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Levels of mineral mixture and urea in supplementation of crossbred heifers, with Gyr predominance, reared at pasture during the dry season[1]

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ABSTRACT - It was evaluated several levels of mineral mixture and urea for crossbred heifers, with Gyr predominance, in the dry season period in Zona da Mata region in Minas Gerais. The experiment was carried out in a Brachiaria decumbens pasture area, divided in five paddocks of 3.5 hectares. It was used 35 heifers distributed in a 2 × 2 + 1 factorial scheme, composed of two levels of urea (10 and 25%), two levels of mineral salt (10 and 25%) and a control diet (only mineral salt), totaling five diets, each one evaluated with seven replicates. The supplements were based on ground corn, urea, ammonia sulfate and mineral mixture with 32 to 72% crude protein, and they composed the following diets: MM (mineral mix), 10:10 (10% mineral mix, 10% urea and 80% corn); 10:25 (10% mineral mix, 25% urea and 65% corn); 25:10 (25% mineral mix, 10% urea and 65% corn), and 25:25 (25% mineral mix, 25% urea and 50% corn). Urea and mineral salt are effective in controlling supplement intake by bovines growing on pastures during dry season because the higher their levels, the lower the intake of supplements. Diets with 25% urea and 10% mineral salt provided higher daily weight gain and higher weight gain:supplemment intake ratio.

Key Words: nitrogen supplement, rearing, weight gain

Níveis de mistura mineral e ureia na suplementação de dietas para novilhas mestiças, com predominância de Gir, recriadas a pasto durante o período da seca

RESUMO - Avaliaram-se diversos níveis de mistura mineral e ureia para novilhas mestiças, com predominância de Gir, no período da seca na região da Zona da Mata de Minas Gerais. O experimento foi realizado em uma área de pastagem formada de *Brachiaria decumbens*, dividida em cinco piquetes de 3,5 ha. Utilizaram-se 35 novilhas distribuídas em um esquema fatorial tipo 2 × 2 + 1, composto de dois níveis de ureia (10 e 25%), dois níveis de sal mineral (10 e 25%) e uma dieta controle (somente sal mineral), totalizando cinco dietas, cada uma avaliada com sete repetições. Os suplementos foram à base de milho moído, ureia, sulfato de amônia e mistura mineral, com 32 a 72% de proteína bruta, e compuseram as seguintes dietas: MM (mistura mineral); 10:10 (10% de mistura mineral, 10% de ureia e 80% de milho); 10:25 (10% de mistura mineral, 25% de ureia e 65% de milho); 25:10 (25% de mistura mineral, 10% de ureia e 65% de milho); e 25:25 (25% de mistura mineral, 25% de ureia e 50% de milho). A ureia e o sal mineral são efetivos em controlar o consumo de suplemento por bovinos em crescimento em pastagem no período da seca, uma vez que, quanto maiores seus níveis, menor o consumo de suplementos. Dietas contendo 25% de ureia e 10% de sal mineral proporcionam maior ganho de peso diário e maior relação de ganho de peso:consumo de suplemento.

Palavras-chave: ganho de peso, recria, suplemento nitrogenado

Introduction

Rearing consists of the period between the end of suckling of a calf and the age in which males starts the finishing phase and females reaches the sexual maturity. Due to the slowness of development between the end of suckling and the beginning of the productive life, the growing phase, in tropical regions, presents the major population group, and it can represent from 30 to 40% of the total herd that accomplishes the complete cycle.

The non uniformity of growth and the elevated age of slaughter and first calving make the growth phase a limiting factor for the Brazilian cattle performance. Therefore, the intensification of the growth phase can generate significant

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gains in capital turnover, production scale and productivity.

Addition of concentrate in forage diets partly increases the efficiency of utilization of metabolizable energy for maintenance and growth (NRC, 1984), due to reduction of methane production, rumination and caloric increment (Van Soest, 1994).

Lana (2005b) verified that the intake of supplement is affected by body weight and by levels of urea and mineral salt in the supplement, because the increase in body weight stimulates the intake, and the increase in urea and mineral salt inhibit it. Urea, in addition to acting as an intake controller, is a source of nitrogen, being transformed in microbial protein in the rumen, and it is more attractive because it costs less than the sources of true protein. In this way, the partial or total replacement of true protein sources by non protein nitrogen (NNP) have stimulated a number of researches (Valadares Filho et al., 2004).

Several researches were performed to quantify the ideal level of urea in replacement of true protein, however it was not demonstrated which level of maximum inclusion of urea negatively affects the animal performance (Valadares Filho et al., 2004).

Some strategies of supplementation after suckling phase at pasture in central Brazil conditions were studied, but little was studied about the level of concentrate, as well as its cost, which can significantly affect the decision by the rural producers and the optimization of economic efficiency (Thiago et al., 2002a, b).

The objective of this work was to evaluate the intake of forage and supplement, apparent digestibility, daily weight gain and economic performance of rearing crossbred heifers supplemented at pasture, as a function of variable levels of urea and mineral salt in the supplement, during the dry season.

Material and Methods

The experiment was carried out at the Departamento de Zootecnia at Universidade Federal de Viçosa, Minas Gerais state, Brazil, from July to October 2007. The experiment was conducted in 17.5-ha pasture of *Brachiaria decumbens* grass, divided in five paddocks of 3.5 ha each. The paddocks were differed in March 2007.

Thirty-five crossbred heifers, with Gyr predominance, were distributed in five diets, each one with seven replicates. The heifers were fed supplements based on corn meal, urea, ammonium sulphate and mineral mixture (Table 1), with content of crude protein ranging from 32.08 to 71.93% (Table 2). The supplements were fed once a day, around 10 a.m., and 10% more than the estimated intake was added, to allow the daily measurement of orts and then the observed intake of each diet since diets were self feeding as a function of different levels of urea and mineral salt.

Table 1 - Composition of ingredients of the supplementary concentrates

Ingredient	Diet (mineral mixture:urea, %)				
	Mineral mixture	10:10	10:25	25:10	25:25
Mineral mixture* (%)	100	10	10	25	25
Urea + ammonium sulphate 9:1 (%)	-	10	25	10	25
Corn meal (%)	-	80	65	65	50

* Dicalcium phosphate, common salt, potassium chloride, sulphates of Mg, Cu, Zn, Fe, Mn and Co, potassium iodate and sodium selenite.

Table 2 - Chemical composition of the supplementary concentrates (%DM)

	Diet (mineral mixture:urea, %)				
	Mineral mixture	10:10	10:25	25:10	25:25
Crude protein	-	33.4	71.9	32.1	70.7
Ether extract	-	4.80	3.32	3.32	2.55
Neutral detergent fiber	-	10.8	8.77	8.77	6.75
Non fiber carbohydrates	-	57.8	47.0	47.0	36.2

Each experimental period was constituted of 17 days, and the experiment consisted of five periods, totalizing 85 experimental days. In the beginning of the experiment, all animals were weighted and submitted to control of external and internal parasites (with product containing 1% ivermectin).

The heifers were submitted to 15-day supplement adaptation period before the beginning of the experiment. The amount of supplement consumed by the group of animals was daily measured. During the experimental period, samples of supplements (furnished and orts) were obtained, stored in plastic bags and frozen for later analyses. Pasture sampling was realized three times (days 4, 10 and 16) in each experimental period.

The animals and treatments (supplements) were rotated among the five paddocks, in order to eliminate possible differences of dry matter availability (DM) among them. Pasture sampling was realized by the handling simulation method, suggested by Aroeira (1997), carefully observing the animal preference in relation to the ingested parts of the plant. Lately, similar material in botanic and morphological composition was manually collected in all experimental paddocks, simulating animal grazing. The samples were dried in oven with forced ventilation (60°C) for the pre drying and posterior analyses. Mean chemical composition of diet selected by cattle in pasture of *Brachiaria decumbens* grass showed the following values: 53.74% dry matter (DM), 4.8 %DM of crude protein, 2.03% DM ether extract, 70.59 % DM neutral detergent fiber, 67.64% DM neutral detergent fiber corrected for ahs and protein, 25.1% DM for indigestible neutral detergent fiber, 5.79 %DM lignine, 6.7% DM ash, 88.35% DM total carbohydrates, and 20.71% DM non fiber carbohydrates.

Chromium oxide was used as external indicator in the amount of 10 g/animal/day. The indicator (70g) was homogenized in the supplement and given to seven heifers. The adaptation period of the indicator was of five days in order to allow the homogenization and continuous flux of chromium oxide in the digestive system, being performed collection of feces on the sixth and seventh day of the indicator supply. Feces were collected from all heifers during the last three days of each period, except in the control group (mineral mixture), which was during the five periods of the experiment, after eight hours of the first day of sampling, in 28-hour intervals. The samples were then frozen at -20^{o}C for posterior analyzes, making a composed sample per animal (based on dry weight at air).

Fecal dry matter excretion was estimated using the external indicator chromium oxide (Gomide et al., 1984; Burns et al., 1994), by calculating the relation between the amount of indicator and its concentration in feces, as it follows: Fecal dry matter (g/day) = [Amount of indicator (g)/ concentration of indicator in feces (%)]*100.

The indigestible neutral detergent fiber (NDFi) was used as internal indicator in order to estimate the dry matter intake. After that, it was established the ratio between the daily ingestion of the internal indicator (NDFi) in the concentrate plus forage and its concentration in feces. The NDFi was obtained after ruminal incubation of concentrates, samples of pasture (forage) and feces in TNT bags (100 g/m^2) for a period of 240 hours. The equation proposed by Detmann et al. (2001) for estimation of dry matter intake per animal was used, as it follows: DMI = [((FE*CIF) – IC)/ CIFO] + CDMI, in which: FE = fecal excretion (kg/day); CIF = concentration of internal indicator in feces (kg/kg); IC = internal indicator present in the concentrate (kg/day); CIFO = concentration of internal indicator in the forage (kg/kg); e CDMI = concentrate dry matter intake (kg/day).

The determination of neutral detergent fiber followed the methods by Van Soest et al. (1991). The other analyses were realized according to the techniques described by Silva & Queiroz (2002). The digestibility of nutrients was obtained using the internal indicator NDFi.

The experiment was analyzed in a completely randomized design, with five diets and seven replicates. The diets consisted of a 2 × 2 + 1 factorial arrangement, with two levels of urea (10 and 25% of supplement), two levels of mineral salt (10 and 25%) plus a control diet (only mineral salt), analyzed by orthogonal contrasts at 5% probability level.

For evaluation of intake and digestibility, the control treatment was excluded, due to inhibition of mineral salt intake caused by chromium oxide, contrary to evaluation of cost with supplementation, which included the control treatment.

The differential of weight gain as a function of differential of intake of supplement was evaluated by subtracting the weight gain of each diet from the weight gain of the control diet (mineral salt), and dividing this value by the result of the subtraction of supplement intake of each diet from the mineral mixture intake of the control diet.

Results and Discussion

The mean daily weight gain was greater for the supplemented animals (diets 10:10, 10:25, 25:10 and 25:25) in relation to the control diet ($P<0.01$), containing only mineral mixture (Table 3). This response is associated with the additional supply of nitrogen, which stimulates microbial growth and ruminal fermentation of fibrous carbohydrates (Van Soest, 1994), supplying more energy and protein for growth. Pasture protein level, observed in the dry season, was lower than the minimum level of 6-7% of dry matter, needed to stimulate ruminal degradation, mainly fibrous contents of the forage.

There was an interaction effect among levels of mineral salt and urea in the supplement ($P = 0.05$), in which the lower average daily gain was verified with the greater urea level associated with the greater mineral salt level. This effect can be associated with the lower intakes of total dry matter and non fibrous carbohydrates (Table 3), although without significance in the first case, probable caused by elevated levels of urea and mineral salt in the supplements. However, more researches are needed to evaluate this result, since the daily intakes of urea and mineral salt were higher in the 10:10 diet, in which there was the lowest levels of urea and mineral salt (Table 4), probably stimulated by low concentration of the intake controllers (mineral salt and urea) associated with the high level of corn meal.

According to Detmann et al. (2007), urea is a good controler of supplement intake by cattle on pasture. These authors suggest that the mechanism of action of urea in controlling the intake of supplements happens due to the relation of learning as a function of sense of negative feelings by the animals. This effect is caused by ammonia

Table 3 - Productive performance of crossbred heifers, with Gyr predominance, in pasture of *Brachiaria decumbens* grass, consuming different proportions of mineral mixture and urea as supplementary ingredients

	Diet (mineral mixture:urea)						Contrast (P value)			
	Mineral mixture (MM)	10:10	10:25	25:10	25:25	CV %	Supplement	Urea	MM	Ur*MM
Initial body weight (kg)	161	170	137	164	171	15.6	0.99	0.40	0.38	0.21
Final body weight (kg)	167	195	166	191	189	15.2	0.28	0.31	0.54	0.38
Average daily gain (kg)	0.071	0.294	0.324	0.316	0.212	0.032	0.01	0.26	0.18	0.051
Total dry matter intake (kg/day)	2.99	3.09	3.15	3.11	2.63	0.270	0.97	0.44	0.36	0.33
Pasture dry matter intake (kg/day)	2.94	2.47	2.97	2.85	2.43	0.260	0.37	0.88	0.75	0.09
Supplementary dry matter intake (kg/day)	0.04	0.62	0.18	0.26	0.20	0.029	0.001	0.001	0.001	0.001
Neutral detergent fiber intake (kg/day)	2.08	1.81	2.11	2.04	1.73	0.184	0.46	0.99	0.66	0.11
Non-fibrous carbohydrates intake (kg/day)	0.61	0.87	0.70	0.79	0.59	0.063	0.09	0.01	0.13	0.85
Crude protein intake (kg/day)	0.132	0.325	0.270	0.219	0.260	0.018	0.001	0.70	0.003	0.013
Ether extract intake (kg/day)	0.059	0.079	0.065	0.065	0.054	0.006	0.28	0.03	0.03	0.86
Total digestible nutrients intake (kg/day)	-	1.92	1.79	1.74	1.49	0.138	-	0.18	0.10	0.66

MM = mineral mixture; Ur*MM = Urea*mineral mixture.

Table 4 - Intake of ingredients in the supplement, weight gain/supplement intake and differential of weight gain/differential of supplement intake ratios in relation to the control diet

	Diet (mineral mixture:urea)				
	Mineral mixture	10:10	10:25	25:10	25:25
Dry matter intake (kg/animal/day)					
Supplement	0.041	0.620	0.180	0.260	0.200
Corn	-	0.494	0.135	0.167	0.102
Urea + ammonium sulphate	-	0.062	0.044	0.026	0.051
Mineral mixture	0.041	0.062	0.018	0.064	0.051
Relation weight gain/supplement intake (g/g)					
Weight gain/supplement intake ratio	-	0.47	1.55	1.22	1.04
Differential of weight gain/differential of supplement intake (g/g)					
Differential of weight gain/differential of supplement intake in relation to the control diet	-	0.38	1.81	0.98	0.88

(product of hydrolysis of urea) that, when reach levels above normal in the blood, affects primarily the central nervous system (Boin, 1984). Other factors that cause control of supplement intake when urea is present are the characteristic bitter taste and flavor of this ingredient, easily recognized by bovines (Chalupa et al., 1979).

Supplement intake was affected by diets ($P<0.01$), in which the diets 10:10, 10:25, 25:10 and 25:25 presented higher values in relation to the control diet due to the presence of corn meal, which stimulates intake (Table 3). Both urea and mineral salt limited the intake ($P<0.01$), having in addition an urea × mineral salt interaction, in which there was an intake limitation in high level of urea, mineral salt or both. The inhibitory effect of urea and mineral salt on the intake of supplement was also verified by Lana (2005b), who observed that intake of supplement was affected by body weight and levels of urea and mineral salt in the supplement, whose increase in body weight stimulates the intake, and increases in urea and mineral salt inhibit it.

Mineral mixture controls dry matter intake by bovines since the intake of mineral salt increases ruminal fluid osmotic pressure, stimulating the animals to cease the ingestion of food and water (Carter & Grovum, 1990). In addition to the effect of ruminal osmolarity, the palatability of supplement and the antimicrobial effect are also responsible for the depletion in intake of supplements containing high levels of mineral mixture.

The antimicrobial effects of mineral salts include, in general, cells dehydration by hipertonicity of the medium (Detmann et al., 2007). This effect explain the result found by Bergen (1972) who, when evaluating the *in vitro* digestibility of cellulose, added sodium chloride in the incubation media in order to increase osmolarity, and observed a significant reduction in the digestion of cellulose after 24 hours of incubation. The change of ruminal fluid osmolarity happens during and after feeding (Bergen, 1972; Forbes, 1995).

The supply of supplement self feeding for animals during the growth phase makes it easy the management and rationalize the utilization of labor in the distribution of supplements for the animals in the pasture. In addition, it avoids that the animals become dependent on supplement and present nutritional and economical negative aspects (Gomes Jr. et al., 2002).

Crude protein intake followed the trend of supplement intake, in which the diets containing urea presented values greater than the control (P<0.01) and, among those, mineral salt also inhibited the intake, especially in the lowest level of urea (P<0.05).

Both urea and mineral salt inhibited intake of ether extract (P<0.05), associated with low intake of corn meal, because it has greater content of lipids than the tropical grasses, or because of the lower intake of total dry matter in the diet with higher level of urea and mineral salt.

The intakes of total dry matter (DMIt), neutral detergent fiber (NDFI) and total digestible nutrients (TDNI) did not differ among treatments, demonstrating that there was no substitutive effect of forage by concentrate. Similar results were found by Restle et al. (2001), Magalhães et al. (2003) and Moraes et al. (2009), by utilizing increased levels of urea in the supplement. These results can be justified by the absence of replacement effect of pasture by supplement, which is common in elevated levels of supplementation, although in the 10:10 diet there was the greatest intake of supplement (0.62 kg), around three times greater than the intake of supplement of the other diets containing urea.

The presence of replacement effect seems to be more effective when energetic supplements are used (Minson, 1990; Poppi & McLennan, 1995) in better quality forages (Minson, 1990; Caton & Dhuyvetter, 1997). Hess et al. (1996), by supplying corn or wheat middling to steers during the rainy season, found replacement effect in all supplements and concluded that, by supplying wheat middling and corn in equal amounts (0.34% BW), there was lower values of replacement in wheat middling, although, when increasing the supply of wheat middling to reach the energetic level of corn, the effect was similar.

Corn is the main ingredient of supplements, consequently its intake follows the same trend verified in the intake of supplements (Table 4). Its greater intake was observed in the supplement containing the lowest levels of urea and mineral salt. However, the greater intake of corn did not reflect in greater weight gain (Table 3), leading probably to greater cost of supplementation and without economical return compared with the 10:25 and 25:10 diets.

The intake of urea in the supplements was 62, 44, 26 and 51 g/animal/day, for the diets 10:10, 10:25, 25:10 and 25:25, respectively. The lowest value of urea intake was found in the supplement containing low level of urea and high level of mineral salt (25:10), and the greatest value of urea intake, in the supplement containing low levels of urea and mineral salt (10:10) (Table 4). In the first case, the increase in mineral salt content inhibited the intake of urea by inhibiting the intake of supplement containing low level of urea. On the other hand, the greatest intake of urea was verified due to the stimulus of intake of supplement caused by corn meal. In this case, there was stimulus of intake not only of urea, but also for mineral salt, although it was not reflected in a higher daily weight gain. This can be explained by the fact that corn is a high palatable ingredient and it can mask the bitter taste of urea (Detmann et al., 2007).

Mineral salt intake ranged from 18 to 64 g/animal/day, and the increase in the level of mineral salt in the supplements stimulated its intake (P<0.01). On the other hand, the increase of urea level in the supplements inhibited the intake of mineral salt, especially in its low level in the supplement. The high level of urea, associated with the low level of mineral salt (10:25), which leaded to reasonable intake of urea (44 g) and low intake of mineral salt (18 g), corn meal (135 g) and supplement (180 g), was the treatment that allowed the best daily weight gain. This result shows that nitrogen really was the most limiting nutrient for growing cattle in pasture during the dry season.

The 10:25 diet, which contains the highest level of urea and the lowest level of mineral salt, allowed the greatest relations of weight gain as a function of intakes of supplement, corn and mineral mixture, and some of the greatest relations of weight gain as a function of urea intake. These results were confirmed by considering the differential of weight gain as a function of differential of supplement intake (Table 5). The levels of mineral mixture, urea and corn in the 10:25 treatment were likely to have allowed greater equilibrium in the microbial population and then a greater intake of supplement and greater response in weight gain.

These results evidenced that high levels of urea in relation to mineral salt are more adequate for growing cattle, when supplemented during the dry season. However, supplements containing increased levels of urea, as verified in this experiment, should contain adequate amount of mineral salt and corn to avoid its excessive intake, as well as adequate procedures should be followed for the correct use of urea and avoid, as a consequence, intoxication by its excessive intake.

The conversion of concentrate in accretion of weight gain due to its use can be obtained by the reciprocal (1/×) of the differential of weight gain (supplemented versus non supplemented or greater versus smaller level of supplementation) as a function of the differential of

Table 5 - Digestibility coefficients of constituents of the experimental diets

	Diet					CV (%)	Contrast (P value)			
	Mineral mixture (MM)	10:10	10:25	25:10	25:25		Suppl.	Urea	MM	Ur*MM
Dry matter	-	58.8	51.1	52.3	52.2	0.573	-	0.001	0.001	0.001
Neutral detergent fiber	-	63.7	60.9	60.5	59.3	0.531	-	0.001	0.001	0.13
Non fiber carbohydrates	-	63.8	42.9	69.1	55.7	3.397	-	0.001	0.014	0.28
Crude protein	-	68.0	57.6	53.3	73.8	2.496	-	0.05	0.76	0.001
Ether extract	-	52.0	20.1	18.8	11.2	6.382	-	0.005	0.003	0.07
Content of total digestible nutrients	-	62.2	56.6	56.0	56.6	0.620	-	0.001	0.001	0.001

MM = mineral mixture; Ur*MM = Urea*mineral mixture.

supplement intake (Lana, 2005a). The observed values for the diets 10:10, 10:25, 25:10 and 25:25 were 2.63, 0.55, 1.02 and 1.14 kg of supplement/kg of accretion of weight gain, respectively.

By using increasing levels of supplementation, Lana et al. (2005) found conversions of 1.5, 7.0 and 40 kg of supplement/kg of accretion in weight gain by changing from 0 to 0.4; from 0.4 to 1.6; and from 1.6 to 3.2 kg of supplement containing 24% of CP/animal/day, due to the response in weight gain being greater in the lowest levels of supplementation and very low response is found by changing from 1.6 to 3.2 kg of supplement/animal/day. The authors informed that the response to supplementation follows the law of diminishing returns, being explained by models of saturation kinetics of Michaelis-Menten and Lineweaver-Burk. Therefore, the best responses observed in the treatments 10:25, 25:10 and 25:25 were due to the low intake of the supplements, close to the value 1.5:1 kg supplement/kg of accretion in weight gain found by Lana et al. (2005), allowing the correction of nitrogen deficiency in the diets.

The control diet was not included in the determinations of digestibility coefficients of nutrients (Table 5), because chromium oxide was not added to the mineral salt since it could limit the intake of both, due to the low ingestion of mineral salt exclusively.

Urea reduced (P<0.01) the digestibility coefficients of dry matter, neutral detergent fiber, non fiber carbohydrates and ether extract and also decreased the total digestible nutrients of the diets, probable by saturation of the ruminal media, that did not favor microbial growth, only by the unbalance of the relation protein and energy promptly available. These results were not expected, once that urea did not change the intakes of total dry matter, forage and neutral detergent fiber, but decreased the intake of non fiber carbohydrates. However, it would be expected opposite results, or else, increase in total and fiber digestibility, by the stimulus in ruminal fermentation.

Mineral mixture reduced (P<0.01) the digestibility coefficients of dry matter, neutral detergent fiber and ether extract, it decreased the content of total digestible nutrients of the diets and increased the digestibility coefficient of non fiber carbohydrates. There was still an interaction between mineral mixture and urea on the digestibility coefficient of dry matter and crude protein and content of total digestible nutrients, in which the mineral mixture decreased the values of these parameters in low levels of urea and increased the digestibility coefficient of crude protein in high level of urea. The inhibitory effect of mineral salt in the digestibility could be associated with the decrease in urea intake and, consequently, decrease in ruminal fermentation, since urea is stimulant of growth of fiber carbohydrate fermentor microorganisms when digestible carbohydrates are present in the rumen (Russell et al., 1992). However, as it was seen before, urea decreased the digestibility of nutrients.

The adoption of the feed supplementation technique in a system of animal production at pasture should be, above all, profitable. The profitability resulted from the successes of application of this kind of nutrition manipulation is normally associated with some productive advantages (Almeida & Azevedo, 1996).

By evaluating the costs of supplementation (Table 6), it can be verified that the diet 10:25 was the one that presented the best economical efficiency, confirming the previous observation (Table 4) that the diet containing the highest level of urea and the lowest level of mineral salt allowed the best ratios of weight gain as a function of intake of supplement, intake of corn and intake of mineral mixture, and some of the greatest ratios of weight gain as a function of urea intake.

Table 6 - Economicity of supplementation of growing cattle in the dry season as function of diets

		Diet				
		Mineral mixture	10:10	10:25	25:10	25:25
Corn	0.42	-	0.210	0.060	0.070	0.042
U+AS	1.14	-	0.071	0.050	0.030	0.058
Mineral mixture	1.20	0.049	0.075	0.022	0.770	0.060
R$/animal/day		0.05	0.36	0.13	0.18	0.16
R$/animal/total time of experiment		4.2	30.6	11.1	15.3	13.6
average daily gain(kg)		6	25	29	27	18
Cost/kg average daily gain		0.70	1.22	0.38	0.56	0.75
Cost/@[2]		21.0	36.6	11.4	16.8	22.5

[1] Source: FNP (february of 2008).
[2] Cost per 15 kg of commercialized carcass, considering 50% carcass yield.
U+AS = urea + ammonium sulphate.

Conclusions

Urea and mineral salt in high levels are effective in controlling the intake of supplements by growing cattle on pasture during the dry season, and increases in their levels cause decreases in supplement intake. The treatment containing 25% urea and 10% mineral salt allows the greatest body weight gain as a function of supplement intake, corn intake and mineral salt intake, and some of the greatest ratios of weight gain as a function of urea intake, which is confirmed by considering the differential of weight gain as a function of differential of intake of supplement. However, supplements containing elevated levels of urea should contain adequate amount of mineral salt to avoid its excessive intake, as well as adequate procedures that should be followed for the correct use of urea in order to avoid intoxication caused by excessive intake.

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