

ENVIRONMENTAL ASPECTS OF SILAGE ADDITIVES: NUTRITENT DIGESTIBILITY AND NITROGEN RETENTION OF INOCULATED ALFALFA HAYLAGE IN SHEEP

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Introduction

During ensiling process, naturally occurring enzymes (proteases) will cause the valuable true protein to break down (McDonald *et al*, 1991). Prolonged fermentation in uninoculated silage allows proteolytic bacteria (eg. *Clostridia*) to degrade high quality plant protein and convert it into ammonia and nitrates. Therefore, it is essential that the decline in pH is as rapid as possible in the first two or three days of ensilage to stem proteolysis as true protein rather than the products of proteolysis is more readily absorbed by the intestine (by-pass protein) than the products of protein hydrolysis (Webb and Matthews, 1998). In uncontrolled silage fermentation 45% of the protein will be broken down (Carpintero *et al*, 1979). The use of lactic acid producing bacteria inoculants can significantly reduce the breakdown of protein, leaving higher levels of true protein in the treated forage. Reducing soluble protein levels in the rumen has been reported to improve microbial protein synthesis (Sharp *et al*, 1994). This overall retention of nitrogen by the animal will lead directly to improved performance, be it live-weight gain in beef animals (Mayne and Steen, 1993), significant extra milk production in dairy cows and helps sustainable development in agriculture owing to lower nitrogen content of the manure. The authors studied the effect of a biological silage additive on apparent nutrient digestibility and nitrogen-retention of alfalfa haylage in whether.

Methods

Ensiling: The ensiled alfalfa was derived from the last cut of a second year alfalfa field in early flowering stage (Experimental Farm, Szent István University). Alfalfa was wilted during 24 hours. Silage additive was added to alfalfa after chopping (5-7 cm): 150g/t plant material with spraying in liquid form. Ensiling was carried out into 2 concrete pits (capacity: 3 m³, respectively). Ensiled amount: 300 kg, density of 410 kg/m³. Silage additive (Sil All - Fire Guard, Alltech Inc.) contained: bacteria (*Streptococcus faecium*, *Pediococcus acidilactici*, *Lactobacillus plantarum*, *Lactobacillus salivarius*), enzymes (amilase, cellulase, hemicellulase, pentosanase) and preservatives (K-sorbate and Na-benzoate).

Sampling and laboratory analysis: Feeding out and sampling were carried out on 180th day of storage. Following parameters were analyzed: dry matter, crude protein, crude fiber, crude fat, crude ash, true protein, NDF content according to Hungarian National Standard Methods (Hungarian Feed Codex II). **Nutrient digestibility:** Experimental animals were 6, one year old, merino sheep's (wether) in weight of 40 kg. Experimental period was: 12 days (7 day adaptation and 5 day sample -feces and urine- collection). The daily feed volume was 4 kg alfalfa haylage. Urine and feces were collected and weighed every day during the experimental period. The alfalfa haylage and feces samples were analyzed by the previously mentioned parameters, nitrogen-content was determined in urine according to Hungarian National Standard (Hungarian Feed Codex II). **Calculations:** Apparent digestibility of nutrients was calculated according to Schmidt (2003.). Net energy and metabolizable protein

content were calculated based on standard and actual measured digestibility data (*Schmidt és mtsai., 2000.*). Nitrogen retention was determined by *Czakó (1982)*.

Results and discussion

Nutrient content of alfalfa haylage are shown in Table 1.

Table 1 Nutrient content of the control and treated alfalfa haylage

	Dry matter	Crude protein	Crude fat	Crude fiber	Crude ash	N-free extract	DF
	g/kg	g/kg DM					
Control	493,4	186,3	35,0	162,2	285,7	330,8	240,1
Treatment	479,8	188,2	36,7	180,4	277,5	317,2	228,6

It was found that apparent digestibility of organic matter ($p \leq 0,01$), crude protein ($p \leq 0,05$), crude fat ($p \leq 0,05$), crude fiber ($p \leq 0,01$) has been significantly improved by the treatment (Table 2) compared to the control according to results of *Scheidemann et al (1998)*. NDF-digestibility was improved (not significantly) by the treatment. Higher digestibility of crude fiber is presumably owing to the effect of fiber degrading enzymes (esp. cellulase and hemicellulase) in the silage additive according to findings of *Johnston and Shivas (1999)*, *Buchanan and Smith (1988)*. The higher apparent digestibility of crude protein can be due to reduced cell wall effect (caused by fiber degrading enzymes in silage additives) or higher protein quality by rapid pH-decline and decreased protein hydrolyses in the haylage in early stage of fermentation (*Cussen et al, 1995.*).

Table 2 Apparent nutrient digestibility of alfalfa haylage in wether (n= 3), %

	Dry matter	Crude protein	Crude fat	Crude fiber	N-free extract	Organic matter	NDF
Control	52±1,6	75±0,6	62±0,7	49±1,4	73±0,8	68±0,23	46,6±3,7
Treatment	55±1,3 NS	77±0,3*	62±2,9 *	54±3,2 **	75±0,9 NS	71±0,83**	51,2±4,1 NS

Notes: NS non significant difference, * $p \leq 0,05$, ** $p \leq 0,01$,

Silage additive significantly increased the metabolizable protein ($p \leq 0,01$; $p \leq 0,001$) and nett energy content ($p \leq 0,01$) due to higher nutrient digestibility (Table 3).

Table 3 Metabolizable protein and net energy content of alfalfa haylage (based on measured digestibility data)

	MFE	MFN	NEm	NEg	NEl
	g/kg DM		MJ/kg DM		
Control	72,2±0,1	110,6±0,0	4,31±0,0	2,00±0,0	4,80±0,0
Treatment	74,6±0,5**	111,7±0,0***	4,71±0,1**	2,38±0,1**	5,09±0,1**

Notes: MFE: energy dep. metabolizable protein, MFN: nitrogen dep. metabolizable protein

NEm, NEg, NEl: nett energy content for maintenance, gain and lactation

NS non significant difference, * $p \leq 0,05$, ** $p \leq 0,01$, *** $p \leq 0,001$

Comparing the calculated energy dependent metabolisable protein content based on standard and measured digestibility data (Table 4), the authors have found that the MFE based on

experimental results were 7,3% higher as MFE based on the standard data in the case of treated haylage (Control : 4,2% difference). It means that silage additive improved the absorbed protein in the intestine by 3,1% and reduced the nitrogen in the manure. Authors have found similar results in the case of nett energy content (NEm:+8,8%, NEg:+19,1%, NEI:+5.5% compared to the control).

Table 4 Comparison of results (metabolisable protein and net energy content) calculated by measured digestibility data to ones based on standard digestibility

	MFE	NEm	NEg	NEI
	Difference %			
Control	4,2	10,2	22,8	6,1
Treatment	7,3	19,0	41,9	11,6

Biological silage additive slightly improved the nitrogen-retention, but the difference was not significant (Control: 30,6±4,2; Treatment 31,1±1,6 NS). *Steen (1991.)* was found significant improvement of nitrogen-retention by silage additive. The more true protein supplied to the ruminant, the less nitrogen in the faeces. It has important role in sustainable development in agriculture. Better protein quality in silage/haylage and nitrogen utilization improve the animal performance (milk yield, daily gain et cet.) and reduce environmental risk of manure application in nitrate sensitive area.

Conclusions

It was found that biological silage additive (SilAll- Fire Guard) improved apparent digestibility of organic matter, crude protein, -fat and -fiber, increased the metabolisable protein and nett energy content, additionally slightly improved the nitrogen retention. It can be explained by the reduced cell wall effect (by the effect of fiber degrading enzymes) and higher protein quality owing to advantageous and controlled fermentation process in the haylage. Recent experiment is initial investigation of the subject, therefore further results are required to prove the effects and explain the processes.

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