EFFECT OF LEVEL OF DRY MATTER AND SOURCE OF SOLUBLE CARBOHYDRATE ON CHEMICAL COMPOSITION OF CORN STOVER SILAGE

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ABSTRACT

The study was conducted in the nutrition laboratory belongs to the Animal Production Department - College of Agriculture/Al-Qasim Green University to investigate the effect of the level of dry matter (DM) of yellow corn stover (YCS), 25, 30, 35 and 40% and the soluble carbohydrates sources (SCS), cane molasses (C-M), date molasses (D-M) and corn flour (C-F) on the chemical composition of produced silage. The results showed that the increase in the level of DM of those materials led to a significant increase (P<0.01) in the DM and ash contents of silage samples produced, while its crude protein (CP) content was decreased (P<0.01) especially in the samples made with a level of 35% DM in which this content was decreased to 5.86%.

The percentages of cell wall components were also decreased with the increasing of the DM level, samples of silage made with the levels of 35 and 40% DM were characterized by the lower (P<0.01) content of the neutral detergent fiber (NDF) of 63.64 and 64.71% respectively. The lower (P<0.01) content of the acid detergent fiber extract (ADF, 33.33%) was found in samples made with a level of 35% DM. While the higher (P<0.01) content of hemicellulose (33.20%) was associated with the samples made with a level of 25% DM. With regard to the effect of the SCS, the results showed that a higher (P<0.01) DM content was associated with the silage samples made by the addition of C-F, while the CP content was significantly (P<0.01) increased to 6.25 and 6.34% in the samples made by the addition of C-M and C-F respectively. It was also observed that the addition of C-M and D-M led to a significant decrease (P<0.01) in the NDF, ADF and hemicellulose contents. While the addition of C-F led to a significant decrease (P<0.01) in the content of lignin (ADL) to 17.11% and cellulose to 11.17%.

Key words: silage, corn stover, dry matter, soluble carbohydrates source

تأثير مستوى المادة الجافة ومصدر الكربوهيدرات الذائبة على التركيب الكيميائي لسايلج سيقان واوراق الذرة الصفراء

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الملخص

اجريت الدراسة في مختبر التغذية الخاص بقسم الانتاج الحيواني التابع الى كلية الزراعة / جامعة القاسم الخضراء للتحري عن تأثير مستوى المادة الجافة في سيقان واوراق الذرة الصفراء, 25 و 30 و 35 و 40% ومصدر الكربوهيدرات الذائبة, مولاس قصب السكر ومولاس الدبس وطحين الذرة على التركيب الكيميائي للسايلج المنتج. اظهرت النتائج ان زيادة مستوى المادة الجافة في تلك المولد ادت الى ارتفاع معنوي (P<0.01) في محتوى نماذج السايلج المنتج من المادة الجافة والرماد فيما انخفض (P<0.01) محتواها من البروتين الخام سيما في النماذج المصنعة بمستوى 35% مادة جافة التي انخفض ذلك المحتوى فيها الى5.86%. كما تراجعت نسب مكونات جدران الخلايا بزيادة مستوى المادة الجافة, وتميزت النماذج المصنعة بمستوى 35 و 40% مادة جافة بأقل (P<0.01) نسبة من مستخلص الالياف المتعادل بلغت 63.64 و 64.71% على التوالي, وسجل اقل (P<0.01) محتوى من مستخلص الالياف الحامضي (33.33%)في النماذج المصنعة بمستوى 35% مادة جافة. فيما ارتبط اعلى (P<0.01)محتوى من الهيميسليلوز (33.20%)بالنماذج المصنعة بمستوى 25% مادة جافة. وفيما يخص تأثير مصدر الكربوهيدرات الذائبة, بينت النتائج ان اعلى (P<0.01) محتوى من المادة الجافة بلغ 30.32% قد ارتبط بنماذج السايلج المصنعة بإضافة طحين الذرة, فيما سجل المحتوى من البروتين الخام في النماذج المصنعة بإضافة مولاس قصب السكر والطحين زيادة معنوية (P<0.01) الى 6.25 و 6.34% على التوالي. كما لوحظ ان اضافة مولاس قصب السكر ومولاس التمر ادت الى انخفاض معنوي (P<0.01) في مستخلص

الالياف المتعادل والحامضي والهيميسليلوز. فيما ادت اضافة طحين الذرة الى انخفاض معنوي (P<0.01)في المحتوى من اللجنين الى 17.11% والسليلوز الى 11.17%
كلمات مفتاحية: السايلج, اوراق وسيقان الذرة, المادة الجافة, مصدر الكربوهيدرات الذائبة

INTRODUCTION

The increase in population enhances the need to exploit the available animal resources to meet the requirements of animal protein, and this will not be possible unless the optimum production of feed is secured. It is possible to utilize silage to provide adequate nutrition for ruminants as it is a good quality diet if it is well produced. Silage is produced from storing crops and their residues at an appropriate level of moisture in anaerobic conditions, where lactic acid bacteria (LAB) converts soluble carbohydrates into organic acids, especially lactic acid (LA) leading to a decrease in pH and maintaining preservation process (30). Ensiling contributes providing good quality feed for ruminants throughout the year (13).

The level of DM of the ensiled crop plays an important role in the quality of silage, as ensiling dried materials leads to a limit fermentation and may expos it to damage because there will not be a rapid decrease in pH (24). In the case of ensiling wet materials, there will be an increase in the amounts of effluent, DM loss, proteolysis, an high concentration of butyric acid and a low palatability and digestibility of silage (6 , 29).

Soluble carbohydrates are the substrate for the growth of LAB and to maintain good fermentation (18). According to Ferreira *et al.* (8), the minimum recommended amount soluble carbohydrates to ensure good quality fermentation is between 6 and 12% DM. Saeed (22) observed a significant increase ($P<0.01$) in the DM content of YCS silage with an increase in the level of DM in YCS at ensiling, and the lower ($P<0.01$) crude fiber content in the samples of silage made with levels of 25 and 30% DM, while the content of CP was not affected by the DM level. Bilal (4) found that addition of C-M increased ($P<0.01$) the DM and ash contents of grass silage as compared with addition of C-F, while the CP content of silage was not affected by the source of the SCS. Based on the above, the current study was conducted to investigate the effect of DM level of corn stover ensiled with different soluble carbohydrate sources on the chemical composition of silage produced.

MATERIALS AND METHODS

A few of yellow corn plants were cut just before harvesting the ears, and they were chopped manually to a length of 1-1.5 cm after removing the ears. Then the chopped materials were field wilted for 5 and 8 hours to raise the DM level to about 25-30% and 35-40%, respectively. Dry matter levels of 25, 30, 35 and 40% according to the study design were adjusted by adding calculated amounts of water based on equation of (22).

The SCS including C-M, D-M and C-F were added to the chopped YCS and their quantities were determined on the basis of the actual content of soluble sugars in 8% of the C-M. Accordingly, the amounts of D-M and C-F equivalent to that percentage of C-M were 6.30 and 29 g per 100 g of DM of the stover, respectively. Urea was added to all samples at a rate of 2% on a DM basis to enhance the nitrogen content and to provide relative protection for the protein content of YCS from degradation during ensiling.

The quantities of all additives were estimated on the basis of the DM of the stover. The number of treatments included in the study were 12 treatments representing the interaction of four levels of DM, 25, 30, 35 and 40% and the mentioned SCS, with five replicates per each.

According to the chemical composition, YCS contained 39.77 and 45.26% DM after field wilting for 5 and 8 hours, respectively, 7.08% ash, 6.96% CP, 2.34% ether extract (EE), 74.39, 38.13, 19.09, 19.04 and 36.26 of NDF, ADF, ADL, cellulose, and hemicellulose, respectively. The In vitro dry matter digestibility (IVDMD) of YCS was 60.66%. Water soluble carbohydrates (WSC) content of SCS were 34.65, 43.91 and 9.55% for C-M, D-M and C-F, respectively.

After mixing the chopped materials with the additives solutions, the treated mixture was packed in double nylon bags at a rate of 500 g per each sample, and they were manually pressed to expel the air from them and immediately sealed. The five replicates of each treatment were placed inside a plastic bag and kept in a pit silos which were covered with soil and pressed well to ensure that no air may entered and left for 60 days. Samples were opened thereafter to perform the chemical analysis according to the AOAC (2) methods. The composition of cell walls was estimated according to the method described by Goering and Van Soest (10). IVDMD was determined according to the method of Telly and Terry (27). Data were statistically analyzed as factorial experiments in a complete randomized design using SAS (23)

RESULTS AND DISCUSSION

Table 1 shows the effect of DM level and SCS on the chemical composition of YCS silage. The results showed that the DM and ash contents of silage were increased significantly (P<0.01) with an increase in the DM levels of YCS at ensiling. this result is consistent with that obtained by (22), in which he observed a gradual increase in the DM content of the corn stover silage with an increase in the DM level from 25 to 30, 35 and 40% at ensiling. This can be explained on the basis of good fermentation of silage and low DM loss. However, Filya (9) did not find significant effect of making corn silage with levels of 21, 28, 36 and 42% DM.

A significant (P<0.01) decrease in the CP content of YCS silage samples was observed with increasing the DM level in those materials before ensiling, where the CP contents were 6.43, 6.36, 5.86 and 6.29% for the levels of 25, 30, 35 and 40% DM, respectively. This result agreed with that reported by (14) who indicated a significant (P<0.01) decrease in the CP content of corn silage with increasing the DM level at ensiling from 33 to 41%.

The EE content was significantly (P<0.01) decreased to 2.65% in YCS silage samples made with a level of 35% DM as compared with 2.79, 2.81 and 2.91% in those made with the levels of 25, 30 and 40% DM, respectively. It was also noted that the EE content in all samples was higher than the content of 2.34% in YCS at ensiling. This increase may be due to the increase in the organic matter associated with the increase in the level of DM, in addition to the improvement of the fermentation of the produced silage. This result is in agreement with those obtained by (31). However, Khan *et al.* (16) reported no effect of making corn silage with the levels of 30, 34, 38 and 42% DM on the content of EE. Moreover, adverse result was observed in another study (22).

With regard to the effect of the level of DM of YCS at ensiling on the cell walls components, the results showed that there was a significant (P<0.01) decrease in the content of NDF with an increase in the level of the DM. No significant differences in the content of ADF were observed among YCS silage samples made with DM the levels of 25, 30 and 40%, even though, lower (P<0.01) ADF content of 33.33% was shown in those made with a level of 35% DM.

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Table 1 - Effect of dry matter level and soluble carbohydrate source on the chemical composition of yellow corn stover silage (mean ± SE)

Nutrients[1]	Dry matter level % (DM)				soluble carbohydrates sources (SCS)[2]			P	
	25	30	35	40	C-M	D-M	C-F	DM level	SCS
DM	22.09[d] 0.25 ±	26.77[c] 0.29 ±	31.04[b] 0.23 ±	36.68[a] 0.36 ±	28.95[b] ± 1.32	28.16[c] 1.18 ±	30.32[a] ± 1.21	**	**
Ash	8.17[c] 0.19 ±	10.52[b] 0.24 ±	11.20[ab] 0.58 ±	11.25[a] 0.46 ±	11.17[a] 0.44 ±	10.96[a] 0.41 ±	8.71[b] 0.21 ±	**	**
CP	6.43[a] 0.04 ±	6.36[ab] 0.04 ±	5.86[c] 0.11 ±	6.29[b] 0.04 ±	6.13[b] 0.09 ±	6.25[a] 0.07 ±	6.34[a] 0.05 ±	**	**
EE	2.79[a] 0.05 ±	2.81[a] 0.07 ±	2.65[b] 0.07 ±	2.91[a] 0.05 ±	2.80 0.06 ±	2.72 0.07 ±	2.84 0.04 ±	**	N.S
NDF	68.28[a] 0.43 ±	66.99[a] 1.68 ±	63.64[b] 0.78 ±	64.71[b] 1.28 ±	64.36[b] 0.91 ±	64.71[b] 0.59 ±	68.65[a] 1.29 ±	**	**
ADF	35.00[a] 0.48 ±	36.27[a] 0.70 ±	33.33[b] 0.66 ±	35.82[a] 0.48 ±	33.56[c] 0.42 ±	34.90[b] 0.48 ±	36.86[a] 0.51 ±	**	**
ADL	18.85[b] 0.66 ±	20.14[a] 0.47 ±	18.37[b] 0.69 ±	20.77[a] 0.57 ±	20.78[a] 0.38 ±	20.71[a] 0.40 ±	17.11[b] 0.43 ±	**	**
Cellulose	13.61[a] 0.43 ±	14.09[a] 0.76 ±	11.40[b] 0.90 ±	12.38[ab] 0.57 ±	12.77[b] 0.47 ±	14.67[a] 0.64 ±	11.17[c] 0.51 ±	**	**
Hemicellulose	33.20[a] 0.76 ±	30.72[b] 1.22 ±	30.30[b] 1.18 ±	28.95[b] 1.09 ±	30.79[ab] 0.99 ±	29.80[b] 0.80 ±	31.79[c] 1.10 ±	**	*

Means with different letters differ significantly at the level of * ($P<0.05$) or ** ($P<0.01$)

[1]DM= dry matter; CP= crude protein; EE=ether extract; NDF=neutral detergent fiber; ADF= acid detergent fiber; ADL=acid detergent lignin

[2]SCS= soluble carbohydrate sources; C-M= cane molasses; D-M= date molasses; C-F= corn flour

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Results revealed that lower (P<0.01) ADL content was observed in YCS silage samples made with the levels of 25 and 35% DM as compared with those made with the levels of 30 and 40% DM. Values were 18.85, 18.37, 20.14 and 20.77% respectively. This result is consistent with that obtained by (12). But it is inconsistent with that obtained by (28).

Samples of YCS silage made with a level of 35% DM were characterized with lower (P<0.01) cellulose content of 11.40% as compared with 13.61 and 14.09% in those made with the levels of 25 and 30% DM, respectively. The content of hemicellulose was significantly (P<0.01) decreased by 2.48, 2.90 and 4.25 with increasing the DM level of YCS at ensiling from 25 to 30, 35 and 40%, respectively. This decrease may be due to the degradation of hemicellulose in the acidic conditions of the silage mass. Morrison (17) showed that hemicellulose is sensitive to low pH and partially degraded under acidic conditions. These results agreed with the those of Yahaya *et al*. (31) who found a significant (P<0.01) increase in the cellulose and hemicellulose contents of grass silage with an increase in the DM level at ensiling.

Regarding the effect of SCS on the chemical composition of YCS silage, the results showed that DM content of silage samples made by the addition of C-F was significantly (P<0.01) increased by 1.37 and 2.16% as compared with those made by the addition of C-M or D-M, respectively. The high amount of C-F added at ensiling as compared with other additives due to its low content of WSC may be the reason for the high DM content in the silage samples made by the addition of C-F. Similar conclusion was reported by (20), where the higher DM content of C-F was reflected on higher DM content of sugar cane silage made by the addition of c-f as compared with that made by the addition of C-M.

The results declared that there was a significant (P<0.01) decrease in the ash content in the samples of YCS silage made by the addition of C-F to 8.71% as compared with 11.17 and 10.96% in those made by adding C-M and D-M, respectively. This result is in agreement with that found by (32), the ash content of grass silage in that study was reduced (P<0.01) by 5.7% due to the addition of C-F as compared with C-M, and it was attributed to the low ash content in C-F. The high content of ash in silage samples made by the addition of C-M and D-M in a current study may be due to the high level of mineral elements in those materials. According to Duraisam *et al.* (7) the ash content of C-M is about 10%.

The CP content was significantly increased (P<0.01) from 6.13 in the samples of YCS silage made by the addition of C-M to 6.25 and 6.34 in those made by the addition of D-M and C-F, respectively. This result may be due to the nature of the fermentation, which seemed that it was positively affected by the addition of C-M leading to lower nutrients loss. This result is in consistent with that reported by (11).

Regarding the cell wall components, the results of a current study revealed an improvement (P<0.01) in the NDF content of the YCS silage samples made by the addition of C-M and D-M by 4.29 and 3.94% as compared with those made by the addition of C-F. Lower (P<0.01) ADF content of 33.56% was observed in silage samples made by the addition of C-M as compared with 34.90 and 36.86% in those made by addition of D-M and C-F, respectively. This may be due to the improvement of silage fermentation due to the addition of C-M and D-M compared to C-F. Baytok *et al.* (3) reported that the degradation of cell wall components in silage treated with C-M and D-M is due to their role in promoting silage fermentation. The improvement in the NDF and ADF contents achieved in a current study is in agreement with the results of Kaya and Caliskan (15).

Despite the above mentioned results, ADL content was significantly (P<0.01) decreased by 3.67 and 3.60% in the samples of YCS silage made by the addition of C-F as compared with those made by the addition of C-M and D-M, respectively. Since relatively high pH high enables some microorganisms to continue growing with the possibility of analyzing the cell wall components (19). The above result may be due to the slow drop rate

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of the pH of the silage samples made by the addition C-F as compared with other samples.

About the content of cellulose, it was significantly (P<0.01) improved from 12.77 and 14.67% in the samples of YCS silage made by the addition of C-M and D-M, respectively to 11.17% in the those made by the addition of C-F. Rooke and Hatfield (21) suggested an explanation for such significant improvement through the occurrence of acidic or enzymatic hydrolysis of the cell wall components during the preservation period to compensate for the low content of sugars in those samples.

The hemicellulose content was lower (P<0.05) in the samples of YCS silage made by the addition of C-M and D-M as compared with those made by the addition of C-F, hemicellulose contents were 30.79, 29.80 and 31.79%, respectively. This may be due to the high content of this component in C-F as compared with C-M and D-M. Shahzad *et al.* (26) obtained similar results.

With regard to effect of the interaction between the DM level of YCS and the SCS added at ensiling on the chemical composition of silage produced, the results shown in table 2 pointed out that the silage samples made with a level of 40% DM and the addition of C-F were characterized by the highest DM content of 37.48%, while lower DM content of 21.40% was observed in those made with a level of 25% DM and the addition of C-M. This can be explained on the basis of the high level of DM in YCS at ensiling, in addition to the high amount of C-F added.

The YCS silage samples made with the level of 40% DM and the addition of C-M were characterized by the higher (P<0.01) ash content of 12.82% as compared with 7.48% in those made with a level of 25% DM and the addition of C-F. The reason for the variation in the silage ash content may be the high content of mineral elements in C-M and its lower content in C-F.

The samples of YCS silage made with a level of 25% DM and the addition of C-F were associated with the higher CP content, while the lower content was associated with silage samples made with a level of 35% DM and the addition of C-M. The high content of CP in C-F as compared with its content in C-M and D-M may be the reason for the discrepancy between the higher and lower CP contents.

The higher (P<0.01) EE content of 3.06% was observed in the samples of YCS silage made with a level of 40% DM and the addition of C-M. While the lower EE content of 2.47% was associated with those made with a level of 35% DM and the addition of D-M. The formation of volatile fatty acids from oxidation of soluble carbohydrates during fermentation may explain the increase in EE content of C-M treated silage samples (1). This decrease could also be due to the dilution effect occurred as a result of addition of molasses with a lower fat content (25).

With regard to effect of the interaction between the level of DM and the YCS on the cell wall components, the higher (P<0.01) NDF content of 75.29% was associated with silage samples made with a level of 30% DM and the addition of C-F, while the lower content of 60.53% was associated with those made with a level of 30% DM and the addition of C-M. Higher and lower ADF contents (38.69 and 32.32%) were observed in the samples of YCS silage made with a level of 30% DM and the addition of C-F and those made with a level of 35% DM and the addition of C-M.

The significant decrease in the NDF (P<0.01) and ADF (P<0.05) contents in the samples of YCS silage made by the addition of C-M and D-M as compared with those made by the addition of C-M may be due to the effect of C-M and D-M in enhancing silage fermentation leading to an increase in the degradation of these cell wall components (5). In addition to low content of NDF and ADF in C-M and D-M as compared with C-F.

Higher (P<0.05) content of ADL of 22.38% was associated with samples of YCS silage made with a level of 40% DM and the addition of C-M, while the lower content was associated with those made with a level of 25% DM and the addition of C-F. Providing source of soluble sugars such as molasses seems to decrease the degradation of cell wall components. The higher content of DM in crop may increase the ADF content of silage produced (28).

With regard to cellulose, the higher content of 16.94% was observed in silage samples made with the a level of 35% DM and the addition of C-M, while the lower content of 8.63% was observed in samples made with a level of 35% DM and the addition of C-F. The YCS silage samples made with DM levels of 30 and 35% the addition and the addition of C-F were characterized with the higher and lower (P<0.01) hemicellulose contents of 36.60 and 25.85%, respectively. Morrison (17) attributed a decrease in the hemicellulose content to the fact that hemicellulose is subjected to partial degradation due to the decrease in the pH in silage samples made with a level of at 35% DM and of C-F.

Table 2 - The effect of the interaction between the level of dry matter and the soluble carbohydrates sources on the chemical composition of the corn stover silage (mean ± SE)

DM level	25			30			35			40			*P*
SCS[1]	C-M	D-M	C-F	C-M	D-M	C-F	C-M	D-M	C-F	C-M	D-M	C-F	
DM	21.50^{i} 0.23±	21.40^{i} 0.04±	23.36^{h} 0.07±	26.40^{g} 0.11±	25.68^{g} 0.07±	28.23^{f} 0.18±	30.83^{e} 0.22±	30.45^{e} 0.32±	31.84^{d} 0.38 ±	37.09^{b} 0.49±	35.10^{c} 0.23±	37.84^{a} 0.30 ±	**
Ash	8.47^{cd} 0.34±	8.56^{cd} 0.19±	7.48^{d} 0.23±	11.06^{b} 0.44±	10.85^{b} 0.30±	9.65^{c} 0.22±	12.35^{a} 0.36±	12.70^{a} 0.87±	8.54^{cd} 0.17±	12.82^{a} 0.67±	11.74^{ab} 0.19±	9.20^{c} 0.29±	**
CP	6.20^{bc} 0.05±	6.53^{a} 0.02±	6.58^{a} 0.00±	6.42^{abc} 0.05±	6.41^{abc} 0.07±	6.26^{bc} 0.07±	5.44^{e} 0.01±	5.82^{d} 0.17±	6.34^{abc} 0.11±	6.45^{ab} 0.04±	6.24^{bc} 0.05±	6.19^{c} 0.09±	**
EE	2.59^{cd} 0.08±	3.04^{a} 0.06±	2.73^{bcd} 0.02±	2.99^{ab} 0.04±	2.50^{d} 0.12±	2.93^{ab} 0.07±	2.57^{cd} 0.10±	2.47^{d} 0.04±	2.90^{ab} 0.13±	3.06^{a} 0.03±	2.88^{ab} 0.15±	2.79^{abc} 0.04±	**
NDF	69.83^{bc} 0.28±	67.72^{cd} 0.47±	67.28^{de} 0.87±	60.53^{h} 0.42±	65.14^{ef} 0.72±	75.29^{a} 0.79±	66.21^{de} 0.42±	63.64^{fg} 1.34±	61.07^{h} 1.06±	60.86^{h} 0.68±	62.34^{gh} 0.42±	70.94^{b} 1.40±	**
ADF	34.11^{def} 0.90±	34.67^{cdef} 0.80±	36.23^{abcd} 0.62±	33.26^{ef} 0.93±	36.85^{abc} 0.32±	38.69^{a} 0.59±	32.47^{f} 0.55±	32.32^{f} 0.82±	35.22^{bcde} 1.50±	34.41^{cdef} 0.91±	35.77^{bcde} 0.44±	37.29^{ab} 0.61±	*
ADL	20.53^{abc} 0.28±	20.23^{abcd} 0.55±	15.79^{e} 0.83±	20.51^{abc} 0.57±	21.81^{ab} 0.27±	18.10^{d} 0.46±	19.72^{bcd} 1.02±	19.49^{bcd} 1.05±	15.91^{e} 0.79±	22.38^{a} 0.61±	21.29^{ab} 0.91±	18.65^{cd} 0.62±	*
Cellulose	13.57^{bc} 0.76±	14.43^{ab} 0.67±	12.83^{bc} 0.77±	12.74^{bc} 1.12±	16.94^{a} 1.26±	12.59^{bc} 0.42±	12.75^{bc} 1.24±	12.82^{bc} 1.73±	8.63^{d} 1.05±	12.03^{bc} 0.70±	14.47^{ab} 0.88±	10.64^{cd} 0.57±	*
Hemicellulose	35.72^{a} 1.07±	33.05^{ab} 0.80±	30.85^{bc} 1.15±	27.27^{d} 0.79±	28.29^{cd} 0.82±	36.60^{a} 1.17±	33.74^{ab} 0.71±	31.32^{bc} 2.02±	25.85^{d} 1.38±	26.45^{d} 0.56±	26.57^{d} 0.66±	33.84^{ab} 1.66±	**

Means with different letters differ significantly at the level of * ($P<0.05$) or ** ($P<0.01$)

[1]SCS= soluble carbohydrate sources; C-M= cane molasses; D-M= date molasses; C-F= corn flour

DM= dry matter; CP= crude protein; EE=ether extract; NDF=neutral detergent fiber; ADF= acid detergent fiber; ADL=acid detergent lignin

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