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Sugar cane dry yeast in feeding for growing and finishing goat kids[1]

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ABSTRACT - It was used 27 goat kids (18 ¾ Boer + ¼ Saanen and nine Saanen; 18.0 ± 1.60 kg) distributed in a completely randomized design with factorial arrangement to evaluate productive performance and the total digestibility of dry matter and nutrients in the rations. Diets were composed of soybean meal, soybean meal + dry yeast or dry yeast as protein source, oat hay, ground corn and vitamin-mineral mixture with mean composition of 2.50 Mcal of ME/kg DM and 17.0% of crude protein on average. Digestibility was determined using indigestible neutral detergent fiber as marker. Intakes of dry matter, organic matter, crude protein and total carbohydrates were not altered by rations. However, inclusion of dry yeast in the rations reduced ingestions of ether extract, neutral detergent fiber and acid detergent fiber. Within breed groups, the ¾ Boer + ¼ Saanen goat kids showed the highest intakes of dry matter and nutrients, as well as the best means of daily gain, feed conversion and days in feedlot. Digestibilities of dry matter, organic matter, crude protein and total carbohydrates were higer – and the digesbility of ether extract was lower – for animals fed rations with dry yeast. There were no differences in digestibility of neutral detergent fiber. Rations with dry yeast showed the highest values of total digestible nutrients. Dry yeast can be used as alternative protein source in rations for goat kids because it does not change animal performance and it does have higher nutritional value than soybean meal. ¾ Boer + ¼ Saanen kids show, in feedlots, better performance in growth and finishing phases when compared to Saanen kids.

Key Words: digestibility, goats, intake, performance, *Saccharomyces cerevisiae*

Levedura seca de cana-de-açúcar na alimentação de cabritos em crescimento e terminação

RESUMO - Foram utilizados 27 cabritos (18 ¾ Boer + ¼ Saanen e 9 Saanen; 18,0 ± 1,60 kg) distribuídos em delineamento inteiramente casualizado com arranjo fatorial para avaliar o desempenho produtivo e a digestibilidade total da matéria seca e dos nutrientes das rações. As dietas foram compostas de farelo de soja, farelo de soja + levedura seca ou levedura seca como fonte de proteína, feno de aveia, milho moído e mistura vitamínico-mineral, com composição média de 2,50 Mcal de EM/kg de matéria seca e 17,0% de proteína bruta. A digestibilidade foi determinada utilizando-se fibra em detergente neutro indigestível como indicador. As ingestões de matéria seca, matéria orgânica, proteína bruta e carboidratos totais não foram influenciadas pelas rações. No entanto, a inclusão de levedura seca nas rações reduziu as ingestões de extrato etéreo, fibra em detergente neutro e fibra em detergente ácido. Dentro dos grupos raciais, os cabritos ¾ Boer + ¼ Saanen foram os que apresentaram maior ingestão de matéria seca e nutrientes, assim como melhores médias de ganho diário, conversão alimentar e dias em confinamento. A digestibilidade de matéria seca, matéria orgânica, proteína bruta e carboidratos totais foi maior – e a de extrato etéreo menor – nos animais alimentados com as rações contendo levedura seca. Não houve diferenças na digestibilidade de fibra em detergente neutro. As rações com levedura seca apresentaram maiores valores de nutrientes digestíveis totais. A levedura seca pode ser usada como fonte proteica alternativa em rações para cabritos, pois não altera o desempenho dos animais e tem valor nutritivo superior ao do farelo de soja. Cabritos ¾ Boer + ¼ Saanen apresentam, em confinamento, melhor desempenho produtivo nas fases de crescimento e terminação em comparação aos cabritos Saanen.

Palavras-chave: caprinos, desempenho, digestibilidade, ingestão, *Saccharomyces cerevisiae*

Introduction

In regions where there is predominance of dairy goat breeds, it is produced a significant amount of kids that may be used for fattening and slaughter, providing additional income to producers. However, because of their dairy origin, these animals tend to have low performance compared to specialized meat goats.

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Saanen and Boer breeds are breeds highly specialized in milk and meat production, respectively. Crosses between them both can improve the production in mixed systems, where the goal is to produce meat and milk. When kids are finished in feedlot, it should be given special attention to the dietary formulation using ingredients that allow the maximal performance.

The use of soybean meal as dietary protein source has been well established for many years and for different systems being a reference for comparisons with other sources. However, conventional feedstuffs, like soybean meal, are vulnerable to price fluctuations. Thus, the research of alternative protein sources for feeding livestock is interesting.

Dry yeast, a by-product from ethanol industries, is composed of cells of *Saccharomyces cerevisiae*. Depending on the strains used in the fermentation process and extraction techniques, dry yeast can provide about 42% of crude protein (Butolo, 2002) and it can be a good protein source for animal nutrition.

Dry yeast from sugar cane can also be satisfactorily utilized by ruminants and it is a highly degradable ruminal protein source (Fregadolli et al., 2001). Messana et al., (2009) stated that dry yeast does not alter the intake pattern in cattle. However, Aguiar et al. (2007) concluded that replacing corn and soybean meal by urea and dry yeast in the diet of sheep negatively affects the energy intake and animal performance.

Therefore, this experiment was conducted with the objective to determine intake and digestibility of dry matter and nutrients and the total digestible nutrients, and to evaluate the performance of ¾ Boer + ¼ Saanen and Saanen goat kids fed diets with dry yeast.

Material and Methods

This experiment was conducted at the Fazenda Experimental de Iguatemi, of the Universidade Estadual de Maringá, southern Brazil. Twenty-seven goat kids were used, randomly distributed in a factorial arrangement with 3 × 2 (three diets and two genetic groups). It was used six ¾ Boer + ¼ Saanen and three Saanen animals fed each diet.

Diets were composed of soybean meal; soybean meal + dry yeast; and dry yeast as protein source. The other ingredients were ground corn, mineral supplement and oat hay with 30:70 of forage:concentrate ratio (Tables 1 and 2). Diets were formulated to meet the following nutritional requeriment (AFRC, 1998): 2.50 Mcal of ME/kg DM and 17.0% of crude protein (Tables 1 and 2).

Previously, the animals were adapted to diets for 15 days. To do so, the goats were kept in feedlot and fed diets composed of oat hay, ground corn and soybean meal (control diet). Rations with dry yeast were gradually added in the diet of animals up to the experimental amount.

During the experimental period, the animals were kept in feedlot, remaining in covered single pens, with feeders and drinkers. The animals were weighed during fasting period (16 h) at the beginning of the experiment and once every two weeks to be adjusted to the offered feeding and to determine the average daily gain. Days in feedlot were also evaluated, which consisted on the time required to reach slaughter weight (± 30.0 kg), started to be counted from the beginning of the trial.

Diets were offered to animals as total mixed rations (pelleted) once a day (8:00 a.m.), based on body weigth in order to provide 10% of orts. Dry matter intake was calculated using the dry matter (DM) from total mixed ration and the DM refused in orts.

Samples of diets and orts of each diet and animal were taken once every two weeks and were homogenized (for each animal) and frozen (–20ºC). At the end of the experiment, samples were unfrozen and oven-dried (60°C; 72 h), then ground through a 1-mm screen (Wiley mill model 4, Arthur H. Thomas, Philadelphia, PA).

Dry matter, crude protein and ether extract were determined according to methods described by Silva & Queiroz (2002). The organic matter was determined by ashing at 600°C in a muffle furnace for 12 h. Concentrations

Table 1 - Chemical composition of ingredients

Item	Ingredient			
	Ground corn	Soybean meal	Dry yeast	Oat hay
Dry matter, DM (%)	89.71	90.38	95.54	91.01
Organic matter (% DM)	98.91	93.46	96.48	94.37
Ash (% DM)	1.09	6.54	3.52	5.63
Crude protein (% DM)	8.86	52.00	42.88	12.55
Ether extract (% DM)	4.23	2.65	0.32	2.80
Neutral detergent fiber (% DM)	14.61	15.28	-	64.12
Acid detergent fiber (% DM)	3.87	7.97	-	34.45
Total carbohydrates (% DM)	85.82	38.80	53.27	79.02

Table 2 - Ingredients and chemical composition of experimental diets

Item	Diet		
	Soybean meal	Soybean meal + Dry yeast	Dry yeast
Oat hay (%)	30.00	30.00	30.00
Ground corn (%)	49.51	47.36	44.59
Soybean meal (%)	17.49	9.86	-
Dry yeast (%)	-	9.78	22.41
Mineral supplement[1] (%)	3.00	3.00	3.00
Dry matter (%)	91.15	91.22	90.94
Organic matter (%DM)	94.89	95.25	95.38
Ash (% DM)	5.11	4.75	4.62
Crude protein (% DM)	17.28	17.35	17.38
Ether extract (% DM)	3.30	3.13	2.76
Neutral detergent fiber (% DM)	30.02	27.69	26.09
Acid detergent fiber (% DM)	13.86	12.95	12.08
Total carbohydrates (% DM)	74.31	74.77	75.23
Total digestible nutrients (% DM)	69.13	69.40	69.69

[1] Chemical composition (per kg of product): A vitamin - 135,000.00 UI; D3 vitamin - 68,000.00 UI; E vitamin - 450.00 UI; Ca - 240.00 g; P - 71.00 g; K - 28.20 g; S - 20.00 g; Mg - 20.00g; Cu - 400.00 mg; Co - 30.00 mg; Cr - 10.00 mg; Fe - 2,500.00 mg; I - 40.00 mg; Mn - 1,350.00 mg; Se - 15,00 mg; Zn - 1,700.00 mg; F - 710.00 mg (max); Citric acid (2%) solubility of phosphorus 95% (min) (Commercial product).

of neutral detergent fiber (NDF) and acid detergent fiber (ADF) were measured according to the procedures of Van Soest (1991) and Goering & Van Soest (1970), respectively.

Total carbohydrates (TC) and total digestible nutrients (TDN) were estimated according to equations described by Sniffen et al. (1992): TC (%) = 100 – (%CP + %EE + %ash) and TDN = DCP + (2.25 × DEE) + DTC, in which DCP = digestible crude protein, DEE = digestible ether extract and DTC = digestible total carbohydrates.

Feces were collected on the 28th day of the experiment for six consecutive days (at 8:00 a.m., on day 1, at 10:00 a.m. on day 2, at 12:00 p.m. on day 3, at 2: 00 p.m. on day 4, at 4:00 p.m. on day 5 and at 6:00 p.m. on day 6) to determine apparent digestibility of dry matter and nutrients.

Indigestible NDF (iNDF) was used as an internal marker to estimate apparent nutrient digestibility and fecal output (Cochran et al., 1986). For iNDF analysis, 0.5 g (1 mm) of feces, orts and food samples were *in situ* fermented (144 h) in the rumen of the goat in nylon bags (F57 Ankon®) followed by neutral detergent analysis (Ankon® system). Fecal output was calculated by using the following equation:

$$FE = \frac{{}_{i}NDFI}{{}_{i}NDFF}$$

in which: FE = fecal output (kg/day); ${}_{i}$NDFI = ${}_{i}$NDFI intake (kg/day); ${}_{i}$NDFF = ${}_{i}$NDF content in the feces (kg/kg).

The obtained data were analyzed using analyses of variance utilizing SAEG system performed by Universidade Federal de Viçosa (2007) with the following general model: $Y_{ijk} = \mu + D_i + G_j + DG_{ij} + b(X_{ijk} - \bar{X}) + e_{ijk}$; where: Y_{ijk} = the dependent variable, μ = overall mean; D_i = effect of diet *i*, *i* = soybean meal, soybean meal + dry genetic group *j*; b_{ijk} = regression linear coefficient of initial body weitgh; eijk = random residual error. Data of digestibility were analyzed using analysis of variance with the following general model: $Y_{ij} = \mu + D_i + e_{ij}$, where: Y_{ij} = the dependent variable, μ = overall mean; D_i = effect of diet *i*, *i* = soybean meal; soybean meal + dry yeast) and dry yeast; e_{ij} = random residual error.

Results and Discussion

Intakes of dry matter, organic matter, crude protein and total carbohydrates were not affected (P>0.05) by the diets (Table 3). However, the inclusion of dry yeast in the diets reduced (P<0.05) intakes of ether extract, neutral detergent fiber and acid detergent fiber.

These differences are a result of the diet composition. Dry yeast has lower contents of ether extract, neutral detergent fiber and acid detergent fiber (Table 1), which was reflected in the composition of the total ration (Table 2) and reduced the intake of the respective nutrients.

Within genetic groups, the ¾ Boer + ¼ Saanen goat kids showed higher (P<0.05) intakes of dry matter, organic matter, crude protein, ether extract, neutral detergent fiber, acid detergent fiber and total carbohydrates than Saanen goat kids (Table 3).

Grande et al. (2003) observed dry matter intake of 0.76 kg/day in Saanen goat kids (± 26 kg) fed corn gluten meal and/or soybean meal and oat hay (30 % of DM). In Boer + Saanen goat kids (± 30 kg) fed diets with 30:70 of forage:concentrate ratio, Hashimoto et al. (2007) reported dry matter intake of 0.97 kg/day. These data show that the intakes observed in this study were similar to the data from experiments performed with these genetic groups.

Table 3 - Intake of dry matter and of nutrients in ¾ Boer + ¼ Saanen and Saanen goat kids fed diets with dry yeast

Genetic group	Diet			Mean	Coefficient of variation
	Soybean meal	Soybean meal + dry yeast	Dry yeast		
		Dry matter intake (kg/day)			
¾ Boer + ¼ Saanen	0.852	0.782	0.828	0.821a	
Saanen	0.779	0.732	0.764	0.758b	9.04
Mean	0.816	0.757	0.796	0.790	
		Organic matter intake (kg/day)			
¾ Boer + ¼ Saanen	0.808	0.745	0.790	0.781a	
Saanen	0.740	0.697	0.729	0.722b	9.04
Mean	0.774	0.721	0.759	0.751	
		Crude protein intake (kg/day)			
¾ Boer + ¼ Saanen	0.147	0.136	0.144	0.142a	
Saanen	0.135	0.127	0.133	0.131b	9.69
Mean	0.141	0.131	0.138	0.137	
		Ether extract (kg/day)			
¾ Boer + ¼ Saanen	0.028	0.025	0.023	0.025a	
Saanen	0.026	0.023	0.021	0.023b	9.68
Mean	0.027a	0.024b	0.022b	-	
		Neutral detergent fiber (kg/day)			
¾ Boer + ¼ Saanen	0.256	0.217	0.216	0.230a	
Saanen	0.234	0.203	0.200	0.212b	9.69
Mean	0.245a	0.210b	0.208b	-	
		Acid detergent fiber (kg/day)			
¾ Boer + ¼ Saanen	0.118	0.101	0.100	0.106a	
Saanen	0.108	0.095	0.092	0.098b	9.69
Mean	0.113a	0.099b	0.096b	-	
		Total corbohydrates (kg/day)			
¾ Boer + ¼ Saanen	0.633	0.585	0.623	0.613a	
Saanen	0.579	0.547	0.575	0.567b	9.69
Mean	0.606	0.566	0.599	0.590	

[a,b]Means with different superscripts in a row or column differ (P<0.05) by Tukey test.

In addition, the greastest intake observed for the crossbred animals indicates higher ingestive capacity than Saanen and this is an important characteristic of animal performance.

The ¾ Boer + ¼ Saanen goat kids also had higher (P<0.05) average daily gain, feed conversion and days in feedlot (Table 4). Studies performed with Saanen goat kids fed diets with forage:concentrate ratio similar to this experiment (30:70) showed values of 0.12 kg and 7.7 (Grande et al., 2003), and 0.23 kg and 3.32 (Alcalde et al., 2007) for average daily gain and feed conversion, respectively.

Grande et al. (2007) reported average daily gain of 0.13 kg and feed conversion of 6.58 in ¾ Boer + ¼ Saanen goat kids fed diets with 2.65 Mcal/kg DM, 17.5% CP and 30% of forage (oat hay).

The obtained results compared to those from literature shows that the average daily gain and feed conversion may have variations within the same genetic group and may be related to factors such as diet, age and genotype of animals used in the cross.

The number of days required for an animal to reach slaughter weight in confinement is very important because it is related to feeding and production costs. This parameter depends on the average daily gain and feed conversion, which are measures of performance in which ¾ Boer + ¼ Saanen were better (P<0.05) than Saanen, reaching established slaughter weight 12 days before the expected.

The best performance presented by ¾ Boer + ¼ Saanen animals may be related to heterosis provided by crossbreeding between the two goat breeds that, probably, increased the capacity for weight gain of these animals.

There were no differences (P>0.05) among total weight gain, average daily gain, feed conversion and days in feedlot. It can be said that diets with dry yeast, compared to the control diet, provided the necessary input of nutrients to meet the maintenance requirements and production in weight gain.

In the period of evaluation digestibility of the diets, the intakes of dry matter (DMI), organic matter (OMI), crude protein (CPI), ether extract, neutral detergent fiber, total carbohydrate and total digestible nutrients were not altered (Table 5).

Hashimoto et al. (2007) reported 0.966 kg of dry matter intake; 0.896 kg of organic matter intake and 0.160 kg of

crude protein intake for Boer + Saanen castrated goat kids fed diets with soybean hulls replacing corn with star grass hay as forage (30%). These values are similar to those obtained in this work and confirm the adjustment of intake in the formulation of rations showing balance of nutrients in dry matter.

Replacing soybean meal by dry yeast in the diets improved (P<0.05) digestibility of dry matter, organic matter, crude protein and total carbohydrates. Martins et al. (2000) reported that diets containing dry yeast showed higher digestibility coefficients for dry matter, crude protein and organic matter evaluated in heifers.

Table 4 - Performance of ¾ Boer + ¼ Saanen and Saanen goat kids fed diets with dry yeast

Genetic group	Diet			Mean	Coefficient of variation
	Soybean meal	Soybean meal + dry yeast	Dry yeast		
		Initial body weigth (kg)			
¾ Boer + ¼ Saanen	18.08	18.07	17.80	17.98	
Saanen	17.97	18.80	17.73	18.17	-
Mean	18.03	18.44	17.77	18.08	
		Final body weigth (kg)			
¾ Boer + ¼ Saanen	31.07	30.09	30.78	30.65	
Saanen	28.91	29.43	30.37	29.57	-
Mean	29.99	29.76	30.58	30.11	
		Total body weigth gain (kg)			
¾ Boer + ¼ Saanen	13.03	12.04	12.74	12.60	
Saanen	10.87	11.39	12.33	11.53	10.61
Mean	11.95	11.72	12.53	12.07	
		Averagy daily gain (kg)			
¾ Boer + ¼ Saanen	0.26	0.24	0.26	0.25a	
Saanen	0.19	0.17	0.19	0.18b	13.33
Mean	0.23	0.20	0.22	0.22	
		Feed conversion (kg DM/kg gain)			
¾ Boer + ¼ Saanen	3.35	3.33	3.26	3.31a	
Saanen	4.06	4.34	3.98	4.12b	9.56
Mean	3.70	3.83	3.61	3.72	
		Days in feedlot			
¾ Boer + ¼ Saanen	51.85	51.76	49.53	51.05a	
Saanen	56.97	67.50	64.89	63.12b	12.89
Mean	54.40	59.63	57.21	57.09	

[a,b]Means with different superscripts in a column differ (P<0.05) by Tukey test.

Table 5 - Intake, digestibility and total digestible nutrients of diets with dry yeast in goat kids

Genetic group	Diet			Mean	Coefficient of variation
	Soybean meal	Soybean meal + dry yeast	Dry yeast		
		Intake (kg/day)			
Dry matter	0.972	0.934	0.975	0.961	14.54
Organic matter	0.923	0.890	0.930	0.914	14.55
Dry matter	0.168	0.162	0.169	0.167	14.55
Ether extract	0.032	0.029	0.027	0.029	14.41
Neutral detergent fiber	0.292	0.259	0.254	0.268	14.50
Total carbohydrates	0.698	0.685	0.725	0.703	14.57
Total digestible nutrients	0.704	0.716	0.751	0.724	14.83
		Digestibility (%)			
Dry matter	73.97b	77.60a	78.22a	-	1.75
Organic matter	74.49b	78.00a	78.67a	-	1.79
Dry matter	77.85b	82.30a	82.82a	-	1.99
Ether extract	78.53a	75.54ab	71.86b	-	4.40
Neutral detergent fiber	45.45	46.97	47.02	46.48	8.89
Total carbohydrates	73.97b	77.66a	78.22a	-	1.84
Nutrientes digestíveis totais	72.36b	76.57a	77.07a	-	1.81

[a,b]Means with different superscripts in a column differ (P<0.05) by Tukey test.

The digestibility of ether extract was reduced (P<0.05) when dry yeast was used in the rations, which reflects the lowest level of this nutrient in the composition of diets (Table 2). The digestibility of neutral detergent fiber did not differ (P>0.05) among diets and it was different from observations of Martins et al. (2000), who reported higher neutral detergent fiber digestibility in heifers fed diets with dry yeast.

The increase of digestibility coefficients resulted in greater (P<0.05) total digestible nutrients in diets with dry yeast. This may be related to the high rate of rumen degradation of yeast (Fregadolli et al., 2001; Magalhães et al., 1999), which may promote greater availability of nutrients in the rumen (Messana et al., 2009).

The average TDN obtained for diets with dry yeast was 10.68% higher than the estimated average TDN in the diet formulation. When compared to the control diet, diets with dry yeast had higher TDN (6.16%), which indicates that the dry yeast in the rations provided better nutritional value compared to soybean meal.

Conclusions

Dried yeast can be used as alternative protein source in diets of goat kids without changing the performance with greater nutritional value compared to soybean meal. Goat kids ¾ Boer + ¼ Saanen show better performance and precocity compared to Saanen.

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