Revista Brasileira de Zootecnia
© 2010 Sociedade Brasileira de Zootecnia
ISSN 1806-9290
www.sbz.org.br

R. Bras. Zootec., v.39, n.11, p.2494-2501, 2010

Energy sources and supplementation levels for beef heifers raised during the dry season

Victor Rezende Moreira Couto[1], Mário Fonseca Paulino[2], Edenio Detmann[2], Sebastião de Campos Valadares Filho[2], Maykel Franklin Lima Sales[1], Lívia Vieira de Barros[1], Marlos Oliveira Porto[1], Ériton Egidio Lisboa Valente[3]

[1] DZO/UFV - Viçosa, MG.
[2] DZO/UFV - Viçosa, MG. Pesquisador INCT-CA.
[3] DZO/UFV - Viçosa, MG. Bolsista PIBIC/CNPq.

ABSTRACT - This experiment aimed at evaluating the productive performance, intake and the apparent digestibility in the raising of beef heifers on *Brachiaria decumbens* Stapf. pastures under supplementation with starch or fibrous energy sources during the dry season. It was used 40 newly weaned heifers (20 Nellore and 20 crossbreed), at 8.5 months of age and 197.9 ± 3.74 kg initial weight. Two supplements were formulated: the first was corn meal- and soybean meal-based diet (high in starch) and the second was based on wheat meal (high in fiber), which were given at the quantities of 0.5 or 1.0 kg/animal/day, compared to the offer of only mineral mixture (control). The animals were distributed according to a complete randomized block design in a 2 × 2 + 1 factorial arrangement with two sources of energy and two levels of supplementation plus the control treatment; the genetic group was used as a measure of local control. The average daily weight gain was higher for the animals under supplementation than those fed only mineral mixture (0.198 *vs.* 0.077 kg/animal/day). Moreover, performance of the animals under supplementation with starch energy source was higher than those fed wheat meal-based supplement (0.232 *vs.* 0.163 kg/animal/day). The intake of pasture dry matter was lower for the group given the highest supplementation level. The supplementation of beef heifers under pasture makes it possible to improve the productive performance. Compared to wheat meal, the use of the corn/soybean mixture meal as the basis of multiple mixture improves the productive performance of the heifers.

Key Words: *Brachiaria decumbens*, heifers, pasture, wheat meal

Fontes de energia e níveis de suplementação para novilhas de corte em recria durante a época seca

RESUMO - Objetivou-se avaliar o desempenho produtivo, o consumo e a digestibilidade aparente na recria de novilhas de corte em pastagem de *Brachiaria decumbens* Stapf, sob suplementação com fontes de energia amilácea ou fibrosa durante o período da seca. Foram utilizadas 40 novilhas (20 da raça Nelore e 20 mestiças), recém-desmamadas, com 8,5 meses de idade e peso inicial de 197,9 ± 3,74 kg. Foram formulados dois suplementos: o primeiro à base de fubá de milho e farelo de soja (rico em amido) e o segundo, à base de farelo de trigo (rico em fibra), que foram ofertados nas quantidades de 0,5 ou 1,0 kg/animal/dia, em comparação à oferta de apenas mistura mineral (controle). Os animais foram distribuídos segundo delineamento de blocos completos casualizados em esquema fatorial 2 × 2 + 1, com duas fontes de energia e dois níveis de suplementação mais o controle; o grupo genético foi adotado como medida de controle local. O ganho médio diário de peso foi maior nos animais sob suplementação que naqueles que receberam apenas mistura mineral (0,198 *vs* 0,077 kg/animal/dia). Além disso, o desempenho dos animais sob suplementação com fonte amilácea de energia foi maior em relação aos daqueles que receberam suplemento à base de farelo de trigo (0,232 *vs* 0,163 kg/animal/dia). O consumo de matéria seca de pasto foi menor no grupo que recebeu o maior nível de suplementação. A suplementação de novilhas de corte sob pastejo durante o período da seca possibilita aumentar o desempenho produtivo. Em comparação ao farelo de trigo, a utilização da mistura milho/farelo de soja como base da mistura múltipla melhora o desempenho produtivo das novilhas.

Palavras-chave: bezerras, *Brachiaria decumbens*, farelo de trigo, pastagem

Received July 30, 2009 and accepted March 5, 2010.
Corresponding author: victorzootecnista@hotmail.com

Introduction

Dry season is the most critical season in the year for bovine production cycle under grazing, not only because of a marked fall of forage grass growth rate but also for the increase on proportions of indigestible compounds in the material consumed by the animals. The use of multiple supplements during this time of the year is shown as an essential condition for maintenance of body weight of the animals under grazing, and even enabling weigh gain instead of losses.

Energy food with lower quantities of non-fibrous carbohydrates, containing higher concentrations of fiber of rapid ruminal degradation could contribute for higher digestibility of dietary fiber, on the contrary, food high in non-fibrous carbohydrates reduce digestibility of the dietary fibrous portion especially in diets with low protein contends (Souza et al., 2010).

According to Paulino et al. (2008), supply of small quantities of energy-mineral-protein supplements is indicated for the raising phase, and levels from 0.1 to 0.4% of the body weight are suggested for this phase or during the entire life of the animal; so, higher levels of supplementation in the diet are usually associated to better performances.

Therefore, it was aimed in this work to evaluate the productive performance, intake and apparent digestibility in raising of beef heifers on *Brachiaria decumbens* Stapf pasture, under starch energy or fibrous source supplementations during the dry season.

Material and Methods

This experiment was carried out in Setor de Bovinocultura de Corte in Departamento de Zootecnia at Universidade Federal de Viçosa during the dry season from July to September 2007, with a duration of 89 days divided in three experimental periods.

It was used 40 heifers, 20 Nellore breed and 20 crossbred, with predominance of Zebu breed, newly weaned at 8.5 months of age and initial average weight 198.0 ± 3.74 kg. The animals were grouped in five treatments, using a complete random block design in a 2×2+1 factorial scheme (two energy sources and two levels of supplementation plus a control group, only fed mineral mixture), and the genetic group was adopted as measurement of local control.

The experimental area for the animals was composed of five 2.5-ha paddocks formed with *Brachiaria decumbens* Stapf., provided with covered water drinkers and troughs.

It was evaluated two supplements with approximately 30% crude protein (Table 1), one containing corn (starch source) and the other containing wheat meal (fibrous source) as energy source, given at 0.5 or 1.0 kg/animal/day ratio in comparison to mineral mix supply. Soybean meal was added to corn-based supplement in order to keep urea level even and content of crude protein in the multiple mix constant.

Table 1 - Composition of the supplements based on natural matter

Ingredient	Supplement source of energy	
	Corn (0.5 and 1.0 kg/animal/day)	Wheat meal (0.5 and 1.0 kg/animal/day)
Mineral mixture[1]	2.00	2.00
Corn	75.00	-
Wheat meal	-	92.00
Soybean meal	17.00	-
Urea/SA – 9:1	6.00	6.00

[1]Percentage composition: bicalcium phosphate - 50.00; sodium chloride – 47,775; zinc sulfate - 1.40; copper sulfate -0.70;cobalt sulfate -0.05; potassium iodate - 0.05; and sodium selenite - 0.025.

The supplements were given every day at 10 a.m. in a grouped feeder with two meters in length and access on both sides in order to allow simultaneous access by the animals. Mineral mix was freely given for all the animals.

At the beginning of the experiment, all animals were submitted to control for ecto and endoparasites and also for ticks, cloth and horn flies which was carried out during the experimental period, when it was necessary.

Animals were weighted without fast at the beginning of the experiment and at every 28 days, always in the morning, aiming at reducing possible interferences which could alter the intake or harm the performance and the correct data measurement.

Every 14 days, animals were rotated among paddocks in order to eliminate possible interferences on the results due to differences among paddocks (grazing availability, localization of water drinkers and trough, relief, shading, etc). For follow up and evaluation of daily average weight gain in each experimental period, weighing of the animals was carried out every 28 days. Total weight gain (TWG) was quantified by the difference between final and initial weight, in which the average daily weight gain is the ratio between total weight gain and number of experimental days.

Forage samples were collected on the first and on the last day of each experimental period in different paddocks through cut at five centimeters from the soil of five area delimitated by a 0.25-m^2 metal square, randomly chosen in each experimental paddocks following recommendations by McMeniman (1997).

After collection, each sample was weighted and homogenized and from them, it was taken two compound samples: one for evaluation of total dry matter (DM) availability and potentially digestible dry matter (pdDM) and another for analyses of availability of fresh leaf, dry leaf, fresh stem and dry stem. After being separated, samples were immediately taken to air forced circulation oven at 55ºC for 72 hours for posterior determination of pasture dry matter total availability.

Potentially digestible dry matter (pdDM) was calculated by Paulino et al. (2008) using the following equation:

pdDM = 0.98 (100 – NDF) + (NDF – iNDF)

in which: NDF = neutral detergent fiber and iNDF = indigestible neutral detergent fiber.

The average temperature within the trial period was 18.6^{o}C in which there was accumulation of 35.8 mm of rain (Figure 1).

Samples for qualitative evaluation of pasture consumed by the animals were obtained through grazing manual simulation every 14 days, to which, together with samples with concentrated food, were evaluated for content of dry matter (DM), ether extract (EE), acid detergent fiber (ADF) and lignine (H_2SO_4 72% w/w), following techniques by Silva & Queiroz (2002).

Contents of neutral detergent fiber (NDF) were calculated following recommendations by Mertens (2002). Correction regarded to ash and protein contained on neutral detergent fiber were carried out following recommendations by Mertens (2002) and Licitra et al. (1996), respectively.

Non-fibrous carbohydrates of the supplements were calculated following recommendations by Hall (2000) using the equation:

NFC = 100–[(%CP-%UCP+%urea)+%NDFacp+%EE+%ash)]

in which: UCP = CP in the supplement from urea; NDFacp = NDF correct for ash and crude protein.

For evaluation of intake and digestibility of the ingested diet, from the 10th day in the second experimental period, a 10-day trial was carried out, in which, by following methodology by Titgemeyer et al. (2001), seven days were for adaptation of the animals to titanium dioxide (TiO_2), which was mixed to the supplementation at the quantity of 10 grams per animal per day immediately before supply of the supplement, so measurement of individual intake of the supplement could be done. In addition to TiO_2, animals were given as an external marker, on the last three days of adaptation, LIPE® (Rodriguez et al., 2006), which was used to calculate fecal excretion and it was applied via esophageal probe always around 12 p.m. On the eighth, ninth and tenth days, fecal collection was carried out at 4 p.m., 12 p.m., and at 8 a.m., respectively, aiming at obtaining representative fecal sampling of each animal during the experimental period.

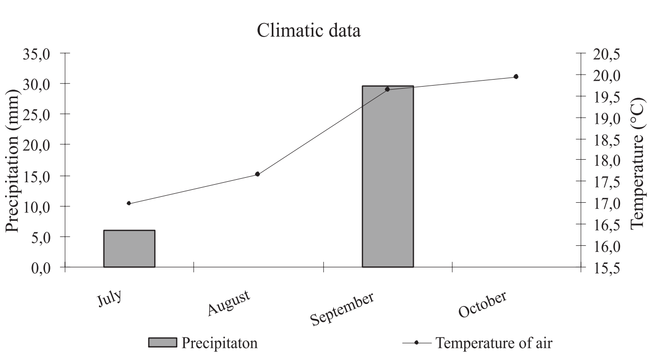

Figure 1 - Precipitation (in millimeters) and average temperature (°C) during the experimental period.

Feces were collected immediately in the rectum or right after defecation of the animals, in quantities around 200 g. These samples were per day and per animal identified and dried in forced ventilation oven at 55ºC for around 72 hours being ground in a Wiley mill with 1.00-mm porosity sieve. Following to separation of an aliquot for estimation of LIPE® concentration, samples were stored as compound samples, per animal, in properly identified and sealed plastic pots.

Individual intake of the supplement was calculated using titanium dioxide as external marker. The estimate of the supplement individual intake was obtained using the following equation:

SupI = FE * iF / iSup

in which SupI = supplement individual intake (kg/day); FE = fecal excretion (kg/day); iF = concentration of feces marker (g/kg); iSup = concentration of marker in the supplement (g/kg).

Total voluntary dry matter intake (DMI) was estimated using indigestible neutral detergent fiber (iNDF) as an internal marker by adjusting the equation proposed by Detman et al. (2001):

DMI (kg/day) = {[(FE × FMC) - IMS] / FOMC} + CMSup

in which: FE = fecal excretion (kg/day); FMC = fecal marker concentration (kg/kg); IMS = consumption of the internal marker in the supplement (kg/day) and FOMC = forage marker concentration (kg/kg).

Estimations of iNDF in the feces, in the pasture samples obtained by manual grazing simulation and in the supplements were obtained after *in situ* incubation for 240 h as suggested by Casali et al. (2008).

It was calculated the replacement coefficient (RC) of the consumed forage by consumed supplement, so positive values of RC indicates that supplement was ingested by substituting forage; null value of this coefficient indicate that supplement ingestion was not performed to replace grazing and negative values demonstrate additive effect of supplement intake over pasture dry matter intake. Replacement coefficient was obtained through the equation:

RC = (PDMIc – PDMIt) /SDMI

in which: PDMIc = average intake of pasture dry matter by the control group animals; PDMIt = average intake of pasture dry matter by the animals in the question group and SDMI = average intake of supplement dry matter by the animals in the question group.

On the last day of digestibility trial, urine *spot* samples (10 mL) were collected in spontaneous urination of the animals and blood samples collection was done approximately four hours after supplement supply. After collection, samples of urine were diluted in 40 mL H_2SO_4 0.036 N (Valadares et al., 1999) and frozen at -20ºC for later determination of creatine, urea and purine derivatives. Blood samples were collected at the end of urine collection period, using vacuum collection tubes and the samples were immediately centrifuged and the serum frozen at -20ºC.

Samples of urine were analyzed for creatine contend using a modified Jaffé method (Bioclin K016-1) for the urea contends and uric acid by colorimetric-enzymatic method (Human do Brasil) and blood samples were analyzed for urea contend using the same method utilized in urine analyses. Commercial kits were used for these analyses.

Calculations for daily urinary volume were done by using the relationship among creatinine daily excretion (CE) and its concentration in the *spot* samples adopting as a reference the equation proposed by Chizzotti et al. (2004):

$$CE_{(mg/kgBW)} = 32.27 - 0.01093 \times BW$$

in which: BW = body weight.

In this way, daily urinary excretion of nitrogenous compounds was the product between its concentration in the spot samples and the estimated value of the urinary volume.

Analyses for alantoine contend in the urine was performed using colorimetric method following Fujihara et al. (1987), quoted by Chen & Gomes (1992).

Total excretion of purine derivatives was calculated by the sum of alantoine and uric acid quantities excreted in the urine, expressed in mmol/day.

Absorbed purines ((X, mmol/day) were calculated form purine derivative excretion (Y, mmol/day) using the following equation:

$$Y = (X - 0.385\ BW^{0.75}) / 0.85$$

in which: 0.85 = recovery of absorbed purine as purine derivatives; and $0.385BW^{0.75}$ = endogenous contribution for purine excretion (Verbic et al., 1990).

Ruminal synthesis of nitrogenous compounds (Y, g Nmic/day) was calculated using the equation described by Chen & Gomes (1992), except for the relationship N purine: N bacteria total 0.134, according to Valadares et al. (1999):

$$Y = 70X / 0.83 \times 0.134 \times 1000$$

in which: 70 = N purine contend (mgN/mol); 0.134 = N purine:total bacteria N; and 0.83 = bacterial purine digestibility.

Statistical analyses referring to performance of the animals were carried out following a complete random block design in 2×2+1 factorial scheme and comparisons among observed means were performed through decomposition of the sum of squares for treatments in orthogonal contrasts related to supplementation and no supplementation, corn and wheat meal and 0.5 kg/animal/day and 1.0 kg/animal/day and interaction among the factors. Statistical procedures were carried out using SAS (*Statistical Analysis System*) computer program, adopting 0.10 as critical probability level for type I error.

Results and Discussion

Wheat meal or corn-based supplements showed contents of crude protein, neutral detergent fiber and non-

Table 2 - Chemical composition of supplements and of *Brachiaria decumbens* pasture

Item	Supplement energy source		
	Wheat meal (0.5 and 1.0 kg/animal/day)	Corn (0.5 and 1.0 kg/animal/day)	*Brachiaria decumbens*[1]
Dry matter	88.60	90.79	38.28 ± 2.51
Organic matter (%DM)	86.27	89.14	91.60 ± 0.39
Crude protein (% DM)	32.43	31.56	8.31 ± 0.99
Neutral detergent insoluble protein (%CP)	20.00	14.69	34.43 ± 0.93
Ether extract (% DM)	3.72	3.43	1.59 ± 0.17
Neutral detergent fiber (% DM)	42.40	13.39	63.30 ± 0.58
Neutral detergent fiber correct for ash and crude protein (% DM)	39.01	11.27	58.29 ± 2.07
Ashes (% DM)	4.70	2.05	8.40 ± 0.39
Non-fibrous carbohydrates (% DM)	31.04	62.33	23.41 ± 0.91
Acid detergent fiber (% DM)	11.21	3.79	29.51 ± 1.35
Indigestible neutral detergent fiber (% DM)	9.07	1.45	18.57 ± 1.91
Lignine (% DM)	2.87	0.23	2.99 ± 0.43

[1] Pasture sample obtained trough grazing manual simulation; iNDF – indigestible neutral detergent fiber after 240 hours of ruminal incubation.

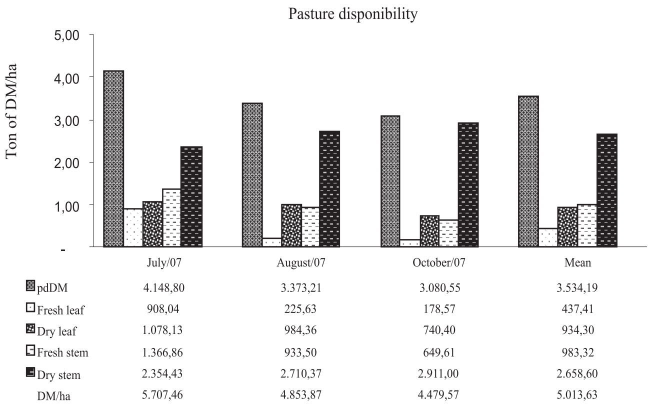

Figure 2 - Availability of potentially digestible dry matter (pdDM), fresh leaf, dry leaf, fresh stem and dry stem and total dry matter over experimental period (kg of DM/ha).

fibrous carbohydrates of 32.43 and 31.56%; 42.40 and 13.39% and 31.04 and 62.33%, respectively (Table 2).

Average availability of forage in the paddocks was 5,013 kg DM/ha (Figure 2). At the beginning of the experiment, when pasture was deferred, dry matter availability of fresh leaf was 908 kg/ha and at the end of the experimental period this availability was reduced for 178 kg/ha, which means an 80% reduction. It is also observed an outstanding replacement of fresh stems by dry stems. A 50% reduction of fresh stem availability is observed while availability of dry stem raised approximately 23% confirming the outstanding drop in the nutritional quality of tropical forages during the year dry season.

Tropical forage species present great production potential, however, accumulation of dry matter is followed by reduction in the leaf:stem ratio and as dry season advances there is an outstanding reduction in the dry matter fresh:dry ratio, denoting the need for corrections in balance of the nutrients in grazing animal diets.

Forage collected trough manual grazing simulation showed an average content of 8.31% (Table 2), which is higher than the 6.13% considered by Sampaio (2007) as a lower limit for the minimal activity of ruminal microorganisms. Nevertheless, this value is lower than 10.83% crude protein showed by Lazzarini et al. (2009) as the level of crude protein that would maximize dry matter intake. Therefore, supplementation of protein in the diet explains the higher consumption of dry matter (P<0.10) by the animals under supplementation than those that were not given supplement (Table 3).

The highest dry matter intake is commonly associated to better performances, which can be confirmed in the present work when supplemented animals showed (P<0.01)

Table 3 - average intake of pasture and supplement nutrients and digestibility of DM and NDFacp

	Mineral mixture	Supplement 0.5 kg/animal/day Wheat meal	Corn	Supplement 1.0 kg/animal/day Wheat meal	corn	CV (%)	Contrasts[1] Control vs suplement	Wheat meal vs corn	0.5 vs 1.0 kg/ animal/day	Sources × levels
Total dry matter (kg/animal/day)	3,932	4,301	4,962	4,194	4,427	18.1	0.0926	0.1180	0.2579	0.4482
Total dry matter (%BW)	1.91	2.02	2.40	2.01	2.08	18.9	0.1671	0.1179	0.2561	0.2837
Pasture dry matter (kg/animal/day)	3,910	3,830	4,480	3,383	3,579	19.2	0.7543	0.1130	0.0139	0.3885
Pasture dry matter (%BW)	1.90	1.80	2.16	1.62	1.68	19.8	0.5778	0.1067	0.0151	0.2488
Organic matter (kg/animal/day)	3,581	3,920	4,538	3,828	4,076	18.2	0.0840	0.1000	0.2863	0.4748
Crude protein (kg/animal/day)	0.325	0.462	0.515	0.535	0.560	17.1	<0.0001	0.1845	0.0490	0.6252
Ether extract (kg/animal/day)	0.062	0.078	0.087	0.083	0.086	17.5	0.0005	0.2280	0.6683	0.4834
NDFacp (kg/animal/day)	2,279	2,405	2,663	2,278	2,180	18.7	0.5601	0.6115	0.0583	0.2624
Non-fibrous carbohydrates (kg/animal/day)	0.915	1,024	1,322	1,018	1,339	17.8	0.0023	0.0001	0.9397	0.8681
Total digestible nutrients (kg/animal/day)	2,304	2,804	3,170	2,716	2,932	24.1	0.0297	0.2278	0.4971	0.7521
Replacement coefficient	-	0,18	-1.26	0.59	0.36	-	-	-	-	-
Dry matter digestibility (%)	59.1	65.2	62.5	63.7	63.6	10.2	0.0777	0.5319	0.9296	0.5580
NDFacp digestibility (%)	61.7	67.1	63.5	63.8	63.7	10.9	0.3179	0.4671	0.5391	0.4864

CV = coefficient of variation; NDFacp = neutral detergent fiber correct for ash and protein; WB = body weight.
[1] Described probability levels (P value) for Type I error for contrasts.

Table 4 - Probability described levels of contrasts for Type I error contrasts and means of initial body weight, final body weight, body weight gain, and average daily weight gain for the different treatments

	Supplement					CV (%)	Contrasts[1]			
		0.5 kg/animal/day		1.0 kg/animal/day						
	Mineral mixture	Wheat meal	Corn	Wheat meal	corn		Control *vs* suplement	Wheat meal *vs* corn	0.5 *vs* 1.0 kg/ animal/day	Sources × levels
Initial body weight (kg)	199.8	200.9	195.4	198.0	195.4	-	-	-	-	-
Final body weight(kg)	206.7	211.9	216.1	216.0	216.1	11.2	0.3829	0.8053	0.8110	0.8110
Total weight gain (kg)	6.9	11.0	20.6	18.0	20.6	38.9	<0.0001	0.0068	0.1086	0.1086
Average daily weight gain (kg)	0.077	0.124	0.232	0.202	0.232	38.9	<0.0001	0.0067	0.1091	0.1080

[1] Probability described levels (P value) for Type I error for contrasts

weight gain (17.6 kg) higher than the non-supplemented animals (6.9 kg) (Table 4).

According to Lazzarini (2007), dietary levels of crude protein above 8.55% provide sufficient microbial growth that do not harm the digestibility of potentially degradable neutral detergent fiber. As the close value of crude protein showed by *B. decumbens* (8.31%) in this work, there was no significant differences (P>0.10) in NDFacp digestibility for supplemented animals in comparison to non-supplemented animals (Table 3).

Supplementation promoted improvements on the performance of the animals by increasing digestibility (P<0.10) and consequently the dry matter intake (P<0.10) (Table 3) and average daily weight gain (P<0.10) (Table 4). Performance in total weight gain of the animals was on average 20.6; 14.5 and 6.9 kg for animals supplemented on corn; wheat meal and non-supplemented animals, respectively (Table 4).

Despite of being low, daily average weight gain of the animals are compatible to those found by Silveira et al. (2007), who also worked during the dry season of the year with tropical grass, in which animals were given the quantity equal to 0.72 kg of the supplement/animal/day and based on corn, soybean meal and urea containing 25.9% of crude protein. The authors obtained average weight gain of 0.005 and 0.183 kg/animal/day for animals given only mineral mixture and supplemented animals, respectively.

The basic principle of pasture supplementation is to give catalytic doses of nutrients that maximize the use of basal substrate, in this case, the forage. Therefore, the effects of replacement of the pasture by supplement with no improvement on the performance are not desirable. It was observed that daily levels of supplementation of 0.5 kg/animal resulted in a similar performance as compared to levels of 1.0 kg per day (Table 4). There was a higher pasture dry matter consumption (P<0.05) by the animals fed 0.5 kg of supplement without making difference on total dry matter intake (P>0.05) when it was compared to animals supplemented with 1.0 kg (Table 3), so the higher supplement intake by the animals than those which consumed 1.0 kg of the supplement was because of the replacement to pasture intake. So, replacement coefficient was -0.72 for animals supplemented with 0.5 kg of supplement/animal/day *versus* 0.48 for the animals supplemented with 1.0 kg of supplement/animal/day.

Use of supplements high in non-fibrous carbohydrates provides the occurrence of "carbohydrate effect" (Arroquy et al., 2005), which is the reduction on fiber digestibility by the fall in the activity of fibrolytics bacteria. Animals supplemented with corn-based ration showed non-fibrous

Table 5 - Microbial nitrogenous compounds, serum ureic nitrogen, ureic urinary nitrogen and microbial efficiency in beef heifers on palisade grass pasture given supplement with two energy sources during dry season

	Supplement					CV (%)	Contrasts[1]			
	Mineral mixture	0.5 kg/animal/day		1.0 kg/animal/day			Control *vs* suplement	Wheat meal *vs* corn	0.5 *vs* 1.0 kg/ animal/day	Sources × levels
		Wheat meal	Corn	Wheat meal	corn					
Microbial N (g/Day)	48.60	44.63	54.71	100.86	97.97	42.6	0.0332	0.7332	<0.0001	0.5394
Serum ureic N (mg/dL)	5.32	16.74	13.67	13.37	12.54	19.7	<0.0001	0.0295	0.0132	0.2015
Urinary ureic N (g/day)	5.57	25.51	24.05	25.91	27.06	27.2	<0.0001	0.9432	0.4258	0.5395
Microbial efficiency										
g CP mic/kg ingested TDN	144.23	99.23	127.18	245.98	218.05	55.5	0.4434	0.9998	0.0009	0.3992
Microbial N/total ingested N (%)	97.63	60.01	71.15	122.89	112.19	47.8	0.7309	0.9889	0.0022	0.4908

[1] Probability described levels (P value) for Type I error for contrasts.

carbohydrate intake higher than those fed wheat meal-based supplement (P<0.01), in counterpart, the expected fall regarded to NDFacp digestibility did not happen in a significant way. The occurrence of carbohydrate effect occurs basically because of a competitive advantage that a non-fibrous carbohydrate source provides to amylolytic bacteria in response to fibrolytic using nitrogen present in the medium. However, as it can be seen, levels of crude protein used in the supplement at about 32.0% outlined the effects of deficiency of this nutrient, which is very common in diets for bovines under tropical grass grazing. This fact can be supported even by the higher levels of ureic nitrogen observed in the blood of supplemented animals (Table 5).

The highest value of serum ureic nitrogen presented by animals fed wheat meal suggests higher utilization of nitrogen by ruminal microorganism when animals are supplemented with energy source high in starch, since they showed the lowest nitrogen absorption in the rumen, indicating lower ammonia concentrations. This value suggests even lower N requirements in the rumen when starch energetic source is replaced by a rapid degradation fibrous source. This fact is important since that protein is the most expensive nutrient in diets for animals.

The best performance of animals fed corn proves that, despite of being the highest in these animals, ruminal nitrogen requirement was completely met by the supplements.

Conclusions

Supplementation for grazing beef steers during the dry season enable an increase on productive performance. The use of corn/soybean meal mixture as base of multiple mixture improves the productive performance of the steers in comparison to wheat meal.

References

ARROQUY, J.I.; COCHRAN, R.C.; NAGARAJA, T.G. et al. Effect of types of non-fiber carbohydrate on *in vitro* forage fiber digestion of low-quality grass hay. **Animal Feed Science and Technology**, v.120, n.1-2, p.93-106, 2005.

CASALI, A.O.; DETMANN, E.; VALADARES FILHO, S.C. et al. Influência do tempo de incubação e do tamanho de partículas sobre os teores de compostos indigestíveis em alimentos e fezes bovinas obtidos por procedimentos in situ. **Revista Brasileira de Zootecnia**, v.37 n.2, p.335-342, 2008.

CHEN, X.B.; GOMES, M.J. **Estimation of microbial protein supply to sheep and cattle based on urinary excretion of purine derivatives** - an overview of technical details. Bucksburnd, Aberdeen: Rowett Research Institute/International Feed Resources Unit, 1992. 21p. (Occasional publication).

CHIZZOTTI, M.L.; VALADARES FILHO, S.C.; VALADARES, R.F.D. et al. Excreção de creatinina em novilhos e novilhas. In: REUNIÃO

ANUAL DA SOCIEDADE BRASILEIRA DE ZOOTECNIA, 41., 2004, Campo Grande. **Anais...** Campo Grande: Sociedade Brasileira de Zootecnia, 2004. (CD-ROM).

DETMANN, E.; PAULINO, M.F.; ZERVOUDAKIS, J.T. et al. Cromo e indicadores internos na estimação do consumo de novilhos mestiços, suplementados, a pasto. **Revista Brasileira de Zootecnia**, v.30, n.5, p.1600-1609, 2001.

HALL, M.B **Calculation of non-structural carbohydrate content of feeds that contain non-protein nitrogen.** University of Florida, 2000. p.A-25 (Bulletin, 339).

LAZZARINI, I. **Consumo, digestibilidade e dinâmicas de trânsito e degradação da fibra em detergente neutro em bovinos alimentados com forragem de baixa qualidade e compostos nitrogenados**. 2007. 53f. Dissertação (Mestrado em Zootecnia) - Universidade Federal de Viçosa, Viçosa, MG.

LAZZARINI, I.; DETAMANN, E.; SAMPAIO. C.B. et al. Intake and digestibility in cattle fed low-quality tropical forage and supplemented with nitrogenous compounds. **Revista Brasileira de Zootecnia**, v.38, n.10, p.2021-2030, 2009.

LICITRA, G.; HERNANDEZ, T.M.; VAN SOEST, P.J. Standardization of procedures for nitrogen fractionation of ruminant feeds. **Animal Feed Science and Technology**, v.57, n.4, p.347-358, 1996.

McMENIMAN, N.P. Methods of estimating intake of grazing animals. In: REUNIÃO ANUAL DA SOCIEDADE BRASILEIRA DE ZOOTECNIA, 34., 1997, Juiz de Fora. **Anais...** Juiz de Fora: SBZ, 1997. p.131-168.

MERTENS, D.R. Gravimetric determination of amylase-treated neutral detergent fiber in feeds with refluxing in beaker or crucibles: collaborative study. **Journal of AOAC International**, v.85, n.6, p.1217-1240, 2002.

PAULINO, M.F.; DETMANN, E.; VALADARES FILHO, S.C. Bovinocultura funcional nos tópicos. In: SIMPÓSIO DE PRODUÇÃO DE GADO DE CORTE, 6.; SIMPÓSIO INTERNACIONAL DE PRODUÇÃO DE GADO DE CORTE, 2., 2008, Viçosa, MG. **Anais...** Viçosa, MG, 2008. p.275-305.

RODRIGUEZ, N.M. Uso de indicadores para estimativa de consumo a pasto e digestibilidade. In: REUNIÃO ANUAL DA SOCIEDADE BRASILEIRA DE ZOOTECNIA, 43., 2006, João Pessoa. **Anais...** João Pessoa: Sociedade Brasileira de Zootecnia, 2006. p.323-352.

SAMPAIO, C.B. **Consumo, digestibilidade e dinâmica ruminal em bovinos alimentados com forragem tropical de baixa qualidade suplementados com compostos nitrogenados**. 2007. 53f. Dissertação (Mestrado em Zootecnia) – Universidade Federal de Viçosa, 2007.

SILVA, D.J.; QUEIROZ, A.C. **Análise de alimentos**: métodos químicos e biológicos. 3.ed. Viçosa, MG: Editora UFV, 2002. 165p.

SILVEIRA, L.F.; DIOGO, J.M.S.; FRANCO, G.L. et al. Ganho de peso de bezerros submetidos a diferentes freqüências de suplementação protéico-energética na época seca. In: REUNIÃO ANUAL DA SOCIEDADE BRASILEIRA DE ZOOTECNIA, 44., 2007, Jaboticabal. **Anais...** São Paulo, 2007. (CD-ROM).

SOUZA, M.A.; DETMANN, E.; PAULINO, M.F. et al. Intake, digestibility and rumen dynamics of neutral detergent fibre in cattle fed low-quality tropical forage and supplemented with nitrogen and/or starch. **Tropical Animal Health and Production**, v.42, n.6, p.1299-1310, 2010.

TITGEMEYER; E.C.; ARMENDARIZ, C.K.; BINDEL, D.J. et al. Evaluation of titanium dioxide as a digestibility marker for cattle. **Journal of Animal Science**, v.79, n.4, p.1059-1063, 2001.

VALADARES, R.F.D.; BRODERICK, G.A.; VALADARES FILHO, S.C. et al. Effect of replacing alfalfa silage with high moisture corn on ruminal protein synthesis estimated from excretion of total purine derivatives. **Journal of Dairy Science**, v.82, n.11, p.2686-2696, 1999.

VERBIC, J.; CHEN, X.B.; MACLEOD, N.A. et al. Excretion of purine derivatives by ruminants. Effects of microbial nucleic acid infusion on purine derivative excretion by steers. **Journal of Agricultural Science**, v.114, n.3, p.243-248, 1990.