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Chemical Composition, Organic Matter Digestibility, *in Vitro* Gas Production Characteristics and Ensilling of Sugar Beet Leaves as Alternative Feed Resource

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Abstract: The aim of this study, was to evaluate the chemical composition, ME and OMD of sugar beet leaves-maize silage mixtures in comparison to pure maize and Sugar Beet Leaves Silages (SBLS). Ensiling sugar beat leaves with whole crop maize had a significant ($p<0.05$) effect on chemical composition, pH, OMD and estimated ME value of the mixtures compared to the silage from the pure crops (maize silage and sugar beet leaves silage). Gas production of all sugar beet leaves-maize silage mixtures at all incubation times was lower than obtained for whole crop maize silage. There were significant differences between silages in terms of ME, OMD with whole crop maize silage and sugar beet leaves-maize than whole crop sugar beet leaves silage ($p<0.05$). Total gas production (a+b) ranged from 50-247.5 and the lowest total gas production was obtained for sugar beet leaves silage. It was concluded that ensiling sugar beet leaves with whole crop maize improved the pH, OMD and ME values. The optimum proportion for mixed silages is 50% sugar beet leaves -50% whole crop maize (C). There is no requirement for additatives to obtain the required pH level for high quality silage.

Key words: Sugar beet leaves, silage, feed value, OMD, *in vitro*, corn silage

INDORUCTION

Average annual sugar beet production in Turkey was aproximately 17 million tones. The sugar beet leaves is the one of the most important byproducts of the sugger beet production after harvest. Aproximately 3, 4 million tones of suggar beet leaves is produced (Anonim, 2001). These freshs by-products are fed to animal or left in the field in practise. However, recently sugar beet leaves has been ensiled alone or with some silage additives (Can *et al*., 2003).

Many of these products currently are completely unused or are largely wasted due to the inability of farmers to use them. Sugar beet is mainly grown for sugar production, but can be used as animal feed. All the components of the sugar beet can be used for feed; crown, tops and roots. Beet tops (leaves and petioles) also can be used as silage. Sugar-beets that produce 20 tons acre^{-1} of roots also produce a total of about 5 tons acre^{-1} of TDN per acre in the tops. Tops are an excellent source of protein, vitamin A and carbohydrates but are slightly inferior to alfalfa haylage or corn silage for beef cattle. Tops are equal to alfalfa haylage or corn silage for sheep. Beet top silage is best fed in combination with other feeds. Tops should be windrowed in the field and allowed to wilt to 60-65% moisture before ensiling (Stanacev Vidica, 2002; B¨ohme *et al*., 2001).

Forage, fed either as hay or silage constitute about 40-50% of dry matter intake for lactating dairy cows (Coblentz *et al*., 1996). Ensilling is inreasing in popularity as an effecttive method to preserve forage in Turkey due to increased maize plant production as a second crop. Sugar beet leaves is waste sugar beet in harvest. It is not genarally evaluate in Turkey. But, animal production in Turkey needs quality forage in all time.

Sugar beet leaves is very difficult to ensile due to their low Dry Matter (DM), water soluble carbohydrate content and high buffering capacity and difficulty wilting (Roberts and Martindale, 1990; Can *et al*., 2003; Azman *et al*., 1997; Ak *et al*., 2003). Ensilling low DM green forage with chemical or biological additives (Henderson, 1993; Flachowsky *et al*., 2006) does not overcome the problem of nutrient losses through effluent production. Wilting and mixing of low DM forage with other material such as straw are used to increase the DM content (Phillips and Penlum, 1984). Wilting is weather dependent. Futhermore excessive wilting results in losses of nutrient and reduction in the nutritive value of herbage

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(Muck, 1998). Therefore, direct ensiling of fresh sugar beet leaves is desirable and can be attanied by increasing the dry matter content and rapid acidification of forage mass (Henderson, 1993; Greg and Anderson, 1999) using acid such as formic acid.

Maize (*Zea mays*) is the most popular cereal crop conserved as silage in many parts of world (McDonald *et al*., 1991) due to relatively high dry matter content, low bufferin capacity and high water soluble carbohydrate for fermaentation to lactic acid which is responsible for the reduction of pH level (Meeske and Basson, 1998) althougt it has a low protein content. Ensiling sugar beet leaves with whole crop maize forage with a high dry matter and water soluble carbhydrate content can be used to ensure reasonable ensiling of sugar beet leaves forage. The other objective of ensiling sugar beet leaves with maize is to complement of the positive characteristics of two crops and thus to produce a silage which is a more complete feed.

However, there is little information available on the nutritive value of sugar beet leaves and sugar beet leaves-maize silage mixtures when ensiled together in Turkey. The present study was, therefore, carried out to determine the chemical composition, digestibility and degradability of sugar beet leaves. *in vitro* gas production technique was widely used to evaluate the nutritive value of forage (Abdulrazak *et al*., 2000; Kamalak *et al*., 2005).

The aim of this study, was to evaluate the chemical composition, ME and OMD of sugar beet leaves-maize sialge mixtures in comparation to pure maize and sugar beet leaves, to determinate the FP and RFV of ensiling sugar beet leaves and whole crop maize using the *in vitro* gas production technique.

MATERIALS AND METHODS

Slage samples: Silages were prepared from different rate of maize and sugar beet leaves given in Table 1. Sugar beet leaves (not sugar beet top silage) was cutted with top area on sugar beet in Kahramanmaras in October 2005. Maize hibrid crop was sown of of Kahramanmaras in the same season. Maize crop was harvested at the stage of half milk line in October, 2005. Representative maize and sugar beet leaves plants were cutted to about 2-3 cm in length until required for gas production studies and other analysis. Chopped plant materials were ensiled in plastic barrels with tight lids experimental silo with a capacity of 10 kg. After filling the silo, the mass was air-tight closed with a plastic sheet to secure anaerobic conditions for fermentation and the protection of silage and sealing them tightly with a lid. The lids were pierced with a pin to get rid of gas pressure that built up during the initial phase of ensiling and then stored for 60 days in a dark room with a temperature ranging of 20-25°C.

Table 1: Silages combinations

	Raw material	
Silages	Maize (%)	Sugar beet leaves (%)
A	100	0
B	75	25
C	50	50
D	25	75
E	0	100

After two months storage, silos were opened and determinated of lactic acids in HPLC.

Then represenative samples of silages were taken and DM of silages (A, B, C, D, E) were 30.65, 20.15, 24.85, 19.90 and 11.90%, respectively. Silage samples dried at 60°C by force air drier. Dry samples were grounded to pass a 1 mm screen for subsequent chemical analysis.

Chemical analysis: Dry matter content was determined by drying the samples at 105°C overnight and the ash by igniting the samples at 105°C overnight in muffle furnance at 525°C for 8 h. Nitrogen (N) content was measured by the Kjeldanl method (AOAC, 1990). The Crude Protein (CP) was calculated as N×6.25. Neutral detergent fiber (NDF) and acid detergent fiber (ADF) were determined by the method of Goering and Van Soest (1970). Sub-samples from each barrel were taken for determinations of dry matter, pH, organic acids and chemical composition. The pH of each sample was determined in triplicate using approximately 25 g wet ensilage added to 100 mL of distilled water. After hydration for 10 min using a blender, the pH was measured using a digital pH meter. Fluid was filtered through filter paper, centrifuged at 5000 rpm for 0.6 h and stored at -120°C for organic acid analysis by gas chromatograph (Shimadzu, GC-14B), as described by Leventini *et al*. (1990). Fleigh Point of the silages was described by Kilic (1984). Fleight points = 220 + (2×DM%-15)-(40 × pH).

Where Fleight Points that values between 85 and 100, very good quality; 60 and 80, good quailty; 55 and 60, moderate quality; 25 and 40, satisfying quality; <20, worthless.

The Relative Feed Value index (Moore, 1994) estimates Digestible Dry Matter (DDM) of forage from ADF and calculates the DM intake potential (as a percent of body weight, BW) from NDF. The index is then calculated as DDM multiplied by dry matter intake (DMI as a percent of BW) and divided by 1.29. The index ranks forages relative to the digestible:

DDM = Digestible Dry Matter = 88.9-(0.779 × % ADF).
DMI = Dry Matter Intake (% of BW) = 120/(% NDF).
RFV = (DDM × DMI)/1.29.

Where the numerator, 120, in the DMI calculation indicates maximum feed intake in forage dairy rations.

When NDF is 1.2 lb per 100 lb of body weight; the divisor, 1.29 in the RFV calculation was chosen so that the RFV of forage has a value of 100 (Schroeder, 2004).

Determination of *in vitro* gas production: Rumen fluid was obtained from rumen fluid in Sheep. Sheep were fed a straw and consantre feed ad libitum.

The concentration of the feed composition is consist of 15% CP, 2700 kcal ME kg^{-1}, 2% CF, 7% ash, 1% Ca, 0.4% P, 7000 IU kg^{-1} Vitamin A, 700 IU kg^{-1} Vitamin D3, 25 mg kg^{-1} Vitamin E. Anaerobic medium and chemicals the medium used in this study was based on that described by Theodorou *et al.* (1994).

Gas pressure transducer technique with LED digital readout voltmeter as described by Theodorou *et al.* (1994) was used to determine the gas production and fermentation kinetics as explained below. A pressure transducer and LED digital readout voltmeter were used to measure the headspace gas pressure of fermenting cultures in laboratory of Departmant of Animal Science of Faculty of Agriculture of University of Kahramanmaras Sutcu Imam. Gas pressure in the headspace was read from the display unit and the corresponding volume of gas displaced into a syringe until the gas pressure in the headspace returned to ambient pressure, as indicated by a zero reading on the display unit. Gas measurements were carried out at regular intervals (after 4, 7, 13, 24, 45, 69 and 96 h) during the fermentation period. Bottles were shaken after every reading and were not removed from the water bath (38±1°C). Both gas pressure and volume in the syringe were recorded in order to correct the possible differences in headspace volumes between bottles. Rumen fluid source and inoculum digesta were taken from a rumen sheep fed on straw and consantre feed and was immediately transported to the laboratory in vacuum flasks. The digesta were filtered through 3 layers of muslin and the rumen fluid collected in a CO_2-filled flask. The solid residue remaining in the muslin was placed in a blender with some of the strained rumen fluid and homogenised for 30-60 sec and strained through the muslin. The resulting rumen fluid was inoculated (10 mL) into each bottle. Total gas values were corrected for blank. Cumulative gas production data were fitted to the model of Orskov and McDonald (1979).

$$y = a + b\,(1-e^{-ct})$$

Where:
a = The gas production from the immediately soluble fraction (mL).
b = The gas production from the insoluble fraction (mL).
c = The gas production rate constant for the insoluble fraction (b).
t = Incubation time (h).
y = Gas produced at time't'.

The energy value of forages can be calculated from the amount of gas produced at 24 h of incubation with supplementary analyses of crude protein, ash and crude fat. Metabolizable energy (ME) (MJ kg^{-1} DM) content of silages was calculated using equation of Menke *et al.* (1979) as follows:

$$ME\ (MJ\ kg^{-1}\ DM) = 2.20+0.136GP+0.057CP+0.0029CP^2$$

Where:
GP = Total 24 h net gas production (200 mL^{-1} mg).
CP = Crude protein.

Organic matter digestibility (OMD) (%) of silages was calculated using equation of Menke *et al.* (1979) as follows:

$$OMD\ (\%) = 14.88+0.889GP+0.45CP+0.0651XA$$

Where:
OMD = Organic Matter Digestibility (%).
XA = Ash content (%).

Statistical analysis: One-way Analysis of Variance (ANOVA) was carried out to compare chemical composition, *in vitro* gas production and estimated parameters for different maturity using General Linear Model (GLM) of Statistica for windows (Stastica, 1993). Significance between individual maturities means were identified using the LSD's multiple range test. Mean differences were considered significant at $p<0.05$. Standard errors of means were calculated from the residual mean square in the analysis of variance. Correlation coefficients between data for chemical composition, *in vitro* gas production were obtained using (SAS, 1991).

RESULTS AND DISCUSSION

Chemical composition of the silage mixtures were given in Table 2. There were significant differences among silage mixtures in terms of chemical composition. The crude protein content of silages ranged from 8.89-24.56%. Crude protein content of silage E have higher than those

Table 2: Chemical composition (%) of silage mixtures

	Silages						
	A	B	C	D	E	LSD	Sig.
DM	30.65±0.25a	20.15±0.25c	24.85±0.85b	19.90±0.40c	11.90±0.70d	1.98	**
CP	8.89±0.12e	11.32±0.03d	12.12±0.06c	16.15±0.12b	24.56±0.15a	0.38	**
NDF	45.80±2.20ab	50.15±0.15a	41.75±1.15b	31.80±1.20c	41.55±1.75b	5.57	**
ADF	31.6±0.60b	33.55±0.55b	27.20±0.40c	22.30±1.10d	39.60±0.60a	2.51	**
Ash	5.15±0.05e	5.80±0.10d	7.30±0.01c	9.05±0.05b	18.10±0.20a	0.38	**
pH	3.70±0.07d	4.10±0.07c	4.08±0.08c	4.92±0.08b	5.88±0.10a	0.29	**
LA	4.91±0.25a	5.18±0.38a	4.57±0.06a	2.91±0.03b	0.11±0.01c	0.75	**

A: Corn %100 silage; B: Corn %75 + SBLS %25 silage; C: Corn %50+ SBLS %50 silage; D: Corn %25 + SBLS %75, Silage E: SBLS %100 silage. Means in rows without common superscripts are significantly different; DM: Dry Matter; CP: Crude Protein; NDF: Neutral Detergent Fiber; ADF: Acid Detergent Fiber; ** $p<0.001$, ns-non-significant; Sig: Significance level; LSD: Least Significant Difference

of the other silages significantly ($p<0.001$). The crude protein content of silage E in agrement with finding of Can *et al.* (2003) who reported that Crude protein sugar beet leaves silage was 22.29%.

As could be seen from Table 2 NDF contents of silage mixtures varied with silage type in the range from 31.80-50.15%. NDF content of silages B was higher than those of the other silage mixtures. There were significant differences among sialge mixtures in terms of ADF. The ADF content of silage E was higher than those of the other silage mixtures. The NDF and ADF contents of silage E were considerably higher than those obtained by Can *et al.* (2003).

There are significant ($p>0.05$) differences among silage mixtures. The ash contents of silage mixtures ranged from 5.15-18.10%. The ash content of silage E was significantly higher than those of the other silage. It was reported that soil contamiantion has a significant effect on the ash content of sugar beet silages (Roberts and Martindale, 1990; Deininder *et al.*, 1996).

The pH of sialge mixtures ranged from 3.70-5.88. The pH of silage E was significiantly higher than those of other silages. It was about 5.88 which is above the pH level required for quality silage. The pH values of silage B and C were similar to those reported by Azman *et al.* (1997) whereas, the pH of silage corn silage (A) was different and lower than those of the other silage mixtures. On other hand Can *et al.* (2003) found that the pH values of maize silages ranged from 3.36-4.43.

As expalined by Ozturk *et al.* (2006), there is several reasons why silage E had a high pH value. First reason may be low level of water soluble corbohydrate of silage E from which lactic acids was produced. It is well known that lactic acid is responsible for reducing the pH of silage raw material. The second reason of high level of soluble protein is in fact the reason of high buffering capacity of sugar-beet leaves. The ammonia combines with H^+ to form NH_4^+ which prevents the pH of silage from reaching the required pH level. The third reason may have been the high buffering capacity of sugar beet leaves silage. It ws repoted that buffering capacity of sugar beet leaves silage is higher than that for maize silage (Ak *et al.*, 2003; Can *et al.*, 2003; Groda and Zufanek, 1988).

It would be essential to present sufficient chemical composition of silages (and mixtures) to allow adequate-interpretation of the results and comparision to other research (Okine *et al.*, 2005). The is particulary important in the current experiment since the sialge pH data suggest that sugar beet leaves ensiled alone was poorly preserved. In order to comfirm if this was indeed poorly and badly preserved and to fulll interpret the potantial implications of outcome, it would be necessery to quantify the concentration of fermentation products such as lactic acid was analyse, the extent of protein degradation using the ammonia-N as index. This is one of limititation of current experiment.

The data of gas production during the fermentation period are given in Table 3. The cumulative volume of gas production increased with increasing time of incubation. Gas produced after 9 h incubation ranged between 50.00 and 247.50 mL/1 g of substrate. There were significant $p<0.001$ differences among silage mixtures in term of gas production at all incubation times. Gas production at 4 h incubation of silage A was significantly ($p<0.001$) higher than the others, possibly due to a higher water soluble carbohydrate content. Generally silage A had a significantly higher gas production than the other silage mixture.

All incubation times showed that generally the silage E produced less gas than those of A, B, C and D silage possibly due to low fermentable carbohydrate. Protein in sugar beet leaveas is poorly utilised by ruminants, especially when high-forage diets are fed with relatively low available energy (Buxton, 1996). Extensive degradation accurs during harvest and storage of silage followed by futher microbial degration in Rumen (Buxton, 1996). Under *in vitro* conditions, gas is produced both directly as a result of fermentation (CO_2 and CH_4) and indrectly, from the acidifying effect of VFA's on CO_2 released from the bicarbonate buffer

Table 3: Gas production and estimated parameters of silages

	Silages						
IT	A	B	C	D	E	LSD	Sig.
4	21.50±0.50a	5.00±0.00b	6.50±0.50b	5.50±0.50b	0.50±0.50c	1.62	**
7	58.50±2.50a	25.50±1.50c	33.00±0.00b	32.00±1.00b	5.00±1.00d	5.26	**
13	87.50±4.50a	48.00±3.00c	61.00±1.00b	57.00±1.00bc	10.00±1.00d	9.23	**
24	172.00±2.00a	131.50±3.50c	147.50±0.50b	137.50±0.50c	26.50±4.50d	9.88	**
45	220.00±3.00a	190.50±4.50b	201.00±1.00b	188.50±1.50b	38.50±7.50c	15.31	**
69	242.00±3.00a	223.00±6.00b	220.50±0.50bc	205.50±2.50c	47.00±8.00d	17.47	**
96	247.50±2.50a	229.50±6.50b	226.00±4.01bc	211.50±2.50c	50.00±7.00d	16.56	**
Estimated parameters							
c	0.0565±0.00a	0.0410±0.00b	0.0515±0.00a	0.0520±0.00a	0.0325±0.00c	0.0065	**
a	5.690±1.68a	-7.537±0.48c	-6.743±0.17c	-6.250±0.68c	-1.130±0.60b	3.2098	**
b	244.132±5.64a	249.961±6.37a	239.078±0.27ba	223.335±2.13b	55.527±7.65c	18.9250	**
(a+b)	249.821±3.97a	242.424±6.85a	232.336±0.10ba	217.085±2.81b	54.397±7.05c	17.8250	**
ME	8.47±0.18a	8.77±0.13a	8.34±0.01a	8.43±0.00a	5.82±0.22b	0.5039	**
OMD	57.44±0.59a	52.10±0.82b	55.63±0.03a	55.50±0.04a	36.02±1.33c	2.7072	**
FP	115.10±2.70a	83.30±4.70b	91.50±4.90b	48.20±2.20c	-6.40±5.40d	15.198	**
RFV	132.05±8.05cb	116.85±0.75c	153.15±4.65b	212.30±7.80a	132.15±5.55cb	21.729	**
DMI	2.63±0.13cb	2.38±0.02c	2.88±0.11b	3.78±0.14a	2.92±0.15b	0.426	**

A: Corn %100 silage; B: Corn %75 + SBLS %25 silage; C: Corn %50+ SBLS %50 silage; D: Corn %25 + SBLS %75 silage E: SBLS %100 silage. Means in rows without common superscripts are significantly different (p>0.05); IT: Incubation Times(hours); ** p<0.05; ns-non-significant; SEM: Standard Error Mean; Sig: Significance level; c: the gas production rate (%) constant for the insoluble fraction (b); a: the gas production from the immediately soluble fraction (mL); b: the gas production from the insoluble fraction (mL); (a+b): Potential gas production (mL); ME: Metabolizable energy (MJ kg^{-1} DM); OMD: Organic Dry Matter Digestibilty (%) Means in rows without common superscripts are significantly different; FP: Fleig Point; RFV: Relatif Feed Value: DMI: Dry Matter Intake ** p<0.05, NS-Non-Significant; Sig: Significance level; LSD. Least Significant Difference

solution (Gtachew *et al*., 1998). The degration of protein yields ammonia, which combines with H+ from the buffer to form NH^{+}_{4}, which, remains in solulition so inhibiting the indrect gas production. This may be one of the reasons why silage E had generally a lower gas production value than the other silages.

The estimated parameters are also given in Table 3. There were significantly (p<0.001) differences among silage mixtures in term of gas production kinetics. Silage A had significantly higher gas production kinetics such as a, b and a+b.

The ME value ranged from 5.82 -8.77. OMD values ranged from 36.02-57.44%. The ME value for A, B C and D were similar to those reported by approximately 7.5 MJ NEL kg^{-1} dry matter of energy) (Deininger *et al*., 1996). But values of DMD were not consistent with findings of Ak *et al*. (2003). The ME and OMD of silage E were significantly (p<0.001) lower than the others. The RFV of D higher than the others but, FP value of D silage less than FP value of A, B, C silage (Table 3).

As can be seen from Table 4 the gas production at all incubation times and estimated parameters (a,b, a + b, ME, OMD, FP) were negatively correlated with ADF which is slowly degradable carbohydrate by micro-organisms. This result is consistent with findings reported by Nonn (1985) and Pimlott (1991). Nevertheless estimated parameters (a, b, a + b and ME, OMD, FP) were significantly (p<0.01) correlated with CP protein which is one of the limiting factors for microbial growth. This result is consistent with findings of Tolera *et al*. (1997).

At all incubation times the gas production and estimated parameters (a, b, a + b and ME, OMD, FP, DMI) were not significantly correlated with RFV value. The findings in current experiment supported the fact that the increasing of sugar beet leaves amount in including silage may also contribute to reduction of microbial activity.

Altough, sugar beet growth in all parts of world, but sugar beet leaves wastes genarally in some parts of Turkey. Sesion of maize crop silage and sugar beet harvest are same period in Turkey, especially in Kahramanmaras. It was make it possible to ensile them in mixture in Turkey. As result, Sugar beet leaves as know waste may be use as alternative feed source in ruminant nurition. Sugar beet leaves not lonely usefull for ensilling. Because sugar beet leaves have got low dry matter and not enough soluble carbohyrate. Suitable dry matter and enough carbohyrate neccesry for ensiling.

Ensilling of sugar beet leaves with whole crop maize had a significant effect on the chemical composition, pH, *In vitro* DM degrability and *in vitro* DMD of the final silage mixtures. Ensilling of sugar beet leaves with whole crop maize plant overcome some of the drawbacks releated to low DM and water soluble carbohyrate contents and high buffering capacity of sugar beet leaves plant. The pH of all silage was normal pH except for D and E silage. The results have good implications for the practice situation. Because this datas of all silage indicated that direct ensilage of sugar beet leaves can be attained by mixing with crop maize. But mixed rate of sugar beet leave and whole crop maize are important. Rate of optimum in mixed silages is 50% sugar beet leaves-50% whole crop maize (C).

Table 4: Correlation coefficient (r) of relationship of chemical composition with *in vitro* gas production and estimated parameters

	Chemical constituents						
IT	DM	CP	NDF	ADF	Ash	pH	LA
4	0.9622***	-0.8499**	0.1013ns	-0.4751Ns	-0.8120**	-0.8193**	0.6303*
24	0.8851**	-0.9423***	0.0850ns	-0.6941*	-0.9663***	-0.9128**	0.7335*
45	0.8643**	-0.9503***	0.1216ns	-0.6768*	-0.9788***	-.9202**	0.7539*
69	0.8485**	-0.9572***	0.1625ns	-0.6503*	-0.9873***	-0.9274**	0.7751*
96	0.8449**	-0.9563***	0.1623ns	-0.6532*	-0.9863***	-0.9268**	0.7761*
Estimated parameters							
C	0.8762**	-0.7427*	-0.2431ns	-0.7360*	-0.7506*	-0.7206*	0.4549ns
A	0.3806ns	-0.0882ns	0.1723ns	0.3344ns	0.0368ns	-0.0827ns	0.0535ns
B	0.7913**	-0.9389***	0.1680ns	-0.6581*	-0.9812***	-0.9100**	0.7709*
(a+b)	0.8257**	-0.9547***	0.1816ns	-0.6419*	-0.9888***	-0.9251**	0.7826**
ME	0.8289**	-0.8520**	-0.1041ns	-0.8065**	-0.8973**	-0.8158**	0.5888*
OMD	0.8591**	-0.8941**	-0.0339ns	-0.7669*	-0.9306***	-0.8603**	0.6495*
FP	0.9276**	-0.9875***	0.4088ns	0.3714ns	-0.9560***	-0.9929***	0.9148**
RFV	-0.0329ns	0.1317ns	-0.9450***	-0.7924*	0.0110ns	0.1836ns	-0.4774ns
DMI	-0.2199ns	0.3632ns	-0.9907***	-0.6085*	0.2516ns	0.4011ns	-0.6661*

IT: Incubation Times; DM: Dry Matter; CP: Crude Protein; ADF: Acid Detergent Fiber; NDF: Neutral Detergent Fiber; c: the gas production rate (%) constant for the insoluble fraction (b); a: the gas production from the immediately soluble fraction (mL); b: the gas production from the insoluble fraction (mL); (a+b): Potential gas production (mL); ME: Metabolizable energy (MJ kg^{-1} DM); RFV: Relatif Feed Value; DMI. Dry Matter Intake; OMD: Organic Madde Digestibilty (%); FP: Fleig Point; *** $p<0.001$,* $p<0.01$,* $p<0.05$; ns-non-significant

This study showed more light on the idea and can provide useful data not only for fellow scientist, but also for those grappling with practical applicication of ruminant nutrition. However, trials with animals are required to determination how these differences in silage mixtures effect animal production. Different types of silage can be made by altering the formula [the choice and mix of by-products].

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