Apparent digestibility of diets with different levels of extruded urea consumption for beef cattle

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ABSTRACT - The objective of this study was to determine the ideal level of extruded urea for cattle consumption, evaluating nutrient intake and apparent digestibility. Four rumen cannulated crossbred steers with an initial mean body weight of 336.25 ± 47.86 kg were distributed in 4x4 latin square experimental design. Four diets containing 50, 60,70 and 80 g of extruded urea for each 100 kg of body weight. Extruded urea was Amireia (Amireia-200®, Pajoara Ind., and Commerce Campo Grande-MS). Control treatment of 50 g / 100 kg PC was considered, 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 no significant effect (P>0.05) of extruded urea levels on nutrient intake and apparent digestibility of DM, OM, CP, NDF and AFD.

Keywords: animal consumption; apparent digestibility amirea; non-protein nitrogen

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Introduction

Rumen microorganisms are capable of producing microbial protein from ammonium and carbonic skeleton being non-protein nitrogen (NNP) one of the possible sources of ammonium (Taylor-Edwards et al., 2009). Extrusion of starch with urea represents an NNP source that presents low solubility in rumen and slow release of ammonium. 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, being able to raise digestion and passage rates, dry matter consumption and animal performance. The used of the extruded urea is given by recommendation of manufacturer that use as base the pointed urea values following the rule of 40g of urea/100 kg PC. In face of the observed aspects, this work’s goal was to determine the idea level of extruded urea for beef cattle, rating consumption and apparent digestibility, aiming to explore maximum potential of animal production.

Literature review

The supply of nutrients represents around 80% of total expenses in confined systems, taking great part of costs and limiting animal production systems profit. Therefore, the supply of nutrients from alternative food available is the fundamental stage in the animal production process (Lana et al., 1999). In this context, the replacement of true protein source for NNP is an option to reduce production costs since they are more economic (R$ per protein kg) when considering the same nitrogen amount (Miranda et al., 2015). Despite urea is greatly used in rumen feed, it has restrictions due to its acceptability by animals, 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. There are alternative sources of NNP where the product named amireia is resultant of the extrusion of starch with urea, presenting low rumen solubility and slow release of ammonium. Among the carbohydrates used and being the main energetic component of concentrates, corn is used as starch source, being able to improve rumen fermentation characteristics, increasing efficiency of NNP sources use (Pereira et al., 2009).

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 nutrient consumption was daily determined from the 12th to the 14th day of each experimental period. The supplies and leftovers were weighed and sampled for determining daily consumption. The total feces production was quantified in the 12th and 13th experimental day of each period, through total feces collection. The samples analyzed for determining the dry matter (MS), organic matter (MO) and raw protein (PB) content according to AOAC (2000), fiber content in neutral detergent (FDN) according to Mertens (2002) and fiber content in acid detergent (FDA) by the Robertson and Van Soest (1985) method. The coefficients of apparent digestibility of nutrients were obtained through the equation: Apparent digestibility (g/kg) = ((g supplied nutrient - g nutrient in leftovers) - g nutrient in feces) / (g supplied nutrient - g nutrient in leftovers) x 1000 Variance analysis were performed using PC as co-variable and it was used the Tukey test to compare averages with 5% significance.

Results and discussion

There was no effect of the supplied extruded urea level over the consumption and digestibility of nutrients. The average consumption of dry matter (CMS) was of 9.16 kg/day (Table 2). The effect absence of the supplied extruded urea level points that the extrusion was effective in protecting nitrogen, without damage to the nutrient consumption. The data presented in Table 2 support the results found by Taylor-Edwards (2009) that did not find any effect of the protected urea over CMS or over the diet digestibility. Vilela et al. (2007) observed CMS reduction when 100% replacement of soybean meal for amireia-150 was used, in the diet of dairy cows corresponding to 2.01% in total diet. However, such fact did not happen in this experiment where the 80 g/100 kg PC level corresponds to 3.12% of Amireia-200 in diet. It is necessary to highlight that there isn’t still a defined level for the use of extruded urea for inclusion in beef cattle diet. The reference values are based on the supply of free urea, which is completely different compared to the extruded urea, once rumen solubility is slower providing better use of N-Ammoniac released (Ítavo et al., 2016). The raw protein consumptions were not significantly different in kg/day and in g/kg ($P>0.05$) (Table 2) for treatments. The FDN consumptions (CFDN, 3.46 kg/day) and FDA (CFDA, 1.48 kg/day) did not suffer effect of the extruded urea supply level in diet ($P>0.05$). The FDN consumption related to body weight was of 9.41 g/kg PC. Detmann et al. (2003) have assessed FDN consumption by confined beef using data published in the Zootechny Brazilian Society magazine and the Zootechny Brazilian magazine in the period of 1991 and 2000 and have observed average results of FDN consumption of 9.95 g/kg PC for zebu animals. According to Owens and Zinn (1988), the compounds with controlled release of nitrogen like the extruded urea with starch, avoid intoxication per N-NH_3 without, however, affecting the nutrient use which supports the results presented in this study. The average digestibility of MS was of 722.91 g/kg, with no effect for the assessed treatment ($P>0.05$). Oliveira Júnior et al., (2004) assessing the nutrients digestibility in beef diets containing urea or amireia-150 in replacement to soybean meal, have not found significant differences for apparent digestibility. The PB digestibility has not significantly differed between treatments (P>0.05) with an average of 709.84 g/kg. Silva et al. (1994) assessing sheep supplementation with amireia-150 has also not found significant differences for PB digestibility. The FDN and FDA digestibility have not significantly differed between treatments. Silva et al. (2002), using nitrogen sources in calf confined have also not observed differences in digestibility of FDN and GDA when extruded urea was included in diet.

Conclusions

Increasing levels of extruded urea (amireia-200) do not provide negative effects over the nutrient consumption and apparent digestibility. 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 PV)					
	50	60	70	80		
Corn silage	400.0	400.0	400.0	400.0		
Maize	488.9	503.2	517.5	531.9		
Soy bran	73.6	55.4	37.2	19.0		
Amireia-200S	19.5	23.4	27.3	31.2		
Mineral Core	18.0	18.0	18.0	18.0		
Chemical Composition					EPM	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;

(http://cdn5.abz.org.br/wp-content/uploads/2017/04/Dig-Ap.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]	P
	50	60	70	80		
Nutrient consumption (kg/day)						
Dry matter	9.3	9.7	8.5	9.1	2.16	0.4299
Organic matter	8.9	9.3	8.1	8.7	2.06	0.4551
Raw protein	1.3	1.3	1.2	1.3	0.33	0.7676
Fiber in neutral detergent	3.5	3.6	3.2	3.6	0.73	0.3770
Fiber in acid detergent	1.5	1.5	1.4	1.5	0.31	0.6290
Nutrient consumption (g/kg PC)						
Dry matter	25.2	24.6	24.2	25.4	4.28	0.8533
Organic matter	24.0	23.4	23.1	24.3	4.07	0.8447
Raw protein	3.4	3.4	3.5	3.6	0.59	0.7073
Fiber in neutral detergent	9.5	9.0	9.1	10.0	1.42	0.2187
Fiber in acid detergent	4.1	3.8	4.0	4.2	0.62	0.3159
Apparent digestibility of nutrients (g/kg)						
Dry matter	710.7	743.2	729.3	703.5	61.95	0.7433
Organic matter	737.3	763.2	752.8	726.6	56.01	0.7410
Raw protein	673.4	733.1.	719.9	707.9	65.71	0.6863
Fiber in neutral detergent	544.6	582.3	539.9	514.5	80.23	0.6983
Fiber in acid detergent	420.4	414.S	386.6	353.7	149.55	0.9162

Averages followed by lowercase letter distinct, differ between each other by the Tukey test (P<0.05); PC – Body weight; EPM=Standard error of average;
(http://cdn5.abz.org.br/wp-content/uploads/2017/04/DIG-AP2.jpg)

References

AOAC. Official Methods of Analysis. 15th ed. Arlington, VA: Association of Official Analytical Chemists, 1990. Chalupa, W. Problems in feed urea to ruminants. Journal of Animal Science, Champaing, v.27, p.207-219.1968. Detmann, E.; Queiroz, A. C.; Cecon, P. R.; et al. Consumo de fibra em detergente neutro por bovinos em confinamento. Revista Brasileira de Zootecnia, v. 32, p. 1763-1777. 2003 ítavo, L. C. V.; ítavo, C. C. B. F.; Dias, A. M.; Franco, G. L.; et ai. Combinações de fontes de nitrogênio não proteico em suplementos para novilhos Nelore em pastejo. Revista Brasileira de Saúde e Produção Animal, v.17, p.448-460. 2016. Lanna, D. P. D.; Tedeschi, L. O.; Beltrame Filho, J. A. Modelos lineares e não- lineares de uso de nutrientes para a formulação de dietas de ruminantes. Scientia Agricola. Piracicaba, v. 56,1999. 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, p.1217-1240. 2002. Miranda, P. A. B.; Fialho, M. P. F.; Saliba, E. O. S.; et ai. Consumo, degradabilidade in situ e cinética ruminal em bovinos suplementados com diferentes proteinados. Arquivo Brasileiro de Medicina Veterinária e Zootecnia, v.67, p.573-582,2015. Owens FN, Zinn RA. Protein metabolism of ruminant animais. In: Church DC, editor. The Ruminant Animal, Digestive Physiology and Nutrition. New Jersey: Prentice Hall; p. 227-249.1988. Oliveira Júnior, R. C.; Pires, A. V.; Susin, I.; et al. Digestibilidade de nutrientes em dietas de bovinos contendo ureia ou amireia em substituição ao farelo de soja. Pesquisa Agropecuária Brasileira, v.39, p.173-178, 2004. Pereira, L.G.R.; Antunes, R.C.; Gonçalves, L.C. et al. O milho na alimentação de gado de leite. In: Gonçalves, L.C.; Borges, I.; Ferreira, P.D.S. (Eds.). Alimentos para gado de leite. (Eds). Belo Horizonte: FEPMVZ, p.240-269. 2009. Robertson,J. B. and Van Soest, P.J. Analysis of forages and fibrousfoods - a laboratory manual for animal Science. Ithaca. 1985. Silva, J.F.C.; Pereira, J.C.; Valadares Filho, S.C.; et al. Valor nutritivo da palha de arroz suplementada com, fubá+ureia e farelo de soja. Pesquisa Agropecuária Brasileira, v.29, p.1475-14881,1994. Silva, L.D.F.; Ezequiel, J.M.B.; Azevedo, P.S.; et al. Digestão total e parcial de alguns componentes de dietas contendo diferentes níveis de casca de soja e fontes de N em bovinos. Revista Brasileira de Zootecnia, v.31, p.1258-1268, 2002. Taylor-Edwards, C.C.; N.A. Elam; S.E. Kitts; et al. Influence of slow-release urea on nitrogen balance and portal-drained visceral nutrient flux in beef steers. Journal of Animal Science, v.87, p.209-221.2009.

Vilela, F.G.; Teixeira, J.C.; Pérez,J.R.O. et al. Efeito da substituição do farelo de soja pela amireia 150S no consumo, produção e composição do leite. Ciência Agrotécnica, v.31, p.1512-1518, 2007.