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EFFECTS OF SUPPLEMENTING WEANLING RABBIT DIETS WITH UNTREATED AND AMMONIATED ANNUAL RYEGRASS STRAW AS FIBER SOURCES ON PERFORMANCE AND NUTRIENT DIGESTIBILITY

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Abstract

Two standard Oregon State University doe herd diets (OSU 47 and OSU 58) were supplemented with or without 20% untreated or ammoniated ryegrass straw and fed to 60 weanling New Zealand White rabbits allotted at random to six treatments (10 animals per treatment) in a 28 day digestion and performance trial. Ammoniation of straw increased the crude protein (CP) and the cell content (CC) levels, decreased acid detergent fiber (ADF) content and enhanced its nutritive value for weanling rabbits. Addition of untreated or ammoniated straw to the diets reduced dry matter (DM) and organic matter (OM) digestibilities, but did not significantly affect CP digestibility. Digestibility of ADF increased with ADF content of the diets. The CC was the most highly digestible chemical component while the ADF was the least digestible. Final live weight, average daily gain and total feed intake were similar among the treatments, indicating that addition of untreated or ammoniated straw to the diets did not result in any adverse effects on these performance parameters. Grass seed straw could serve as an inexpensive source of fiber in rabbit nutrition.

Introduction

The roles of dietary fiber in rabbit nutrition have been described by Cheeke (1987). Growth rate is reduced when rabbits are fed low-fiber diets due to prolonged cecal retention time, reduced feed intake and predisposition to diarrhea. Low-fiber diets also crumble more easily which further reduces acceptability. Dietary fiber is favorable in rabbit diets due to the scabrous effects of the large particles and the increased bulk of the digesta which stimulate cecal-colonic motility, and have a protective effect against enteritis. Low-fiber diets result in cecal-colonic hypomotility, prolonged retention time and enteritis due to dysbiosis. Dietary fiber also has protective effects against fur pulling and trichobezoars (hair balls) in the rabbit stomach. The objective of this research was to study the effects of supplementing weanling rabbit diets with untreated and ammoniated annual ryegrass straw as fiber sources on performance and nutrient digestibility. Large quantities of grass seed straw are produced as by-products of the grass seed industry of Oregon. The Willamette Valley of Oregon is one of the major forage- and turf-grass seed producing areas of the world.

Materials and Methods

Two standard Oregon State University doe herd diets (OSU 47 and OSU 58) were supplemented with or without untreated or ammoniated annual ryegrass straw and fed to 60 weanling New Zealand White rabbits (5 weeks old, average weight 1034.6 g) allotted at random to 6 treatments with 10 rabbits per treatment in a 28-day digestion and performance trial. The various experimental diets were (a) OSU 47, (b) 80% OSU 47 plus 20% untreated straw, (c) 80% OSU 47 plus 20% ammoniated straw, (d) OSU 58, (e) 80% OSU 58 plus 20% untreated straw and (f) 80% OSU 58 plus 20% ammoniated straw. Addition of straw to the diets was on a DM basis. Ammoniation was internally generated by applying 4% urea, 1% raw soybean and 20% water to untreated straw which was then covered tightly with plastic for three months. All diets were pelleted and fed ad libitum to the animals during the 28 day experimental period. The ingredient composition of the basal diets (OSU 47 and OSU 58) is shown in Table 1. The chemical composition of the untreated and ammoniated straw used in the experimental diets is shown in Table 2. Table 3 shows the chemical composition of the various diets.

Table 1. Ingredient components (%) of OSU 47 and OSU 58 diets which constitute the major components of the experimental diets.

	Diet	
	OSU 47[a]	OSU 58[b]
Alfalfa meal	74.0	54.0
Wheat meal run	21.0	26.0
Cane molasses	3.0	3.0
Corn (yellow dent)	-	1.25
Soybean meal	-	15.0
Vegetable oil	1.25	-
Dicalcium phosphate	0.25	0.25
Trace minerals	0.5	0.5

[a] OSU 47 contained 0.9 kg $CuSO_4$,11.1 kg permapel (pellet binder) and 1.8 kg DL-methionine per ton.

[b] OSU 58 contained 7 million IU vitamin A and 20,000 IU vitamin E per 908 kg.

Table 2. Chemical composition of untreated and ammoniated annual ryegrass straw used in the experimental diets.

Item	Ingredient	
	Untreated Straw	Ammoniated Straw
Dry matter (DM, %)	90.6	85.4
Organic matter (OM, %)	84.9	78.8
Analyses, % of DM:		
Crude protein (CP)	5.8	11.0
Acid detergent fiber (ADF)	47.0	44.7
Cell contents (CC)	27.2	31.5
Ash	5.7	6.6

The experimental animals were kept in individual cages equipped with automatic waterers. Live weight of each animal was recorded on days 1, 21 and 28, respectively. Fecal collection screens were attached to the bottom of each cage during the fourth week and total daily feces voided by each animal during this period were kept in labeled plastic bags at 5° C. Grab samples (about 100 g) of each experimental feed were collected during each feeding and kept in air-tight polythene bags. Sub-samples of each experimental diet were mixed together, ground in a Wiley mill (20-mesh screen) and kept in covered plastic containers for further analysis. Cumulative fecal samples of each experimental animal were dried in an oven at 60° C for 48 h, ground and kept in similar manner as the feed samples. The experimental feeds and feces were analyzed for dry matter (DM), organic matter (OM), crude protein (CP) and ash by the AOAC (1975) procedures. Acid detergent fiber (ADF) was determined by the method of Van Soest (1963) as described in the modified micro-procedure of Waldern (1971). Cell contents (CC) were determined by the method of Van Soest and Marcus (1964). Digestion coefficients for components of each diet were determined by methods described by Schneider and Flatt (1975). Data for the digestion and performance trial were analyzed using the general linear models procedure as described by Neter and Wasserman (1977). Means were compared using Tukey's studentized range test as outlined by Steel and Torrie (1980).

Table 3. Chemical composition of the experimental diets.

Item	Diet					
	OSU 47	OSU 47: untreated straw; 80:20	OSU 47: ammoniated straw; 80:20	OSU 58	OSU 58: untreated straw; 80:20	OSU 58: ammoniated straw; 80:20
Dry matter (DM, %)	91.4	91.5	90.7	89.5	90.6	89.5
Organic matter (OM, %)	81.2	82.2	80.9	80.5	82.2	80.8
Analyses, % of DM:						
Crude protein (CP)	17.2	15.4	16.4	18.2	16.7	17.6
Acid detergent fiber (ADF)	29.8	33.5	32.3	24.4	28.8	27.7
Cell contents (CC)	54.9	47.7	52.9	57.2	51.0	50.6
Ash	10.2	9.3	9.8	9.0	8.4	8.7

Results and Discussion

The ammoniation process increased the CP and the CC contents and decreased the ADF content of the straw (Table 2). The experimental diets (Table 3) contained similar levels of DM, OM and ash. CP ranged from a low of 15.4% in the 80% OSU 47:20% untreated straw (47 UNST) diet to a high of 18.2% in the OSU 58 diet. ADF ranged from a low of 24.4% in the OSU 58 diet to a high of 33.5% in the 47 UNST diet. CC ranged from a low of 47.7% in the 47 UNST diet to a high of 57.2% in the OSU 58 diet. The chemical components of the experimental diets were similar to those contained in feeds that are commonly fed to rabbits.

Table 4 shows the % digestibility for components of the experimental diets. Digestibilities of DM and OM were higher ($P < .05$) for the OSU 47 and OSU 58 diets than for the straw containing diets with no difference ($P > .05$) between the OSU 47 and OSU 58 diets. Digestibilities of DM and OM for the straw containing diets were not different ($P > .05$). These showed that the addition of untreated or ammoniated straw to rabbit diets as

a source of fiber would have a decreasing effect on DM and OM digestibilities. The % CP digestibility was higher ($P < .05$) for the 80% OSU 58:20% untreated straw (58 UNST) diet than for the 47 UNST diet with no differences ($P > .05$) among the other diets. Thus, addition of untreated or ammoniated straw to the various diets did not significantly affect CP digestibility. The % ADF digestibility was higher ($P < .05$) for the OSU 47 and other OSU 47 containing diets (47 UNST and 47 AMST) than for the OSU 58 and other OSU 58 containing diets (58 UNST and 58 AMST) with no differences ($P > .05$) among the other diets. This reflected the higher level of ADF in the OSU 47 diets than the OSU 58 diets (Table 3) and indicates a direct relationship between ADF content of rabbit diets and ADF digestibility. However, the low % ADF digestibility in all the diets (<18%) makes this result less meaningful. The % CC digestibility was higher ($P < .05$) for the OSU 47 diet than for the 47 UNST, 47 AMST and the 58 AMST diets, with no differences ($P > .05$) among the latter diets. Digestibility of CC among the OSU 47, OSU 58 and 58 UNST diets was not different ($P > .05$). It should be pointed out that the CC was the most highly digestible chemical component while the ADF was the least digestible. The % digestibility of ash was higher ($P < .05$) for the OSU 58 diet than for the OSU 47, 47 UNST and 47 AMST diets, with no differences ($P > .05$) among the latter diets. Digestibility of ash was also higher ($P < .05$) for the OSU 58 diet than for the 58 AMST diet. However, digestibility of ash between the OSU 58 and the 58 UNST diets were not different ($P > .05$).

Table 4. Digestibility (%) of individual components of each experimental diet.

	Diet					
Component	OSU 47	OSU 47: untreated straw; 80:20	OSU 47: ammoniated straw; 80:20	OSU 58	OSU 58: untreated straw; 80:20	OSU 58: ammoniated straw; 80:20
Dry matter	54.5^{b}	50.2^{a}	50.7^{a}	55.2^{b}	51.7^{a}	51.0^{a}
Organic matter	52.4^{b}	47.5^{a}	48.0^{a}	51.9^{b}	48.9^{a}	48.2^{a}
Crude protein	$73.5^{a,b}$	72.9^{a}	$73.3^{a,b}$	$73.6^{a,b}$	75.8^{b}	$74.6^{a,b}$
Acid detergent fiber	17.1^{b}	16.4^{b}	15.2^{b}	10.7^{a}	11.7^{a}	11.3^{a}
Cell content	82.2^{b}	78.4^{a}	79.0^{a}	$80.2^{a,b}$	$80.6^{a,b}$	79.2^{a}
Ash	$55.9^{a,b,c}$	52.4^{a}	$53.6^{a,b}$	60.4^{d}	$58.3^{c,d}$	$56.3^{b,c}$

^{a,b,c,d} Means in the same row with different superscripts differ ($P < .05$).

The results of some performance characteristics of the experimental animals are shown in Table 5. Final live weight, average daily gain and total feed intake were similar ($P > .05$) among the treatments. Thus, addition of 20% untreated or ammoniated straw to the two diets did not result in any adverse effects on these performance parameters. These indicate that grass seed straw could serve as an inexpensive source of fiber and other valuable nutrients in rabbit nutrition. Feed conversion (FC) was higher ($P < .05$) for the 47 UNST diet than for the OSU 47, 47 AMST, OSU 58 and 58 AMST diets, with no differences ($P > .05$) among the latter diets. FC between the 47 UNST and the 58 UNST diets were not different ($P > .05$). Thus, the OSU 58 diet was the most efficient for weanling rabbits while the 47 UNST diet was the least efficient. Addition of ammoniated straw to each of the two diets resulted in higher ($P < .05$) efficiency of feed utilization than the addition of untreated straw. Mortality of the experimental animals was very low. Two animals died during the experiment, one on the OSU 47 diet and the other on the OSU 58 diet. Both animals died during the first week of the experiment. Necropsy findings showed that both animals died from enteritis.

Table 5. Selected data on performance characteristics of the experimental animals.

	Diet					
Item	OSU 47	OSU 47: untreated straw; 80:20	OSU 47: ammoniated straw; 80:20	OSU 58	OSU 58: untreated straw; 80:20	OSU 58: ammoniated straw; 80:20
Avg initial live wt, g	1026.0	1053.0	1002.2	1034.1	1088.9	1003.3
Avg final live wt, g	2044.3	1962.7	1950.3	2042.7	2063.3	1928.0
Avg live daily gain, g	36.4	32.5	33.9	36.0	34.8	33.0
Total feed intake, g (dry wt basis)	4059.1	4224.9	3874.6	3697.3	4097.8	3690.0
Avg feed conversion, g feed/g gain (dry wt basis)	$4.0^{a,b}$	4.7^{c}	$4.1^{a,b}$	$d.7^{a}$	$4.3^{b,c}$	$4.0^{a,b}$
Mortality	1/10	0/10	0/10	1/10	0/10	0/10

^{a,b,c} Means in the same row with different superscripts differ ($P < .05$).

Conclusions

The average daily gains (Table 5) are excellent, considering that the diets were based on fibrous ingredients. Low-cost diluents such as grass seed straw may have useful application as an inexpensive source of fiber in rabbit nutrition. Ammoniation of straw increased the CP and the CC contents, decreased the ADF content and enhanced the nutritive value for weanling rabbits. Addition of 20% untreated or ammoniated straw to rabbit diets did not result in any adverse effects on various performance characteristics.

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