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Original Article

Sunflower Disc Floret Silage as Feedstuff For Ruminant; *In Vitro* Evaluation

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ABSTRACT

The aim of present study was to estimating nutritional value of sunflower disc florets silage (SFDFS) using in vitro gas production technique. Three fistulated native bulls fed experimental rations twice daily for 15 days, and ruminal fluid was collected for using in in vitro fermentation. Gas production of in vitro fermentation was measured as the volume of gas in the calibrated syringes and was recorded before incubation 2, 4, 6, 8, 12, 24, 48, 72 and 96 hours after incubation. Total gas values were corrected for blank incubation which contained only rumen fluid. The SDFDS has significantly more fermentation potential when compared with dried sunflower disc floret (SFDF). All of gas production fractions (soluble, insoluble, and potential gas production value) are greater for SFDFS in comparison with SFDF. Also, all of energy indices include organic matter digestibility (OMD), metabolizable energy (ME), short chain fatty acids (SCFA), and net energy for lactation (NE_L) are significantly greater for SFDFS. It can be concluded that the ensiling treatment can increase nutritional value and digestibility of SFDF. So, sunflower disc floret silage can be used in ruminant nutrition. Although the nutritional value of ensiled sunflower disc floret is less than sunflower silage.

Key words: *sunflower silage, in vitro gas production technique, ensiling, ruminant.*

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INTRODUCTION

Sunflower wastes have potential for supplementation in ruminant diet. In this regard, Mafakher *et al.* [1] had reported that sunflower waste silage can be used as combined feedstuff with corn silage (1:1 ratio) to improve nutritional value of ration. In their investigation, 12.87% rude protein (CP) was reported for sunflower silage. The nutritional value of sunflower silage for ruminant is equals to 80% of corn and 80-90 % of corn silage [2].

The sunflower is a good substrate for silage fermentation. The amount of fermentation products was very high in sunflower silage and 57% more lactic, butyric, acetic and total volatile fatty acids, respectively, than in maize silage. Ammonia N content was also highest in this silage [3]. In sunflower, the compaction level and maturity stage had significant effects on silage quality. The dry-matter content increased in the silages with maturity. The best results were observed when harvesting at the stage of one-third Milk Line and compaction with the level 498 kPa [4].

Sunflower hulls are somewhat poor quality roughage with high fibre content and a low digestibility (DM digestibility 18). Consequently, limited amounts of sunflower hulls should be introduced in diets [5] and constitute less than 50 % of the total roughage. They are well consumed when finely ground and included in pelleted feeds [5].

In growing cattle, Sunflower hulls may be included at up to 20 % dietary level to increase the total fibre content in the diets of dairy heifers or to provide roughage in high-grain rations for growing or finishing beef cattle [6]. In dairy heifers, Sunflower hulls included at 10 to 40 % decreased nutrient (DM, CP, ADF) digestibility. At 27 % dietary level, the average daily gain was 1360 g/d and the feed efficiency was higher than for the control diet (+21 %). A higher level of sunflower hulls in the diet (50 %) was detrimental to DM intake and growth [7]. In Growing steers, Unground sunflower hulls introduced at 5 or 10 % as roughage in the diet of fattening steers (374 kg) resulted in lower daily gains and DM intake (1240 *vs* 1500 g/d and 0.766 kg/d *vs* 0.840 kg/d respectively). However, using

sunflower hulls could be cost-effective at this inclusion rate [8]. Bueno et al., [9] suggested that lambs fed sunflower silage-based diets need more concentrate ration to obtain suitable performance, similar to those fed corn silage-based diets.
Since, the nutritional value of “sunflower disc florets silage” for ruminant is unclear. So the aim of present study was to estimating nutritional value of sunflower disc florets silage using in vitro gas production technique. Also, we will compare of measures of disk floret silage with dried sunflower disc floret and sunflower silage which reported in published studies.

MATERIALS AND METHODS

The samples of sunflower disc florets were collected after completely harvesting. Seed-removed disc florets were divided for two treatments include drying and ensiling. All of samples were broken to 3-5 cm segments. The drying treatment was conducted under without sunshine. Next, the prepared substrate for ensiling was compacted by pressure and vacuum. Plastic kits include silages materials were kept for 45 d in room temperature (22-24$^{\cdot c}$). After 42 d, the prepared silage was transferred to laboratory for *in vitro* assay.
The nutritional analysis is described below;
Chemical analysis of samples
Dry matter (DM) was determined by drying the samples at 105°C overnight and ash by igniting the samples in a muffle furnace at 550°C for 6 h. Nitrogen (N) content was measured by the Kjeldahl method [10] . Crude protein was calculated as N X 6.25. Acid detergent fibre (ADF) content and neutral detergent fibre (NDF) content of leaves were determined using the method described by Van Soest *et al.,* [11]. All of chemical analyses were carried out in triplicate.
Statistical analysis
Data on apparent gas production parameters were subjected to one-way analysis of variance using the analysis of variation model ANOVA using SAS [12]. The comparison of means was evaluated by unpaired t-test. All values were shown as standard error of difference between means (SEM).
In vitro gas production
Rumen fluids was obtained from four fistulated cattle (cross-bred bulls), fed twice daily with a diet containing alfalfa and concentrate. The samples were incubated in the rumen fluid in calibrated glass syringes following the procedures of Menke and Steingass [13] as follows. 0.200 g dry weight of the sample was weighed in triplicate into calibrated glass syringes of 100 ml in the absence. The syringes were pre-warmed at 39°C before injecting 30 ml rumen fluid-buffer mixture into each syringe followed by incubation in a water bath at 39°C. The syringes were gently shaken 30 min after the start of incubation and every hour for the first 10 h of incubation. The gas production was measured as the volume of gas in the calibrated syringes and was recorded before incubation 2, 4, 6, 8, 12, 24, 48, 72 and 96 hours after incubation. Total gas values were corrected for blank incubation which contained only rumen fluid. Cumulative gas production data were fitted to the model of Ørskov and McDonald [14].
$y= a + b\ (1\text{-}exp^{-ct})$
Whereas:
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 OMD (organic matter digestibility) of forages was calculated using equations of Abash *et al.* (2005) as follows:
$DOM\ \% = 0.9042 \times GP + 0.0492 \times CP + 0.0387 \times CA + 16.49$
Whereas:
GP is 24 h net gas production (ml / 200 mg),
CP = Crude protein (%)
CA = Ash content (%)
ME (MJ/kg DM) content of forages (disc florets) was calculated using equations of Ismail Abash *et al.,* (2005) as follows:
$ME\ (MJ/kg\ DM) = 0.136 \times GP + 0.0057 \times CP + 0.000286 \times EE^2 + 2.20$
$NE_L\ (MJ/kg\ DM) = 0.096 \times GP + 0.0038 \times CP + 0.000173 \times EE^2 + 0.54$

Whereas:
GP is 24 h net gas production (ml/200 mg),
CP = Crude protein (%)
EE = Ether Extract (%)
For determination of metabolizable energy (ME), net energy for lactation (NE_L) and digestibility of organic matter (DOM) in *in vitro* conditions, Menke and Steingass [13] equation was applied for gas production volume from a milligram of sample and turned it for 200 mg sample to 24h.

RESULTS

The chemical composition of SFDF silage is presented in table 1.

Table1. Chemical composition of sunflower disc floret silage (present study) with sunflower silage [9].

Composition (%)	Dry matter (DM)	Crude protein (CP)	Ether extract (EE)	Ash	Acid detergent fibre (ADF)	Neutral detergent fibre (NDF)
SFDFS	35	13.43	3.70	9.7	16	21.4
SFS	22.0	11.6	10.1	14.7	42.7	44.3

- All data presented in percent.

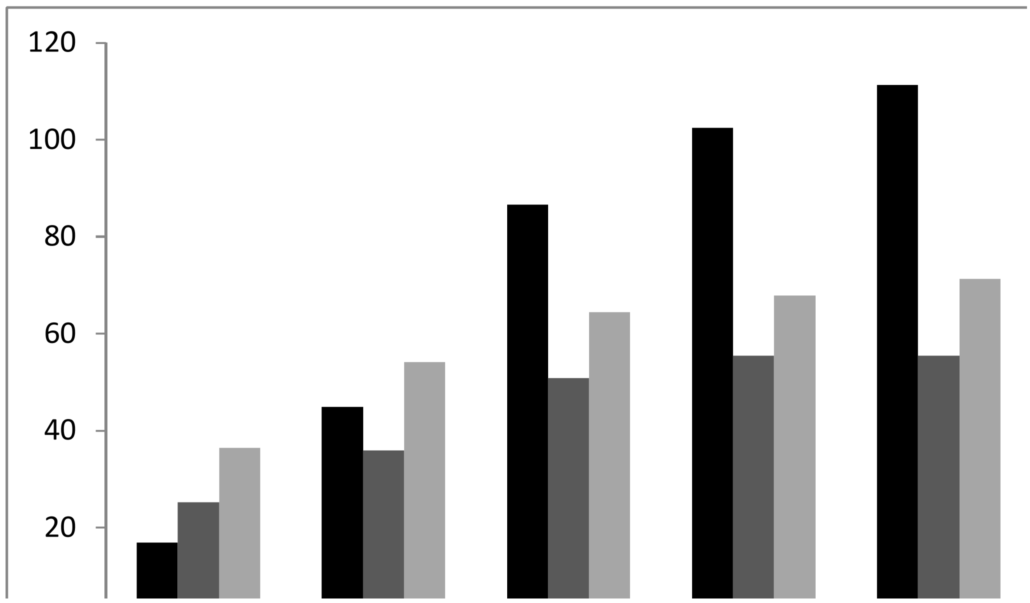

Figure1. The gas production for sunflower disc florets (SFDF), sunflower disc florets silage (SFDFS) and sunflower silage (SFS) (ml/200 mg DM) at different time of fermentation period, Data for sunflower silage (SFS) was summarized from Jayme et al., [15] for Mycogen 93338 strain of sunflower.

The gas volumes produced in 6 and 12h were significantly greater for SFDFS when compared with SFDF or SFS, whereas gas volumes produced with SFDFS in next steps of fermentation (24-96h) was lower than SFS, whereas it was greater than for SFDF (figure 1). SFS has considerable greater whole gas volume (96h) in comparison with SFDF or SFDFS (figure 1).

Table 2. The estimated parameters from the gas production and energy indices for sunflower disc florets silage (SFDFS)

	Estimated Parameters							
Substrate	a	b	|a|+b	C	OMD	ME	SCFA	NE_L
SFDFS	5.37	69.52 [a]	74.92[a]	0.117 [a]	68.32 [a]	10.92 [a]	1.13 [a]	6.47 [a]
SFDF	1.10	56.23 [b]	57.40 [b]	0.08 [b]	59.89 [b]	9.59 [b]	1.12 [b]	5.50 [b]
P value	0.09	0.001	0.001	0.001	0.0001	0.0001	0.0001	0.0001
SEM	0.41	0.26	0.34	0.003	0.21	0.03	0.004	0.019

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 (t)
a+b : Potential gas production,
ME : Metabolizable energy, (MJ/kg DM),
OMD : Organic matter digestibility (%), SCFA: short chain fatty acids,
NEL: Net Energy Lactation (MJ/kg DM),
SEM: standard error of the mean. Different letters (a or b) in each row shows significant difference between means.

All of gas production fractions (soluble, insoluble, and potential gas production value) are greater for SFDFS in comparison with dried SFDF (table 2). Also, all of energy indices include OMD, ME, SCFA, and NE_L are significantly greater for SFDFS (table 2).
In present study, based on tables 1 and 2, the SFDFS has significantly better nutritional value for ruminant in comparison with dried SFDF.

DISCUSSION

Anandan *et al.,* [16] had investigated on sunflower heads based complete feeds by in vitro analysis. In their study, incorporation of sunflower heads as a sole roughage resulted in higher digestibility values. They had suggests that sunflower heads can be a satisfactorily substitute for conventional roughages in complete diets for ruminant. A published study on sunflower straw [17] shows lower OMD (34.72%) and CP (5.72%), greater NDF (65.19%), when compared with present results (OMD: 59.89-73.42, CP: 8.35-10.76%, NDF: 20-23.2%)(Table1 and 3). These results indicated that SFDF has better feedstuff in comparison with sunflower straw [17]. In other hand, present results in agreement with Anandan *et al.,* [16], indicate that sunflower disc florets can be incorporate in formulated diets for ruminant. Albeit, SFDF has lower nutritional value than for sunflower silage [1]. The ensiling treatment can increase nutritional value and digestibility of SFDF. So, SFDF silage may have better results in ruminant nutrition.
It can be concluded that, sunflower disc floret as a sunflower seed by-product can be used in ruminant nutrition. Although the nutritional value of ensiled sunflower disc floret is less than sunflower silage.

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