*S
DDM	56.45	55.68	56.45	55.11	49.16	1.40	0.001	0.844	0.464	0.842
DOM	59.18	58.66	58.56	57.34	51.36	1.36	0.001	0.472	0.517	0.793
DCP	62.87	63.40	67.12	65.72	35.25	2.32	0.001	0.148	0.846	0.665
DEE	83.90	82.25	80.73	81.32	81.76	1.59	0.876	0.223	0.751	0.501
DNDFap	38.72	39.12	40.99	39.85	37.00	1.18	0.168	0.381	0.827	0.651
DNFC	81.83	81.18	81.70	81.26	75.06	1.21	0.001	0.983	0.679	0.936
TDN (%)	63.28	61.20	64.05	61.65	50.48	1.53	0.001	0.682	0.142	0.916
DE	2.79	2.70	2.84	2.73	2.16	0.07	0.001	0.507	0.132	0.875

DOM: digestibility of organic matter; DCP: digestibility of crude protein; DEE: digestibility of ether extract; DNDFap: digestibility of insoluble neutral detergent fiber corrected for ashes and protein; DNFC: digestibility of non-fiber carbohydrates; MSE: mean standard error; SU: supplemented diets x non supplemented; UR: diets with 10% urea x diets with 20%; SM: diets with 10% mineral salt x diets with 20%; U*S: effect of the interaction between urea and mineral salt.

As expected, supplemented treatments provided higher rates ($p < 0.05$) in milk production in kg day^{-1} and in milk production corrected for 3.5% fat, when compared to control (Table 5). Higher DM intake and greater digestibility probably made available a greater quantity of nutrients and energy to the cows and thus, according to Bauman and Griinari (2003), increased the molar concentration of propionate in the rumen, with a greater amount of substrate for glucose production in the liver. Part of the available glucose is used in the synthesis of lactose with an increase of the osmotic potential in the mammary gland and thus triggering the transport of water to the inside of the alveolar lumen which is the main factor causing an increase in milk production.

Milk composition was not altered ($p > 0.05$) due to the experimental diets. Fat is the milk component with the greatest variation caused by the diet, with changes in the rumen fermentation processes (Santos et al., 2012). Valadares et al. (1999) reported decrease in milk fat rates when cows were fed on a diet with more than 65% of the concentrate. This is due to the high NFC levels which increased rumen propionate and reduced the acetat:propionate ratio and rumen pH. Silva et al. (2001) reported that fat production decreased linearly with urea increase in the supplement. In current analysis however no significant variations in milk fat rates were registered, even at the highest urea level employed.

A similar behavior occurred with the protein level in milk. Increase of protein level in milk mainly requires a greater dietetic amount of NFC to increase the synthesis of microbial protein and thus the offer of amino acids for protein synthesis in milk (Santos et al., 2012).

Another factor related to milk composition in crossbred animals is the blood degree, or rather, zebu cows provide higher fat and protein rates proportionately to decrease in Holstein genes due to the reduction of milk production.

In current analysis, fat proportion averaged 4.14%, confirming the authors' report, with mean fat proportion in the milk of Holstein cows at 3.66% (Aikman et al., 2008).

Several factors may affect variations in SCC and TBC in the milk, such as the order of delivery, age, lactation period, month and season of the year, management, nutritional status and mainly the health of the mammary gland (Cunha et al., 2008). Highest SCC and TBC rates ($p < 0.05$) in the milk of animals which received control may be associated with the lowest function of the immunological system due to the worst nutritional conditions of the animals.

Since animal performance did not differ among the supplemented treatments, supplements with 20% urea were more efficient. In fact, they had a production similar to that of the supplements with 10% urea. The DM of the supplement decreased, confirmed by the efficiency of the supplement (kg of milk increase kg^{-1} of DM of supplement) with rates 1.07; 1.08; 1.80 and 1.80 for the different ratios of urea: mineral salt (10:10, 10:20, 20:10 and 20:20, respectively) in the supplement.

Table 5. Milk production and composition and the efficiency of the supplement, according to different proportions of urea and mineral salt in the supplement.

Item	Urea x Mineral salt					MSE	P			
	10:10	10:20	20:10	20:20	0:100		SU	UR	SM	U*S
	kg day^{-1}									
Milk	7.16	7.13	6.93	6.72	4.72	0.43	0.001	0.459	0.770	0.830
Milk 3.5%	7.39	7.43	7.36	7.05	5.22	0.56	0.003	0.721	0.816	0.760
	%									
Fat	4.45	3.98	4.16	3.99	4.10	0.17	0.835	0.443	0.088	0.412
Protein	3.59	3.56	3.54	3.59	3.48	0.05	0.121	0.846	0.962	0.457
Lactose	4.36	4.38	4.39	4.30	4.35	0.04	0.934	0.588	0.447	0.274
TS	13.27	12.78	12.96	12.76	12.79	0.15	0.539	0.444	0.111	0.492
DFDE	8.82	8.80	8.80	8.77	8.68	0.06	0.192	0.776	0.741	0.497
	/mL x 1000									
SCC	1006.4	744.0	574.6	761.2	1631.6	214.9	0.002	0.369	0.868	0.331
TBC	490.5	488.1	388.7	504.9	1107.7	160.5	0.002	0.793	0.726	0.715
Efic.	1.07	1.08	1.80	1.80	-	-	-	-	-	-

Milk 3.5%: corrected milk production for 3.5% fat; TS: total solids; DFDE: defatted dry extract; SCC: somatic cell counts; TBC: total bacterial count; Efic. = efficiency in the use of the concentrate, in kg of increase of milk kg^{-1} of DM of concentrate; MSE: mean standard error; SU: supplemented diets x non supplemented; UR: diets with 10% urea x diets with 20%; SM: diets with 10% mineral salt x diets with 20%; U*S: effect of the interaction between urea and mineral salt.

The use of the supplements 10:10; 10:20; 20:10 and 20:20 did not differ statistically from control (0:100) for the variables total purines and Nmic. There was a decrease ($p < 0.05$) in the gCPmic kg^{-1} TDN ratio since the production of microbial protein remained unaltered and the animals fed on supplements had a higher intake of TDN (Table 6). Contrastingly, Paixão et al. (2006) in their research on confined animals with increasing urea levels failed to detect a significant effect on the efficiency of the microbial protein synthesis at level 113 g of CPmic per kg of TDN. An essential factor in the yield of microbial production is the synchronism between rumen degradation of carbohydrates and protein. Degradation rates of each fraction in the carbohydrates and proteins ingested should be weighed and thus synchronize the duration of rumen availability of the sub-layers to microorganisms by maximizing the use of degraded protein in the rumen and minimizing ammonia loss through the rumen wall.

Supplemented diets and increase in urea proportion in the supplement provided higher UNU, UNS and UNM concentrations. Van Soest (1994) reported that when the concentration of CP in the diet and the ingestion of nitrogen increase, there is a

greater nitrogen excretion in the urine. According to Valadares et al. (1999), urea concentration in blood and in urine is positively related to nitrogen ingestion. UNS concentrations higher than 19 mg dL^{-1} are the limit for loss of dietetic nitrogen. In fact, a higher concentration would indicate the inefficiency of the use of protein in the diet by milk cows (Broderick & Clayton, 1997). Among the treatments assessed in current analysis, only treatment 20:10 had a higher rate than the above limit. The treatment had also the highest CP level. Chizzotti et al. (2007) also reported that the limit rates of ureic nitrogen in serum would lie between 13 and 15 mg dL^{-1}.

No interaction effect ($p > 0.05$) between urea and mineral salt rates in the supplement occurred in any of the evaluated parameters in current study.

Table 6. Daily excretions of purine derivatives (TP, mmol day^{-1}), production of microbial nitrogenated compounds (Nmic, g day^{-1}), microbial efficiency (EfM, g kg^{-1}) and concentration of ureic nitrogen according to different urea and mineral salt proportions in the supplemented diet.

Item	Urea: Mineral salt					MSE	P			
	10:10	10:20	20:10	20:20	0:100		SU	UR	SM	U*S
TP	113.90	110.38	107.94	105.68	99.42	3.90	0.148	0,389	0,646	0,917
Nmic	64.71	61.81	59.64	57.20	52.07	3.26	0.138	0,357	0,617	0,964
EfM	76.76	71.90	79.71	75.41	103.3	4.89	0.027	0,755	0,667	0,978
			mg dL^{-1}							
UNS	16.94	14.21	20.09	18.06	8.49	1.298	0.001	0.018	0.098	0.801
UNU	554.8	385.8	764.5	621.2	90.2	60.60	0.001	0.002	0.023	0.842
UNM	18.84	15.80	22.35	20.08	9.44	1.298	0.001	0.018	0.098	0.801

EfM: CPmic/NDT; UNS: ureic nitrogen in blood serum; UNU: ureic nitrogen in urine; UNM: ureic nitrogen in milk; MSE: mean standard error; SU: supplemented diets x non supplemented; UR: diets with 10% urea x diets with 20%; SM: diets with 10% mineral salt x diets with 20%; U*S: effect of the interaction between urea and mineral salt.

Conclusion

Supplemented diets may be used to correct nutritional deficiencies of sugar cane, with higher intake, digestibility and milk production.

Treatments with 20% urea (20:10 and 20:20) in the composition of the supplement caused a lower DM consumption with the same performance in the animals. The above-mentioned treatments had the best efficiency.

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