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NUTRITIONAL AND METABOLIC PARAMETERS OF EWE LAMBS FED YEAST IN THE DIET CONTAINING FIBROLYTIC ENZYME

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Abstract

This study aimed to evaluate the dry matter digestibility, intake and metabolic profile of ewe lambs fed active or inactive yeasts in the diet containing fibrolytic enzyme. Twenty crossbred animals with an average weight of 33.4kg and an average age of six months were distributed in a completely randomized design. The treatments consisted of yeasts: Control (no yeast), Milk Sacc X® (active yeast), Active Flora® (active yeast + inactive yeast) and Rumen Yeast® (inactive yeast). Analysis of variance and SNK test were applied with a significance level of 5% for type I error. There was no difference for dry matter intake between treatments (P>0.05). There was a significant trend (P=0.0596) for dry matter digestibility, with higher values for the control treatment. There was a significant trend for blood metabolites (P=0.0705), in which the diet containing Milk Sacc® was superior to the other treatments for total protein concentration. In addition, there was a statistical difference (P<0.05) for urea concentration, in which control and Active Flora® treatments were superior to the others. The inclusion of active or inactive yeasts in the diet for ewe lambs containing fibrolytic enzyme reduces dietary digestibility, without affecting the dry matter intake, in addition, it increases urea and total protein levels without causing liver or kidney damage in ewe lambs.

Key words

Microbial additive, Digestibility, Metabolites, *Ovis aries*, Ruminants.

PARÂMETROS NUTRICIONAIS E METABÓLICOS DE BORREGAS ALIMENTADAS COM LEVEDURAS NA RAÇÃO CONTENDO ENZIMA FIBROLÍTICA

Resumo

Objetivou-se avaliar a digestibilidade da matéria seca, consumo e perfil metabólico de borregas alimentadas com leveduras vivas e inativadas na ração contendo enzima fibrolítica. Foram utilizados vinte animais mestiços com peso médio de 33,4kg e idade média de seis meses, distribuídas em delineamento inteiramente casualizado. Os tratamentos consistiram nas leveduras: Controle (sem levedura), Milk Sacc X® (levedura ativa), Active Flora® (levedura viva mais levedura inativada) e Rúmen Yeast® (levedura inativa). Foi realizada à análise variância e teste SNK com nível de significância de 5% para o erro tipo I. Não houve diferença entre tratamentos para consumo de matéria seca com uso ou não de levedura na dieta (P>0,05). Houve tendência significativa (P=0,0596) para a digestibilidade da matéria seca sendo superior para com o tratamento sem inclusão de leveduras. Para os metabólitos sanguíneos houve tendência significativa (P=0,0705) sendo o Milk Sacc® superior aos demais tratamentos para concentração de proteínas totais. Além disso, houve diferença estatística (P<0,05) para concentração de ureia cujos tratamentos controle e Active Flora® foram superiores aos demais. A inclusão de leveduras vivas ou inativadas na dieta para borregas contendo enzima fibrolítica diminui a digestibilidade da dieta, sem afetar o consumo de matéria seca, além disso, aumenta teores de ureia e proteínas totais sem causar prejuízos hepáticos ou renais as borregas.

Palavras-chave

Aditivo microbiano, Digestibilidade, Metabólitos, *Ovis Áries*, Ruminantes.

INTRODUCTION

Yeasts are unicellular fungi and the main genus used in the food industry is *Saccharomyces*. In ruminant nutrition, yeasts are additives classified as probiotics, with regulatory action on the intestinal flora and maintaining the balance between beneficial flora and pathogenic microorganisms in the intestine. According to Noschang and Brauner (2019), yeasts can be available in active and inactive form. Inactive yeasts favor the cellulolytic bacteria activity. The active form, on the other hand, has better benefits in ruminant feeding, as it works in combination with lactic acid bacteria, reducing lactic acid accumulation, maintaining pH and the rumen environment.

Although the mode of action of yeasts has been investigated, it is still not completely elucidated, with conflicting results regarding its use in the diet for ruminants. As pointed out by Amin and Mao (2020), the use of yeasts can increase cellulolytic population, fiber digestibility, and help maintain rumen pH. However, Amin and Mao (2020) report, for example, that the use of yeast for dairy cows did not change the performance and parameters of rumen fermentation. For ewe lambs, Siqueira et al. (2020) observed that the inclusion of yeasts in the diet did not influence the intake and digestibility of nutrients.

With this problem, more studies are required to understand the mode of action of yeasts, these combined with enzymes and their influence on intake, digestibility and metabolism. Fibrolytic enzymes are additives that increase the availability of sugars for rumen bacteria. The synergistic action between these additives can contribute to better conditions in the rumen environment, so that the yeasts increase the rumen conditions, generating an environment that makes the activity of rumen microorganisms effective. While the enzymes act in the best use of nutrients, improving the dry matter digestibility.

Therefore, the hypothesis is that the inclusion of active and inactive yeasts in the diet containing fibrolytic enzymes increases the dry matter digestibility and intake by ewe lambs without metabolic damage. Therefore, the objective was to evaluate the effects of the inclusion of active, inactive and inactive + active yeasts in the diet for ewe lambs containing a mix of enzymes on dry matter intake, dry matter digestibility and blood metabolites.

MATERIAL AND METHODS

The experiment was conducted in January and February 2018, at the Federal University of Uberlândia, sector of small ruminants, in Uberlândia, under a climate with average temperature and relative humidity of 23.6°C and 80.7%, respectively, during the experimental period, according to data of CLIMA (Climatology and Environmental Meteorology Laboratory). The experimental protocol of this study was approved by the Ethics Committee on Animal Use (CEUA) of the Federal University of Uberlândia under number 092/17.

The experiment lasted 20 days, in January 2018, with 15 days for adaptation and five days for data collection and sampling.

Twenty Dorper x Santa Inês ewe lambs with an initial average of 33.4 kg body weight (BW) and six months of age were distributed in a completely randomized design. Animals were kept in metabolism cages, equipped with a drinker, trough and salt lick, according to the National Institutes of Science and Technology (INCT) standards. They were weighed, identified, dewormed with Zolvix® (Novartis Saúde Animal, Basel-City, Basel, France) at a dose of 2.5 mg Monepantel per kg bodyweight, vaccinated against rabies, leptospirosis, clostridioses and botulism; and randomly assigned to the experimental groups.

Four treatments were tested: control (without addition of yeast), Milk Sacc X® ((Alltech®, Maringá, Paraná, Brazil), active yeast - *Saccharomyces cerevisiae* strain 1026, 5.0 x 10^8 CFU g^{-1}) at a dose of 0.0015kg animal day^{-1}, Rumen Yeast® ((York Ag Products INC., York, Pennsylvania, United States), inactive yeast - *Saccharomyces cerevisiae*, with 1.5 x 10^4 CFU g^{-1}) at a dose of 0.0045kg animal day^{-1} and Active Flora® ((ICC, Louisville, Kentucky, United States), active yeast + inactive yeast - *Saccharomyces cerevisiae*, with 2.0 x 10^{10} CFU g^{-1}) at a dose of 0.003kg animal day^{-1}. All treatments contained the fibrolytic enzyme Fibrozyme®. Yeasts were added when mixing with the concentrate. Meals were supplied at 8:00 hr and 16:00 hr, with 50% total offered in each meal.

The experimental diet consisted of corn silage (30.0%) and concentrate (70.0%) and balanced according to the NRC (2007) for gains of 300 g/day, and to allow for leftovers between 5 and 10% of the total provided. Table 1 shows the values of the enzyme composition, the ingredients of the concentrates and the chemical composition of corn silage, concentrate and experimental diet.

Table 1 – Proximate composition of the concentrate and chemical composition of the ingredients and experimental diet.

Ingredients (%)		Concentrate	
Bran corn		72	
Soyben meal		18	
Urea		2	
Mineral salt		5	
Fibrozyme®[1]		3	
Adsorbent		0.002	
Nutrients (g/kg)	Corn silage	Concentrate	Diet
Dry matter	322	900.5	726.95
Crude protein	63	290.7	222.39
Total digestible nutrient	62.3	759.6	719.61
Neutral detergent fiber	546	81	220.5
Acid detergent fiber	326	-	-
Composition		Fibrozyme®[1]	
Xylanase		Min. 100 XU/g[2]	

[1]Fibrozyme® (*Trichoderma longibarachiatu*). Information obtained from analysis carried out at the UFU's animal nutrition laboratory. [2]A unit of xylanase enzyme activity equivalent to the amount of enzyme that releases 1 micromol xylose per minute from xylan at pH 5.3 and 50°C.

During the collection period, the food offered, leftovers and feces in natural matter were daily sampled and weighed on a scale accurate to 5 g. A composite sample was taken from the simple samples for each animal during the five days of collection. Urine was collected in buckets with a screen for separation of feces, which were collected in plastic trays. The total volume of urine was measured in a 2 L plastic beaker accurate to 20 mL and the urine density was determined using a Megabrix® portable handheld refractometer (Fremont, Ohio, United States).

The fecal score was evaluated according to Gomes et al. (2012), in which, on score one (1), feces are dry and dull; on score two (2), feces are normal; on score three (3), feces are slightly softened; on score four (4), feces are softened, losing their shape and sticking to each other (bunch of grapes); on score five (5), feces are soft and not normally shaped (swine feces); and on scale six (6), feces are diarrheic.

Samples of food, leftovers and feces were packed in plastic bags, identified and stored in a freezer at -15ºC. At the end of the test, samples were thawed and homogenized, and a sample of 20% total was taken for further laboratory analysis. Dry matter contents were obtained using the INCT-CA G-003/1 method. Subsequently, the definitive dry matter, intake and apparent digestibility were calculated according to Maynard et al. (1984).

The calculation of drinking water intake was based on the difference between

the offered and the leftovers, subtracting the evaporated value. Every day, a standard volume of six liters of water was offered to each animal, with replenishment when necessary. A bucket of water was used to control evaporation every 24 hours, six liters of water were added and the rest was measured on the following day. The volume of evaporated water was subtracted from the water intake of each animal.

Blood samples were taken by jugular venipuncture into five mL Vacutainer® tubes (BD, São Paulo, São Paulo, Brazil) containing fluoride and EDTA, and properly identified for each animal. The glycemic curve was assessed on the last day of collection; in turn, biochemical parameters were determined on the first, third and fifth day of collection of the experiment. These harvests took place before the first meal with the fasting animal. For glycemic assessment, samples were collected at 8:00 h (before the first meal), 11:00 h, 14:00 h, 17:00 h and 20:00 h. On the day of glycemic assessment, the second meal was only offered after the 20:00 h harvest. The effects of the stress of collecting every three hours on the animals were not measured.

The collected blood samples (glycemia and biochemistry) were centrifuged at 3,000 rotations per minute for 10 minutes, and sera were separated into aliquots, poured into micro tubes and stored in a freezer at -5ºC for later laboratory analysis. All samples were processed in a Bioplus 2000 automated biochemical analyzer (Bioplus©, Barueri-SP, Brazil), using a commercial kit from Lab Test (Labtest Diagnóstica S.A., Lagoa Santa, state of Minas Gerais, Brazil).

The biochemical components evaluated to determine energy metabolism were: triglycerides, cholesterol, fructosamine and glucose; to determine liver function were: gamma glutamyltransferase (GGT), aspartate aminotransferase (AST) and alkaline phosphatase (FA); to determine protein metabolism were: total protein (PT), urea, albumin, uric acid and creatinine.

The statistical model was: $Y_{ij} = \mu + T_i + e_{ij}$

Where: Y is the observation, T is the fixed treatment effect, and *e* is the random error. All data were tested for normality (SHAPIRO and WILK, 1965) and homoscedasticity (LEVENE, 1960) of residual variance. Analysis of variance was run considering 5% significance ($p<0.05$). When relevant for comparison between means, the SNK test was applied at 5% significance ($p<0.05$) and ($p<0.10$) for trend. The fecal score variable, as it is a non-parametric variable, was evaluated by the Kruskal-Wallis

test (1952) at a significance level of 5%. All analyses were performed using the SAS software.

RESULTS AND DISCUSSION

There was no significant difference (P>0.05) between treatments evaluated for dry matter intake (DMI) in kg per day, in percentage of body weight and metabolic weight (Table 2). The average DMI was 1.15 kg/day, falling within the recommended range for the analyzed animal category, which is 1.0-1.3 kg/day according to NRC (2007). The DMI in relation to body weight (DMI%BW) recommended by the NRC (2007) is 3.51%, with the overall mean close to the recommended.

Table 2 – Dry matter intake and digestibility in ewes fed or not with yeast in the diet.

Treatment	DMI (kg/ day)	DMD (% BW)	DMI ($BW^{0.75}$)	DMD (%)
Control	1.15	4.11	88.20	85.57A
Active Flora®	1.14	3.55	84.20	80.97B
Milk Sacc X®	1.27	3.88	94.03	83.74AB
Rumen Yeast®	1.05	3.25	77.38	82.78AB
P-Value	0.3375	0.2761	0.3108	0.0596
Overall mean	1.15	3.70	85.95	83.26
CV	15.58	19.11	16.00	2.95

DMI: dry matter intake; DMD: dry matter digestibility; BW: body weight; CV: coefficient of variation (%); Different letters in the same column are significantly different by the SNK test at 5% significance.

With the same chemical composition and ingredients (Table 1), changing only the additive, the maintenance of dry matter intake between treatments is justified. There was a significant effect of dry matter digestibility (DMD) (P=0.0596), with higher values for the control treatment (no yeast) (Table 2). This was because the action of yeasts may have inhibited a positive effect of interaction between enzymes. According to Kozloski (2011), enzymes aim to increase the degradation of indigestible fractions of some fiber foods, with synergism with the endogenous rumen enzymes, which favored the control group.

There was no influence of the use of yeasts for water intake, urine volume (UV), urine density (UD), fecal mass in natural matter (FMNT), feces in dry matter (FDM) and fecal score (P >0.05) (Table 3).

The average water intake of ewe lambs was 3.90 liters water per day. Based on the DMI, the intake recommended by the NRC (2007) is 3.45 liters per day. That is, the lambs ingested 13% more water than recommended. However, it is worth

Table 3 – Water consumption, fecal and urinary parameters of lambs fed or not with yeast.

Treatment	WI (L/day)	WI/DMI (L/Kg/day)	VU (L/day)	DU (g/mL)
Control	3.34	3.04	1.51	1.0212
Active Flora®	3.99	3.63	1.61	1.0236
Milk Sacc X®	4.28	3.40	1.37	1.0224
Rumen Yeast®	3.98	3.83	1.47	1.0210
P-Value	0.5347	0.5098	0.9620	0.9419
OM	3.90	3.48	1.49	1.0220
CV	26.25	24.30	13.81	0.74
Treatment	DMF (%)	FDM (Kg/day)	FMNM (Kg/day)	Fecal score[2]
Control	33.33	0.558	1.24	2.00
Active Flora®	32.87	0.679	1.29	2.32
Milk Sacc X®	29.33	0.728	1.31	2.60
Rumen Yeast®	33.22	0.573	1.25	2.00
P-Value	0.3766	0.4742	0.4839	0.4523
OM	32.19	0.634	1.27	2.23
CV	12.66	31.07	5.95	-

[2]Non-parametric statistics; UV: urine volume, UD: urine density; DMF: dry matter of feces; FDM: feces in dry matter; FMNM: fecal mass on a natural matter basis; WI: water intake; OM: overall mean; CV: coefficient of variation.

remembering that the recommendations do not consider tropical conditions, which leads to oscillation in the parameters.

Regarding urine volume (UV), there was no difference between treatments (Table 3) (P>0.05). The overall mean of urine production was 1.49 L/day. For Reece (2006), in sheep, urine excretion should be between 0.1 and 0.4 L for every 10 kg body weight. In the present study, animals had an average weight of 33.4 kg, that is, the urine excretion should vary between 0.3 and 1.3 L, which indicates that the average urine excretion was 14% above the range recommended, demonstrating a direct relationship with water intake, which was 13% above the recommended level.

There was no difference in urine density (UD) according to the addition or type of yeast in the diet (Table 3) (P>0.05). The mean value detected for this variable was 1.0220, considered normal for the species. According to Carvalho (2008), for sheep, the variation in urinary density is between 1.0150 and 1.0450. Evaluating the values found for water intake, WI/DMI, UD and UV, it can be affirmed that the animals did not suffer from water restriction.

No differences (P>0.05) were detected for feces weight in natural matter, dry matter and fecal dry matter (Table 3). Feces weight may be related to diet composition,

rate of passage of food through the rumen and its digestibility (SANTOS and NOGUEIRA, 2012). As the diets contained the same forage: concentrate ratio, there was no effect of yeast addition on feces weight. According to EMBRAPA (2008), an adult sheep produces between 0.8 and 1.5 kg/feces/day in natural matter. Thus, the animals in question showed fecal output within the recommended range. According to Van Clef et. al. (2010), the reference values for FDM for the sheep species range from 37% to 44%. Therefore, this remained below the mentioned values (32.19%).

The fecal score (FS) had a mean of 2.23, close to the recommended score 2, considered normal for sheep (GOMES et al., 2012). Yeasts are responsible for modulating rumen fermentation, changing the composition of the rumen microbiota, improving digestibility and consequently the use of food, which causes reduced excretion, with more consistent feces (GOMES et al., 2012).

For energy metabolites, there was no difference between the addition or not of yeast in the diet for ewe lambs (Table 4) (P>0.05). All parameters were within the range recommended by Varanis et al. (2021) for the animal category.

Table 4 – Energy metabolites of ewe lambs fed or not with yeast in the diet.

Treatment	TG (mg/dL)	Cholesterol (mg/dL)	Fructosamine (µmol/L)	Glucose (mg/dL)
Control	52.34	50.73	153.60	52.64
Rumen Yeast®	48.39	52.06	152.40	51.84
Active Flora®	43.13	50.60	153.60	58.88
Milk Sacc X®	44.00	42.79	144.20	53.72
P-Value	0.2044	0.4263	0.4511	0.5914
OM	47.01	49.04	150.95	54.27
CV	15.77	19.42	6.98	20.07
RV	5-78	15-139.9	111-413.61	33-98.1

TG: triglycerides; OM: overall mean; CV: coefficient of variation; RV: reference value for sheep from birth to one year of age, according to Varanis et al. (2021).

Siqueira et al. (2020) found values of 37, 83, 52, 48 and 154.90 for triglycerides, cholesterol and fructosamine, respectively, testing similar diets with the same forage: concentrate ratio and addition of enzymes and yeast, similar to that presented in Table 4.

Glucose remained stable throughout the day (Figure 1). Plasma glucose in ruminant animals has non-carbohydrate compounds as precursors, such as the volatile fatty acid (VFA) propionate. After absorption by the ruminal epithelium, propionate

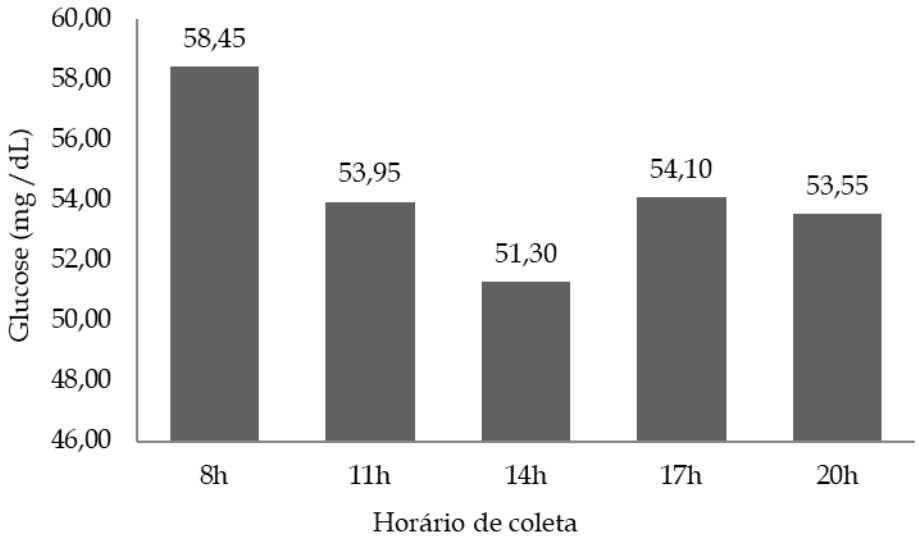

Figure 1. Glucose concentration (mg/dL) in relation to collection time in ewe lambs P-value: 0.2787 (time). P-value: interaction (treatment x time): 0.6628.

travels through the bloodstream to the liver, and is converted into glucose during gluconeogenesis to finally be used as an energy source by the animal (VARANIS et al., 2021). Therefore, diets containing a higher percentage of concentrate compared to forage allow a greater increase in propionic acid, which is the only one of the VFA's precursor of glucose in the ruminant, from the fermentation of soluble carbohydrates, consequently increasing the concentration of glucose in plasma. As it is an indirect pathway, its production time is relatively long, which explains the 6 h required to raise blood glucose, with the peak occurring 9 h after ingestion.

Regarding liver metabolites, there was no effect on concentrations with the addition or not of yeast in the diet for ewe lambs (P>0.05) (Table 5). The increase in

Table 5 – Liver metabolites of ewe lambs fed or not with yeast in the diet.

Treatment	ALP (U/L)[1]	AST (U/L)	GGT (U/L)[1]
Control	122.53	229.31	45.26
Rúmen Yeast®	160.60	153.54	30.46
Active Flora®	205.40	142.20	45.33
Milk Sacc X®	132.46	128.74	38.00
P-Value	0.4686	0.4643	0.4304
OM	155.25	163.44	39.76
CV	28.35	30.44	18.84
VR	58-727.7	47-353.5	31-154

ALP: alkaline phosphatase; AST: aspartate aminotransferase; GGT: gammaglutamyltransferase; OM: overall mean; CV: coefficient of variation; RV: reference value for sheep from birth to one year of age, according to Varanis et al. (2021).

alkaline phosphatase levels in blood plasma indicates several pathological conditions, such as liver overload (SILVA et al., 2020). In general, values of this enzyme were within the reference range (VARANIS et al., 2021), indicating good liver function by the animals.

Aspartate aminotransferase (AST) is a cytoplasmic and mitochondrial enzyme, which in sheep may indicate cases of liver necrosis or muscle damage. In cases of high AST levels and low cholesterol and albumin levels, it can be said that there are disorders in liver function. AST levels were within the range considered normal for the species (VARANIS et al., 2020), indicating once again that these animals did not develop hepatocellular injury.

Gammaglutamyltransferase (GGT) should be taken into consideration together with AST, since both can indicate whether or not there is an injury to the liver tissue. GGT of hepatic origin is found in the blood, since that originated in the kidney is excreted in urine. GGT of hepatic origin may indicate cholestasis and proliferation of bile ducts, while urinary GGT indicates possible kidney damage. Serum GGT activity is also used in large animals to screen for liver diseases (SILVA, 2020). In all treatments, this enzyme was always close to the lower limit described by VARANIS et al. (2020), indicating no liver overload.

Energy metabolites are efficient in evaluating the energetic status of the animal, however they indirectly evaluate the protein status of the animals, making it necessary to evaluate some protein metabolites. Thus, there was an effect ($P<0.05$) of the addition of yeast combined with the fibrolytic enzyme on the levels of urea and total proteins; for the other protein metabolites, there was no effect of the treatments ($P>0.05$) (Table 6).

The Milk Sacc X® group was superior in the concentration of total proteins, 10% above the control treatment. The total protein content of serum is made up of a large number of individual proteins, mainly albumins, globulins and fibrinogen, in addition to other clotting factors. Total proteins reflect the protein nutritional status, and represent the most sensitive indicator to determine it, since low values indicate inadequate protein intake (OLIVEIRA et al., 2014). Therefore, it can be inferred that animals had adequate protein intake in the diet. Mainly due to the synergism between fibrolytic enzyme and yeasts in the diet, which may have favored the production of microbial protein in the Milk Sacc X® treatment, since it containd active yeasts. These

Table 6 – Protein metabolites of ewe lambs fed or not with yeast in the diet.

Treatment	TP (g/dL)	Urea (mg/dL)	UA (mg/dL)	Albumin (g/dL)	Creatinine (mg/dL)
Control	4.68B	80.93A	0.03	3.89	0.91
Rumen Yeast®	4.70B	75.53AB	0.04	3.80	0.77
Active Flora®	5.04AB	76.19A	0.04	4.05	0.79
Milk Sacc X®	5.15A	64.80B	0.02	3.70	0.84
P-Value	0.0705	0.0383	0.9223	0.4825	0.1187
OM	4.89	74.36	0.03	3.86	0.83
CV	6.47	10.87	2.28	9.27	11.13
RV	3.1-11.4	12.8-100	0-2.9	1.12-5.38	0.40-1.80

TP: total protein, UA: acid uric; OM: overall mean; CV: coefficient of variation; RV: reference value for sheep from birth to one year of age, according to Varanis et al. (2021); Different letters in the same column are significantly different ($p<0.05$) by SNK test.

have biological activity and act directly by stimulating bacteria that use lactic acid and contribute to the constant supply of nutrients to the bacterial population in the intestine, improving animal digestion, rumen fermentation, milk production, ingestive behavior, proportion of volatile fatty acids, reduction of ammonia, increase in microbial population and pH stabilization (NOSCHANG and BRAUNER, 2019).

The urea concentration was higher for the control and Active Flora® groups ($P<0.05$) (Table 6). High levels of urea are harmful to animals. On the other hand, these treatments presented the lowest values for total proteins. Part of the protein reaching the rumen is transformed into ammonia, so that it can be used by the rumen microbiota in the production of microbial protein. In the case of protein degraded in the rumen, its use depends on favorable rumen conditions, particularly on the availability of energy to be incorporated as microbial protein. An important aspect for this to occur is the fermentation of carbohydrates, since it is the origin of this necessary energy. When there is a lack of dietary carbohydrates for the complete utilization of this ammonia, it is absorbed by the rumen wall and taken to the liver where it is transformed into urea with high energy and nitrogen loss. This urea can be eliminated in the urine, return to the rumen via saliva or diffusion in the rumen wall and be eliminated in the milk in the case of a lactating animal (SILVA et al., 2020). All treatments were within the range recommended by Varanis et al. (2021) for the sheep species. The Milk Sacc X® treatment was responsible for the lowest value (64.80 mg/dL). Therefore, it can be inferred that the use of fibrolytic enzymes combined with yeasts improves ruminal conditions, increasing energy generation for a better protein

utilization of the animals.

For albumin, values also remained within the recommended range (VARANIS et al., 2021). When albumin levels are decreased along with urea, it may indicate protein deficiency, while normal urea levels and/or elevated enzyme levels indicate liver failure (OLIVEIRA et al., 2014).

Creatinine values were below the normal range according to Varanis et al. (2021) and there was no statistical difference between treatments, which may be because animals were confined, which results in low energy consumption by the muscle, since creatinine is closely related to muscle mass that varies according to the level of exercise performed by the animals. The daily amount of creatinine that is formed depends on the amount of creatine in the body, which in turn depends on muscle mass, but little affected by food, mainly by protein intake (OLIVEIRA et al., 2014).

All metabolites and liver enzymes were within the range indicated as ideal in the literature. This demonstrates that the diets used were efficient in maintaining the metabolites at adequate levels, keeping the animals free from liver and kidney overload. This occurred due to the synergism between the fibrolytic enzyme and yeasts, which contributed to an adequate nutrition of the animals, keeping their organisms without significant alterations.

CONCLUSION

The inclusion of active and inactive yeasts in the diet for ewe lambs containing fibrolytic enzymes does not change dry matter digestibility and intake, however it improves the protein utilization by the animals, without liver damage.

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EMPRESA BRASILEIRA DE PESQUISA AGROPECUÁRIA - EMBRAPA. **Métodos**

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