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Effect of berseem-wheat straw based silage on intake and utilization of nutrients in crossbred heifers

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Abstract
Eighteen growing female crossbred heifers (live weight 135±8.0 kg) were randomly divided into 3 groups of 6 animals in each. The heifers of control group (T_1) were fed on conventional ration consisting of wheat straw *ad libitum* along with 1.0 kg concentrate mixture (comprised of maize grain, mustard cake, wheat bran, mineral mixture and common salt in the ratio of 30:40:28:1:1, respectively). Heifers of group T_2 and T_3 were offered forage, silage-1 and silage-2 along with 0.5 kg of concentrate mixture, respectively for a period of 30 days. Study indicated that there was no difference in DM intake amongst the groups. Average CP and DCP intake were higher ($P<0.05$) in T_3 while TDN intake was lower ($P<0.05$) in T_2 as compared to T_1 and T_3, which were comparable. Apparent digestibility of nutrients was higher for molasses berseem silage (T_3) than other groups (T_1 and T_2), except for CP and CF, which was lower ($P<0.05$) in T_2 and T_1, respectively. It was concluded that ensiled berseem with wheat straw along with molasses could be used as roughage during lean period with the conventional ration in maintaining the nutrients intake with greater digestibility of nutrients at the reduced consumption of concentrates in crossbred heifers.

Keywords: Berseem-wheat straw silage, Heifers feeding, Molasses, Nutrient utilization

Abbreviations: **ADF**: Acid detergent fiber; **CF**: Crude fiber; **CP**: Crude protein; **DCP**: Digestible crude protein; **DM**: Dry matter; **NDF**: Neutral detergent fiber; **NH_3-N**: Ammonia nitrogen; **OM**: Organic matter; **TDN**: Total digestible nutrients; **TVFA**s: Total volatile fatty acids

Introduction

Efficient ruminant production system requires regular supply of good quality forage. Irregular supply of quality forage is the main constraint in India, which is adversely affecting ruminant productivity (Khan *et al*., 2006). Further, climatic conditions are also affecting the regular fodder availability to ruminants, particularly during the months of November- December and May to June. Regular supply of quality forages can be ensured through ensiling when the green fodders such as berseem, oats and lucerne are available in plenty. Berseem (*Trifolium alexandrium* L.) can be ensiled in the form of silage, however, being a leguminous fodder it has high buffering capacity, high moisture content and low water soluble carbohydrate content, leading to poor ensiling characteristics and higher nutrient loss (Bolsen *et al*., 1996; Singh *et al*., 2015). Since the legumes are low in soluble sugars, the molasses provides fermentable sugar to initiate the fermentation process during ensiling. Hence, in the present investigation attempts were made to conserve and evaluate the green berseem as silage using wheat straw as absorbent along with sugarcane molasses as additives in crossbred heifers.

Materials and Methods

Ensiling of berseem: Berseem fodder was collected from the experimental farm, Indian Grassland and Fodder Research Institute, Jhansi. They were chaffed with a power operated chaff cutter and then it was mixed with wheat straw in the ratio of 2:1, to achieve around 35% DM. Two types of berseem silages were prepared. In silage type-1, sugarcane molasses was not used, while in silage type-2, two kg of sugarcane molasses dissolved in 4 liters of water was sprayed over one quintal of materials using hand water sprinkler (*Hajara*). Whole contents were then mixed again and put in to a concrete silo, compacted by trampling and covered with polythene sheet for a period of 45 days. After completion of ensiling period, silage quality was evaluated using analytical techniques of Singh and Pandit (1978).

Feeding of experimental animals: Eighteen growing female crossbred heifers (age 15-18 months; live weight 135±8.0 kg) were randomly divided into 3 groups of 6 animals in each group. Heifers of control group (T_1) were fed on conventional ration consisting of wheat straw *ad libitum* along with 1.0 kg of concentrate mixture (comprised of maize grain, mustard cake, wheat bran,

mineral mixture and common salt in the ratio of 30:40:28:1:1, respectively). Heifers of group T_2 and T_3 were offered forage; silage type-1 and silage type-2 along with 0.5 kg of above concentrate mixture to meet the nutrient requirements (ICAR, 2013). After 30 days of initial feeding, a digestibility trial of 7 days duration was conducted to evaluate the intake and nutrient digestibility of experimental diets.

Analysis: The chemical composition of feed and faeces were determined as per AOAC (1990) and fiber fractions were analyzed as per Van Soest *et al.,* (1991). Data were analyzed to test the significant differences among the treatments following Snedecor and Cochran (1968).

Results and Discussion

Chemical composition of silages: The chemical composition of silage type-1 and silage type-2 were comparable (Table 1). The physical parameters *viz*., colour, smell and visible mould growth have shown that the quality was better in silage-2 where molasses was used as additive. Silage made with the addition of molasses consistently showed lower pH, TVFAs and NH_3-N and higher DM and lactic acid concentrations. Berimavandi *et al*. (2010) reported that addition of molasses to berseem clover fodder before ensiling reduced silage pH due to increased lactic acid production. In the present study, the addition of wheat straw improved the DM content (31-41%) of ensiled material, while addition of molasses improved fermentable sugar contents, leading to higher lactic acid concentration in silage type-2 as reported earlier by Iqbal *et al*. (2005).

***Nutrient intake and utilization*:** Average dry matter intake was 3.06, 2.61 and 3.04 kg/d and 2.33, 1.84 and 2.25 kg/100 kg body weight in heifers of T_1, T_2 and T_3 groups, respectively, which did not differ significantly (Table 2). These findings were in agreement with Narang and Pradhan (1974) who reported the similar effect in Haryana cows fed cowpea-wheat straw silage. The intake of CP and DCP was significantly ($P<0.05$) higher in T_3 as compared to T_1 or T_2, which were comparable. Higher CP and DCP intakes in T_3 might be due to the higher CP content in silage type-2. While the intake of TDN was significantly lower in T_2 as compared to T_1 and T_3. Lower TDN intake in T_2 group where berseem silage (silage type-1) without molasses was fed to heifers, might be due to the loss of nutrients owing to high pH (Bolsen *et al*., 1996), leading to the prolong enzyme activity of plant and microbes resulting in higher loss of nutrients in the form of ammonia and VFAs (Khan *et al*., 2006).

Apparent digestibility of nutrients between conventional ration (T_1) and silage type-1 fed to group (T_2) compares well, except for CP, which was significantly ($P<0.05$) lower in T_2. Low CP digestibility in T_2 might be in part due to the unsatisfactory conservation of berseem silage type-1, leading to higher loss of crude protein in the form of ammonia as shown in Table1. Further, owing to the uncontrolled fermentation in silage type-1, the degradation of protein was less in the rumen, which resulted in higher level of ruminal undegraded protein passing to the small intestine leading to lower digestibility of CP (Mustafa and Seguin, 2003). Crude fibre digestibility was significantly ($P<0.05$) lower in T_1. However, the digestibility of almost all nutrients (DM, OM, NDF, ADF) was significantly ($P<0.05$) higher in T_3 as compared to T_1 and T_2, corroborating earlier results of Gampawar and Kakde (1986) who observed improved utilization of ensiled berseem-wheat straw silage in Sahiwal heifers. Digesti-

Table 1. Chemical composition (% DM basis) of wheat straw, silage and concentrate mixture

Particulars	Wheat straw	Silage type-1	Silage type-2	Concentrate mixture
DM	92.10	31.43	41.68	95.10
OM	88.71	86.09	85.36	90.65
CP	4.78	10.01	10.70	21.71
NDF	73.68	63.30	61.88	46.10
ADF	47.33	46.81	46.50	11.35
CF	33.31	31.15	28.6	58.53
EE	1.83	2.33	2.32	4.68
NFE	48.79	42.60	43.68	55.73
Silage characteristics				
pH		5.54±0.05	4.46±0.08	
NH_3-N (mg/100g)		20.55±1.44	12.45±1.11	
TVFAs (m mol/100g)		3.62±0.12	2.85±0.16	
Lactic acid (%)		2.78±0.14	4.85±0.15	

Table 2. Effect of berseem-wheat straw silage on intake and utilization of nutrients

Particulars	Treatment groups		
	T_1	T_2	T_3
Intake of DM and nutrients			
Body weight (kg)	133.33±11.79	137.50±9.07	135.0±03.68
DM intake (kg/d)	3.06±0.15	2.62±0.04	3.04±0.19
DMI % body weight (kg)	2.33±0.11	1.84±0.13	2.25±0.10
CP intake (g/d)	302.93±6.78^a	312.13±4.48^a	377.12±20.79^b
DCP intake (g/d)	178.76±1.46^a	160.97±6.65^a	218.47±12.92^b
TDN intake (kg/d)	1.81±0.08^b	1.49±0.06^a	1.80±0.11^b
Digestibility of nutrients (%)			
DM	58.65±0.78^a	56.46±2.16^a	63.24±0.82^b
OM	61.23±0.61^a	59.23±1.90^a	64.83±0.67^b
CP	59.16±2.63^b	50.23±1.61^a	57.92±1.96^b
NDF	58.85±0.70^a	55.75±2.40^a	60.94±1.20^b
ADF	41.90±0.65^a	45.53±3.19^a	55.21±1.33^b
CF	64.60±0.41^a	67.85±1.49^b	68.53±0.40^b
EE	71.18±1.04	70.36±0.66	70.72±0.72
NFE	62.28±1.11^b	57.97±1.22^a	65.58±0.55^b
Nutritive value (%)			
DCP	5.91±0.34^a	5.93±0.19^a	7.19±0.16^b
TDN	59.25+0.49^b	54.79+1.49^a	59.17±0.52^b

Means bearing different superscripts in a row differ significantly (P<0.05)

-bility of the nutrient in T_3 was within the range reported for good quality silage of leguminous and other forage crops such as pea (Mustafa *et al*., 2002), alfalfa (Rizk *et al*., 2005), berseem and lucerne (Toquir *et al*., 2007) and oat-stover silage (Singh *et al*., 2014).

Further, the nutritive value of the diets offered to heifers suggested that DCP level was significantly (P<0.05) higher for molasses berseem-straw silage (T_3) as compared to T_1 and T_2, which were comparable. TDN value was significantly lower in T_2 as compared to T_1 and T_3. A similar range of nutritive values was reported earlier by Rizk *et al*. (2005) and Toquir *et al*. (2007) for pea, berseem and lucerne silage in dairy cows and Nili-Rabi buffalo bulls.

Conclusion

It was concluded that ensiled berseem with wheat straw along with molasses could be used as roughage during lean period in maintaining the nutrients intake with higher digestibility of nutrients at the reduced consumption of concentrates in crossbred heifers.

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