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Bromatological characteristics and *in vitro* digestibility of four sugarcane varieties subjected or not to the application of quicklime

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ABSTRACT. The experiment was conducted to evaluate the bromatological characteristics and the *in vitro* digestibility of four sugarcane varieties, subjected or not to hydrolysis, with quicklime. A completely randomized design was employed with three replications arranged in a 4 × 2 factorial scheme, with four sugarcane varieties (SP 52454, RB 867515, RB 855536 and IAC 862480), hydrolyzed or not. There was significant effect on brix ($p < 0.05$) and industrial fiber ($p < 0.05$), and IAC 862480 variety had the lowest levels of industrial fiber. There were no significant difference ($p > 0.05$) in neutral detergent fiber, acid detergent fiber and lignin levels among the sugarcane varieties under analysis and for the sugarcanes, hydrolyzed or not. The use of sugarcane hydrolysis with 1% quicklime improves the *in vitro* digestibility of NDF and ADF, regardless of the variety studied. Hydrolysis with 1% quicklime did not alter the sugarcane chemical composition.

Keywords: calcium oxide, cell wall, fiber, ruminants, *Saccharum officinarum* L.

Características bromatológicas e digestibilidade *in vitro* de quatro variedades de cana-de-açúcar submetidas ou não à aplicação de cal virgem

RESUMO. O experimento foi conduzido para avaliar as características bromatológicas e a digestibilidade *in vitro* de quatro variedades de cana-de-açúcar submetidas ou não à hidrólise com cal virgem. Utilizou-se delineamento inteiramente casualizado com três repetições, arranjadas em esquema fatorial 4 × 2, com quatro variedades de cana-de-açúcar (SP 52454, RB 867515, RB 855536 e IAC 862480), hidrolisadas ou não. Houve efeito significativo para as características brix ($p < 0,05$) e fibra industrial ($p < 0,05$), sendo a variedade IAC 862480 a que apresentou os menores teores de fibra industrial. Não foram observadas diferenças significativas ($p > 0,05$) nos teores de fibra em detergente neutro, fibra em detergente ácido e lignina entre as variedades de cana-de-açúcar estudadas, bem como para cana-de-açúcar hidrolisada ou não. O uso da hidrólise da cana-de-açúcar com 1% de cal virgem melhora a digestibilidade *in vitro* da FDN e FDA independente da variedade estudada. A hidrólise com 1% de cal virgem não modificou a composição químico-bromatológica da cana-de-açúcar.

Palavras-chave: óxido de cálcio, parede celular, fibra, ruminantes, *Saccharum officinarum* L.

Introduction

In recent years, sugarcane has attracted increasing attention from farmers, mostly because of its low production costs when compared to traditional roughage sources, such as corn silage. Low cost is mainly explained by high dry matter production per area unit, by the easiness in cultivation and by harvest during the dry season, which permits self-storage or conservation in the field. There are countless studies in Brazil that demonstrates sugarcane's potential in ruminant production (MAGALHÃES et al., 2004; ROMAN et al., 2010).

Traditionally, the use of sugarcane is based on daily cuts and immediate ministration of the fresh roughage to the animals, which requires the producer to support a daily labor supply. Recently, the use of quicklime in the treatment of sugarcane to maintain its nutritive quality for a few days, without the need of daily cuts, is being explored (RIBEIRO et al., 2009). In fact, it solves logistical problems and improves the producer's life quality (MOTA et al., 2010). Thus, the viability of its utilization requires the improvement of these treatment methods which may prolong storage time without impairing the sugarcane's nutritional value.

In some cases, such treatments may provide other benefits since they break the fibrous fraction structure (CARVALHO et al., 2006; PIRES et al., 2006) and makes it more accessible to rumen microflora. It is common knowledge that roughage quality depends on cell wall components and on the manner they are arranged. It may vary within the same species, according to the age and part of the plant or to interferences caused by cultivation environment (DECRUYENAERE et al., 2009). The use of sugarcane in animal nutrition has some limitations, such as high levels of non-degradable fiber, high lignocelluloses contents and low crude protein levels (FREITAS et al., 2006). The sugarcane varieties currently used in animal nutrition are those with good performance in sugar industry, usually more available to farmers on the market. However, sugarcane breeding programs for alcohol and sugar production aim primarily at high sucrose production per hectare, with greater agronomic efficiency. In fact, they produce plants with thicker cell walls that are resistant to lodging and pests. Consequently they improve crop management and attend to the alcohol and sugar industries requirements, which do not necessarily mean varieties with high digestibility per dry matter unit. Thus, the optimization of harvest logistics and the utilization of varieties and techniques that improve digestibility is a matter of permanent interest in recent studies.

Current study evaluates quality parameters (pH, *brix* value and industrial fiber), bromatological characteristics and *in vitro* digestibility of four sugarcane varieties (SP 52454, RB 867515, RB 855536 and IAC 862480), hydrolyzed or not with 1% quicklime.

Material and methods

The experiment was conducted at the Dairy Cattle Sector of the Animal Science Department of the College of Agricultural and Veterinary Sciences, on the Jaboticabal campus, Universidade Paulista Júlio de Mesquita Filho, Jaboticabal, São Paulo State, Brazil. A completely randomized design, arranged in a 4 x 2 factorial scheme, with three replications each, was used. There were four sugarcane varieties (SP 52454, RB 867515, RB 855536 and IAC 862480), hydrolyzed or not with quicklime.

The four sugarcane varieties were used in the respective cuts: SP 52454 – 3rd cut, RB 867515 – 3rd cut, RB 855536 – 5th cut and IAC 862480 – 1st cut. Each one of these varieties featured approximately 10 months of development. Sugarcane was manually cut and chopped in a fixed stationary chopper, providing a particle size of approximately 8 mm. Further, mounts of 15 kg of sugarcane were placed under a covered shed with a concrete floor. The sugarcane was spread on the floor by a hoe and treated with quicklime solution, according to the corresponding treatments. A proportion of 1 kg of quicklime (calcium oxide) in 2 liters of water per 100 kg of sugarcane was used for the preparation of the solution. After hydration, the calcium oxide was converted to calcium hydroxide, which was effectively used in the sugarcane treatment. The solution was applied to the mounts with a plastic watering can and then homogenized by hoe. After this process, the mounts remained at rest for 48 hours and then samples were retrieved and sent for analysis.

According to the manufacturer, the original quicklime (calcium oxide) constitution was: 0.4% MgO; 0.3% Al_2O_3; 1.4% SiO_2; 94.1% CaO; 87.3% of available CaO; 0.2% Fe_2O_3; 0.07% S and 1.5% CO_2.

The technological parameters of the four sugarcane varieties were determined at the analysis laboratory of the Sugarcane Growers Cooperative of the Guariba Zone, state of São Paulo, Brazil. Sugarcane pH was measured with a pH-meter and the *brix* value with a refractometer at 20°C. Protocols described by Scheneider (1979) were used for determination of the broth POL, cane POL, purity, reducing sugars, total recoverable sugars and industrial fiber.

Fresh samples from the mounts, with approximately 0.5 kg, were pre-dried in a forced-air circulation oven at 55°C for 72 hours and then ground in a mill with a 1 mm sieve to determine dry matter (DM) in a 105°C oven, ether extract (EE), organic matter (OM), acid detergent fiber (ADF) and lignin, as described by Silva and Queiroz (2002). Crude protein (CP) level was determined in a LECO nitrogen auto-analyzer (WILES et al., 1998). Neutral detergent fiber (NDF) was determined by methodology adapted by Van Soest et al. (1991), without α-amylase and using an autoclave for 40 minutes. Total carbohydrates (TCH) levels were obtained by difference, according to Sniffen et al. (1992), in which TCH (%) = 100 - (%CP + %EE + %MM). Non-fibrous carbohydrates (NFC) levels were calculated according to Hall (2003), by subtracting de NDF from total carbohydrates, in which NFC CNF% = 100% – (NDF% + CP% + EE% + MM%).

The *in vitro* digestibility assay was undertaken in a DAISY II Ankom® ruminal lab fermenter. A rumen cannulated Holstein cow, in a pen with feed and water *ad libitum*, was the ruminal fluid donator. The cow was fed 20 kg of sugarcane, half chopped *in natura* and half hydrolyzed with 1.0% quicklime. The animal feed was supplemented with 3 kg of concentrate (ground corn kernels + soybean meal + mineral mixture) during the whole experimental period, in which the first 15 days represented the adaptation period. After adaptation, the ruminal fluid was sampled in the morning, prior to the first meal. The ruminal content was manually filtered in cotton tissue to separate the liquid from the solid portions. The liquid phase was properly stored in a thermos bottle, pre-heated to 39°C, and taken to incubation in DAISY II® Ankon fermenter jars that contained the bags with samples and artificial saliva, formed by buffer solution A (KH_2PO_4 = 10.0; $MgSO_4$ $7H_2O$ = 0.5; NaCl = 0.5; $CaCl_2.2H_2O$ = 0.1 and Urea = 0.5) and solution B (Na_2CO_3 = 15.0 and $Na_2S.9H_2O$ = 1.0), in grams/liter.

Incubated samples consisted of 0.5 g pre-dried material from the different sugarcane varieties, which was weighed in F57 (Ankom®) bags. These bags remained in the fermenter jars for 48 hours, to which pepsin and 6 N hydrochloric acid were added. The bags remained in this solution for another 24 hours. After the incubation period, bags were removed from the fermenter and washed thoroughly in running water till they became white and then put in an oven at 55°C where they were left to dry for another 72 hours. The bags were then weighed and residues removed for analysis. Dry matter and ADF levels were determined following Silva and Queiroz (2002), while NDF levels were analyzed according to methodology adapted from Van Soest et al. (1991), without α-amylase and using an autoclave for 40 minutes.

Analysis of variance was carried with SAS® statistical program, 8.2 for Windows® (SAS, 2001), and means were compared by Tukey's test with a 5% significance level.

Results and discussion

Table 1 shows mean levels of broth POL, cane POL, purity, reducing sugars and total recoverable sugars, in kg per ton, of the studied sugarcane varieties. POL rates represent the percentage of apparent sucrose mass contained in the analyzed material. Thus, varieties RB 855536 and SP 52454 have, numerically, greater sugarcane broth and fresh sugarcane sucrose concentration (20.11 and 13.28%, respectively). Purity represents the relation between sugarcane POL percentage and its *brix* degree, and the higher the purity of the material, the greater the recovery of sugar and the better the material's quality. Variety RB 867515 had the highest purity value (83.76%), followed by variety SP 52454 (83.49%).

Since total recoverable sugars indicate the total amount of sugar in sugarcane (sucrose, glucose and fructose), SP 52454 had the highest concentration per ton (132.17 kg). When only the feeding of fresh sugarcane to the animals is taken into account, SP 52454 is probably the variety which contains the highest concentration of rapidly degradable carbohydrates in the rumen, since it showed higher total sugar concentration and sugarcane POL percentage.

Table 1. Mean levels, in percentage, of sugarcane broth POL, sugarcane POL, purity, reducing sugars (RS), and total recoverable sugars (TRS) in kg $ton.^{-1}$, in non-hydrolyzed varieties.

Variety	Sugarcane broth POL (%)	Sugarcane POL (%)	Purity (%)	RS (%)	TRS (kg $ton.^{-1}$)
SP 52454	16.73	13.28	83.49	0.61	132.17
RB 867515	17.58	12.71	83.76	0.61	122.97
RB 855536	20.11	12.29	82.00	0.61	122.59
IAC 862480	14.14	11.07	80.00	0.70	111.83

When pH, *brix* and industrial fiber values are taken into account, there is no significant interaction ($p > 0.05$) between sugarcane variety and treatment (hydrolyzed or non-hydrolyzed) (Table 2). There was no difference in pH rates among sugarcane varieties ($p > 0.05$). However, hydrolyzed sugarcane had higher pH than non-hydrolyzed ones ($p < 0.05$). However, pH increase in hydrolyzed sugarcane was expected since the application of a base (calcium oxide) in the mass decreased the mobility of H^+ ions and consequently decreased its concentration in sugarcane, with an increase in pH. Domingues et al. (2011) also observed an increase in pH to about 7.61 when sugarcane was hydrolyzed with 0.1% quicklime.

Table 2. pH, *brix* degree and industrial fiber of four sugarcane varieties treated or not with quicklime.

Variety	Treatment		Means
	Non-hydrolyzed	Hydrolyzed	
	pH		
SP 52454	5.54	6.01	5.78^a
RB 867515	5.48	5.50	5.49^a
RB 855536	5.37	5.96	5.66^a
IAC 862480	5.47	5.77	5.62^a
Means	5.47^B	5.81^A	
CV (%) = 4.26			
	brix degree (%)		
SP 52454	20.03	19.65	19.84^{ab}
RB 867515	20.97	21.81	21.39^a
RB 855536	20.45	20.04	20.25^a
IAC 862480	17.64	19.13	18.39^b
Means	19.78^A	20.16^A	
CV (%) = 5.24			
	Industrial fiber (%)		
SP 52454	15.69	23.05	19.37^a
RB 867515	18.85	23.19	21.02^a
RB 855536	20.02	24.27	22.14^a
IAC 862480	16.51	21.65	19.08^a
Means	17.77^B	23.04^A	
CV (%) = 9.39			

Means followed by the same uppercase letters (row) and lowercase letters (column) do not differ by Tukey's test ($p > 0.05$); CV = coefficient of variation.

The *brix* rates differ among the varieties ($p < 0.05$) with IAC 862480 at the lowest (18.39%) and RB 867515 at the highest (21.39%) value. The *brix* value variations, observed in this study, in which sugarcane varieties were harvested when approximately 10 months old, were a little higher than those reported by Oliveira et al. (1999), who observed rates ranging between 18.22 and 19.96%. In Animal Science literature *brix* has been used because, besides indicating sugarcane sugar levels (OLIVEIRA et al., 1999; RODRIGUES et al., 1997), it also presented other soluble non-sugar compounds, such as aminoacids, fat, wax, dye matters, organic acids and inorganic solids, corresponding to the rapidly degraded fraction in the rumen. In animal nutrition, *brix* is a more complete non-fibrous carbohydrates measure, since it represents all high degradability carbohydrates, rather than only sucrose. Since there was no difference ($p > 0.05$) in *brix* values between hydrolyzed and non-hydrolyzed sugarcane, quicklime hydrolysis does not directly affect the final sugar concentration in sugarcane.

Industrial fiber concentration did not differ among varieties ($p > 0.05$), even though this parameter is usually considered a varietal characteristic. From the industrial viewpoint, the raw-material is considered to be constituted of two parts, fiber and absolute broth. Thus, industrial fiber corresponds to cellulose, pentosan, lignin and sugarcane gum, or rather, to the sample percentage that is not absolute broth. Hydrolyzed sugarcane had higher industrial fiber concentration (23.04%; $p < 0.05$) when compared to non-hydrolyzed ones (17.77%). This may have happened due to the calcium oxide application, since industrial fiber measurement considers the wet sample weight. The greater this weigh, the greater the industrial fiber.

Tables 3 and 4 show that there was no interaction ($p > 0.05$) between variety and treatment (hydrolyzed or not) in dry matter, organic matter, crude protein, neutral detergent fiber, acid detergent fiber and lignin concentrations. Dry matter levels differ among sugarcane varieties ($p < 0.05$). This is probably due to that fact that this characteristic is linked to diverse photosynthetic capacity of the genotypes. Variety RB 855536 had the highest dry matter level (30.46%) and variety IAC 862480 (26.67%) the lowest. There was no difference ($p > 0.05$) in dry matter levels of hydrolyzed or non-hydrolyzed sugarcane. Analyzing three intermediate cycle sugarcane varieties for animal nutrition, Azevêdo et al. (2003) reported a variation in dry matter levels from 27.4 to 30.2%, which is similar to the present study.

Table 3. Dry matter, organic matter and crude protein levels of four sugarcane varieties treated or not with quicklime.

Variety	Treatment		Means
	Non-hydrolyzed	Hydrolyzed	
DM (%)			
SP 52454	28.61	29.75	29.18^{ab}
RB 867515	29.88	29.79	29.83^{ab}
RB 855536	30.97	29.96	30.46^{a}
IAC 862480	26.44	26.90	26.67^{b}
Means	29.10^{A}	28.97^{A}	
CV (%) = 7.69			
OM (% DM)			
SP 52454	93.93	93.44	93.69^{a}
RB 867515	95.70	94.17	94.93^{a}
RB 855536	96.55	95.42	95.99^{a}
IAC 862480	94.26	92.51	93.38^{a}
Means	95.11^{A}	93.89^{A}	
CV (%) = 3.51			
CP (% DM)			
SP 52454	3.42	2.63	3.03^{b}
RB 867515	2.41	2.39	2.40^{c}
RB 855536	2.81	3.10	2.95^{b}
IAC 862480	3.68	3.49	3.58^{a}
Means	3.08^{A}	2.90^{A}	
CV (%) = 9.10			

Means followed by the same uppercase letters (row) and lowercase letters (column) do not differ by Tukey's test ($p > 0.05$); CV = coefficient of variation.

There was no difference in the concentration of organic matter among sugarcane varieties and between treatments (hydrolyzed or not) ($p > 0.05$). Even when calcium oxide was applied, OM values remained constant. Concentration of crude protein differed according to the variety ($p < 0.05$). In fact, IAC 862490 had the highest rate (3.58%), while RB 867515 had the lowest (2.40%). This kind of variation in crude protein levels was also reported by Azevêdo et al. (2003), who observed rates between 2.4 and 2.8%. There was no difference in CP concentration between hydrolyzed or non-hydrolyzed sugarcane ($p > 0.05$), which was already expected, since the product did not have a nitrogen source.

Table 4. Neutral detergent fiber, acid detergent fiber and lignin from four sugarcane varieties treated or not with quicklime.

Variety	Treatment		Means
	Non-hydrolyzed	Hydrolyzed	
NDF (% DM)			
SP 52454	51.16	47.62	49.39^{a}
RB 867515	49.10	52.71	50.90^{a}
RB 855536	50.08	52.35	51.21^{a}
IAC 862480	46.84	47.75	47.30^{a}
Means	49.29^{A}	50.11^{A}	
CV (%) = 9.25			
ADF (% DM)			
SP 52454	31.36	30.68	31.02^{a}
RB 867515	30.13	31.77	30.95^{a}
RB 855536	37.68	31.20	34.44^{a}
IAC 862480	29.67	30.08	29.88^{a}
Means	32.21^{A}	30.93^{A}	
CV (%) = 18.18			
Lignin (% DM)			
SP 52454	6.35	5.94	6.15^{a}
RB 867515	6.26	6.57	6.42^{a}
RB 855536	6.24	5.60	5.92^{a}
IAC 862480	7.57	5.43	6.50^{a}
Means	6.61^{A}	5.89^{A}	
CV (%) = 18.91			

Means followed by the same uppercase letters (row) and lowercase letters (column) do not differ by Tukey's test ($p > 0.05$); CV = coefficient of variation.

There was no difference in neutral detergent fiber, acid detergent fiber and lignin among the studied varieties ($p > 0.05$), as well as between the treatments (hydrolyzed or not). The NDF values varied from 47.30 to 51.21% in this study, respectively for IAC 862480 and RB855536. The tendency of a lower NDF concentration in IAC 862480 was already expected due to its specific development in animal nutrition, with plants featuring less fiber in their composition. Studying the bromatological composition of three sugarcane varieties, Azevêdo et al. (2003) failed to observe any difference in NDF and ADF levels. These authors reported NDF values between 43.8 and 47.6% and ADF values between 25.2 and 27.8%. On the other hand, when they compared a group of early and intermediate cycle sugarcane varieties, Fernandes et al. (2003) reported that early cycle plants had higher NDF and ADF concentrations than the intermediate cycle ones. The authors also observed that lignin did not differ among the variety or production cycles. In current study, the absence of difference in lignin levels may be explained by the fact that lignin is linked to the ADF fraction, which did not differ among varieties.

Ether extract levels differed among varieties ($p < 0.05$), albeit not between treatments (hydrolyzed or not) ($p > 0.05$). Variety SP 52454 had the highest EE concentration (1.39%), and the other three varieties had similar levels. There were no difference in non-fibrous and total carbohydrates levels among varieties or treatments (hydrolyzed or not) ($p > 0.05$). Azevêdo et al. (2003) registered total carbohydrates rates between 95.2 and 95.9%.

Table 5. Ether extract, non-fibrous carbohydrates and total carbohydrates levels of four sugarcane varieties treated or not with quicklime.

Variety	Treatment		Means
	Non-hydrolyzed	Hydrolyzed	
	EE (% DM)		
SP 52454	1.42	1.37	1.39^{a}
RB 867515	1.27	1.01	1.14^{b}
RB 855536	0.93	1.27	1.10^{b}
IAC 862480	0.92	0.99	0.95^{b}
Means	1.14^{A}	1.16^{A}	
CV (%) = 10.35			
	NFC (% DM)		
SP 52454	37.93	41.82	39.87^{a}
RB 867515	42.93	38.05	40.49^{a}
RB 855536	42.73	38.70	40.71^{a}
IAC 862480	42.82	40.28	41.55^{a}
Means	41.60^{A}	38.71^{A}	
CV (%) = 6.04			
	TC (% DM)		
SP 52454	89.09	89.44	89.26^{a}
RB 867515	92.03	90.76	91.39^{a}
RB 855536	92.81	91.05	91.93^{a}
IAC 862480	89.66	88.04	88.95^{a}
Means	90.90^{A}	89.82^{A}	
CV (%) = 3.89			

Means followed by the same uppercase letters (row) and lowercase letters (column) do not differ by Tukey's test ($p > 0.05$); CV = coefficient of variation.

There was no interaction between variety and treatment (hydrolyzed or not) ($p > 0.05$) for dry matter *in vitro* digestibility (DMIVD), neutral detergent fiber *in vitro* digestibility (NDFIVD) and acid detergent fiber *in vitro* digestibility (ADFIVD). There was no difference ($p > 0.05$) in DMIVD among the sugarcane varieties or treatments (hydrolyzed or not) under analysis (Table 6). Hydrolyzed sugarcane had higher NDFIVD and ADFIVD than non-hydrolyzed ones ($p < 0.05$). Mota et al. (2010), evaluating the *in vitro* digestibility of IAC 862480, hydrolyzed with 0.5% quicklime, obtained rates of 60.57, 38.83 and 38.84% for DMIVI, NDFIVD and ADFIVD, respectively, which were higher than those observed in this study for the same variety. According to the results reported by some authors (DOMINGUES et al., 2011; MOTA et al., 2010), hydrolysis with 0.5 kg quicklime in 2 liters of water for 100 kg of chopped sugarcane is sufficient to alter the plant cell wall, with an enhancement in DMIVD, NDFIVD and, eventually, ADFIVD.

Table 6. Dry matter, neutral detergent fiber and acid detergent fiber *in vitro* digestibility of four sugarcane varieties treated or not with quicklime.

Variety	Treatment		Means
	Non-hydrolyzed	Hydrolyzed	
	DMIVD (%)		
SP 52454	59.24	55.39	57.32^{a}
RB 867515	60.86	56.92	58.39^{a}
RB 855536	59.15	56.63	57.89^{a}
IAC 862480	59.45	59.81	59.63^{a}
Means	59.68^{A}	57.19^{A}	
CV (%) = 4.76			
	NDFIVD (%)		
SP 52454	23.50	31.27	27.38^{a}
RB 867515	25.92	28.85	27.38^{a}
RB 855536	17.20	25.80	21.50^{a}
IAC 862480	20.71	30.69	25.70^{a}
Means	21.83^{B}	29.15^{A}	
CV (%) = 16.41			
	ADFIVD (%)		
SP 52454	16.50	27.98	22.24^{a}
RB 867515	24.42	26.37	25.39^{a}
RB 855536	22.26	31.91	27.08^{a}
IAC 862480	19.49	32.09	25.79^{a}
Means	20.67^{B}	29.59^{A}	
CV (%) = 5.95			

Means followed by the same uppercase letters (row) and lowercase letters (column) do not differ by Tukey's test ($p > 0.05$); CV = coefficient of variation.

The chemical composition and NDF digestibility may be partially manipulated in the selection of varieties with higher digestibility (FREITAS et al., 2006), by the plant maturity stage at harvest (FERNANDES et al., 2003) or by alkalizing agents that alter the plant's fiber composition. The colonization and digestion of the fiber is thus facilitated by the activity of the rumen microorganisms. According to Spanghero et al. (2009), the dry matter intake may be predicted, in part, by diet NDF concentration and by the correlation between ADF, digestibility and physical rumen filling. In ruminant nutrition, the effect of quicklime in the NDF would enhance its digestibility and favor its disappearance from the rumen, reducing the physical filling and allowing greater intake. This effect was indeed observed in current study, since hydrolyzed sugarcane had greater NDF digestibility (29.15%). In this context, Oba and Allen (1999) evaluated the effect of forage NDF digestibility in dairy cows performance and observed that an enhancement in NDF digestibility increased dry matter intake and milk production. The elevation of one percent in NDF digestibility has been associated with an increase of 0.17 kg in dry matter intake and of 0.25 kg in milk production, corrected to 4% of fat. Dias et al. (2011), working with crossbred cows (Angus x Nellore), reported higher intake and digestibility of calcium hydroxide hydrolyzed sugarcane when compared to that by non-hydrolyzed sugarcane. Therefore, the effect of quicklime in NDF digestibility is an important parameter in enhancing feed intake and improving the production.

The above-mentioned quicklime effect promotes the cell wall expansion and rupture of tissue components in hydrolyzed forages. Therefore, hydrolysis includes hemicellulose solubilization and an increase in cellulose and hemicellulose digestion, due to fiber expansion (CARRASCO et al., 2010). As reported in current study, lignin levels are not usually affected. However, the quicklime effect results in an increased digestion rate, since there is a reduction in the intermolecular hydrogen bonds which allows the rumen microorganisms to attack the cellulose and hemicellulose. This aspect effectively collaborates to higher NDF digestibility. Whilst enhancing digestibility, hydrolysis provides higher amounts of energy (MOTA et al., 2010) and increases milk production, since it favors the activity of ruminal microorganisms.

Conclusion

Sugarcane hydrolysis with 1% quicklime enhances NDF and ADF *in vitro* digestibility, regardless of sugarcane variety. Hydrolysis with 1% quicklime did not alter the sugarcane chemical-bromatological composition.

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