Production and milk composition of lactating cows supplemented with different levels of extruded urea in substitution of soy bran

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ABSTRACT - It was evaluated the substitution of crude protein of soy bran by non-protein nitrogen in the productive performance, composition and quality of milk of 20Jersey cows in the middle third of lactation. The cows were maintained under a rotational stocking system in Cynodon spp. and corn silage and isoprotein concentrate, containing increasing levels (0, 0.90, 1.86, 2.87 and 3.95% of the DM) of extruded urea were offered during milking. Milk production, milk production corrected to 4% fat, fat contents and total solids did not suffer (P>0.05) between treatments. Protein content had an effect (P<0.05) at 25% replacement levels. Milk urea nitrogen presented a linear increasing effect (P<0.05) when extruded urea was added and the somatic cell count indicated that the mammary gland remained healthy. With this, the extruded urea can be used at different levels for cows in the middle third of lactation.

Keywords: lactating cows, milk production, milk urea nitrogen, non-protein nitrogen

PH and ammoniacal nitrogen from beef cattle fed diets containing different levels of extruded urea consumption

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Introduction

For production systems to be sustainable, it has been necessary to produce milk at lower costs, where the protein sources are the costliest items. The replacement of true protein source for non-protein nitrogen becomes an alternative and diminishes competitions between humans and animals for the same food. Nitrogen is an essential element for animals and the search for the release control of N with carbohydrates synchronization increases production and microbial protein flow being possible to reduce the needs of true protein sources (EKINCI e BRODERICK, 1997). The intensification of the use of urea as NNP source has highlighted with the development of industrial processing capable of reducing the urea degradation speed in rumen, like the extrusion process (HARISSON et al. 2008). Amireia is a product resulting from the extrusion of starch with urea, and has the goal of improving the use of ammonium by rumen microorganisms, being obtained low ammonium concentrations in rumen fluid after 4 hours of fermentation and higher concentrations of microbial protein that get to the small intestine (HELMER e BARTLEY1971). Therefore, the goal was to assess replacement levels of soy bran for extruded urea in milk productive performance, composition and milk quality of Jersey cows in middle third of lactation.

Literature review

Ruminants have the ability to synthesize NNP in microbial protein of high biological value in synchrony with the available carbohydrate. In this case, dairy cows fed with proper energetic concentrations, that make available energy deriving from carbohydrates, may be fed with NNP sources being able to provide PDR needs that associated to the ammonium released by urea is used for the production of microbial protein and, later, has digestion in the abomasum and small intestine, releasing amino acids for absorption (AQUINO et al., 2007). A higher yielding of N microbial for slow releasing urea may explain in parts the increase in milk production (HARRISON et al., 2008). Conversely, Silva et al. (2001) when corrected the milk production of 3.5% of fat have observed a descending linear effect (P<0,05) with the increase of NNP levels in animal food. Milk fat is one of the components that may suffer variation according to diet but Valadares Filho et al. (2000) have used 8.5% of PB in the form of NNP in animal food and have observed constancy in milk fat content up to 50% of concentrate in diet. According to Susmel et al. (1995) when urea was used as supplementing

for dairy cows, the milk fat contents were higher, resulting from a better use of dietary fiber which is the precursor of lipids synthesis of mammary gland. As for the protein levels in milk, many studies report not to have effect in diets with the inclusion of urea in partial replacement to true protein sources (AQUINO et al., 2007). Besides, milk protein production can also be positively related to milk production (SILVA et al., 2001). The values of urea nitrogen in milk serve as an important parameter for the assessment of diets in protein levels for aiding in the monitoring of effects of protein excess and of fermentable carbohydrates deficiency or of the non-synchrony between the protein degradability and the energy availability in rumen (NASCIMENTO et al., 2004). When urea N in milk surpasses values above 20 mg/dL, pathological problems may happen (BUTLER et al., 1996).

Materials and methods

The experiment was performed in a dairy property sited in the municipality of Campo Grande, MS. It was used 20 lactating cows of the Jersey breed, in middle third of lactation with average weight 412 kg/PV with average production 13 liters/day, milked twice a day. The cows were kept in handling system under rotated capacity in grass Cynodon spp. cv. Tifton and during milking, it was offered corn silage and the isoproteic concentrate with increasing levels of extruded urea (Amireia 200S®) in replacement of a true protein source of the soy bran (Table 1). The concentrates were formulated according to NRC (2001) in order to meet small size dairy cows requirements with average production of 20 L/day. The cows were mechanically milked twice a day, at 5 AM and at 4 PM, and the milk production was daily recorded, and the samples for the composition and urea nitrogen analysis in milk were obtained in the afternoon of the 6th day and morning of the 7th day forming a compound sample. The milk production was corrected to 4% of fatness (PLC) according to Sklan et al. (1992) formula, where PLC = (0.432 + 0.1625 * milk fat content) * kg of milk. It was performed content analysis of fat, protein, lactose, total solids, somatic cells count (CCS) and urea nitrogen in milk (NUL). The experimental design used was completely casual (DIC) with 4 repetitions per treatment. It was performed variance analysis and averages compared by the Dunnet test (SAEG, 1997). The experiment had a total duration of 30 days composed of 4 experimental periods.

Results and discussion

The raw protein consumption in concentrate was isoproteic for all treatments (1.013 kg PB/day), and the concentrate consumption (kg MS/day) was decreasing as the replacement level of soy bran for extruded urea was added, the milk production and the corrected milk production for 4% of fatness did not present effect ($P>0.05$) between treatments keeping production between 13.77 and 16.25 kg/day when corrected. Aquino et al. (2007) when using urea levels of up to 1.5% in MS of the diet added to the concentrate, effects in milk production were not found ($P>0.05$). There may have a reduction in MS consumption when extruded urea levels in animal food do not increase which could explain diminishing in milk production (OLIVEIRA et al., 2004). Silva et al. (2001) and Oliveira et al. (2004) have proved a negative linear effect of ascending urea levels over milk production. The milk fat contents did not suffer effect in face of diets, confirming other works that observed constancy in milk fat content (Valadares Filho et al. 2000). The protein contents were smaller ($P<0.05$) for the 25% replacement. The absence of negative effects in terms of milk protein production with the inclusion of NNP in diets points that the metabolizable protein was not limiting for milk production (BRODERICK et al., 1993), which is frequently pointed by literature that reports not to have effect in milk protein in diets with NNP inclusion in partial replacement of true protein sources (AQUINO et al., 2007; SANTOS, 2001). Total solids have great relevance in processing of dairy products and the replacement of soy bran for extruded urea did not change ($P>0.05$) the recommended levels that vary between 13

to 16% (FONSECA e SANTOS, 2000). Lactose is the milk component that suffers less change due to diet, and the variation range is found between 4.7% to 5.2% but this study levels are below recommended which may be related to environmental factors (FONSECA e SANTOS, 2000). Measurement of Urea-N in milk constitutes an important indirect measure to determine the efficiency of nitrogen use by the ruminant. In this study, there was an ascending linear effect ($P<0.05$) and the averages of 13.8, 14.3, 14.5, 17.0 and 17.8 mg/dL were obtained when the extruded urea was added to diet, even so, these values are found in normal variation of 12 to 18 mg/dL recommended for lactation cows (TORRENT, 2000). The somatic cells count (CCS) is important to monitor the happening of subclinical mastitis that could influence in milk production and composition. The results are found in proper levels ($P>0.05$) pointing that all treatments do not change health of mammary gland.

Conclusions

The urea extruded in replacement to soy bran may be used in different levels (0.90, 1.86, 2.87 and 3.95% of MS) for cows in middle third of lactation without changing milk production, fat contents and without surpassing excretion levels of N in milk.

Graphs and Tables

Table 1 – Percentage of ingredients of experimental concentrates containing replacement levels of soy bran per extruded urea.

Ingredients	Replacement levels (%)[1]				
(% da MS)	0	12.5	25.0	37.5	50
Corn	68.06	70.00	72.05	74.23	76.55
Soy bran	29.22	26.30	23.21	19.92	16.44
Amireia-200S®	0.00	0.90	1.86	2.87	3.95
Mineral	2.72	2.80	2.88	2,97	3.05

[1]Replacement levels of soy true protein per NNP of extruded urea;

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

Table 2 - Averages of milk production (PL), corrected milk production (PLC) for 4% fat, fat contents (G), protein (P) total solids (ST), lactose (L), urea nitrogen in milk (NUL) and somatic cells count (CCS) in cow milk receiving supplement with replacement levels of soy bran per extruded urea.

Variables	Replacement levels (%)[1]					EPM[2]	p3
	0	12.5	25	37.5	50		
PL (kg/day)	12.0	13.2	12.8	11.6	12.0	0.69	0.3667
PLC (kg/day)	14.0	16.8	14.7	15.3	13.2	0.72	0.4712
G (%)	4.9	4.9	4.5	5.2	4.5	0.17	0.0733
P (%)	4.0a	3.9a	3.7b	3.9a	4.1a	0.07	0.0123
ST (%)	14.3	14.0	13.7	14.5	14.0	0.23	0.2356
L (%)	4.4a	4.4a	4.6a	4.2b	4.4a	0.05	0.0039
NUL (mg/dL)	13.8b	14.3b	14.5b	17.0a	17.8a	0.70	0.0014
CCS (x1000 cell-mL)	157.96	114.87	124.96	109.51	112 47	11.17	0.7001

[1]Replacement levels of soy true protein per NNP of extruded urea; [2]Standard average error; [3]Averages followed by lowercase letters in line differ between themselves by the Dunnet test.

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

References

AQUINO, A. A.; BOTARO, B.G.; IKEDA, F.S. et al. Efeito de níveis crescentes de ureia na dieta de vacas em lactação sobre a produção e a composição físico-química do leite. **Revista Brasileira de Zootecnia**, v.36, n.4, p.881-887, 2007. BRODERICK, G. A.; CRAIG, W. M.; RICKER, D. B. Urea versus true protein as supplement for lactating dairy-cows fed grain plus mixtures of alfafa and corn silages. **Journal of Dairy Science**, v. 76, n. 8, p. 2266-2274,1993. BUTLER, W.R., CALAMANJ.J., BEAM, S.W. et al. Plasma and milk urea nitrogen in relation to pregnancy rate in lactating dairy catlle. **Journal of Dairy Science**, v.74, p. 858-865,1996. EKINCI, C.; BRODERICK, G.A. Effect of processing high moisture ear corn on ruminal fermentation and milk yield. **Journal Dairy Science**, v.80; p.3298-3307,1997. FONSECA, L.F.L.; SANTOS, M.V. Qualidade do leite e controle da mastite. São Paulo: Lemos Editorial, 2000.175p. HARRISON, G.A.; MEYER, M.D.; DAWSON, K.A. Effect of Optigen and dietary neutral detergent fiber level on fermentation, digestion and N flow in rumen-simulating fermenters. **Journal of Dairy Science**, v. 91(Suppl. 1), p. 489, 2008. HELMER, L.G.; BARTLEY, E.E. Progress in the utilization of urea as a protein replace for ruminants. Journal of Dairy Science, Champaign, v.54, n.1, p.25-51,1971. NASCIMENTO, M.N.F.O.; TORRES, C.A.A.; COSTA, E.P. et al. Ureias para vacas leiteiras no pós-parto. **Revista Brasileira de Zootecnia**, v.33, n.6, p. 2266-2273,2004. NATIONAL RESEARCH COUNCIL. **Nutrient requeriments of dairy cattle**. 7. Ed. Ver. Washington: National Academy Press, 2001.381 p. OLIVEIRA, M.M.N.F.; TORRES, C.A.A.; VALADARES FILHO, S.C. et al. Urea for post partum dairy cows: productive and reproductive performance. **Revista Brasileira de Zootecnia**, v.33, n.6, p.2266-2273,2004. SILVA, R.M.N.; VALADARES, R.F.D.; VALADARES FILHO, S.C. et al. Ureia para vacas em lactação. 1. Consumo, digestibilidade, produção e composição do leite. **Revista Brasileira de Zootecnia**, v.30, n.5, p.1639-1649, 2001. SKLAN, D.; ASHKENAZI, R.; BRAUN, A. et al. Fatty acids, calcium soaps of fatty acids, and cottonseeds fed to

high yielding cows. **Journal of Dairy Science**, v. 75, n. 9, p. 2463-2472,1992. SUSMEL, P.; SPANGHERO, M.; STEFANON, B. Nitrogen balance and partitioning of some nitrogen catabolites in milk and urine of lactating cows. **Livestock Production Science**, v. 44, p. 207-219,1995. TORRENT,J. Nitrogênio ureico no leite e qualidade do leite. In: SIMPÓSIO INTERNACIONAL SOBRE QUALIDADE DO LEITE, 2,2000, Curitiba. **Anais**... Curitiba: Associação Paranaense de Criadores de Bovinos da Raça Holandesa, 2000. p. 98. UNIVERSIDADE FEDERAL DE VIÇOSA - UFV. **SAEG - Sistema para análises estatísticas e genéticas**. Versão 7.1. Viçosa, MG; 150p (Manual do Usuário).1997. VALADARES FILHO, S.C., BRODERICK, G A, VALADARES, R.F.D. et al. Effect of replacing alfalfa silage with high moisture corn on nutrient utilization and milk production. Journal of Dairy Science, v.83; n.1; p.106-114, 2000.