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Chemical Composition, *In vitro* Digestibility and Drying Rate of Sugarcane Tops Using Different Curing Methods

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የሸንኮራ አገዳ ጫፍ በአገራችን በስኳር ፋብሪካዎች አከባቢና እና በአነስተኛ ሸንኮራ አገዳ አምራች ገበሬዎች ዘንድ የሚገኝ የእንስሳት መኖ ሀብት ነው፡፡ ይሁን እንጂ በሀገራችን እስካሁን የመኖ ጠቃሜታውን ለማሻሻልና በአያያዝ ጉድለት የሚመጣውን ብክነት ለመቀነስ የተካሄደ ጥናት በስፋት የለም። የዚህ ጥናት ዓላማም የርጥብ ሸንኮራ አገዳ ጫፍን ድርቆሽ በማዘጋጀት ሳይበላሽ ለረጅም ጊዜ ለማቆየት እንዲቻል ጥራቱን በተለያዩ የድርቆሽ አዘገጃጀት ዘዴዎች መፈተሽ ነው። ይህም በሳት የተቃጠለና (የተለበለበ) ያልተቃጠለ (ያልተለበለበ) የሸንኮራ አገዳ ጫፍን ሳይከረታተፍና ተከረታትፎ በፀሀይና በጥላ ሥር በማድረቅ ዘዴ የሚዘጋጀውን ድርቆሽ የንጥረ-ነገር ይዘት፣ የመፈጨት ደረጃውንና ለመድረቅ የሚፈጀውን ጊዜ ለመገምገም ነበር። የእያንዳንዱን አሰራር ዘዴ አምስት ጊዜ በመደጋገምና በተለያዩ ጊዜያት ናሙናዎች በመውሰድ አማካይ የድርቀት መጠናቸዉ 85 በመቶ ሲቃረብ በማቆም የናሙናዎች ኬየሚካለዊ ትንተና ተካሂደዋል። በተለበለቡና ባልተለበለቡ የሸንኮራ አገዳ ጫፍ መነሻ ናሙናዎች (fresh/original sugarcane tops) መካከል ያለው የመኖ ንጥረ-ነገር ይዘት ልዩነት የጎላ አልነበረም። ተከርትፈዉ በፀሀይ የደረቁት የሸንኮራ አገዳ ጫፍ ናሙናዎች ሦስት ቀናት ባልበለጠ ጊዜ የደረቁ ሲሆን፤ በአንፃሩ ያልተከረተፉት ናሙናዎች ለመድረቅ ከ45 እስከ 68 ቀናት ወስደዋባቸዋል። በማድረቂያ ዘዴዎችና በሸንኮራ አገዳ ጫፍ ዓይነቶች መለየት ምክንያት በሚንራል(ash)፣ በቃጫ (NDF, ADL)፣በሚሚ ካርቦኃይድሬቶች (NFC)፣ በኃይል ሰጪ (ME)፣ በፎስፈረስ ይዘትና በተፈጭነት ደረጃ (digestibility) ልዩነት ማየት ተችሏል። የማድረቂያ ዘዴዎቹ መለያየት ከናሙናዎቹ ድርቀት(DM) እና ፕሮቲን ይዘት ዉጪ በሌሎች ንጥረ-ነገሮች ይዘቶች ላይ ልዩነት አልነበራቸዉም። በሌላ በኩል በፀሀይ የደረቀ ያልተከረተፈ-የተቃጠለ የሸንኮራ አገዳ ጫፍ ድርቆሽ የቃጫ(NDF) ይዘት አነስተኛና በፀሀይ ከደረቀው ያልተከረተፈ-ያልተቃጠለ ናሙና ልዩነት የለውም። በአንፃሩ የተከረተፉና በፀሐይ የደረቁ ናሙናዎች ሳይከረተፉ ከደረቁት ናሙናዎች በሚሚ ካርቦሀይድሬት፣ በቅባትና በሄማይሴሉለስ-ቃጫ ይዘት ከፍተኛ ሆነው በADF-ቃጫ ይዘት በእጅጉ ያነሱ ናቸዉ። በአጠቃላይ ከሸንኮራ አገዳ ጫፍ ድርቆሽ ለማዘጋጀት መከርተፍና በፀሀይ ማድረቅ የሚወስደዉን ጊዜ በእጅጉ ይቀንሳል፣ ብልሽትንና የንጥረ-ነገር ብክነትን በመቀነስ የመኖ ጠቀሜታውን ያጎላል።

Abstract

This study was conducted to evaluate effects of different drying methods on chemical composition, in vitro digestibility and drying rate of sugarcane tops (SCT). Treatments were set in factorial arrangement (2 SCT types (green and burnt) x 3 drying methods (shed and sun drying of intact SCT and sun drying of chopped SCT) in a completely randomized design. Each treatment was replicated 5 times and samples were dried at a swath density of 4 kg/m^2. Dry matter (DM) of samples was determined at time interval until the treatment average approached the safest content (≈ 85% DM) for storage. Fresh (samples at harvesting) and dried samples were chemically analyzed. The fresh burnt SCT had slightly higher DM, ash, EE, ADL, Ca, P, IVDMD, IVOMD and ME contents, but had lower CP and NFC contents than the fresh green SCT. The chopped burnt and green SCT dried at a rate of 19.8 and 20.7% per day, respectively. Rate of drying was highest in the 1st week for all drying methods, then after decreased progressively. The lowest dehydration rate (0.92 and 0.99% per day), or longest drying time (68 and 60 days) was attained by shed dried intact green and burnt SCT, respectively. There were significant interaction effects ($P<0.05$) of drying methods and SCT types on ash, NDF, ADL, IVDMD, IVOMD, ME, NFC and P *contents. Except for DM and CP, the drying methods had varied (P<0.0001) effect on nutrient content of SCT. The NDF content of burnt SCT was lower (P<0.05) for intact sun dried samples compared to other drying methods, but values for the green SCT did not vary (P>0.05) among the drying methods. However, ADF contents of sun- and shed dried intact SCT were not different (P>0.05), but were higher (P>0.05) than that of chopped sun-dried SCT. The sun-dried chopped SCT had higher (P<0.05) ether extract (EE) and hemicelluloses contents. However, sun-dried chopped green SCT had lower NDF and ADL than sun-dried chopped burnt SCT, but were similar (P>0.05) in DM, OM digestibility and ME contents. The NFC content was inversely related to the fiber fraction, being lower (P<0.05) for sun-dried chopped burnt SCT and shed-dried intact burnt SCT. The under shed dried intact green SCT had higher NFC content than sun dried chopped green SCT (P<0.05). In conclusion, the drying methods used in this study had variable effect on chemical composition, although lacks consistency in the trend. Chopping SCT clearly increases drying rate, shorten drying period and conserve nutrients that has been reflected in better in vitro digestibility and ME.*

Introduction

Feed is one of the major inputs accounting for 75-80% of livestock production cost in Ethiopia (Demissie, 2017). Natural pasture and crop residues have the largest share (54.6 and 31.6%) of available feed resources (CSA, 2017), but have low digestibility and low voluntary intake, limiting potential performances of animals (Adugna, 2008). On the other hand, nutrient rich feeds such as grains, oil seed cakes, bran, and improved forage crops are inadequate, inaccessible, or unaffordable to most of livestock producers, which consequently increased the price of animal products. Generally, feed supply in Ethiopia is incongruent to demand.

One option of reducing the gap in feed supply and demand is through efficient utilization of cheap non-conventional feeds (Tegene *et al*., 2009) such as sugarcane tops (SCT). Abundant SCT are available at sugar factories and small-scale farms. Report has shown that the annual production of SCT will increase from 622,805 tons in 2016 to 1,833,962 tons in 2020, owning to the expansion of old sugar factories and establishment of new ones (EMAPRM, 2016). Sugarcane tops are often left in the farm after burning the field for cane stalks harvesting, and the harvesting season (October to June) coincides with green forage scarce period. However, at small-scale farms, green SCT is harvested when the stalk is cut for marketing to generate money. It is potential sources of feeds for livestock feeding, but should be augmented with protein rich feeds (Adugna, 2007, Naseeven, 1988). Studies have shown that inclusion of SCT in the diet of ruminant increases performance and reduces cost of production (Noroozy and Alemzadeh, 2006; Riaz *et al*., 2008; Mahala *et al*., 2013; Anteneh *et al*., 2015).

In Ethiopia, smallholder farmers in the vicinity of sugar factories conserve SCT for use during times of feed scarcity. Farmers collect SCT using family labor from cane field post-harvesting, or purchase from local collectors and stack in an open air, or under shed for over three months. Storing SCT is done without due consideration to proper drying before storage. In a preliminary assessment, livestock owners witnessed that SCT stored for long period develop mold, becoming inedible to animals and thus wasted. Hence, the surplus SCT obtained during cane harvesting should be properly dried to avoid spoilage and retain nutritional quality. However, information on proper ways of hay making of SCT is lacking. Therefore, this study was aimed to evaluate the effect of sun and shed drying of intact and chopped SCT (green or burnt) on rate of drying, nutrient composition and digestibility of the SCT hay.

Materials and Methods

Study site

The study was undertaken at Debre-Zeit Agricultural Research Centre (DZARC), located at 45 km southeast of Addis Ababa (08°44'N latitude, 38°58'E longitude; altitude of 1900 meters above sea level). The area is known for bimodal rainfall distribution (June to September and March to May), with an average annual rainfall of 814 mm and minimum and maximum temperature of 10.9 and 28.3°C, respectively (DZARC, 2017). During experimental period (December 25, 2016 to March 2, 2017), the daily temperature (˚C), relative humidity (%) and wind speed (m/s) ranged 7.6-27.5, 39-66, 0.01-3.65, respectively, while there was no rainfall throughout (Figure 1).

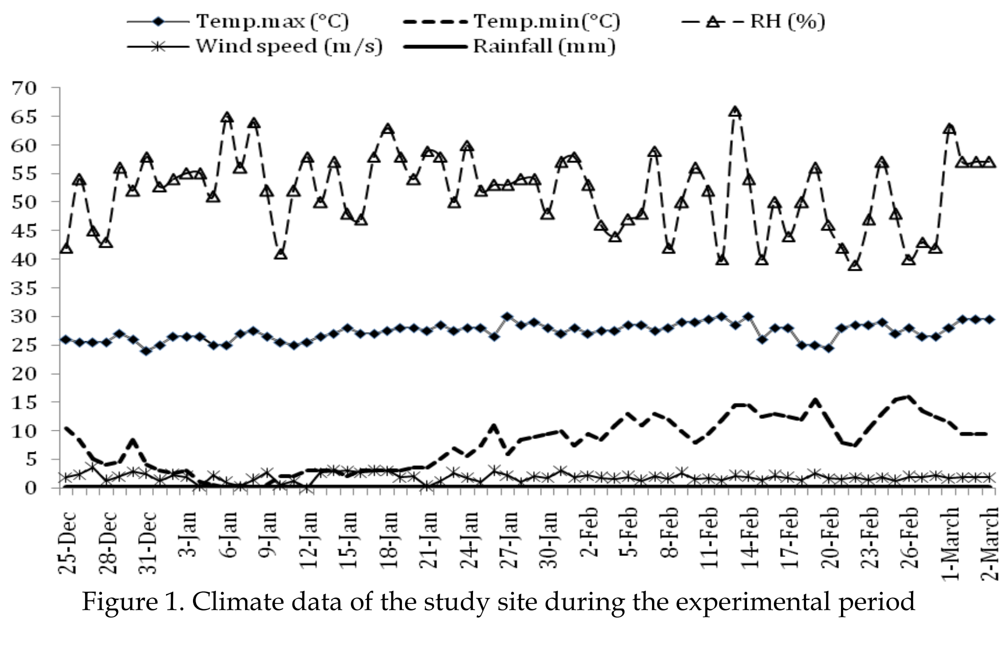

Figure 1. Climate data of the study site during the experimental period

Experimental design and treatments

The study was designed in a 2 x 3 factorial arrangement of treatments in a completely randomized design (CRD). Treatments were 2 SCT types (green and burnt) and 3 drying methods (sun drying of intact SCT, sun drying of chopped SCT, under shed drying of intact SCT).

Sampling and drying procedure

Sugarcane tops of variety N-14 (Natal) were collected from Wonjishoa sugar factory plantation. The cane was grown on heavy black soil (*Vertisols*), 23 months old and harvested at 1st stage of cutting after planting. Sampling was done randomly at six marked specific sites at interval of 17 meter along a gradient line (diagonally and horizontally) in one hectare cane field. The green SCT was sampled right before burning sugarcane field, while the burnt SCT after burning from the same site. The cutting point for SCT sampling was as used by the staff (cutters) of the sugar factory for cane harvesting. After cutting, the samples were put into polyethylene bags and immediately transported to the research center.

At arrival, the burnt and green SCT samples were mixed thoroughly and independently. About one-third of each forage type was chopped into 2-5 cm length using electrically operating forage chopper (Ethio Chopper) and was dried under sun. The remaining intact sample per SCT type was divided into two equal parts for drying under shed and in the sun. Each treatment (drying method) was replicated 5 times and the replicates were spread uniformly on a sack each at swath density of 4 kg/m^2. The shed used for the under shed drying was high roofed, well-ventilated and protected SCT from exposure to direct sun light. For all drying methods, samples were turned twice daily at 10:00 AM and 9:00 PM. Forage samples were taken per replicate at day 0, 1, 2, 3, 8, 18, 24, 34, 45, 51, 60 and 68 for DM determination. At each sampling day, about 120 g of SCT was taken per replicate and care was taken to sample proportionally from the stem and leaf fractions. According to the drying method, forage drying was terminated when the average DM content of the respective treatment approached 85%, at which microbial damage becomes minimal and the hay is ideal for storage (Andy *et al.*, 1987; McGechan, 1990).

Chemical analysis of samples

Representative samples of the fresh forages were taken and weighed right after cutting (day 0). Samples taken during the course of drying were chopped, dried in a forced air oven and ground to a 1.0 mm size in a Wiley mill. The ground samples were stored in a deep freezer (-20°C) pending laboratory analysis. Dry matter, crude protein (CP=Nitrogen*6.25), ash, ether extract (EE), calcium (Ca) and phosphorus (P) contents were determined according to the procedures of AOAC (1990), while neutral detergent fiber (NDF), acid detergent fiber (ADF) and acid detergent lignin

(ADL) contents were analyzed according to Van Soest and Robertson (1985). The *in vitro* organic matter and dry matter digestibility coefficients (IVOMD and IVDMD) were determined applying a two-stage digestion process of Tilley and Terry (1963). Non-fibre carbohydrate (NFC%) were determined as 100–(CP% + Ash% + EE% + NDF%) (Hall, 2000). Metabolizable energy (ME, MJ/kg DM) was determined as IVDOMD (g/kg DM) *0.016 (McDonald *et al.*, 2010) and Hemicelluloses as NDF-ADF. Drying rate (%/day) = ((% initial moisture - % final moisture)/drying duration (days))*100.

Statistical analysis

Data was analyzed using General Linear Model procedure of SAS (SAS, 2004). When interaction between factors was non-significant, only main effect means were presented and discussed, otherwise simple effect means were presented. Treatment means were separated using Tukey test. The statistical model was: $Y_{ij} = \mu + \alpha_i + \beta_j + (\alpha\beta)_{ij} + \varepsilon_{ij}$. Where; Y_{ij} is the response variable; μ = Overall mean; α_i = the effect of SCT type; β_j = Effect of drying methods; $(\alpha\beta)_{ij}$ = Interaction effect of SCT type and drying methods; ε_{ijk} = random error.

Results and Discussion

Chemical composition of fresh sugarcane tops

The burning of sugarcane field for harvesting had only slight effect on dry matter and nutrient composition of SCT (Table 1). The burnt SCT DM, ash, EE, ADL, Ca, P, IVDMD, IVOMD and ME contents were higher by 18.6%, 8.3%, 16.4%, 18.5%, 47.4%, 73.68%, 2.3%, 2.5% and 2.5%, respectively, over that of green SCT due to loss of moisture and/or organic matter during burning. Burnt SCT had slightly lower contents of CP and NFC than green SCT. Similarly, a none to slight change in DM, CP, ash and fiber components (except ADL) due to burning SCT were reported by other studies (Gendley *et al.*, 2002; Magaña *et al.,* 2009; Ramírez-Cathí *et al.,* 2014; Alemayehu *et al.,* 2014; Anteneh, 2014). The CP content of SCT is below the minimum level (<70 g/kg DM) required to maintain an adequate ruminal fibrolytic activity (Sampaio *et al.*, 2009). However, CP contents of SCT higher than the present results were reported (Akinbode *et al.*, 2017; Sharma *et al.,* 2012; Khanal *et al.*, 1995), and differences might relate to cane varieties, cutting phase, and level of nitrogen fertilizer used.

Table 1. Dry matter (%) and nutrient contents (% DM unless specified) of green and burnt sugarcane tops at harvesting

Parameter	Sugar cane top type	
	Burnt	Green
Dry matter (%)	27.3	23.1
Crude protein (% DM)	2.45	2.77
Ash (% DM)	11.7	10.8
Ether extract (% DM)	1.42	1.22
Neutral detergent fiber (% DM)	68.8	68.4
Acid detergent fiber (% DM)	39.2	39.2
Acid detergent lignin (% DM)	6.40	5.40
Hemicellulose (% DM)	29.6	29.2
Calcium (% DM)	0.56	0.38
Phosphorous (% DM)	0.33	0.19
In vitro dry matter digestibility (%)	53.2	52.0
In vitro organic matter digestibility (%)	48.2	47.0
Metabolizable energy (MJ/kg DM)	7.71	7.52
Non-fiber carbohydrates (% DM)	15.63	16.81

DM=dry matter, MJ=mega joule

Drying rate and DM content of SCT

Drying methods had effect ($P<0.0001$) on moisture loss of SCT as evidenced by different dehydration rates (Figure 2 and Table 2). However, the average dehydration rate was not affected by SCT type ($P>0.05$). The sun-dried chopped burnt and green SCT achieved 86.4% and 85.3% DM at day 3, loosing moisture at a rate of 19.8 and 20.7% per day, respectively, which significantly ($P<0.0001$) surpassed the other drying methods. However, the mean DM contents of SCT over the drying period did not differ significantly ($P>0\text{-}05$) among curing methods. It was reported that chopping forages increases drying rate, as it breaks stem and damages its waxy cuticle, allowing more water removal (Undersander, 2011). Except for chopped SCT, rate of drying during the 1st 8 days was nearly equal for the other drying methods, at which the sun and shed dried intact green SCT lost moisture at a rate 2% and 1.9% per day, respectively. Similarly, the respective moisture loss rate, during the first 18 days, for the sun and shed dried intact burned SCT was 1.4% and 1.2% per day.

The dehydration rates of sun and shed dried intact green and burnt SCT did not differ ($P>0.05$) until day 45. Dehydration rate was subsequently decreasing and drying rate for intact sun dried was higher than shed dried samples (Table 2). Higher moisture loss rates for the intact SCT between days 18 and 24 was probably related to the drop in the relative humidity (RH) (<60%) and the rise in temperature during this period (Figure 1).

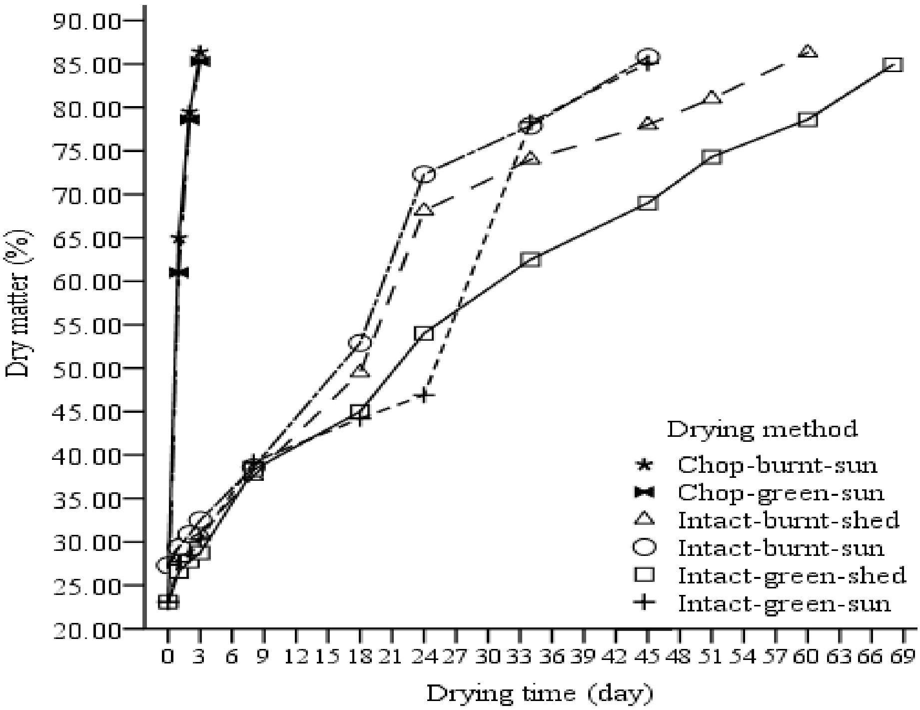

Figure 2. Dehydration curve of intact or chopped green and burnt sugarcane tops dried in the sun and shed

Table 2. Average drying rate (% per day) and dry matter content (%) over the drying period of burnt and green SCT subjected to different drying methods

Parameter	Drying methods (T)				SCT type			*P*-value		
	Intact, sun dried	Chopped, sun dried	Intact, shed dried	SEM	Burnt	Green	SEM	SCT type	T	SCT type x T
Drying rate	1.35[b]	20.27[a]	0.96[c]	0.167	7.37	7.69	0.140	0.1094	<0.0001	0.2006
DM content	47.3	63.2	52.5	6.27	56.0	52.6	5.24	0.6491	0.2912	0.9877

[a-c]Means with different superscript within treatment and SCT type in the same row differ (P < 0.05); SEM=standard error of the mean; DM=dry matter; SCT= sugarcane tops

The overall lowest moisture loss rates were attained by shed dried intact green SCT (0.9% per day) and burnt SCT (1% per day), which took 68 and 60, respectively to attain the safest moisture content for storage (average final DM = 85.6%). Collins and Owens (2003) stated that attaining moisture content below 20% is difficult with thick-stemmed forages as the greater radial distance between stem core and epidermis slows water movement for removal. Hence, conditioning is essential to split or crack the thick stem and hasten drying process (Collins and Owens 2003; Alemu *et al.*, 2007). According to Undersander (2011), plant respiration rate was highest at cutting and decreases until moisture content drops below 60%, while Rotz (2003) stated this effect persists up to 40% moisture content. In this study, it appeared that the higher moisture contents of intact SCT until day 24 (DM<60%,

Figure 2) might have favored plant respiration. For shed dried green SCT, this effect was extended to day 34 of drying. Hence, actions that facilitate rapid drying is crucial to reduce plant respiration and preserve nutrients.

Effect of drying method on SCT quality

The EE, ash, IVDMD, IVOMD, ME and NFC contents decreased slightly, while NDF, ADF and hemicelluloses increased in both green and burnt SCT in the process of hay making (Table 1 and 3). The CP content of burnt SCT remains almost unchanged while that of green SCT decreased by about 8%. Such losses of nutrients could be attributed to the extended plant respiration and microbial action due to delayed moisture removal. The quality of the hay depends on the extent of moisture loss (Coblentz *et al*., 2000) that in turn influenced by plant factors, climatic condition and management type (Collins and Owens, 2003; Rotz and Shinners, 2007). However, leaf shattering during hay making from SCT was not observed and be not a cause for nutrient loss, as opposed to most herbaceous forage crops. Similarly, a significantly decreased CP, but increased NDF, ADF and ADL contents of native grass and Brachiaria grass during hay making were reported (Enoh *et al*., 2005). Remarkably, green SCT dried in shed retained its original leaf color (green), while the color was bleached with other drying methods due to damage of chlorophyll. According to Roberts (1995), color change through bleaching and excessive drying reduces the palatability of the hay and hence reduces feed intake.

The DM and CP content of SCT was unaffected (P>0.05) by both drying method and SCT type (Table 3). Ether extract content of SCT was highest for chopped and lowest for shed-dried intact SCT (P<0.05), while values for the burnt and green SCT was similar (P>0.05). There were significant interaction (P<0.05) effect of drying methods and SCT types on ash, NDF, ADL, IVDMD, IVOMD, ME, NFC and P contents. Except for the intact sun dried treatment, the NDF content was lower (P<0.05) in the green than burnt SCT for the other two drying methods. The NDF content was lower (P<0.05) for intact sun dried as compared to the other drying methods for the burnt SCT, but values for the green SCT was similar (P>0.05) among drying methods. Differences noted for the burnt SCT might indicate loss of soluble sugars with prolonged drying under shed, which delayed moisture removal and favored plant respiration and microbial fermentation (Dzowela *et al*., 1995); or increased the surface area of chopped burnt SCT that might have favored yeast growth on sugar, leading to loss of non-fiber components (Rotz, 2003). However, a similar trend was not observed for ADF content where values for sun- and shed dried intact SCT were similar (P>0.05), while the value for chopped sun dried was lower (P< 0.0002) than the other two drying methods. The lack of difference in the fiber fraction of sun dried and shed dried intact green SCT noted in this study could be attributed to only slight temperature differences between the two drying areas (27.4°C in sun and 25.6°C in shed drying).

The hemicellulose content was higher (*P*<0.05) for sun-dried chopped SCT, while values were similar for shed and sun dried intact SCT. The green SCT had lower (*P*<0.0001) hemicelluloses content than burnt SCT, implying that the prolonged drying period might have favored decomposition of some green SCT hemicelluloses in to pentose sugar. The NFC content showed opposite trend to that of the fiber fraction and was lower (*P*<0.05) in the sun-dried chopped burnt SCT and shed-dried intact burnt SCT. However, under shed dried intact green SCT had higher NFC content than sun dried chopped green SCT (*P*<0.05). Yuangklang *et al* (2003) reported that the chopped sugarcane tops dried in sun for 3 to 4 days had higher content of CP (4.1%) and ash (15.3%), but low NDF (41.3%), ADF (23.2%) and ADL (3.4%) than the present results.

Table 3. Nutrient contents (% DM) and *in vitro* digestibility of green and burnt sugarcane tops (SCT) made by different drying methods

Parameter	SCT type	Drying methods (T)				SCT type			*P*-value		
		Intact, sun dried	Chopped, sun dried	Intact, shed dried	SEM	Burnt	Green	SEM	SCT type	T	SCT type x T
Dry matter %		85.45	85.83	85.62	1.00	86.17	85.10	0.81	0.3609	0.9652	0.9780
Ash	Burnt	9.62^{c}	11.10^{ab}	10.30^{bc}	0.18				0.1557	<.0001	<.0001
	Green	10.90^{ab}	11.20^{a}	9.58^{c}							
Crude protein		2.51	2.56	2.47	0.07	2.47	2.56	0.06	0.3282	0.6642	0.1913
Ether extract		0.90^{c}	1.36^{a}	1.14^{b}	0.05	1.14	1.12	0.04	0.7125	<.0001	0.6291
NDF	Burnt	70.40^{b}	72.91^{a}	73.20^{a}	0.47				<.0001	0.0025	0.0362
	Green	69.20^{b}	70.12^{b}	69.40^{b}							
ADF		39.50^{a}	37.70^{b}	41.10^{a}	0.47	38.93	39.93	0.39	0.0793	0.0002	0.5912
ADL	Burnt	6.04^{a}	6.25^{a}	6.47^{a}	0.24				0.0258	0.0007	0.0008
	Green	6.38^{a}	4.56^{b}	6.41^{a}							
Hemicellulose		30.30^{b}	33.82^{a}	30.20^{b}	0.61	33.24^{a}	29.64^{b}	0.50	<.0001	0.0003	0.1097
IVDMD	Burnt	47.56^{abc}	48.29^{ab}	46.70^{bcd}	0.55				0.0096	<.0001	0.0043
	Green	44.28^{d}	49.26^{a}	45.07^{cd}							
IVOMD	Burnt	42.15^{abc}	43.48^{ab}	41.93^{abc}	0.77				0.0545	0.0003	0.0237
	Green	38.85^{c}	44.77^{a}	40.04^{bc}							
ME (MJ/kg DM)	Burnt	6.88^{ab}	6.96^{ab}	6.71^{abc}	0.14				0.0441	0.0028	0.0232
	Green	6.22^{c}	7.16^{a}	6.41^{bc}							
NFC	Burnt	16.74^{ab}	12.07^{d}	12.82^{cd}	0.52				<.0001	<.0001	0.0002
	Green	16.31^{ab}	14.76^{bc}	17.2^{a}							
Calcium	*Burnt*	0.58^{b}	0.59^{b}	0.68^{a}	0.02	0.61	0.63	0.01	0.3723	0.0004	0.1990
Phosphorous	Burnt	0.33^{abc}	0.31^{bc}	0.37^{ab}	0.02				0.0017	<.0001	<.0001
	Green	0.16^{d}	0.28^{c}	0.41^{a}							

Means with different superscript within treatment and SCT type in the same row differ (P < 0.05); SEM=standard error of the mean; DM=dry matter; NDF=neutral detergent fiber; ADF=acid detergent fiber; ADL=acid detergent lignin; IVDMD=In-vitro dry matter digestibility; IVOMD=In-vitro organic matter digestibility; ME=metabolizable energy; NFC=non-fiber carbohydrate

In vitro DM and OM digestibility and ME contents of burnt SCT were not affected (*P*>0.05) by the drying methods. For the green SCT, *in vitro* DM and OM digestibility and ME contents were higher for chopped sun dried as compared to the other drying methods. This is consistent with the lower ADF content in chopped sun dried SCT. It is concluded that chopping SCT increases drying rate, shorten drying period, and conserve nutrients that has been reflected in better *in vitro* digestibility and ME. However, detailed study is warranted to evaluate impact of drying methods on nutrient losses and microbial load of SCT and impact on animal performance.

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