ASSOCIATIVE EFFECTS OF UNTREATED AND AMMONIATED WHEAT STRAW DIETS AND ALFALFA FED TO SHEEP

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Story in Brief

Thirty-five and twenty-eight wether lambs (50 lb) were individually fed ad libitum once a day untreated (US) or ammoniated wheat straw (AS) in combination with different proportions of high quality roughage (HQR) as alfalfa hay (ALF) or dehydrated alfalfa pellets (DEHY) (100:0; 67:33; 33:67 and 0:100 for US/AS:ALF:DEHY) in two separate experiments. The substitution of HQR produced a linear increase ($P<.01$) in organic matter (OM) intake for both types of straw diets. Digestibility of dietary organic matter (OMD) was linearly increased in both US and AS diets as the proportion of HQR increased. For US:HQR up to 33:67, the digestibility of dietary neutral detergent fiber (NDFD) remained similar, while a reduction was observed with AS based diets. Ammoniation of straw increased OM intake, OMD and NDFD.

Associative effects observed between straw and HQR varied depending on the type of straw and the HQR. With US:ALF diets, negative associative effects were observed for total diet OMD and NDFD, while positive associative effects were observed for OMD and NDFD with AS:ALF diets. DEHY depressed NDFD of the total diet for both types of straws.

Ammoniation of straw resulted in a similar metabolizable energy intake between the 100:0 AS diet and that observed with 67:33 US:HQR in the diet. A higher level of production could be expected from diets of AS plus HQR, particularly with DEHY. Calculated metabolizable energy intakes indicate that mature non-pregnant, non-lactating ewes could be maintained on a diet of 67:33 AS:ALF while a ratio of 33:67 would be required with US based diets.

Key Words: Ammoniation, Wheat Straw, Alfalfa, Associative Effects, Digestibilities, Sheep.

Introduction

The poor digestibility and low voluntary intake of low quality roughages result from their low protein content and extensive lignification of cell walls. Both physical processing and chemical treatment have been used to improve the feeding value of low quality roughages such as wheat straw (Streeter and Horn, 1980). Alfalfa hay is a good source of supplemental protein and minerals and a logical choice for addition to low quality roughages, such as wheat straw, to increase the extent of ruminal organic matter digestion by correcting for nutrient deficiencies.

The objective of this study was to determine the effect of combining alfalfa hay (ALF) or dehydrated alfalfa pellets (DEHY) with untreated (US) and ammoniated (AS) wheat straw in different proportions, on feed intake, apparent digestibility of organic matter (OMD) and neutral detergent fiber (NDFD). The identification of

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possible associative effects between US or AS and HQR on OMD and NDFD was also an objective of the experiments, and was determined as a significant difference between observed and calculated digestibilities of the diets. Calculated percent nutrient digestibilities were obtained by the following relationship:

$$CPND = \frac{(A \times B) + (C \times D)}{E} \times 100$$

where

CPND = Calculated percent nutrient digestibility
A = Nutrient intake from straw
B = Observed nutrient digestibility in 100 percent straw diet
C = Nutrient intake form HQR
D = Observed nutrient digestibility in 100 percent HQR diet
E = Total nutrient intake

Materials and Methods

Thirty-five and twenty-eight wether lambs (50 lb) were housed in individual pens and randomly assigned to seven treatments in two separate experiments (five and four lambs/treatment for experiments 1 and 2, respectively; Table 1).

In experiment 1, US was blended with either ALF or DEHY, while AS was used in experiment 2. Straws and ALF were ground through a 1.5 inch screen. Lambs were fed once a day, ad libitum, and supplemented daily with 45 g of mineral-vitamin supplement shown in Table 1. Lambs on the 100 percent US diet also received 5 g of urea/day. Individual feed refusals were recorded and sub-sampled daily. After a 15-day adaptation period, individual collection of total feces was achieved by means of bags during a 7-day period in experiment 1 and a 5-day period in experiment 2. Animals were weighed at the beginning and end of each period. Representative samples of feed, feed refusals and feces were analyzed for dry matter, ash and NDF. Data were analyzed by analysis of variance with a test made for linear and quadratic effects on OM intake, OMD and NDFD.

Results and Discussion

Substitution of ALF or DEHY for both types of straws resulted in an increase ($P<.01$) in OM intake (Figure 1) and organic matter digestibility (Figure 2). The NDFD was linearly increased ($P<.01$) with the progressive inclusion of HQR in US based diets, but it was linearly decreased ($P<.01$) in AS based diets. This was due to the marked increase in NDFD caused by ammoniation and the relatively low NDFD of 0:100 AS:HQR diet (Figure 2). Ammoniation of wheat straw also improved its OM intake and digestibility (Figures 1 and 2).

Different associative effects were observed between wheat straw and HQR depending on type of straw and HQR used. For the US:HQR diets, the combination of US with HQR resulted in a decrease in OMD and a negative associative effect on NDFD of the whole diets. On the other hand, with AS:ALF diets, positive associative effects were observed for OMD and NDFD. Substitution for AS with DEHY resulted in negative associative effects on OMD and NDFD of the whole diet (Table 2).

Calculated metabolizable energy (ME) intake increased as the level of substitution of HQR increased in the diet with US:HQR diets. The ME intake was not sufficient to meet maintenance ME requirements of lambs

Table 1. Formulation and composition of diets.

	Dietary treatment													
	Experiment 1							Experiment 2						
	US:ALF				US:DEHY			AS:ALF				AS:DEHY		
	100: 0[a]	67: 33	33: 67	0: 100	67: 33	33: 67	0: 100	100: 0	67: 33	33: 67	0: 100	67: 33	33: 67	0: 100
Ingredients (% as fed basis)														
US	100	67	33	--	67	33	--	--	--	--	--	--	--	--
AS	--	--	--	--	--	--	--	100	67	33	--	67	33	--
ALF	--	33	67	100	--	--	--	--	33	67	100	--	--	--
DEHY	--	--	--	--	33	67	100	--	--	--	--	33	67	100
Vit & Min[b] supplement	+	+	+	+	+	+	+	+	+	+	+	+	+	+
Composition (% DM basis)														
Organic matter	93.6	93.5	93.3	93.2	92.0	90.3	88.7	95.8	94.7	93.7	92.6	93.9	91.8	89.9
Crude protein	4.3	8.9	13.5	18.1	8.8	13.3	17.8	11.4	13.8	16.3	18.7	14.6	17.8	21.0
Neutral detergent fiber	83.2	71.4	59.3	47.5	72.5	61.4	50.7	77.6	69.3	60.7	52.4	66.8	55.7	44.9

[a]100% US treatment received 5 g of urea daily.
[b]Supplement level and composition: 45 g/head/day, molasses 20.25 g, dicalcium phosphate 18.18 g, trace mineralized salt 2.0 g, potassium sulfate 4.46 g, plus vitamins A, D and E to supply 970, 21 and .05 IU/head/day, respectively.

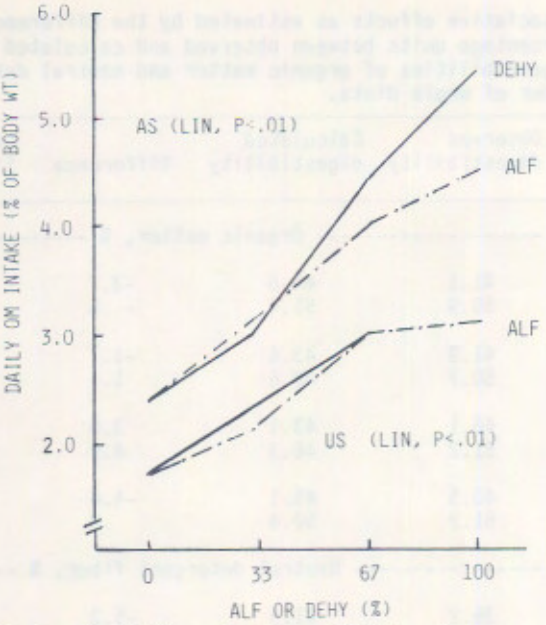

Figure 1. Effects of addition of ALF or DEHY to wheat straw diets when fed ad libitum on daily organic matter (OM) intake (% of body wt).

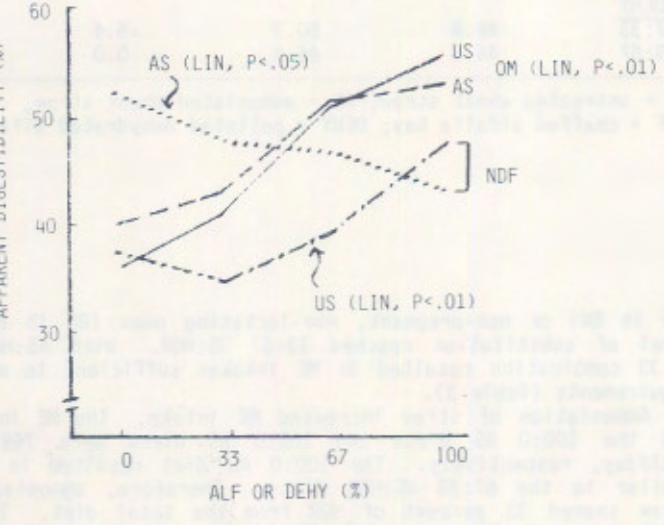

Figure 2. Effect of addition of ALF or DEHY to straw diets when fed ad libitum on OMD and NDFD (%).

Table 2. Associative effects as estimated by the differences in percentage units between observed and calculated digestibilities of organic matter and neutral detergent fiber of whole diets.

Treatment[a]	Observed digestibility	Calculated digestibility	Difference	Level of Significance
	Organic matter, %			
US/ALF				
67:33	41.1	44.8	-3.7	NS
33:67	50.9	51.4	- .5	NS
US/DEHY				
67:33	41.9	43.6	-1.7	NS
33:67	50.7	49.6	1.1	NS
AS/ALF				
67:33	46.1	43.1	3.0	NS
33:67	51.2	46.3	4.9	.02
AS/DEHY				
67:33	40.5	45.1	-4.6	.02
33:67	51.2	50.4	.8	NS
	Neutral detergent fiber, %			
US/ALF				
67:33	36.2	41.5	-5.3	.10
33:67	39.1	44.2	-5.1	NS
US/DEHY				
67:33	33.6	40.0	-6.4	.05
33:67	40.3	41.4	-1.1	NS
AS/ALF				
67:33	52.1	48.9	3.2	NS
33:67	48.6	44.9	3.7	.08
AS/DEHY				
67:33	44.9	50.3	-5.4	.01
33:67	46.6	46.6	0.0	NS

[a]US = untreated wheat straw; AS = ammoniated wheat straw, ALF = chaffed alfalfa hay; DEHY = pelleted dehydrated alfalfa.

(55 lb BW) or non-pregnant, non-lactating ewes (80 lb BW), until the level of substitution reached 33:67 US:HQR. With AS:HQR diets, the 67:33 combination resulted in ME intakes sufficient to meet the above requirements (Table 3).

Ammoniation of straw increased ME intake. The ME intake of lambs fed the 100:0 AS diets and 100:0 US diets were 769.6 and 442.2 Kcal/day, respectively. The 100:0 AS diet resulted in an ME intake similar to the 67:33 US:HQR diets. Therefore, ammoniation of wheat straw spared 33 percent of HQR from the total diet. The economical implication of this saving needs to be considered by each producer using prices for his available feedstuffs.

Table 3. Potential to meet metabolizable energy requirements for maintenance (MEMT) for lambs or ewes, with observed intakes of calculated ME(MEIn), under different wheat straw/high quality roughages diets.

Diet[a]	ME In (Kcal/day)	ME In/ME Mt[b]	
		55 lb lamb	80 lb ewe
US/ALF			
100:0	442.2	.41	.37
67:33	726.6	.67	.61
33:67	1300.2	1.21	1.09
0:100	1541.6	1.43	1.29
US/DEHY			
67:33	786.3	.73	.66
33:67	1371.9	1.28	1.15
0:100	1486.6	1.38	1.24
AS/ALF			
100:0	769.6	.72	.64
67:33	1190.2	1.11	1.00
33:67	1864.2	1.73	1.56
0:100	2103.2	1.95	1.76
AS/DEHY			
67:33	1058.8	.98	.89
33:67	2313.5	2.15	1.94
0:100	3209.8	2.98	2.69

[a]US = untreated wheat straw; AS = ammoniated wheat straw; ALF = chaffed alfalfa hay; DEHY = dehydrated alfalfa pellets.

[b]Ratio = calculated ME intake/ME maintenance requirement , 55 lb lamb = 1075.5; 80 lb ewe = 1195.0 Kcal/day.

Literature Cited

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