

## The effect of additives on palatability, voluntary intake and digestibility of lucerne and whole-crop oat silages

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### ABSTRACT

Second-cut lucerne media (*Medicago media Pers* var. Radius) harvested at the budding stage was ensiled with whole-crop oats (var. Santor), cut at milk stage, at a 75:25 or 50:50 (wt/wt) ratio. Additionally, each combination was conserved with or without an enzyme-bacterial additive (Goldzym). The experimental silages were: lucerne, 75 + whole-crop oats, 25; lucerne, 50 + whole-crop oats, 50; lucerne, 75 + whole-crop oats, 25 + Goldzym; lucerne, 50 + whole-crop oats, 50 + Goldzym. The experiment was conducted on 7-month old male lambs of the Polish Long-haired breed.

Neither the content of whole-crop oats in the silage nor the addition of Goldzym had any effect on the chemical composition of silages. However, both factors had a positive effect on fermentation in the silo and silage quality. Voluntary and free-access dry matter intakes were influenced mainly by the lucerne to whole-crop oats ratio. Inclusion of 50% of whole-crop oats increased voluntary dry matter intake as well as digestibility and N-balance.

**KEY WORDS:** silage, lucerne, whole-crop oats, lambs, intake, digestibility, N-balance

### INTRODUCTION

Due to its high yield, divided by 3-5 cuts per year, as well as high nutritive value, lucerne media (LM; *Medicago media Pers*) plays an important role among forages produced on cultivated lands in Poland (Pyś et al., 2000). It can be utilized in animal feeding artificially dehydrated or as herbage, hay or silage. Due to the

high cost of dehydration and losses during hay production, ensiling is the proper conservation method for lucerne (Khorasani et al., 1993; Brzóška et al., 1999). However, its high protein content and high buffering capacity together with low sugar concentration, classify lucerne to the group of difficult-to-ensile forages (Playne and McDonald, 1966). Several methods of ensiling lucerne have been developed so far. Less attention has, however, been given to the ensiling of lucerne together with whole-crop oats, which could be cut at the same time (Okine et al., 1994; Borowiec et al., 1998). Spring oats is a popular, high-yielding crop in Poland. Its high suitability for ensiling has been well documented (e.g., McCartney and Vaage, 1993). Moreover, it is used as a protective plant for sod-seeded legumes and grasses and in this case the suggested harvest date is the milk stage of grain (Nielsen et al., 1981).

The aim of this study was to determine the effect of the level of inclusion of whole-crop oats (WCO) and enzyme-bacterial additive Goldzym on the chemical composition and quality of lucerne media (LM) as well as on dry matter intake, digestibility and N-balance in young lambs.

## MATERIAL AND METHODS

Second cut lucerne media (*Medicago media Pers* var. Radius) harvested at budding stage was ensiled with milk stage whole-crop oats (var. Santor) at a ratio of 75:25 or 50:50 (wt/wt). After harvesting the herbage was chopped into about 2 cm particles and mixed manually. Additionally, each combination was mixed with or without 200 ml<sup>T-1</sup> of enzyme-bacterial additive Goldzym (Polmass, Bydgoszcz, Poland). The experimental silages were: lucerne, 75 + whole-crop oats, 25 (A); lucerne, 50 + whole-crop oats, 50 (B); lucerne, 75 + whole-crop oats, 25 + Goldzym (C); lucerne, 50 + whole-crop oats, 50 + Goldzym (D). The forages were ensiled in 100 L plastic containers.

The palatability of silages was determined in an experiment conducted on six 7-month-old male lambs of the Polish Long-haired breed ( $\pm 40$  kg of liveweight), kept in individual cages. The animals had simultaneous free-access to four silages, given in plastic baskets. After a preliminary period of 14 days, the intake of each silage was controlled for 5 days.

Voluntary dry matter intake of silages was determined on 12 male lambs divided into 4 groups. The animals were kept individually and in each group they were fed *ad libitum* with different silages. Preliminary and controlled periods lasted 14 and 5 days, respectively. The same animals were then used in the digestibility and N-balance trial. The animals were transferred into individual metabolic cages. The preliminary and collection (faeces and urine) periods lasted 21 and 7 days, respectively.

Chemical composition of forages, silages, faeces and urine (nitrogen) was determined by standard methods (AOAC, 1990). Gross energy was determined by bomb-calorimetry. Water-soluble carbohydrate content in forages was determined by the Deriaz method (1961), buffering capacity according to Playne and McDonald (1966), and NDF and ADF by the method of Goering and Van Soest (1970). The concentration of acids and ethanol in silages was determined by GC (Varian Star 3400CX; detector FID, argon as a carrier gas; column DB-FFAP). Ammonia-N concentration in silages was determined by the Conway method. The quality of silages was assessed on the Flieg-Zimmer score.

The results were subjected to one-way analysis of variance using the GLM procedure of SAS (1995).

## RESULTS AND DISCUSSION

Lucerne M and oat herbage contained 190.2 and 224.7 g of DM (in 1 kg). One kg of DM contained 203.9 and 119.7 g of crude protein and 28.4 and 76.0 g of water-soluble carbohydrates for LM and WCO, respectively. Its buffering capacity was 40.5 and 23.6 mEq/100g DM.

Its high protein content and high buffering capacity as well as low sugar concentration make lucerne difficult to ensilage (Playne and McDonald, 1966; Mir et al., 1995; Pyś et al., 2000). In contrast, WCO, cut at milk stage of grain development, is a good ensiling substrate (Garnsworthy and Stokes, 1993).

Neither the content of whole-crop oats in the silage nor addition of Goldzym had any effect on the chemical composition of silages (Table 1). However, silages made with Goldzym (C and D) had slightly higher contents of DM and N-free extractives. The addition of 50% of WCO and Goldzym had a positive effect on fermentation in the silo and silage quality (Table 1). The concentration of lactic acid and its proportion to total acids increased when the content of WCO increased from 25 to 50% (silage B vs A and D vs C). An additional increase was caused by Goldzym (silages C and D vs A and B). Similar, but inverse tendencies were shown for the concentration of ethanol and ammonia-N. The effect of WCO content in the silage seems to be stronger than the effect of Goldzym. Silages B, C and D were also highly evaluated by the Flieg-Zimmer score points and classified as very good silages. A positive effect of enzyme-bacterial additives on silage quality was also shown by others (Charmley et al., 1996; Nadeau et al., 2000).

The inclusion of 50% of WCO increased free-access intake of silage and dry matter by lambs (Table 2). The animals preferred silages without Goldzym. However, in the experiment on voluntary intake, the lambs consumed more silage with the 25% content of WCO, particularly with Goldzym (silage C). The differences between free-access and voluntary intake are difficult to explain.

TABLE 1

Chemical composition and quality of silages

Item	Silages: lucerne + whole-crop oat			
	75:25	50:50	75:25	50:50
	+ enzyme bacterial preparation			
pH				
Dry matter, g·kg <sup>-1</sup>	198.3	193.9	205.0	204.7
In dry matter, g·kg <sup>-1</sup>				
crude protein	178.0	153.7	175.6	150.0
ether extract	75.6	70.6	66.8	62.0
crude fibre	293.6	310.9	296.6	303.8
NDF	507.8	517.2	507.3	523.2
ADF	399.9	383.7	396.6	388.9
N-free extractives	338.9	353.3	342.0	370.9
lactic acid (L)	52.1	69.5	82.1	102.4
acetic acid (A)	29.1	25.0	33.6	24.2
butyric acid	0.16	0.23	0.3	0.25
ethanol	5.9	6.4	5.1	5.8
Acid proportions				
L:A	1.8	2.8	2.4	4.2
L : total acids	0.62	0.73	0.71	0.81
N-NH <sub>3</sub> , % of total N	11.3	9.7	10.9	8.9
Flieg-Zimmer score, points	77	91	88	98

There was no significant effect of Goldzym on nutrient digestibility (Table 2;  $P>0.05$ ), which is similar to the results of Mir et al. (1995) and Nadeau et al. (2000). On the other hand, Podkówka et al. (1998) observed higher digestibility of lucerne ensiled with a microbial-enzymatic inoculant. Increasing the content of WCO from 25 to 50 % decreased digestibility of CP, NDF and ether extract (Table 2;  $P<0.05$ ).

Irrespective of WCO content and Goldzym addition, all the animals were in a positive N-balance, which was in the range of 3.06-3.30 g d<sup>-1</sup> (Table 2). The effects of treatments were not significant ( $P>0.05$ ). However, there was a tendency toward higher N-retention (as a % of N-intake and N-digested) in animals fed with 50% WCO silages (B and D).

## CONCLUSIONS

Based on these results it may be concluded that lucerne media can be successfully ensiled and utilized by the animals when mixed with whole-crop oats.

TABLE 2  
Intake, digestibility and nitrogen balance in lambs

Item	Silages: lucerne + whole-crop oat				Total	SE
	75:25	50:50	75:25	50:50		
	+ enzyme bacterial preparation					
Free-access silage intake						
silage, g d <sup>-1</sup>	1100	1300	930	1090	4420	64.11
dry matter, g d <sup>-1</sup>	218.1	252.1	190.6	223.1	883.9	11.99
Voluntary intake of silages						
silage, g d <sup>-1</sup>	3914	3859	4221	3794	-	110.5
dry matter, g d <sup>-1</sup>	776.1	748.3	865.3	776.6	-	23.11
Digestibility, %						
dry matter	60.5	60.9	60.4	61.0	-	0.76
organic matter	63.7	63.1	63.2	63.6	-	0.76
crude protein	79.8 <sup>a</sup>	73.1 <sup>b</sup>	78.9 <sup>a</sup>	74.0 <sup>b</sup>	-	0.75
crude fibre	55.9	50.8	54.4	52.2	-	1.28
NDF	49.0 <sup>a</sup>	38.0 <sup>b</sup>	48.0 <sup>a</sup>	39.0 <sup>b</sup>	-	2.18
ADF	51.5	50.4	51.7	50.2	-	0.97
ether extract	84.9 <sup>a</sup>	78.7 <sup>b</sup>	84.8 <sup>a</sup>	78.8 <sup>b</sup>	-	1.40
N-free extractives	63.4	59.4	63.3	59.5	-	1.21
Gross energy	63.1	62.3	62.6	62.7	-	0.84
N-retained, g d <sup>-1</sup>	3.30	3.06	3.14	3.20	-	0.71
% of N-intake	16.62	18.21	16.40	19.59	-	1.01
% of N-digested	20.65	23.72	20.34	24.06	-	0.98

<sup>a,b</sup> - P ≤ 0.05

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## STRESZCZENIE

### **Wpływ dodatku preparatu enzymatyczno-bakteryjnego na smakowitość, pobranie i strawność kiszonek z lucerny z owsem**

Do zakiszania użyto zielonkę drugiego pokosu lucerny mieszańcowej odm. Radius, zebraną w fazie pączkowania, oraz zielonkę owsa odm. Santor, zebraną w fazie młeczej dojrzałości ziarna. Sporządzono cztery kiszonki: lucerna 75% + owies 25% (A); lucerna 50% + owies 50% (B); lucerna 75% + owies 25% + preparat enzymatyczno-bakteryjny Goldzym (C); lucerna 50% + owies 50% + preparat enzymatyczno-bakteryjny Goldzym (D). Badania żywieniowe przeprowadzono na młodych tryczkach rasy polskiej długowłnistej.

Dodatek zielonki z owsa lub preparatu Goldzym do zakiszanej lucerny nie miał wpływu na wartość podstawowych składników pokarmowych w kiszonkach. Wykazano natomiast pozytywny wpływ tych dodatków na przebieg fermentacji i jakość kiszonek.

Dowolne oraz maksymalne pobranie kiszonek przez tryczki zależało głównie od dodatku owsa. Również strawność oraz bilans azotu zależała od udziału owsa w kiszonce.