Blood parameters of beef cattle fed diets containing different levels of extruded urea consumption

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ABSTRACT - The objective of this study was to determine the ideal level of extruded urea for bovine consumption, evaluating blood parameters. Four crossbreed cannulated rumen steers were fed with four diets containing 50, 60, 70 and 80 g of extruded urea were evaluated for each 100 kg of body weight. The extruded urea was Amireia (Amireia- 200®). It was considered control treatment of 50 g /100 kg PC because based on the urea content of the product used, it corresponds to 40 g of urea /100 kg PC, which is the indicated dose for use. There was a treatment effect on aspartate aminotransferase (AST) concentrations (P = 0.0059), with values of 68.46, 61.37,107.54 and 89.98 U/L for treatments of 50, 60,70 and 80 g / 100 kg PC respectively. Increasing levels of amireia-200 do not provide negative effects on blood parameters. It is recommended to supply extruded urea in up to 80 g /100 kg CP for beef cattle receiving balanced diets for 13% CP.

Keywords: amireia, creatinine, non-protein nitrogen, steers

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Introduction

Non-protein nitrogen sources with slow release of ammonium may present advantages when used in feed of beef cattle for increasing ammonium availability to the microbial synthesis and for reducing toxicity problems (Bartley & Deyoe, 1975). According to Daugherty and Church, (1982) urea is greatly used in rumen feed, it has limitations caused by its low acceptability by animals besides segregation when mixed with other ingredients and mainly due to its toxicity (Chalupa, 1968) worsened by its high solubility in rumen, for it quickly transforms into ammonium. One part of the formed ammonium is again converted in urea, involving energy expenditure in order to avoid NH_3 toxicity (Swenson & Reece, 1996). To keep the protein consumption near to animal demands, blood urea concentrations have been used (Broderick & Clayton, 1997). The use of extruded urea is given by manufacturer's recommendation that use as basis the specified urea values following the 40g of urea/100kg PC rule. In face of the approached aspects, the goal of this work was to determine the ideal level of extruded urea for beef cattle, without change in blood parameters, aiming to explore the maximum animal production potential.

Literature review

When there is excessive ammonium in rumen, it is absorbed by the rumen wall therefore increasing its concentration in blood, subsequently changing the hepatic metabolism, increasing urea genesis, and it may affect the glucose metabolism in liver and peripheral tissues (Fernandez et al., 1990; Huntington et al., 2006). A case of intoxication in animal may be accentuated if the animal ingests urea in a short period of time (Helmer & Bartley, 1971). One part of the ammonium is metabolized and again transformed in urea, involving energy expenditure that costs the animal nearly 12 kcal/g of nitrogen (Van Soest, 1994). The urea formed may be recycled to the rumen through rumen wall or saliva, or may be excreted through urine (Blaxter, 1962). Rumen microorganisms are capable of producing microbial protein from ammonium and carbonic skeleton. Non protein nitrogen (NNP) may be one of the sources of ammonium. Among them the compounds of purine and pyrimidine, urea, amireia, biuret, uric acid, nitrogen glucosides, alkaloids, ammonium salts and nitrates can be named (Taylor-Edwards et al., 2009). In this context, the replacement of true protein source for non-protein nitrogen (NNP) is a feasible option to reduce production costs since they are more economic (R$ per protein kg) when considering the same nitrogen amount

(Miranda et al., 2015). Another alternative source of NNP are those of slow release of ammonium, where the formed product is resultant of the extrusion of starch with urea and is named amireia. According to Miranda et al., (2015), the association of food that provide NNP with carbohydrates sources that provide energy with equivalent degradation rate, will result in a better use of ammoniacal nitrogen by rumen microorganisms, maximization of microbial protein synthesis, and consequently increasing digestion and passage rates, dry matter consumption and animal performance.

Materials and methods

The work was performed in the Experimental Farm and in the Lab of Applied Animal Nutrition of UFMS in Campo Grande, Brazil. Four cross-bred, castrated and rumen fistulated beef cattle with initial average body weight (PC) of 336.25 ± 47.86 kg, were distributed in Latin square framework 4x4 with four treatments and four 14 day periods, being 10 days for adaptation and 4 days of data collection. The experimental treatments were four diets (Table 1) with voluminous:concentrate rate of 40:60 for cross-bred beef cattle with 350 kg of PC and average weight gain of 1.25 kg/day. Diets had 50, 60, 70 and 80 g of extruded urea for every 100 kg of PC being considered control treatment the one of the 50 g/100kg of PC, because based on the urea content of the used product, it corresponds to 40 g of urea/100kg PC that is the recommended dosage use. The extruded urea used was Amireia-200® (Pajoara Ind. e Comércio Ltda. Campo Grande-MS, Brazil). The blood collections were performed in the 11th day of each experimental period through puncture of jugular vein with vacuum tubes containing clot activator and separator gel and sodium fluoride as glycolytic inhibitor. Samples were collected before feed (0) and 1,2 and 4 hours post-prandial; next, tubes were centrifuged (3,000 rpm during 15 minutes) and stored in "Eppendorf" type tubes of 2 mL for performing total protein analysis, albumin, creatinine, glucose, urea, triglycerides, alanine aminotransferase, aspartate aminotransferase. The blood parameters data were submitted to variance analysis using GLM procedure of SAS (SAS Institute, Inc., 2002) according to Latin Square 4 x 4 framework. The main variation sources analyzed were collection times and interaction between treatment and time. The averages were analyzed using initial body weight as co-variable and they were compared through the Tukey test in a 5% significance level.

Results and discussion

Blood parameters are presented in Table 2. It may be observed that the values of total protein, albumin, creatinine, urea, alanine aminotransferase and aspartate aminotransferase do not surpass the reference values (66-75 g/L, 27-38 g/L, 1-2 mg/dL, 23-58 mg/dL, 0-38U/L, 0-132 U/L, respectively) found in Literature (Kaneko et al., 1997). The aspartate aminotransferase (AST) is an enzyme with activity in hepatocytes and muscle fibers, and it has been used for assessing muscular and hepatic injuries (Kaneko et al., 1997)., and it has presented significant difference between treatments (P=0.0059) (Table 2), being treatments of 50 and 60g the lowest with values of 68.46 U/L and 61.37 U/L respectively, and value of 107.54 U/L for the 70g treatment. Despite this is the biggest value found for different levels, it is still within reference values for this enzymatic activity that is of 0-132 U/L for beef cattle. The reference values for glucose are of 45-75 mg/dL and all treatments presented values above average (88.9 mg/dL, 86.4 mg/dL, 89.8 mg/dL, 85.9 mg/dL for each treatment, respectively), that may be explained due to the high concentrate ratio present in diet (60%), which results in a bigger contribution of propionic acid in liver, and consequently, higher glucose synthesis. The harvest time has significantly influenced the plasma urea (P=0.0271) (Table 2) despite all treatments have presented values within the reference standards. The highest contents were observed after the post-prandial hours, being the biggest value found 4 hours after food supply (37.24 mg/dL) (Table 2). The inclusion levels of extruded urea in diet were capable of providing good results of blood parameters. Besides, it was observed a significant increase in animal body weight during the experimental period, with initial average weight of 336.25+47.86 kg and final average weight of 458.75+73.58, which corresponds to a daily average body weight gain of 1.75 kg/day. These results suggest that the supply of extruded urea (amireia-200) may be of up to 80 g for every 100 kg of body weight.

Conclusions

Increasing levels of amireia-200 do not provide negative effects over blood parameters. It is recommended the extruded urea supply in up to 80 g/100 kg PC for beef cattle receiving balanced diets of 13% of PB.

Graphs and Tables

Table 1 – Ingredients and chemical composition of experimental rations.

	Extruded urea (g/100 kg PC)					
	50	60	70	80		
Corn silage (g/kg MS)	400.0	400.0	400.0	400.0		
Maize (g/kg MS)	488.9	503.2	517.5	531.9		
Soy bran (g/kg MS)	73.6	55.4	37.2	19.0		
Amireia-200S (g/kg MS)	19.5	23.4	27.3	31.2		
Mineral Core (g/kg MS)	18.0	18.0	18.0	18.0		
Chemical Composition					EPM[2]	P*
Dry Matter (g/kg of MN)	435.5	438.9	434.7	435.1	16.5	0.9821
Organic Matter (g/kg of MS)	951.1	952.1	953.2	955.8	4.3	0.4778
Raw protein (g/kg of MS)	133.7	138.3	143.1	143.0	9.8	0.3515
Fiber in neutral detergent (g/kg of MS)	380.4	369.7	377.7	374.6	33.3	0.9716
Fiber in acid detergent (g/kg of MS)	170.9	153.7	167.2	154.9	15.37	0.3267

[1]Assurance levels: Na: 100 g/kg; P: 88 g/kg; Ca: 188 g/kg; S: 22 g/kg; Mg: 8000 mg/kg: Zn: 3000 mg/kg: Cu: 1000 mg/kg: Co: 80 mg/kg: I: 60 mg/kg: Se: 20 mg/kg: F: 880 mg/kg; [2]EPM= Average standard error; Averages followed by lowercase letter distinct, differ between each other by the Tukey test (P<0,05);

(http://cdn5.abz.org.br/wp-content/uploads/2017/04/Tabela-1-27.jpg)

Table 2 - Nutrient consumption and digestibility and ingestive behavior of cutting steers according to experimental treatments.

	Extruded Urea (g/100 kg PC)				EPM[1]	Ptrat	Phour	Ptrat* hour
	50	60	70	80				
PT[2] (g/L)	75.5	71.1	75.8	74.3	9.40	0.3818	0.5416	0.9087
ALB[3] (g/L)	35.2	32.2	33.7	33.6	4.043	0.1498	0.6250	0.8753
TGR[4] (mg.dL)	17.25	19.3	18.2	19.8	5.05	0.3793	0.3622	0.7823
CRE[5] (mg.dL)	1.1	1.0	1.1	1.0	0.25	0.5552	0.6697	0.9963
GLI[6] (mg.dL)	38.0	86.4	89.9	35.9	10.71	0.5901	0.6932	0.9936
UR[7] (mg.dL)	32.9	33.1	34.1	36.0	3.24	0.6253	0.0271	0.9975
ALT[8] (U/L)	19.3	13.0	19.3	19.8	3.25	0.3450	0.8060	0.9845
AST[9] (H/L)	68.[b]	61.4[b]	107.5[a]	90.0[ab]	43.92	0.0059	0.9808	1.0000

	Hours post-prandial				EPM[1]	P*
	0	1	2	4		
PT[2] (g/L)	74.2	76.2	74.4	71.8	9.40	0.5416
ALB[3] (g/L)	33.3	34.6	33.8	33.1	4.04	0.6250
TGR[4] (mg.dL)	17.5	19.5	19.8	17.8	5.05	0.3622
CRE[5] (mg.dL)	1.0	1.1	1.1	1.1	0.25	0.6697
GLI[6] (mg.dL)	89.8	87.7	87.9	85.7	10.71	0.6932
UR[7] (mg.dL)	29.5[b]	33.9[ab]	35.5[ab]	37.2[a]	8.24	0.0271
ALT[8] (U/L)	18.5	19.3	19.4	19.2	3.25	0.8060
AST[9] (H/L)	71.7	75.2	76.1	76.3	43.92	0.9808

*Averages followed by lowercase letter distinct, differ between each other by the Tukey test (P<0.05); [1]EPM=Standard error of average;

[2]Total protein (g/L); [3]Albumin (g/L); [4]Triglycerides (mg/dL); [5]Creatinine (mg/dL); [6]Glucose (mg/dL); [7]Urea (mg/dL); [8]Alanine aminotransferase (U/L); [9]Aspartate aminotransferase (U/L)

(http://cdn5.abz.org.br/wp-content/uploads/2017/04/Tabela-2-14.jpg)

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