VISCERAL ORGAN MASS OF LAMBS FED FOUR ROUGHAGE DIETS

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ملخص

تأثير نوع العلف المالئ على أوزان مكونات الجهاز الهضمي وملحقاته في خراف التسمين

أستخدم في التجربة ٢٨ خروفا بمعدل وزن ٤٥ كغم. وحسب نوع العليقة المقدمة فقد قسمت الخراف عشوائيا الى أربع مجموعات : قش الدريس العادي، سيلاج الذرة ، البرسيم وقش الشوفان. واحتوت هذه العلائق على ما لايقل عن ١٢٪ من البروتين الخام و ١٠٪ علاوة عن الاحتياجات من الطاقة اللازمة للادامه وتم وزن الخراف كل عشرة أيام طيلة أيام التجربة. وبعد مرحلة التسمين فقد تم ذبح الخراف ،وبعد نزع الجهاز الهضمي تم وزن أجزاؤه بعد عزل ما عليها من دهون وكذلك محتواها من المادة المهضومة . وقد أخذت الأوزان على أساس وزن الجزء بالغرام لكل ١كغم من وزن الذبيحة. وتبين من التجربة أن نوع العليقة لم يكن له تأثير على كل أجزاء الجهاز الهضمي الا أن وزن الكبد والرئتين في الخراف المسمنة على البرسيم ازداد (P<.05) بمقدار ١٢٪ مقارنة بالخراف المسمنة على العلائق الأخرى بينما ازداد وزن الأمعاء الدقيقة (P<.05) بمقدار ١١٪ مقارنة بالأوزان للخراف المسمنة على العلا ئق الأخرى . أما قش البرسيم فقد أدى الى زيادة (P<.05) تقدر بحوالي ٥٥٪ في وزن الأعور مقارنة بالوزن عند التغذية على العلائق الأخرى .

وبينت التجربة أن مصدر العلف المالئ لم يكن له تأثير معنوي على وزن الكرش، الانفحة، الأمعاء الغليظة واجمالي وزن الجهاز الهضمي ومحتوياته .

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ABSTRACT

Twenty-eight lambs averaging 45 kg live weight were divided among four roughage dietary treatment : grass hay, corn silage, alfalfa and oat hay. The diets contained a minimum of 12% crude protein and provided 10% over the required energy for maintenance. Lambs were fed twice a day (0800 and 1700) for 28 days. Animals were weighed at 10-d intervals at 0700 prior to being fed that morning. At the end of the feeding period the lambs were slaughtered and the weights of fat-free gastrointestinal tract segments, their content and other organs were taken and expressed as g/kg of empty body weight (EBW). Sampled of the rumen and small intestine were separated into mucosal and nonmucosal (serosal) fractions.

No single forage diet consistently increased the weights of all visceral organs. However, lambs fed the 70% alfalfa hay has 12% heavier liver and lung weights ($p < .05$) compared to lambs receiving other treatments and 11% heavier small intestine weights compared to the oat and silage diets. The grass hay diets resulted in lambs with 55% heavier cecum dry weights ($P < .05$) compared to other roughage sources . Lambs fed silage diets had 7% heavier rumen mucosa (wet and dry) weights . The roughage sourse had no effect on total rumen, omasum, large intestine and total tract weights or contents.

INTRODUCTION

The goal of animal science research is to improve the efficiency of livestock production, and enabling farmers to produce more economically. Fiber diets have been shown to variably affect visceral organ mass (Johnson, 1985). Variable mass of this active tissue may, in turn, alter the energetic efficiency of animal growth and maintenance (Johnsons, 1985).

Forage level can vary in ruminant's diets ranging from 0 to 100%. Typical forages are considered to be approximately 50% neutral detergent fiber. On high roughage diets, ruminal fiber digestion seldom exceeds 60% of the fiber intake. When low roughage diets are fed , high rates of passage and low PH frequently inhibit cellulytic bacteria which limits fiber digestion. Significant amounts of fiber escape rumen digestion and may cause fiber effects in the lower gut similar to those observed in nonruminants.

Total intravenous feeding resulted in severe atrophy of the gastrointestinal tract when compared to oral intake (Levine et al., 1974; Wretlind. 1981). Luminal nutrition plays a major role in maintaining stimulation of both small intestine mucosal structure and enzyme levels (Johnson, 1985). Dunaif and Sheeman (1981) reported that the activities of several enzymes in the rat intestine are changed in response to fiber addition. Different sources of protein, carbohydrates and lipid did not change or influence the growth of small intestine, cecum or colon of rats but some types of fiber did exert an influence (Younoszai et al., 1978). Cassidy et al. (1981) reported various levels of mucosal surface changes including distorted and damaged cells when 15% fiber from four different sources (alfalfa, pectin, purified cellulose and bran) were fed to rats. The smallest changes occured with bran and cellulose and increased in severity with pectin and alfalfa. In another study, alfalfa in the diet caused wet and dry weights,length and weight per length measurements of small intestine, cecum and colon to be greater than other fiber sources including oat, soy and cellulose fibers (Younoszai et al., 1978). Similarly, 50% alfalfa diets when fed to pigs caused heavier colon, rectum, kidney and total tract weights and tended to increase cecum, small intestine, pancreas and liver weights when compared to pigs fed a regular corn-soy diet (Pekas et al..1983).Kass et al. (1980) reported similar results, that 40 and 60% alfalfa meal tended to increase colon and total gastrointestinal tract but that 20% alfalfa meal showed no effect. Johnson (1985) reported that steers fed a grass hay had heavier gut segment weight compared to alfalfa in both wet and heavier gut segments weights compared alfalfa in both wet and dry weight of these segments, while kidney, lungs and heart showed no response to treatment.

This study was conducted to determine the effects of several forage diets on fat free gut tissues and other visceral organ mass of lambs, which included an attempt to confirm the grass vs alfalfa results noted previously in experiments with steers.

MATERIALS AND METHODS

Twenty-eight lambs were obtained from commercial market at about 45 kg body weight in order to be ready for marketing at the end of the 28-d trial. These lambs were stratified into weight categories and randomly assigned into four groups of seven lambs each. Each group was assigned to one of four dietary roughages (table 1). The roughage were native grass hay (from North park, Colorado), corn silage, alfalfa and oat hay which were offered in a chopped form. A supplement was provided

Table (1): Feed Ingredient And Chemical Composition Of Rations

	Dietary forage treatment			
Ingredient	Alfalfa	Oats	Corn silage	Grass
	---------	% of diet	as fed	-------
Alfalfa	70			
Oat hay		70		
Corn silage			70	
Grass hay				70
Supplement[a]	30	30		
Supplement[b]			30	30
Chemical composition, DM basis				
Crude Protien	15.35	16.03	13.08	12.18
ME Mcal/kg[c]	2.17	2.1	2.23	1.47
NDF	54.3	55.9	59.5	50.0
ADF	23.5	32.9	39.7	27.3
Average daily intake (Kg DM/d)				
Alfalfa hay	.959			
Oat hay		.899		
Corn silage			1.049	
Grass hay				.922
Supplement 1	.429	.385		
Supplement 2			.395	.414

[a] Supplement 1 = 27.5% shelled corn: 1.2 SBM: 1%(vitamin A. antibiotic).

[b] Supplement 2 = 20% shelled corn: 9% SBM: 1% (vitamin A. antibiotic).

[c] Calculated from NCR (1984).

with the roughage diets. The supplement consisted of shelled corn, soybean meal and vitamins (table 2). The diets contained a minimum of

Table (2): Composition Of Feedstuffs, Dry Matter Basis

Feed	Dry matter %	Acid detergent fiber %	Crude protein %	Neutral detergent fiber %	Mcal/ kg[a]
Alfalfa	90	23.57	12.8	54.2	.97
Oat hay	90	32.85	9.3	55.0	1.99
Grass hay	91	39.70	9.1	59.45	1.95
Corn silage	34	27.3	8.1	50.0	2.53
Supplement 1	89	7.8	11.8	35.1	3.24
Supplement 2	89	7.6	22.3	34.0	5.18

[a] NRC (1984).

12.1% crude protein and provided the maintenance energy requirement plus 10% as estimated from NRC (1984). Lambs were fed twice a day (0800 and 1700) and weighed at 10-d intervals at 0700 prior to being fed that morning.

The lambs were slaughtered during a 3-d period by stunning with a captive bold pistol and bleeding as routinely practiced at the slaughter plant, skinning and eviscerating. The rectum and esophagus were tied off to prevent loss gastrointestinal tract (GIT) contents before the viscera were removed from the carcass. The liver and gall bladder were removed from the viscera. The heart was removed from the body at the plane immediately adjacent to the base. Lungs, without trachea, were removed and weighed, and the total weight for kidnies was recorded.

The lower gut and abomasum were tied off at the pylorus, the omasal-abomasal juction and the ileo-cecal junction. The viscera were then placed into a plastic lined offal tray and transported to Colorado State University for dissection.

After the total GIT weights were taken, the tract was tied and sectioned into the esophagus, reticulo-rumen, omasum, abomasum, small intestine, cecum and large intestine. The spleen and pancreas were generally removed first and weighed.

The external fat was removed from each organ of the foregut (rumen, omasum, abomasum) and the cecum . The full fat-free organ weight was recorded. The rumen was emptied, scraped as clean as possible without washing and then weighed. The contents were homogenized and a one liter sample taken for dry matter analysis(DMA). A small 2 cm2 sample of ventral sac tissue was removed, placed on a cork piece and frozen. The rumen was washed and weighed. The wet weight of the washed tissue and the dry weight of each segment (organ) was determined.

The omasum and abomasum were opened, emptied of their contents and washed. Their contents and their washed tissues were sampled for DMA. The weight of contents was calculated as the difference between the full and washed weights.

The large and small intestine were separated from the alimentary tract leaving some fat. The contents were removed, weighed and sampled. The fat was removed from the intestines leaving only the tissue which was weighed . The length of these organs was then measured. Approximately 10 cm of small intestine samples were removed from a point approximately 30 cm from the pylorus and approximately one half the distance from the pylorus to the ileo-cecal junction. The colon tissue samples were removed 1 meter from the secal-colic junction.

As soon as the tissue and digesta were taken, they were placed into a walk-in freezer at -20 C and stored until analysis. The tissue samples from each organ were stored in 11 x 20 cm whirl-pak bags.

The DM analyses of the samples were conducted following the completion of the slaughter. The digesta DM were determined by thawing for 12 h then homogenized and a sample of each organ's digesta taken from every individual animal. The samples were dried at 60 C for 48 h.

Two, 2-cm subsamples, were removed from the small intestine tissue sample, cut lengthwise and placed mucosal side up on a moist cutting board. The mucosa was separated from the serosa by gently pressing the edge of a glass slide across the tissue. Two, 3-cm2 samples were removed from the rumen tissue sample. The mucosal and serosal fractions were separated using a scalpel. The tissue sample DM were detremineed by drying a portion of the tissue sample at 60 C at 20 psi vacuum for 24 h.

The feeds were sampled every 10 d throughout the trial. DM was determined at 105 C. Nitrogen was determined by microkjeldahl procedure on the feed. Neutral detergent fiber (NDF), acid detergent fiber (ADF) and acid detergent lignin (ADL) were determine as described by Robertson and Van Soest (1977) and Goering and Van Soest (1970). A one-way analysis of variance was used to examine the effects of dietary roughage treatment using SAS (1988).

RESULTS AND DISCUSSION

Lambs fed a 70% alfalfa hay diet had heavier liver and lung wet weights compared to animals fed grass diets. The liver weights were 12% heavier ($p < .05$) compared to lambs consuming the grass hay diet (Table 3). Alfalfa hay also had 13% heavier ($p <.05$) lungs when compared to grass diets (Table 3). This contrast to the results reported by

Johnson (1985) who suggested that the type of hay (grass vs alfalfa) had no effect on liver and lung weights of cattle. Pekas et al. (1983) however, working with swine, found heavier livers when alfalfa was added to the diet and compared to no roughage. The considerable (15%) increase in gut fill noted in steers fed grass as compared to alfalfa (Johnson, 1985) also was only partially repeated in this lamb experiment. Grass fed lambs averaged about 9% more fill than those on other diets, however, the result was not statistically significant.

Type of hay had no statistically significant influence on the wet weight of rumen, omasum, large intestine or cecum. However, rumen dry weight was heavier in corn silage treatment compared to other roughage. In contrast, Johnson (1985) reported that grass hay caused 14% heavier rumen wet weight compared to alfalfa treatment. Silage treatment caused a heavier ($p < .05$) rumen mucosa wet and dry weights compared to other roughages. Lambs consuming the alfalfa hay had heavier mucosa dry weights, compared to those consuming the oat hay. The oat hay treatment had no effect on both wet and dry rumen serosa weights. Source of roughage had on effect on ruminal serosa weights. The lack of roughage source effect on serosa is in agreement with results reported by Johnson (1985).

Omasum wet weights were not significantly different ($p > .3$) for lambs on different roughage, however, lambs fed the corn silage averaged heavier omasum wet weights followed by oat treatments; Similarly roughage had no effect on omasum dry weights and on both abomasum dry and wet weights.

Table (3): Metabolizable Energy Intake, Weight And Organ Mass Of Lambs Fed Different Source Of Forage

	Roughage Source					
	Alfalfa	Oats	Corn silage	Grass	RSD	P
n	6	7	7	7	-	-
ME intake, Mcal/d		3.03	3.47	3.58	-	-
Beginning wt., kg	40.9	41.09	41.96	41.06	-	-
Final wt., kg	44.8	44.86	47.3	45.67	-	-
EBW, kg	36.45	36.42	38.55	36.6	5.7	.8
Gut fill, g/kg EBW	230.46	233.4	229.	252.2	36.7	.6
Organs			g/kg EBW			
Liver	17.7^{a}	16.0^{ab}	15.6^{b}	15.4^{b}	1.4	.04
Kidney	3.1^{a}	3.0^{a}	2.6^{b}	3.1^{a}	.28	.008
Lung	14.4^{a}	12.1^{b}	11.8^{b}	13.1^{ab}	1.74	.06
Spleen	1.8	2.0	1.7	2.0	.3	.3
Pancreas	1.3	1.6	1.4	1.6	.4	.5

1 RSD : Residual Standard Error
2 Means within a row followed by the same letters are not significantly different at p = .05.

Both grass and alfalfa hay treatments caused heavier ($p<.05$) small intestins wet and dry weights compared to corn silage and oat roughage. Similarly, grass fed lambs had heavier weights of wet and dry mucosa in the small intestine compared to lambs consuming other diets (Table 4). Lambs fed the corn silage diet were found to have lighter ($p < .05$) small intestine weights in nearly all sections. These results, in part, agree with Johnson (1985) who reported 28% increase in both wet and dry mucosa when grass hay was fed, however, he also reported increased serosa with grass hay treatment compared to alfalfa hay. Younoszai et al., (1983) observed heavier small intestines, in monogastric animals, when alfalfa diets were compared to oat and corn-soy diets.

Large intestine weights were not significantly different by type of roughage, although lambs consuming the oat hay had 14 to 26% heavier large intestines as compared to lambs fed the other roughages(Table 4). Johnson (1985) reported 10 to 28% increase in large intestine weights with grass hay compared to alfalfa, while Younoszai et al. (1978) reported a heavier large intestine in steers fed alfalfa compared to oat hay, and in pigs compared to the regular corn-soy diets (Pekas et al ., 1983).

Lambs fed grass hay had heavier cecum dry weights ($p <.01$) compared to other lambs, while roughage treatment had no effect on cecum wet weights. While reasons for lack of agreement between wet and dry weights is unknown, the dry weight increase agrees with Johnson (1985) who reported that grass hay increases cecum weights.

No one roughage diet consistently resulted in heavier or lighter weight throughout the GIT. Consequently, total tract weights were not significantly changed with roughage treatment (Table 4). This again is marginally different from the results of Johnson (1985) where grass hay resulted in heavier total tract weights.

In conclusion, roughage sources had variable effects on visceral organ mass. Lambs on alfalfa hay diet had heavier liver and lung wet weights compared to other treatments and had heavier small intestines compared to oat and corn silage diets. The corn silage diet caused heavier rumen mucosa (wet and dry) weights and generally lighter small intestines. Roughage source had no effect on total weight of the rumen, wet or dry weight, omasum, large intestine weights and had no significant effects on total tract weights and contents.

There is no indication that one particular forage results consistently increase overall GIT weights. Nevertheless, indications of heavier or lighter weights in individual portion of GIT and possibly other visceral organs may have important nutritional consequences. For example, the increase in mucosal mass found with corn silage may relate to VFA absorption and could marginally increase maintenance energy requirement.

Table (4): Gastrointestinal Tract Of Lambs Fed Diets Containing 70% Roughage From Different Sources

Variable	Alfalfa	Oats	Corn Silage	Grass	RSD	P
			Roughage Source			
Gastrointestinal tract	-----	-----	g/kg EBW	-----	----	----
Rumen, wet	26.3	27.8	26.3	27.2	4.6	.8
Rumen, dry	5.0	5.2	5.8	5.4	.91	.6
Mucosa, wet	12.1^{ab}	11.4^{a}	12.7^{b}	12.0^{ab}	.78	.09
Mucosa, dry	1.8^{ad}	1.5^{b}	2.4^{c}	1.7^{d}	.13	.0001
Serosa, wet	14.2	16.3	13.6	15.3	3.8	.4
Serosa, Dry	3.3	3.6	3.4	3.7	.9	.8
Omasum, wet	3.1	3.9	4.1	3.6	.73	.3
Omasum, dry	.7	.6	.7	.6	.13	.3
Abomasum, wet	6.5	6.8	6.2	6.5	1.7	.8
Abomasum, dry	1.3^{a}	1.5^{ab}	1.9^{ab}	2.0^{b}	.49	.08
small intestine, wet	24.8^{a}	23.3^{ab}	20.7^{b}	24.6^{a}	2.96	.06
small intestine, dry	4.9	4.6	4.5	4.8	.6	.6
Mucosa, wet	5.3^{a}	4.6^{a}	5.0^{a}	7.0^{b}	.67	.0001
Mucosa, dry	1.0^{ab}	.9^{b}	.8^{b}	1.0^{a}	.13	.01
Serosa, wet	19.6^{a}	18.7^{a}	15.7^{b}	18.2^{a}	2.2	.02
Serosa, dry	4.0	3.8	3.8	3.8	.48	.5
Large intestine, wet	16.9	21.5	16.9	17.7	3.8	.1
Large intestine, dry	3.3	4.1	3.7	3.7	.77	.3
Cecum, wet	1.6	1.6	1.4	1.7	.37	.3
Cecum, dry	.4^{a}	.3^{a}	.3^{a}	.7^{b}	.15	.0001
Total tract	77.5	84.2	75.0	81.4	9.5	.3

1 RSD : Residual Standard Error.

2 Means within a row followed by the same letter(s) are not significantly different at p =.05.

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