Research article

Nutrient Value and Palatability for Cattle on Corn Stover Silage

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Abstract As cultivated areas in Cambodia have increased, feed resources for feeding and grazing cattle have decreased significantly. Plantings of yellow corn, however, have increased substantially, in particular, in the north-west of Cambodia; consequently, a huge amount of corn residue is being produced but remains unused, despite offering potential as a cattle feed, particularly after ensiling. The aim of this study was to identify nutritive value and palatability of corn stover silage for cattle feeding. Corn stover was chopped at approximate 4 to 6 cm in length and ensilaged with different treatments as follows: 15% water (CSN), 3% salt+15% water (CSSa), 3% sugar palm+15% water (CSSu), and 10% rice bran+15% water (CSRB). Cattle were adapted over a 5 day periods and 1 kg of each silage was offered to each animal. The result shown that crude protein content in silage increased on average from 6.41 to 9.7%. Within the treatments the chemical composition of dry matter, crude protein, organic matter, ash and crude fiber were similar. However, the intake of silage was significantly different. Cattle consumed more CSSu (177.88 gDM) than the other types of silages and ate about 100 gDM or less. CSSa was the lowest intake. In conclusion, sugar (palm sugar) should be added to reach carbohydrate requirement in order to help the silage fermentation process as the stover was mature with high DM% and needed additional flavour added to the silage.

Keywords cattle, corn stover silage, flavour, palatability, silage

INTRODUCTION

Cattle play an important role in Cambodian farming systems and contribute to the household income. The estimated cattle population in 2011 was about 3,406,972 heads (DAHP, 2012).

The total estimated quantity of corn produced in 2012 was 780,774 tons, 83.9% of red corn and 16.1% of white corn, that was mostly grown in Battambang (106, 789.00 ha), Pailin (27,347.00 ha), and Kandal (18,805.00 ha) and 4,028,404 tons of fresh corn residue (leave, stem, bushes and cob) was produced in 2010 (FAO, 2012).

Cambodian cattle farmers depend mainly on the use of natural feed resources (Mob et al., 2014), and feed availability is the most significant constraint on cattle production in Cambodia (Pen et al., 2009; Mob et al., 2014). Martin (2013) recommended that some corn stover should be

left in the field to conserve the soil, improve crop water-use efficiency, and feeding cattle. However, the remaining should be used for other purposes, although, currently, few cattle farmers utilize the residue for feeding (Mob et al., 2014). Feeding or grazing cattle in cropland after harvesting only provides feed to cattle for short while. Moreover, during the harvesting period, other natural feed resources are in abundance, leading to less use of fresh crop residues. Limin (2001) suggested that storing maize as silage can be an outstanding way to store maize crop residues, but to maximize quality, it has to be ensiled using proper methods to create an anaerobic environment.

The fibrous increasing in the plants can lead to undesirable results of silage as a rapid development of mould from difficult of removing oxygen (Randy et al., 1999) and inefficient fermentation (Clark et al., 2009). Moreover, the more mature the plants the less digestible the diets since there are a loss of nitrogen and carbohydrate (Randy et al., 1999). These studies attempted to improve the quality of silage by adding extra carbohydrates during the silage making process. Silage can be fed any time and is very palatable to livestock (Anon, 2013) and increases productivity of beef and dairy cattle (Chin, 2002). The large amount of corn residues produced in Cambodia can be stored and fed to cattle via hay making and silage making (Martin, 2013). However, feed intake becomes a constraint for cattle production (Mob et al., 2014). By improving the palatability of silage by using additives, intakes can be improved.

OBJECTIVE

This study was conducted to identify chemical contents of corn stover silage mixed with different additives, and to investigate their effects on palatability.

METHODOLOGY

Silage Preparation and Experimental Animals

At harvesting time 105 day-old, sweet corn stover was obtained from farmers in Lerkdek district, Kandal province, Cambodia and cut into 5 cm lengths above the cob. Then, the stover was immediately transported to Royal University of Agriculture (RUA) and chopped into approximately 4 to 6 cm lengths using a cutter machine. The chopped stover was fermented for 75 days with different ensilaging treatments: 15% water (CSN), 3% salt+15% water (CSSa), 3% sugar palm+15% water (CSSu), or 10% rice bran+15% water (CSRB) and transferred into plastic bags with each bag weighing 2kg and hand compress.

Four crossbred Haryana beef cattle, 2 bulls (2.5 year-old) and 2 cows (3 year-old), were assigned to study on the palatability of corn stover silage. Prior to the experiment, all cattle were adapted at least 5 days with corn stover fermented with 15% water. After that four trays containing 1 kg each of the four kinds of silage were offered to each animal at 8 am. At first, animals were allowed to smell the silage for about 2 minutes and then they were allowed to select and eat for about 10 minutes. The residues were collected and recorded then sub-sampled for chemical analysis.

Data Collection and Analysis

After 75 days of ensilaging, samples of each silage were collected and analysed for dry matter (DM), organic matter (OM), crude protein (CP), crude ash (Ash) according to AOAC (1955) and crude fibre (CF) (Van Soest et al., 1991) at graduate school laboratory, Royal University of Agriculture. Prior the experiment, the silages (200 g) were taken for chemical analysis and also after the experiment.

Data Analysis

All data obtained from the present study were subjected to One-way ANOVA of variance using SPSS 16.0 for analyze of the average of chemical composition of silage and feed intake. Significant differences between the variables were identified using LSD multiple range test.

RESULTS AND DISCUSSION

Preservation of crop residues can be challenging to some producers as it needs proper methods and procedures to ensure the silage is in good condition. Harvesting plants for making silage must consider the stage of maturity of the plant. Moisture content in plant is very important if the plant is too young or too old; it can affect the quality of silage. In this study, we tried to use the mature crop residue that is produced in large quantities in local areas.

Before ensiling, the stover had 6.41% crude protein and the dry matter was 45% (Table 1). However, after preservation, the crude protein increased to about 9.7%. There were no differences between treatments in crude protein content, with an observed range from 9.15 to 10.45% (Table 2). This finding agreed with those of Kilmer and Hoyer (2012) that ensiling can produce high feed quality for ruminants.

Table 1 Chemical composition of samples

Samples	DM (%)	CP (%)	OM (%)	Ash (%)	CF (%)
Corn stover	45.00	6.41	85.12	0.35	22.30
Rice bran	93.05	11.53	84.18	0.41	11.56

Table 2 Chemical composition of corn stover silages

Type of corn stover silages	DM (%)	CP (%)	OM (%)	Ash (%)	CF (%)
	Mean	Mean	Mean	Mean	Mean
CSN	40.09	9.32	88.83	0.31	25.22
CSSa	35.74	9.87	80.80	0.50	23.75
CSSu	40.21	9.15	84.14	0.44	24.14
CSRB	42.63	10.45	86.40	0.39	22.61
SEM	1.41	0.22	1.23	0.02	0.56
P	0.399	0.153	0.103	0.116	0.456

(CSN: Corn stover + no additives, CSSa: Corn stover + added salt, CSSu: Corn stover + added sugar palm, CSRB: Corn stover + added rice bran, SE: Standard Error Mean, P: Probability)

There were significant differences between the treatments (P=0.000) in the amount of silage eaten by cattle (Table 3). In ten minutes eating, cattle showed a strong preference for CSSu (177.88 g). Consumption of other types of silage was about 100 g or less. CSSa (57.21 g) had the lowest intake.

As the corn stover was collected to ensile at harvesting stage that cause to the lack of carbohydrate and moisture (45% DM, Table 1). Sugar palm and rice bran (grade 3) were used to encourage the silage fermentation in which the acetic bacteria play a vital role in silage fermentation process. This agree with Yokota and Ohshima (1997) that used raw or/and defatted rice bran to better additive on the fermentation quality of the silage. The less intake of CSRB in the study may come from the long term preservation (75 days). According to Limin (2001), adding true carbohydrate such as molasses could encourage the fermentation process and Limin (2014) also indicated that silage additive with molasses effects on lactic fermentation, reducing silage pH, discouraging a clostridia fermentation and proteolysis, and generally decreasing organic matter losses that it agreed with those of Keady (1996) that used molasses as silage additive improve silage preservation and silage DM intake, but did not show the silage digestibility or animal

performance. From our results, adding palm sugar to silage not only improved silage fermentation but also increased palatability for cattle in comparison to non-additive silage and it provided include a good odour, colour, flavour, and texture. Jerry (2013) claimed that some research attempted to prove adding salt to forage material at the time of ensiling can improve silage fermentation, and with his result not only adding 40 g of salt/1 kg of fresh sorghum did show positive effect, but it did also with the combination of lactic bacteria. However, it is argued by the study of Shockey and Borger (1991) that adding salt (4 g of salt/1 kg fresh alfalfa) would inhibit growth of Clostridium and lactic acid bacteria result the silage was not well-preserved. With our result, adding salt 3% made less intake and short-preservation. Adding 15% water could increase artificial moisture and can aid in dissolving sugar and salt. According Jerry (2013) found that no additive sorghum silage contained 13.1 and 5 g/kg dry matter of butyric and propionic acid respectively result from fermentation by clostridia bacteria that lead to less energy value and reduced palatability.

Table 3 Silage intake of corn stover silages (gDM)

Type of corn stover silages	Mean	SEM	P
CSN	105.13[b]	10.29	0.000
CSSa	57.21[c]		
CSSu	177.88[a]		
CSRB	81.34[bc]		

(CSN: Corn stover + no additives, CSSa: Corn stover + added salt, CSSu: Corn stover + added sugar palm, CSRB: Corn stover + added rice bran, SE: Standard Error Mean, P: Probability, significant different: a>b>c)

CONCLUSION

The study shows that ensiling corn stover increases its crude protein content by 3.29%. Corn stover ensiled with added sugar is more palatable for cattle than the corn stover silage without additives, or with added salt or rice bran.

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