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Effects of different lipid levels on protozoa population, microbial protein synthesis and rumen degradability in cattle

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ABSTRACT. Protozoa population, microbial synthesis efficiency and rumen degradability of dry matter and neutral detergent fiber in cattle fed on diets with different lipid rates were evaluated. Nine 16-month-old Nelore young bulls, cannulated in the rumen and duodenum, weighing 232 ± 35 kg, were used in the trial. Experimental design consisted of a 3 x 3 square in triplicate, comprising the following treatments: 2, 4 and 6% lipid in diet. In situ degradability was assessed by rumen incubation of corn silage, soybean, soybean meal and citrus pulp during 0, 3, 6, 12, 24, 48, 72 and 96h. The flow of microbial nitrogen and microbial efficiency were not influenced ($p > 0.05$) by the inclusion of lipid levels in the diet. When the animals received diet with 4% lipid, there was a reduction ($p < 0.05$) in the potential and effective degradation of dry matter of corn silage (64.10 and 55.04%, respectively), soybean meal (94.55 and 60.83%, respectively) and soybeans (98.45 and 76.44%, respectively). Since the degradability of neutral detergent fiber was not affected, 4 and 6% lipid levels in the diet may be used without altering the parameters of rumen degradation of fiber.

Keywords: degradability, fat, microorganisms, ruminants, soybean.

Efeito de teores de lipídeos sobre a população de protozoários, síntese de proteína microbiana e a degradação ruminal em bovinos

RESUMO. Avaliaram-se a população de protozoários, a eficiência de síntese microbiana e a degradabilidade ruminal da matéria seca e da fibra em detergente neutro, em bovinos que consumiram dietas contendo diferentes teores de lipídeos. Foram utilizados nove novilhos da raça Nelore, canulados no rúmen e duodeno, com idade inicial 16 meses e 232 ± 35 kg de peso corporal. O delineamento experimental utilizado foi quadrado latino 3 x 3 triplicado, sendo os tratamentos: 2; 4 e 6% de lipídeos na dieta. A degradabilidade "in situ" foi avaliada por meio da incubação ruminal da silagem de milho, soja grão, farelo de soja e polpa cítrica por 0, 3, 6, 12, 24, 48, 72 e 96h. O fluxo de nitrogênio microbiano e a eficiência de síntese microbiana não foram ($p > 0,05$) influenciados pela inclusão de teores de lipídeos nas dietas. Quando os animais receberam 4% de lipídeo na dieta ocorreu redução ($p < 0,05$) da degradação potencial e efetiva da matéria seca da silagem de milho (64,10 e 55,04%, respectivamente), farelo de soja (94,55 e 60,83%, respectivamente) e soja grão (98,45 e 76,44%, respectivamente). Teores 4 e 6% de lipídeos na dieta podem ser utilizados sem alterar os parâmetros de degradação ruminal da fibra.

Palavras-chave: degradabilidade, gordura, microrganismos, ruminantes, soja.

Introduction

Lipid supplementation in the diet has become a promising strategy to increase the efficiency in animal production by an increase in the diet's energetic density (HESS et al., 2008). However, the incorporation of lipids in diets is limited since they are modified by rumen microorganisms that transform them through two important processes, namely lipolysis and bio-hydrogenation. The processes' intensity largely depends on supplement sources and rates (MOATE et al., 2004).

Unsaturated fatty acids rates in the rumen above the saturation capacity of microorganisms produce adverse effects on rumen fermentation, such as decrease in fiber degradability, lowering of protozoa concentration, reduction in quantity and proportions of the short chain fatty acids (SILVA et al., 2007). The above effects may be due to the fiber's physical lining with lipids (JENKINS; MCGUIRE, 2006) and to the decrease in bacterial (in particular, gram-positive cellulolitic ones) and protozoa growth (TAMMINGA; DOREAU, 1991). Decrease in the number of protozoa is generally

associated with a reduction in bacterial N recycling in the rumen (MORAIS et al., 2006). Thus, an increase in the number of gram negative bacteria and a decrease in ammonia concentration occur (JOUANY, 1996), with a possible increase in the flow rate of rumen solids (CZERKAWSKI et al., 1975). These effects contribute towards an increase in the efficiency of microbial protein synthesis when lipids are supplemented for ruminants (DOREAU; FERLAY, 1995).

Diets with higher rates of ether extract are evaluated with regard to rumen protozoa, microbial protein synthesis and diet degradability.

Material and methods

Experiment was conducted in the Food and Digestibility Evaluation Center of the Department of Animal Science of the Faculty of Agrarian and Veterinarian Sciences, UNESP, Jaboticabal, São Paulo State, Brazil. Nine 16-month-old gelded young Nelore bulls, cannulated in the rumen and the duodenum, mean initial weight 232 ± 35 kg, were employed.

The animals were grouped within a 3 x 3 design with three simultaneous replications, three treatments and three experimental periods for 26 days each, or rather, 15 days for the animals' adaptation to diet, 7 days for sample collection and the last 4 days for in situ degradability evaluation. Experimental diets, formulated according to Fox et al. (2003) with Cornell Net Protein and Carbohydrate System, were as follows: 1) 2% ethereal extract in dry matter; 2) 4% ethereal extract in dry matter and 3) 6% ethereal extract in dry matter, composed of 50% corn roughage silage and of 50% concentrates. Table 1 shows the percentages of ingredients and the chemical composition of the diets.

Protozoa population was evaluated in samples of rumen contents collected 1h after feeding on the 18th day of each experimental period (VIDAL et al., 2007). Protozoa were counted directly in a Sedgewick-Rafter chamber (DEHORITY et al., 1989). Counts were obtained from aliquot of rumen contents conserved in formaldehyde, water solution and an equal volume of formaldehyde 37%. Samples were diluted with 20% glycerol and stained by Lugol solution for counting (D'AGOSTO; CARNEIRO, 1999).

Approximately 2 L of rumen contents from each animal were collected for bacterial isolation on the 19th day of each experimental period so that microbial protein synthesis may be evaluated (CECAVA et al., 1990). Purine bases were the microbial indicators and their determination in bacteria and duodenal digest was conducted according to recommendation by Zinn and Owens (1986), with modifications by Ushida et al. (1985). Amount of microbial compounds in the duodenum was determined by N-RNA flow in the duodenum divided by the ratio N-RNA: total N of the rumen's isolated bacteria. Dry matter flux and microbial protein in the duodenum could be calculated.

Degradation of dry matter (DM) and of neutral detergent fiber (NDF) was evaluated by rumen incubation of corn silage, citric pulp, soybean meal and soybeans according to the in situ technique described by Orskov and McDonald (1979).

Table 1. Percentage of ingredients and chemical composition of experimental diets.

Ingredient (%)	Diet⋆ (%DM)		
	2%	4%	6%
Corn silage	50.0	50.0	50.0
Citric pulp	28.0	26.0	24.0
Ground soybeans	0.0	12.0	23.0
Soybean meal	19.0	9.0	0.0
Mineral supplement[1]	3.0	3.0	3.0
Chemical composition			
Dry matter (DM)	63.74	63.76	63.78
Organic matter	91.60	91.81	92.00
Crude protein	15.26	14.28	13.45
Ether extract	1.93	4.23	6.32
Neutral detergent fiber	33.56	33.26	32.96
Acid detergent fiber	22.11	21.86	21.60
Lignin	2.72	2.67	2.63
Total Carbohydrates	74.26	73.15	72.06
Non-fibrous carbohydrates	40.70	39.90	39.10
	(Mcal kg^{-1})		
Gross energy	4.21	4.30	4.39
Digestible energy	3.09	3.15	3.09
Metabolized energy	2.53	2.58	2.53
Total digestible nutrients (%)	70.09	71.56	70.12

⋆2, 4 and 6% = rate of lipids in diet. [1]Composition of mineral supplement: Ca:155 g; P: 80 g; Mg: 10g; S: 40 g; Na: 130 g; Cu: 1350 mg; Mn: 1040 mg; Zn: 5000 mg; I: 100 mg; Co: 80 mg; Se: 26 mg; F (maximum.): 800 mg; Solubility of P in citric acid at 2% (minimum).: 90%.

Ingredients were incubated separately in the animals which received diets with increasing lipid rates: 2, 4 and 6% in DM so that their effect in the degradation of ingredients used in diets could be verified. During the last week of each experimental period nylon bags (7 x 14 cm), mean porosity 50 μm, with approximately 5 g of sample, were incubated by cannulas in the animals' rumen for 3, 6, 12, 24, 48, 72 and 96h. Samples were pre-dried at 55ºC during 72h and ground in a 5.0 mm sieve. During incubation, the bags were attached by stainless steel rings to nets and thus they could be fixed to the rumen cannula by nylon string with free movement within the rumen. After removal, the rumen bags were washed in running water till the wash liquid became colorless; they were then placed in buffers at 55ºC for 72h for later weighing and DM and NDF analyses. Degradability at 0 time occurred when bags were immersed in a recipient with water at 39ºC during 10 min. (CUMMINS et al., 1983).

Potential degradability (PD) was estimated by curves in the disappearance of the nutrients from the bags, adjusted according to model PD = a + b (1-e-ct) suggested by Orskov and McDonald (1979), in which "a" is the soluble fraction; "b", the potentially degradable fraction; "c", the constant rate of degradation of "b" in time "t" of incubation. Real degradability was calculated by DE = a + (bc/c+k), in which k is the flow rate of the rumen content at 0.05 h^{-1}.

Experimental design to evaluate protozoa population, microbial protein synthesis and degradability was a 3 x 3 square with three simultaneous repetitions, with three treatments and three periods, according to the following statistical model:

$$Yijkl = \hat{A}\mu + Qi + Tj + Pk + Al(i) + \mathrm{QTij} + eijkl$$

In which *Yijkl* is a dependent variable; $\hat{A}$ is a mean of calculations; *Qi* is the n^{th} effect of the square; *Tj* is the j^{th} of treatment or diet; *Pk* is the k^{th} effect of the line or period; *Al(i)* is the effect of the column or animal l, embedded in square i; *QTij* is the effect of the interaction between square i and treatment j; *eijkl* is the randomized error, presumed error distributed normally and independently (0, s2).

Results and discussion

Protozoa population was not influenced by 2, 4 and 6% lipid rates in the diet (Table 2). High coefficients of variation (CV) in the experiment are intrinsic to the method used (DEHORITY et al., 1989) since growth has not been reported in some counts, whereas a relatively large number of protozoa was observed in others (ORPIN, 1984). Gordon and Phillips (1989) and Messana et al. (2010) have reported coefficient variations similar to those in current experiment.

Table 2. Mean number of protozoa in the rumen of cattle fed on different lipid rates in the diet.

Mean population mL^{-1}	Diet*			MSE**	VC***	Effects	
	2%	4%	6%			Linear	Square
Total Protozoa (no. x 10^5 mL^{-1})	8.69	5.60	9.40	1.25	76.01	0.73	0.44
Entodinium	7.49	4.29	7.63	1.18	85.27	0.96	0.20
Epidinium	0.60	0.33	0.46	0.26	91.50	0.83	0.49
Isotricha	0.43	0.59	0.80	0.11	70.50	0.11	0.90
Dasytricha	0.17	0.39	0.51	0.19	70.79	0.51	0.18

*2, 4 and 6% = Lipid rates in diet; **Mean standard error; ***Variation Coefficient.

Rumen microorganisms are dependent on an ideal environment for their development with a temperature between 38 and 40°C and a pH range between 5.5 and 7.0 (HOOVER, 1986). The conditions reported in current analysis (pH between 6.6 and 6.4) may have been triggered to protozoa growth.

Protozoa of the genus *Entodinium* (Table 2) were found in absolute larger amounts in all treatments, as Valinote et al. (2006) have reported when they evaluated fatty acids as fat sources in cotton seeds and calcium salt, and the effect of monensin in diets with cotton seeds in diets for beef cattle. Predominance of *Entodinium* protozoa has also been reported by other authors who investigated protozoa populations in cattle with different food conditions, such as diet rich in sugarcane (FRANZOLIN; FRANZOLIN, 2000), in concentrate-rich diets, with or without fat addition (TOWNE et al., 1990), or with ionophores in diets rich in roughage or concentrates (GUAN et al., 2006; MARTINELE et al., 2008).

Several authors (VAN NEVEL; DEMEYER, 1988; CHAUDHARRY et al., 1995) reported that ciliated protozoa influence the degradation of structural carbohydrates, in particular, diets with high concentrate rates. Beside lipid adhesion to food particles and the toxic effect to fibrolytic bacteria, decrease in protozoa numbers may lessen the degradation of the diet fiber when lipids are inserted in the diet of ruminants, especially in diets with high concentrates. Consequently, treatments with increasing rates of lipids in the diet probably do not influence protozoa populations according to the proportion of fiber in the diet.

Results show that lipid rates did not affect ($p > 0.05$) intake of DM (IDM), nitrogen (IN) or quantities of organic matter (OMDR) or energy (EDR) digested in the rumen (Table 3).

Table 3. Efficiency of microbial protein synthesis in cattle fed on diets with different lipid rates.

Parameters	Diet*			MSE**	Effects	
	2%	4%	6%		Linear	Square
IDM (kg day^{-1})	5.39	6.07	5.65	0.24	0.58	0.21
IN (g day^{-1})	123.06	134.47	117.11	6.05	0.85	0.27
MODR (kg day^{-1})	3.39	4.04	3.67	0.18	0.43	0.13
EDR (Mcal day^{-1})	14.51	16.02	13.23	0.87	0.38	0.12
Flow to the duodenum						
MO (kg day^{-1})	1.74	1.78	1.82	0.09	0.29	0.70
N-mic (g day^{-1})	67.33	67.03	68.22	6.83	0.72	0.88
Efficiency of microbial synthesis						
g N kg^{-1} MODR	18.97	17.19	19.34	0.22	0.95	0.72
g N $Mcal^{-1}$ of EDR	4.46	4.23	5.23	0.3	0.61	0.64

IMS = Ingestion of dry matter; IN = Ingestion of nitrogen; MODR = Organic matter digested in the rumen; EDR = Energy digested in the rumen; Nmic = Microbial Nitrogen. *2, 4 and 6% = Lipid rates in diet. **Mean standard error.

No difference in bacterial flow occurred; this was probably due to the fact that increasing lipid rates did not influence nitrogen consumption (Table 3). When ratio total N in the duodenum / total N ingested in diets with 2, 4 and 6% lipids is taken into account, 62.84, 60.55 and 64.60% of total N consumed reached the duodenum, respectively. Above results show that lipid rates did not significantly influence ($p > 0.05$) the efficiency of the microbial synthesis.

The provision of vegetal oils frequently causes an increase in the efficiency of microbial synthesis through a smaller predation by the oil's defaunated additive effects rather than by an increase in fermentable energy in the rumen (DEWHURST et al., 2000). On the other hand, results show that no defaunated effects caused by lipid rates were reported (Table 2). Thus, no difference was reported ($p > 0.05$) in the efficiency of microbial synthesis (Table 3). Mean rate 18.50 g for Nmic kg^{-1} of MODR of microbial efficiency synthesis is below the rates given by HAGEMEISTER et al. (1981). These authors registered efficiency rates of microbial synthesis of 18.0; 22.0; and 16.8 g 100 g^{-1} of MODR for 0 to 20%, 30 to 70% and 70 to 100% rates of diet concentrates, respectively. These rates were higher than those in current analysis which employed different lipid rates in a diet with 50% concentrate. However, variation in efficiency rates of microbial synthesis in the literature (BÜRGER et al., 2000; HAGEMEISTER et al., 1981) is related to the type of microbiota and its growth phase, to nutrient availability, changes in diet and variations in feed frequency used in each experiment. The percentage of nutrients in the diet and food degradation synchronization which compose them is related to the efficiency of microbial synthesis (CLARK et al., 1992).

Lipid rates used influenced ($p < 0.05$) the digestibility kinetics of DM degradability (Table 4).

Table 4. In situ degradability kinetics of DM and NDF of corn silage in cattle fed on different lipid rates in the diet.

Item[1]	Diet*			EPM**	Effects	
	2%	4%	6%		Linear	Square
	Dry Matter					
a (%)[a]	39.93	40.71	40.83	0.13	0.002	0.008
b (%)[b]	34.29	24.76	31.61	1.27	0.04	0.005
kd (% h^{-1})[c]	2.29	2.50	3.42	0.20	0.01	0.08
DP (%)[d]	70.41	64.10	71.07	1.12	0.26	0.003
DE 0,05 (%)[e]	58.25	55.04	60.62	0.66	0.01	0.009
	Neutral detergent fiber					
b (%)[f]	58.10	57.18	52.10	0.94	0.004	0.02
kd (% h^{-1})	1.54	1.14	1.46	0.09	0.68	0.14
DP (%)	44.90	37.46	39.02	1.59	0.16	0.19
DE 0,05 (%)	25.32	20.52	21.89	1.02	0.19	0.18

[1]Soluble fraction (a), potentially degradable insoluble fraction (b), degradation rate of fraction b (kd), potential and (DP) and effective degradability (DE0.05) = effective degradability with presumed passage rate of 0.05 h^{-1}; 2 , 4 and 6% = Lipid rate of diet **Mean standard error; [a]$a = 38.37 + 0.98\,a - 0.098\,a^2$, $r^2 = 0.97$; [b]$b = 57.20 - 15.05b + 1.79\,b^2$, $r^2 = 0.97$; [c]$kd = 1.63 + 0.28\,kd$, $r^2 = 0.65$; [d]$DP = 90.0 - 13.11\,DP + 1.66\,DP^2$, $r^2 = 0.97$; [e]$DE = 57.71 - 4.89\,DE + 0.70\,DE^2$, $r^2 = 0.86$; [f]$b = 54.84 + 2.67\,b - 0.52\,b^2$, $r^2 = 0.98$.

Results for diets with 4 and 6% lipids agree with those by Palmquist and Jenkins (1980) who suggested a tolerance 4 to 5% more than total available energy by lipid supplement. A smaller potentially degradable fraction (b) in dry matter was reported when the animals were fed on diets with 4% lipids in DM. The same lipid rate also caused a lower potential degradability of DM of corn silage when rates with 2 and 6% lipids are compared. Real degradability (DM) of corn silage was higher when animals received a diet with 6% lipids, perhaps due to their adjustment mode to the mathematic model used for the evaluation of results.

Although no significant difference in the degradability of NDF occurred, a significant decrease ($p = 0.02$) occurred in the potentially degradable insoluble fraction (b) proportional to the increase of non-saturated fatty acids rates in the diet.

It seems that the mechanisms by which non-saturated fatty acids influenced the degradability of DM of corn silage occur regardless of the adsorption of bacteria and food particles, since NDF degradation was not altered. Similarly to current research, Broudiscou et al. (1990) reported that decrease in degradability was similar, regardless of covering or not of the cellulose with hydrolised soybean oil.

Degradation decrease of silage DM with an increase in the diet's lipid rates found in current analysis failed to influence total digestibility of the DM of the diet. Even though a decrease in energy benefits of roughage feed in later treatment is taken into account, results show that, depending on the extension by which the fiber's rumen degradability is decreased, it may be compensated by a greater intestine digestion (WEISBJERG et al., 1992). Therefore, lipid dissociation in the rumen and their effects on the rumen degradability are closely related to pH rates of the rumen, or rather, with other diet components and their intake level (BALIEIRO NETO; MELOTTI, 2007).

When the kinetic degradation parameters of dry matter (DM) of citric pulp (Table 5) are taken into account, the soluble fraction in water at time 0 (a) was more appropriate for diet with 4% lipids. However, fraction "a" comprises two fractions: a soluble fraction in water and a fraction composed of solid particles that are released through the nylon bags' pores during washing. The difference between treatments may have been caused by this fact.

Although rumen degradability of dry matter of soybean meal decreased to the power of two when lipids were added to the diet (Table 6), degradability of neutral detergent fiber showed no difference among diet's lipid rates.

Real degradability of DM of soya meal was higher when the animals received 6% lipids in diet, perhaps due to adjustment to the mathematic model employed to evaluate results. When potential degradation is calculated for different timings, highest degradability occurred for the least lipid rate (2%) in diet.

Table 5. In situ degradability kinetics of DM and NDF of citric pulp in cattle fed on diets with different lipid rates.

Item[1]	Diet*			MSE**	Effects	
	2%	4%	6%		Linear	Square
	Dry matter					
a (%)[a]	45.17	45.78	45.65	0.12	0.04	0.12
b (%)[b]	53.02	47.49	51.37	0.15	0.02	0.07
kd (% h^{-1})	6.75	7.08	8.39	0.26	0.26	0.89
DP (%)	96.86	97.08	97.12	0.02	0.47	0.54
DE 0,05 (%)	73.10	77.50	77.73	1.40	0.27	0.65
	Neutral detergent fiber					
b (%)[c]	83.86	80.17	81.74	0.55	0.02	0.01
kd (% h^{-1})[d]	3.74	3.49	3.76	0.05	0.76	0.04
DP (%)[e]	81.54	77.35	79.53	0.62	0.05	0.01
DE 0,05 (%)[f]	35.89	32.97	35.10	0.46	0.24	0.02

[1]Soluble fractions (a), potentially degradable non-soluble fraction (b), degradation rate of fraction b (kd), potential (DP) and real (DE0.05) degradability = real degradability with passage rate of 0.05 h^{-1}). *2, 4 and 6% = lipid rate in diet. **Mean standard error [a] a = 44.96 + 0.15 a, r^2= 0.51; [b] b = 52.32 – 0.18b, r^2= 0.53; [c]b = 95.83 – 58.0 b + 0.66 b^2, r^2= 0.95; [d]kd = 4.51 – 0.51 kd + 0.065 kd^2, r^2= 0.84; [e]DP = 92.09 – 6.87 DP + 0.79 DP^2, r^2= 0.94; [f]DE = 43.87 – 5.26 DE + 0.63 DE^2, r^2= 0.89.

Table 6. In situ degradability kinetics of DM and NDF of soya meal in cattle fed on diet with different lipid rates.

Item[1]	Diet*			MSE**	Effects	
	2%	4%	6%		Linear	Square
	Dry Matter					
a (%)	33.66	33.62	33.64	0.14	0.93	0.96
b (%)	64.96	62.61	64.13	0.44	0.36	0.09
kd (% h^{-1})[a]	5.63	4.88	7.36	0.53	0.007	0.002
DP (%)[b]	98.30	94.55	97.69	0.58	0.006	0.0001
DE 0,05 (%)[c]	68.02	60.83	71.79	1.68	0.02	0.003
	Neutral detergent fiber					
b (%)	96.75	97.74	97.84	0.20	0.06	0.22
kd (% h^{-1})	4.19	4.12	3.77	0.08	0.10	0.39
DP (%)	95.03	95.87	95.14	0.21	0.69	0.06
DE 0,05 (%)	44.14	44.17	42.01	0.49	0.13	0.28

[1]Soluble fraction (a), potentially degradable non-soluble fraction (b), degradation rate of fraction b (kd), potential (DP) and real (DE0.05) degradability = real degradability with estimated passage rate 0.05 h^{-1}); *2, 4 and 6% = diet's lipid rates; **Mean standard error; [a]kd = 12.65 – 4.81 kd + 0.65 kd^2, r^2= 0.90; [b]DP = 108.9 – 7.04 DP + 0.86 DP^2, r^2= 0.99; [c] DE = 93.35 – 17.20 DE + 2.27 DE^2, r^2= 0.89.

Different rates of unsaturated fatty acids in the diet did not influence the degradability of soybeans (Table 7). In fact, it revealed degradation kinetics similar to that found by Silva et al. (2002) in research on animals supplemented with concentrated diet with ground soybeans.

The effect of unsaturated fatty acids rates tested on fiber degradability is extremely low or non-existent in most ingredients under analysis. Consequently, lipid rates did not influence diet degradation. Although ground soybean has been used, Silva et al. (2007) reported that release of lipids of oleaginous seeds is slow and provides small quantities of lipids within the rumen environment. This may cause fast bio-hydrogenation and thus may prevent the accumulation of unsaturated fatty acids. In fact, liability in rumen degradation, especially the diet fiber, is thus avoided. Further, the amount is not sufficient for the adhesion of food particle which may be a physical impairment to microorganism and microbial enzymes.

Table 7. In situ degradability kinetics of DM and NDF of soybeans in cattle fed on diet with different lipid rates.

Item[1]	Diet*			MSE**	Effects	
	2%	4%	6%		Linear	Square
	Dry matter					
a (%)	46.37	47.41	47.44	1.09	0.06	0.11
b (%)	53.71	51.13	51.51	1.14	0.07	0.08
kd (% h^{-1})	8.24	7.56	7.59	0.49	0.19	0.12
DP (%)	99.06	98.45	98.87	0.09	0.07	0.07
DE 0,05 (%)	78.72	76.44	78.41	0.49	0.75	0.11
	Neutral detergent fiber					
b (%)	96.39	94.82	96.56	0.31	0.75	0.06
kd (% h^{-1})	3.99	3.97	4.02	0.25	0.15	0.31
DP (%)	93.67	92.55	95.78	0.70	0.28	0.22
DE 0,05 (%)	42.39	41.85	48.38	1.56	0.18	0.30

[1]Soluble fractions (a), potentially degradable insoluble fraction (b), degradation rate of fraction b (kd), potential (DP) and real (DE 0.05) degradability rate = real degradability with estimated passage rate 0.05 h^{-1}; *2, 4 and 6% = lipid rates in diet; **Mean standard error.

Conclusion

Ground soybean with up to 6% lipids caused an increase in real degradability of silage roughage and a clear similarity in protozoa population, efficiency in microbial synthesis and fiber degradability. An inclusion of up to 6% lipids in the diet of Nelore young bulls may be thus employed.

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