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Synthesis of rumen volatile fatty acids in beef cattle fed diets containing extruded urea[1]

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Abstract: It was aimed to evaluate the increasing effects of extruded urea on the synthesis of volatile fatty acids in confined beef cattle. Four crossbreed cannulated rumen steers with a mean initial weight of 336 ± 47 kg were distributed in Latin Square 4x4. Four diets containing 50, 60, 70 and 80 g of extruded urea were evaluated for each 100 kg of PC. The extruded urea was amireia with protein equivalent of 200%. There was no significant effect of extruded urea levels on nutrient intake and ruminal volatile fatty acid synthesis. The concentrations of acetate (C2), propionate (C3) and butyrate (C4) were 59.04; 19.71 and 12.94 mMol/L, respectively. It is recommended to supply extruded urea in up to 80 g/100 kg BW for beef cattle receiving balanced diets for 14% CP.

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Introduction

Ruminants have the characteristic presence of active microbial populations in their pre-stomachs, which has high capacity of using amino acids and nitrogen present in foods to synthesize their own proteins (KOZLOSKI, 2011). The ruminal microorganisms are capable of producing microbial protein from ammonia and carbon skeleton (PIRES, et al., 2004). In this context, substitution of true protein sources (such as oleaginous meal) by non-protein nitrogen (NNP) is an option to decrease the use of true protein (AZEVEDO et al., 2015). Among the main ingredients used in feeding ruminants to supply NNP and ammonia to ruminal microorganisms are urea and urea extruded with starch (Pires et al., 2004; TAYLOR-EDWARDS, et al., 2009). The extruded urea was created aiming to solve the problems encountered with the use of urea, releasing the ammonia slowly. These products present advantages by providing available energy to rumen

microorganisms, while urea is transformed (through hydrolysis) into ammonia. According to Miranda et al., (2015) the synchronization between protein and energy can increase the synthesis of microbial protein, consequently raising the rates of digestion and passage, consumption of dry matter and animal performance.

Currently, the use of extruded urea follows the same rule of 40 g of urea/100 kg PC. Because it is a food that presents slow release of ammonia, there is the demand for knowledge to assess whether it can be used beyond the value stipulated by the rule. Therefore the aim of this work was to evaluate the effects of increasing levels of extruded urea on the synthesis of volatile fatty acids in confined cut bovine animals.

Material and methods

The work was developed at the Experimental Farm and the Applied Animal Nutrition Laboratory of UFMS, in Campo Grande, Brazil. Four crossbred, castrated, rumen fistulated cattle with body weight (PC) of 336.25 ± 47.86 kg, were distributed in Latin Square 4x4. The experimental treatments were four diets (table 1) with a bulky proportion: concentrated of 40:60, for cross-cutting cattle with 350 kg of PC and average gain of 1.25 kg/day.

Table 1 – ingredients and chemical composition of experimental diets

	Extruded Urea (g/kg PC)			
	50	60	70	80
Corn silage	400.0	400.0	400.0	400.0
Ground corn	488.9	503.2	517.5	531.9
Soy bran	73.6	55.4	37.2	19.0
Extruded Urea (200%)[1]	19.5	23.4	27.3	31.2
Mineral core[2]	18.0	18.0	18.0	18.0
Dry matter (g/kg MN)	413.3	413.3	413.3	413.4
Organic matter (g/kg MS)	934.3	935.4	936.6	937.7
Crude protein (g/kg of MS)	144.0	143.6	143.2	142.8
Non-fibrous carbohydrates (g/kg MS)	377.9	387.0	396.1	405.2
Fiber in neutral detergent (g/kg MS)	409.0	406.3	403.5	400.8
Fiber in acid detergent (g/kg MS)	220.7	218.2	215.7	213.2
Ethereal extract (g/kg MS)	25.9	26.2	26.5	26.7

[1]Amireia-200® (Pajoara Ind. e Comércio Ltda. Campo Grande-MS, Brazil);
[2]Guarantee 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

The diets contained 50, 60, 70 and 80 g of extruded urea for each 100 kg of PC, being considered control treatment of the 50 g/100 kg PC, because based on the urea content of the product used, corresponds to 40 g of urea/100kg pc, which is the dosage indicated for use. The consumption of nutrients was determined daily from the 12th to the 14th day of each trial period. The supplied and leftovers were weighed, sampled and analyzed for MS, PB and FDN for determining daily consumption. Aliquots of 10 ml of ruminant and acidified liquid were collected with the addition of 2 ml of 25% metaphosphoric acid. The samples were centrifuged at 3500 rpm for 5 minutes, transferred 100 µl to the test tube containing 800 µL of distilled water and 100 µL of the internal standard (trimethylacetic acid, Sigma aldrich). The solution was homogenized in vortex for 30 seconds and filtered through a syringe filter comprised of PVDF membrane, 13 mm in diameter and 0.45 µm pore size. They were then analyzed on a gas chromatograph (Trce GC Ultra, Thermo, Nukol column, 30m x 0.25mm, Supelco Analytical 0.25 µm). The entrainment gas used was Helium with flow rate of 0,8 mL/min. Concentrations of acetate (C2), propionate (C3), butyrate (C4), and total AGV in mMol per liter of ruminal liquid were considered. Data were submitted to analysis of variance and regression with significance level of 5%.

Results and Discussion

There was no effect (P> 0.05) of the extruded urea level on the concentrations of C2, C3 and C4 in mMol/L. This effect can be explained due to the fact that there is no difference also for MS, PB, and FND intakes. (Table 2).

Table 2 – Nutrient intake and synthesis of volatile fatty acids in beef steers fed diets containing increasing levels of extruded urea

	Urea extruded (g/100kg PC1)				EPM[2]	*P-value*	
	50	60	70	80		Linear	Quadratic
Consumption (kg/day)							
Dry matter	9.17	8.75	8.43	8.77	0.240	0.3314	0.2731
Crude protein	1.32	1.26	1.20	1.24	0.035	0.2207	0.3136
FDN	3.79	3.69	3.41	3.59	0.098	0.2159	0.2262
Consumption (% of PC)							
Dry matter	23.93	22.50	21.67	22.41	0.474	0.1920	0.2380
Crude protein	3.45	3.23	3.08	3.17	0.071	0.1103	0.2616
FDN	9.88	9.33	8.78	9.16	0.198	0.1153	0.2154
AGV (mMol/L)							
C2	61.96	55.58	63.40	55.23	1.698	0.5928	0.6783
C3	20.53	18.89	21.71	17.73	0.836	0.7132	0.6839
C4	14.83	12.46	12.30	12.16	0.368	0.4394	0.6371
Total	97.32	86.94	97.41	85.12	2.688	0.5710	0.6684

[1]PC = body weight; [2]EPM = Standard error average.

The average value for the concentration of C2 in the ruminant liquid was 59.04 MMol/L (table 2), and corroborate data from Carmo et al. (2005), which evaluated the replacement of soy bran by urea in the dairy diet and observed an average of 58.71% of C2 for the treatment containing the extruded urea. For the concentrations of C3, the average value found was 19.71 mMol/L. Gonçalves et al. (2015), assessing urea of slow release in the supplementation of cutting steers by means of the replacement of the true protein by NNP (urea protected), did not obtain difference to the C3 between the treatments, in which the average was 17.06 mol/100mol. Carmo et al. (2005), obtained an average result of 24.33% for the treatment containing extruded urea. Both results are close to the values found in this study. Oliveira Júnior et al. (2004) evaluating nutrient digestibility in bovine diets containing extruded urea in substitution of soy bran, found average values of 11.80 mMol for C4 in the treatment containing extruded urea (with protein equivalent of 150%). The average C4 content found in this study is 12.94 mMol/L, and corroborate with the data described by Oliveira Júnior et al. (2004) and Carmo et al. (2005), which obtained a value of 13.35% of butyric acid for the treatment containing extruded urea (with protein equivalent of 150% PB). There was no effect (P>0.05) of the extruded urea level on the total concentration of AGV (mMol/L). The average total AGV was 91.96 mMol/L, similar to those of Gonçalves et al. (2015), which observed 93.49 mMol of total AGV, while Oliveira Junior et al. (2004a), found 105.7 mMol.

Conclusions

Increasing levels of urea with a protein equivalent of 200% did not cause negative effects on the production of AGV. It is recommended the supply of extruded urea with a protein equivalent of 200% in up to 80 g/100 kg PC for cutting cattle receiving balanced diets for 14% PB.

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To Pajoara® Indústria e Comércio Ltda - Campo Grande – MS.

Literature cited

AZEVEDO, H.O.; BARBOSA, F.A.; GRAÇA, D.S. et al. Urea de liberação lenta em substituição ao farelo e soja na terminação de bovinos confinados. **Pesquisa agropecuária brasileira**. v.50, n.11, p.1079-1086. 2015.

CARMO, C.A.; SANTOS, F.A.P.; IMAIZUMI, H. et al. Substituição do farelo de soja por urea ou amireia para vacas em final de lactação. **Acta Scientiarum Animal Science**. v.27, p.277-286, 2005.

GONÇALVES, A.P.; NASCIMENTO, C.F.M.; FERREIRA, F.A. et al. Slow-release urea in supplement fed to beef steers. **Brazilian Archives of Biology and technology**. v.58, n.1, p. 22-30. 2015.

KOZLOSKI, G.V. **Bioquímica dos ruminantes.** 3. ed. Santa Maria: editora UFSM, 216p.

2011.
MIRANDA, P.A.B.; FIALHO, M.P.F.; SALIBA, E.O.S. et al. Consumo, degradabilidade in situ e cinética ruminal em bovinos suplementados com diferentes proteinados. **Arquivo Brasileiro de Medicina Veterinária e Zootecnia.** Belo Horizonte, V.67, n.2, p.573-582, 2015.
OLIVEIRA JÚNIOR, R.C.; PIRES, A.V.; SUSIN, I. et al. Digestibilidade de nutrientes em dietas de bovinos contendo urea ou amireia em substituição ao farelo de soja. **Pesquisa Agropecuária Brasileira.** Brasília, v.39, n.2, p.173-178, 2004.
PIRES, A.V.; OLIVEIRA JUNIOR, R.C.; FERNANDES, J.J.R. et al. Substituição do farelo de soja por urea ou amireia na dieta de bovinos de corte confinados. **Pesquisa Agropecuária Brasileira.** Brasília, v.39, n.9, p. 937-942. Set, 2004.
TAYLOR-EDWARDS, C.C.; ELAM, N.A.; KITTS, S.E. 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.