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Extruded urea could replace true protein source in supplements for lambs finished in tropical pastures

[*A ureia extrusada pode substituir a fonte de proteína verdadeira em suplementos para cordeiros terminados em pastagens tropicais*]

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ABSTRACT

The aim of this study was to evaluate the effects of replacing 50% of the true protein from soybean meal with extruded urea on the performance and carcass characteristics of lambs finished on pasture. Twenty lambs with initial weight of 29.9±6.2kg and 5 months of age, distributed in two treatments in blocks at random, were kept in pastures of *Urochloa* spp. Supplemented with 2% of body weight (BW). The treatments consisted of supplements containing soybean meal as the only true protein source (control), or extruded urea replacing 50% of soybean meal (NPN treatment). There was no effect of treatment on total supplement intake. There were differences in average daily gain (242.1 vs. 264.6g/day), slaughter weight (41.9 vs. 45.0kg) and carcass weight (18.9 vs. 20.1kg). There was no effect of the treatment on the final body condition score, hot carcass yield, carcass length, breast depth, subcutaneous fat thickness or rib eye area. The group of animals that received extruded urea showed superior carcass finishing characteristics (99.0% vs. 66.0%), maturity (22.0% *vs.* 0.0%), marbling (55.0% *vs.* 33.0%), meat texture (44.0% *vs.* 33.0%) and fat (66.0% *vs.* 22.0%). There were no significant effects on tenderness (7.5kg/f) or flesh color (L* = 33.2; a* = 16.2; b* = 8.3). There were no significant changes in the biochemical profile of the animals' blood during the experiment for both treatments. The replacement of 50% of protein from soybean meal by the extruded urea as NPN source in the supplement for lambs finished in *Urochloa* spp pastures provides better animal performance and qualitative characteristics of meat, without altering quantitative carcass characteristics.

Keywords: *Urochloa* spp. carcass composition, non-protein nitrogen, sheep, supplementation

RESUMO

Objetivou-se avaliar os efeitos da substituição de 50% da proteína verdadeira do farelo de soja por ureia extrusada sobre o desempenho e as características de carcaça de cordeiros terminados em pasto. Vinte cordeiros de 29,9±6,2kg de peso inicial e com cinco meses de idade, distribuídos em dois tratamentos em blocos ao acaso, foram mantidos em pastagens de Urochloa *spp. suplementado com 2% do peso vivo (PV). Os tratamentos consistiram em suplementos contendo farelo de soja como única fonte de proteína verdadeira (controle), ou ureia extrusada em substituição a 50% do farelo de soja (tratamento NPN). Não houve efeito do tratamento na ingestão total de suplemento. Houve diferenças no ganho médio diário (242,1* vs. *264,6 g/dia), no peso ao abate (41,9* vs. *45,0kg) e no peso da carcaça (18,9* vs. *20,1kg). Não houve efeito do tratamento sobre escore de condição corporal final, rendimento de carcaça quente, comprimento de carcaça, profundidade do peito, espessura de gordura subcutânea ou área de olho de lombo. O grupo de animais que recebeu ureia extrusada apresentou características superiores de acabamento de carcaça (99,0%* vs. *66,0%), maturidade (22,0%* vs. *0,0%), marmoreio (55,0%* vs. *33,0%), textura da carne (44,0%* vs. *33,0 %) e gordura (66,0%* vs. *22,0%). Não houve efeitos significativos na maciez (7,5 kg/f) nem na cor da carne (L * = 33,2; a * = 16,2; b * = 8,3). Não houve mudanças significativas no perfil bioquímico do sangue dos animais durante o experimento para ambos os tratamentos. A substituição de 50% da proteína do farelo de soja pela ureia extrusada como fonte de NPN no suplemento para cordeiros terminados em pastagem de* Urochloa *spp.*

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Proporciona melhor desempenho animal e características qualitativas da carne, sem alterar as características quantitativas da carcaça.

Palavras-chave: Urochloa *spp., composição da carcaça, nitrogênio não proteico, ovinos, suplementação*

INTRODUCTION

The finishing of sheep in *Urochloa* spp pastures, although little used in intensive systems, is an alternative to confinement when protein-energy supplementation is used to meet the needs of weight gain (Araújo *et al.,* 2022). The incorporation of urea in the lambs' diet is an inexpensive way to improve the efficiency of consumption of low-quality tropical pastures in the dry season and to reach the nutritional requirement of the growing category and provide satisfactory weight gain since ruminants can use non-protein nitrogen by ruminal fermentation (Moraes *et al.,* 2019).

Extruded urea is the product resulting from the extrusion of a mixture of starch, urea (200% crude protein) and sulfur (3.2% S) by means of high temperature and pressure, leading to the gelatinization of starch (Kozerski *et al.,* 2021a). In this type of processing, the starch granules are gelatinized, and the urea modified from a crystalline structure to a non-crystalline form, with most of the non-crystalline structures found within the gelatinized portion, making it more palatable than grain mixtures of unprocessed urea, allowing the food to be better accepted by animals (Kozerski *et al.,* 2021a).

In addition, the fermentation of the starch present in the extruded urea can influence the rate of use of the starch, optimizing the energy supply for microbial growth (Ítavo *et al.,* 2016). Studies indicate that the growth of microorganisms is maximized when the fermentation rates of starch and proteins are synchronized (Firkins, 1996; Russel *et al.,* 1992). Extruded urea acts as a slow-release complex, which can reduce potential toxicity and improve the acceptability and use of urea-based concentrates. The gradual release of ammonia from the diet and recycling allows ruminal microorganisms to benefit from a slow and continuous protein synthesis.

The use of urea extruded with the 200% protein equivalent and enriched with S, has already been studied in beef cattle (Ítavo *et al.,* 2016; Moraes *et al.,* 2019) and dairy cow (Kozerski *et al.,* 2021b). However, there are no reports in beef sheep to date, requiring research involving performance and serum levels in this animal species, and this extruded urea can maintain or improve performance, without compromising serum levels, and consequently reduce costs with supplementation.

The hypothesis tested was that the use of urea extruded as a non-protein Nitrogen source could replace 50% true protein from soybean meal in supplement to lambs in the finishing phase. Thus, the objective of the work was to evaluate the effects of the substitution of 50% of the true protein of the soybean meal for the extruded urea on the productive performance, meat quality, and carcass of lambs supplemented and finished in Brachiaria-grass pasture.

MATERIAL AND METHODS

The research protocol was prepared according to the ethical principles established by the National Council for Experimental Control (CONCEA) and was approved by the Ethics Committee on Animal Use (CEUA) of the Federal University of Mato Grosso do Sul (UFMS – Protocol Nº 481/2012).

The experiment was carried out at the School Farm of the Federal University of Mato Grosso do Sul, located in Terenos, Mato Grosso do Sul, with the following geographical coordinates (20°26'34.31" South and 54°50'27.86" West, 530.7m altitude). Twenty contemporary Texel crossbred lambs, 5 months old, with an average initial weight of 29.9±6.2kg was used. The animals were supplemented at a proportion of 2% of body weight (BW) once a day.

The animals were distributed in two treatments in blocks at random, blocking the weight. The treatments consisted of supplements containing: 1) 100% true soybean meal protein (100% FS) and 2) 50% true soybean meal protein and 50% extruded urea (50% EU). The supplement was provided in the early morning and leftovers were checked in the late afternoon and weighed when they existed.

The animals were managed in rotational stocking in pastures of *Urochloa* spp., (predominantly *Urochloa decumbens*) with a total area of 1.3 hectares, with an average stocking of 25.4 animals of 34.6 kg per hectare (2.0 animal unit of 450kg/ha). The experiment lasted 90 days.

The diets were formulated to meet the nutritional requirements for an average daily gain of 200g, according to NRC recommendations (Nutrient…, 2007).

The control supplement (control treatment) consisted of cornmeal (650.0g/kg), soybean meal (300.0g/kg) and mineral mixture (50.0g/kg). The supplement with extruded urea (NPN treatment) was composed of cornmeal (750.0g/kg), soybean meal (150.0g/kg), essential minerals (50.0g/kg) and extruded urea (50.0g/kg).

The test supplement was formulated with the aim of replacing 50% of the real protein from soy flour with extruded urea (without nitrogen protein - NPN source). The extruded urea used was Amireia-200® (Pajoara Ind. & Comércio Ltda. Campo Grande - MS, Brazil) with 200% protein equivalent.

Pasture samples were collected every 30 days in the months of June, July and August 2018, characterized by the dry/winter period. The sward height was measured with a centimeter ruler at 40 different points distributed along five imaginary straight lines across each paddock (Euclides *et al.*, 2016). The sward height at each point was determined as the average height of the curvature of the leaves around the ruler. The average of each paddock was calculated based on these 40 points. The forage mass (FM) was estimated by cutting the forage contained in nine rectangular areas of 1m² (1 m × 1 m) distributed randomly across the paddock (Euclides *et al.*, 2016). The samples were conditioned in paper bags, weighed, and dried in a forced air ventilation oven at 55°C until the weight stabilized, at which point they were again weighed to estimate the forage dry mass. To evaluate the morphological components, three subsamples were taken and separated into leaf (leaf blade), stem (pseudostem+sheath), and dead material. After a manual separation, the components were dried using the same protocol used to evaluate the FM. The leaf to stem ratio was estimated as the product of the mass of leaves and the mass of stems.

The samples composed of the paddocks were weighed, kiln dried with forced air circulation at 55ºC, and the following analyzes were performed: dry matter (DM), crude protein (CP), neutral detergent fiber (NDF), acid detergent fiber (ADF) and total digestible nutrients (TDN) according to the methodology applied by Detmann *et al.* (2012) (Table 1).

Table 1. Productive, structural, and chemical composition characteristics of the pasture

Characteristics	Mean	SD
Forage mass (kg/ha DM)	2608.9	204.5
Leaf blade mass (kg/ha DM)	1.066.1	52.4
Stem mass (kg/ha DM)	753.4	88.7
Dead material mass (kg/ha DM)	789.4	63.4
Leaf blade:stem rate	1.7	0.09
Canopy height (cm)	32.6	1.8
Leaf (%)	40.9	1.2
Stem (%)	28.8	1.9
Dead material (%)	30.3	1.2
Chemical composition		
Dry matter (%)	36.5	1,4
Organic matter (%)	91.4	0.1
Crude protein (%)	4.2	0.1
Neutral detergent fiber (%)	67.9	1.2
Neutral detergent acid (%)	36.7	0.5
Total digestible nutrients (%)[1]	59.4	0.2
IVDMD (%)	68.7	2.0

SD = Standard deviation[1]; IVDMD: *in vitro* dry matter digestibility. [1]Value estimated by the equation of Capelle *et al*. (2001): TDN = 83.79– 0.4117 * NDF (r^2 = 0.82; P < 0.01).

The animals were weighed on an analog scale, at the beginning of the experimental period, every 21 days to adjust the supplement supply and estimate the average daily weight gain and at the end of the experiment. The period of adaptation to the diet was 15 days. At the time of weighing, the body condition score (BCS) was evaluated according to the method of Russel *et al.* (1969).

Every 30 days, blood was collected by venipuncture in collection tubes without anticoagulant before supplying the supplement. The samples were centrifuged to obtain serum, to evaluate the serum levels of aspartate aminotransferase (AST), glutamyltransferase (GGT), albumin, creatine, total protein and urea in a Cobas C-111 device (Roche).

Thus, blood samples were taken every 30 days to assess the rib eye area (AOL) and subcutaneous fat thickness (EGS) using ultrasound, using the Aloka SSD-500 equipment with a 12cm linear transducer and a frequency of 3.5 MHz. The images were saved and later interpreted in the Lince® software.

The animals were slaughtered at the end of 90 days of experiment. Prior to slaughter, the animals were kept on a water diet for 18 hours. Carcasses were identified individually according to the order of slaughter. After slaughter, the carcasses were weighed to obtain the hot carcass weight and carcass yield (ratio between the hot carcass weight and live slaughter weight) and transferred to a cold room at 2°C, where they remained for 24 hours. At the end of this period, cold carcass weight and carcass finishing scores, rear distribution, carcass conformation and maturity, marbling, and texture of meat and fat were obtained.

Carcass evaluation was carried out according to Osório *et al*. (1996a, 1996b). The color, texture and firmness of the meat and fat were verified according to the standards proposed by AMSA (Meat…, 2001) and the meat quality analyses were performed according to procedures of AMSA (Research…, 2016). Desirable scores were considered: for carcass finishing, 3 or 4; carcass conformation, 3 to 5; carcass maturity, 1; meat marbling (slightly higher); meat texture, 2 or 3; and texture of the meat and fat, 1.

The scale using L*, a*, b* of the CIELAB system was used to evaluate the color of meat and fat, with an observation angle of 10° and D65 illumination, using a previously calibrated Konica Minolta CR-400 calorimeter. The samples were exposed to oxygen in the environment for 20 minutes for blooming prior to readings. The final values of L*, a*, b* were the average of three readings.

The ribeye area (REA) and the subcutaneous fat thickness (SFT) in the carcass after slaughter were evaluated in the *longissimus* muscle, between the 12th and 13th ribs of the right half of the carcass. The REA was drawn on tracing paper placed over the muscle section and later calculated using a transparent grid, resulting in an area in cm^2. The SFT, in millimeters, was obtained from the same section of the *longissimus*, in the final third of the muscle, using a caliper.

The experimental design was in randomized blocks (weight), the data analysis performed using analysis of variance, with the means compared using the F-test at the 0.05% significance level, using the statistical model represented by: $Yij = \mu + ti + bj + eij$ where μ = general average; ti = treatment effect; bj = block effect; eij = random error associated with Yij observation.

Nonparametric variables (scores and scores) were submitted to the chi-square test at 5% significance.

RESULTS

Replacement of 50% of the true protein from soybean meal with extruded urea of amirea did not influence the consumption of supplements (946.7±10.0) and crude protein (208.8±2.2) by sheep kept on pastures of *Urochloa* spp., (Table 2).

Table 2. Supplement intake of lambs supplemented with and without extruded urea (control vs. NPN)

	Treatment		SEM	P-value
	Control	NPN		
Supplement (g/animal/day)	953.7	939.6	142.2	0.8265
Crude Protein (g/animal/day)	210.3	207.2	31.4	0.8265
Soybean Meal (g/animal/day)	293.8a	160.1b	34.3	0.0001

NPN = non-protein nitrogen source; SEM = standard error of the mean; [a, b] Different letters between columns indicate differences between treatment P<0.05.

The results for productive performance to demonstrate differences (P = 0.0001) between treatments regarding average daily body weight gain (greater than 200g/day), slaughter weight and hot carcass weight, the animals that received the supplement with urea extruded had higher weight averages (Table 3). However, there was no treatment effect on the ribeye area (REA) ($14.4\pm0.4cm^2$) and the subcutaneous fat thickness (SFT) (28.9±1.2mm).

Table 3. Productive performance of lambs supplemented with and without extruded urea (control vs. NPN)

	Treatment		SEM	P-value
	Control	NPN		
Final BCS (points)[1]	3.0	3.0	0.1	0.9999
Average daily gain (g/day)	242.1b	264.6a	96.6	0.0001
Slaughter weight (kg)	41.9b	45.0a	6.2	0.0001
Hot carcass weight (kg)	18.9b	20.1a	3.2	0.0001
Hot carcass yield (%)	45.0	44.7	0.02	0.7595
SFT (mm)	3.6	3.1	0.1	0.3477
Carcass length (cm)	66.9	66.0	3.7	0.6171
Chest depth (cm)	28.0	29.7	0.3	0.1845
REA (cm^2)	14.1	14.6	2.5	0.6460

NPN = non-protein nitrogen source; SEM = standard error of the mean; [a, b] Different letters between columns indicate differences between treatment P<0.05; [1]Values followed by the same letters on the line do not differ from each other (P<0.05) by the Chi-Square test.

The group of animals that received 50% extruded urea showed superior carcass finishing characteristics (50.0% EU 99.0% *vs.* 100.0% FS 66.0%), maturity (50.0% EU 22.0% *vs.* 100.0% FS 0.0%), marbling (50.0 % EU 55.0% *vs.* 100.0% FS 33.0%), meat texture (50.0% EU 44.0% *vs.* 100.0% FS 33.0%) and fat (50.0% EU 66.0% *vs.* 22.0%). There were no significant effects (P>0.05) on tenderness (7.5 kgf), pH (5.8), cooking losses (30.7%) flesh color (L* = 33.2; a* = 16.2; b* = 8.3). The fat of these animals showed a light-yellow color (L* 65.8, a* 4.1, b* 10.7) (Table 4).

Table 4. pH and physical-chemical parameters of lambs supplemented with and without extruded urea (control vs. NPN)

	Treatment		SEM	P-value
	Control	NPN		
Shear Force (kgf)	7.9	7.0	3.1	0.2555
Cooking loss (%)	29.4b	32.0a	5.0	0.0467
pH	5.8a	5.7b	0.04	0.0155
L meat	33.3	33.2	1.9	0.9079
a meat	15.6	16.8	1.4	0.0818
b meat	7.90b	8.7a	0.8	0.0408
L fat	65.6	66.0	2.6	0.7277
a fat	4.50	3.6	1.2	0.1122
b fat	10.6	10.8	1.3	0.6893

NPN = non-protein nitrogen source; SEM = standard error of the mean; L = Brightness, fresh color; a = Red contet, fresh color; b = Yellow content, fresh color. [a, b] Different letters between columns indicate differences between treatment P<0.05.

There was no effect (P>0.05) of replacing 50% of the true protein source as soybean meal by extruded urea as NPN source on the AST (98.3 IU/L), GGT (57.1 IU/L), albumin (3.7mg/dL), creatinine (1.0mg/dL), total protein (7.1mg/dL) and urea (30.1mg/dL) in the blood serum of lambs in the finishing phase of Brachiaria-grass (Table 5).

Table 5. Biochemical blood profile of lambs supplemented with and without extruded urea (control vs. NPN)

	Treatment		SEM	P-value
	Control	NPN		
Aspartate aminotransferase (mg/dl)	100.4	96.2	4.0	0.4699
Glutamyltransferase (mg/dl)	57,1	57.0	3.1	0.9824
Albumin (g/L)	36.1	38.4	1.0	0.1247
Creatine (mg/dl)	0.9	1.0	0.1	0.2481
Total protein (g/L)	70.0	71.3	0.9	0.3003
Urea (mg/dl)	30.9	29.3	2.0	0.5756

NPN = non-protein nitrogen source; SEM = standard error of the mean.

DISCUSSION

The average forage mass was 2608.9kg/ha DM, which amount does not limit forage consumption by sheep, values lower than 2000kg/ha DM in tropical pastures may limit consumption (Gurgel *et al.*, 2017). Euclides *et al.* (1998) stated that 2500kg/ha of forage mass green would be satisfactory to guarantee selective grazing in *Brachiaria decumbens* pastures. In addition, about 40% of the available forage mass was composed of leaf blade, a component preferably selected by the animal and of better nutritional value (Pereira *et al.*, 2022). Pastures with higher proportions of leaf and stem can reduce consumption, as they are important physical barriers to deep bites (Gurgel *et al.*, 2021a).

No surplus supplement was observed in the troughs, which demonstrated the acceptance of extruded urea by the lambs. According to Owens *et al.* (1980), slow-release urea complexes can reduce potential toxicity and improve the acceptability of urea in supplements by animals. The extruded urea, in addition to having a buffering action in the rumen to maintain the pH in a more suitable range for the digestion of cellulose, also changes the eating habits for more frequent meals, resulting in an increase in the energy efficiency of the diets.

Thus, the lack of effect on the consumption of crude protein between treatments (Table 2) indicates similarity in the crude protein content of the substitution of the extruded urea for the true protein of the soybean meal, making the isoprotein supplements and meeting the nutritional needs of the animals, whether by non-degradable protein in the rumen or by the microbial protein.

The voluntary and total consumption of the supplement contained in the extruded urea shows the acceptability by the animals, which allows the inclusion of this source of NNP in the animal supplement, which results in a reduction in the production cost of sheep finished with *Urochloa* spp., when compared to production systems that use supplements containing 100% of the crude protein source with ingredients of plant origin, especially soybean meal, which is the most expensive ingredient in the formulation of feed.

The use of extruded urea partially replaces soybean meal in the supplement of finishing lambs is an alternative that brings nutritional benefits, since the animals receive both forms of protein (True and NNP). This contributes to ruminal stability, favoring microbial growth and, therefore, reflecting on the better performance of the animals, with greater daily gains (264.6 vs. 242.1g/day) and higher slaughter (45.0 vs. 41.9kg) and carcass weights. Besides that, NNP-fed sheep reached slaughter weight earlier, with a daily gain of approximately 9% superior, which contributes to early slaughtering of animals, reduces production costs in general, in addition to providing better carcass and quality characteristics of the meat.

Reports on the use of extruded urea for lambs are scarce, so the comparison of data obtained in this study was restricted to those relating to cattle and other ruminants. Gonçalves *et al.* (2004) used a supplement with extruded urea and observed better productive performance in the dry season have reported similar results with cattle.

The partial replacement of the true protein by NNP did not negatively affect tissue deposition in the carcass when evaluated by ultrasound *in vivo*. The age of the animals may have helped to standardize the parameters analyzed, since the

AER is directly correlated with the growth rate of the animals (Lira *et al.,* 2017; Gurgel *et al.,* 2021b). Therefore, supplementation with different proportions of protein sources for lambs finished on pasture did not affect muscle development or deposition of subcutaneous fat. This result was already expected since the ultrasound technique has a high correlation (0.70–0.80) with the measurements performed after slaughter since both provide objective quantifications of these characteristics (Orman *et al.,* 2010). Subjective finishing evaluation using in vivo ultrasonography is a complementary measure to estimate the SFT in the carcass based on a visual assessment of the fat distribution in the carcass as a whole and thus schedule the best slaughter season to maximize yield.

The SFT and REA measurements made by ultrasound directly on the carcass, are more objective due to the precision of the right point in the carcass (between the 12^{th} and 13^{th} ribs), without the presence of physical barriers such as wool and the instability of the animal through movement (Pinheiro *et al.,* 2010).

This study still demonstrates that the animals that received extruded urea showed superior quality carcasses for finishing, which indicates a greater deposition of subcutaneous fat in the carcass, this may be related to the greater synchronicity between protein and energy than the extruded urea provides, which maximizes microbial production and fermentation, which promotes a synthesis of the products derived from fermentation. ruminal and less energy loss, that surplus can be stored in the form of subcutaneous fat.

Carcass finishing refers to the qualitative assessment of the quantity and distribution of fat in the carcass, with its excess or shortage being undesirable in the production of sheep meat. In addition, it protects the carcass against fluid loss and prevents the shortening of muscle fibers and the darkening of meat during the cooling process (Boito *et al.,* 2018). In this study, the animals showed adequate deposits of fat (3.4 mm), according to the classification proposed by Silva Sobrinho (2001).

The meat of the animals showed a red-purple color, which is in accordance with the description by Osório *et al.* (2009), in which the animals raised on pasture have a darker meat color, although consumers prefer the pinkish red color. The fat of these animals showed a light-yellow color, which contributes to a better acceptance by consumers. The color of the meat can be altered mainly in function of the feeding. Diets based on roughage tend to provide meat with a more intense yellow coloration, due to the deposit of carotenoids in the adipose tissue (Macedo *et al.,* 2000). However, it is noteworthy that young animals tend to have lighter fat, which may partially explain the results obtained in this study (Osório *et al.,* 2009) considering that the lambs were slaughtered at seven months.

The shear force was similar between treatments, however, configuring a hard meat (above 3.63kgf cm^2) according to Cezar and Souza. (2007). Thus, it is known that the texture of meat and fat cannot be reduced to myofibrillar and marbled components, respectively, since the composition of these characteristics includes the amount and solubility of collagen, the diameter of muscle fibers and the composition and fatty acid profile of meat. Thus, further studies on the quality of meat from sheep fed with NPN should be carried out to elucidate these possible effects.

The results for AST, GGT, albumin, creatinine, total protein, and urea found in this study are in accordance with the reference values of Kaneko *et al.* (2008) for these blood variables in sheep.

The plasma urea concentrations of lambs between the treatments evaluated were similar. Such similarity is justified by the fact that the solubilization of ruminal nitrogen from extruded urea occurs gradually, allowing its use by ruminal microorganisms, which would prevent the accumulation of ruminal ammonia and plasma urea, thus reducing the chances of intoxication and excretion excessive nitrogen in the environment.

Assessing the substitution of soybean meal for extruded urea for beef cattle, Oliveira Junior *et al.* (2004), also found no differences in the blood parameters of the animals in the experiment. Moraes *et al.* (2019), in a study with cattle supplemented with extruded urea, also found this effect on the values of total protein, albumin, creatinine, urea or AST.

CONCLUSIONS

The replacement of 50% of protein from soybean meal by the extruded urea as NPN source in the supplement for lambs finished in *Urochloa* spp., pastures provides better animal performance and qualitative characteristics of meat, without altering quantitative carcass characteristics and biochemical profile to those fed with soybean meal only, superior. We recommend the inclusion of extruded urea in the supplement for the finishing of lambs in tropical pastures.

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