APPARENT DIGESTIBILITY BY SHEEP OF LIGNIN IN PEA AND LIMA-BEAN VINES[1]

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INTRODUCTION

This paper reports the results of the second part of a study of the composition and apparent digestibility by sheep of pea and lima-bean vines[3] that were preserved by artificial dehydration. The first part of the investigation was concerned primarily with hemicellulose and related compounds (*11*);[4] this paper has to do with the apparent digestibility of lignin.

WORK OF OTHER INVESTIGATORS

It is generally accepted that lignin is the least digestible portion of the structural constituents of plant material (*7*). Some investigators claim that lignin is in part digested by animals, others maintain that it is undigested. Csonka and coworkers (*4*) concluded, from an experiment in which alkali lignin was fed to cows and dogs, that lignin was at least partly broken down by the digestive processes of the animal body. Maynard (*9*) found that digestion of lignin by rabbits and guinea pigs fed alfalfa hay was practically nil, but that a lamb digested 28 percent of the lignin from the same hay. Louw (*7*) reported that with sheep the digestibility coefficient of lignin was 24.5 in grass of 1 month's growth, whereas in grass of 4 months' growth it was only 11.6. In a later experiment in which hay was fed to sheep at daily levels of 600, 800, and 1,000 gm., Louw (*8*) found that the digestibility coefficients were 15.6, 12.4, and 16.4, respectively. Lancaster (*6*) obtained digestibility coefficients ranging from −40.5 for a sample of rape to +32.4 for turnips, in a series of metabolism trials with sheep. In a metabolism experiment in which several different forage plants were fed to sheep, Bondi and Meyer (*1*) obtained di-

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[3] As used in this paper the terms "pea vines" and "lima-bean vines" include the vines and empty pods obtained as byproducts from canneries.

[4] Italic numbers in parentheses refer to Literature Cited, p. 287.

gestibility coefficients that ranged from 35.1 to 64, indicating that the sheep digested lignin comparatively well. Among the investigators who reported that lignin is indigestible are Rogozinski and Starzewska (*12*) and Naumann (*10*). Crampton and Maynard (*3*) recovered 97.8 and 99.3 percent of the dietary lignin in the feces of rabbits and a steer, respectively, and in a later paper Crampton (*2*) reported that lignin was not only poorly digested but also that it interfered with the digestibility of other constituents of the plant material.

MATERIAL AND METHODS

The pea and lima-bean vines used in this study were obtained from a cannery in Pennsylvania. They were dehydrated in a commercial dryer and shipped to the Agricultural Research Center at Beltsville, Md.

Lignin determinations were made by the method of Davis and Miller (*5*). This method includes both enzymatic and chemical treatment. The material was first extracted with ether and then digested by pepsin, clarase, and trypsin. The residue from these digestions was analyzed for lignin by the 72-percent sulfuric acid method. The analytical procedure was the same for both feed and feces. Complete analyses for pea and lima-bean vines were reported in the previous paper (*11*).

The feeding trials were conducted during the winter of 1942. Four yearling and 2-year-old Hampshire ewes were used. During a preliminary period alfalfa hay was mixed with the pea and lima-bean vines, but the amount of alfalfa hay was gradually reduced until the entire feed consisted of pea or lima-bean vines. The animals were placed in metabolism cages a few days prior to the experimental period and confined there throughout the test. The experimental period was 10 days. Details of the procedure are given in the previous paper.

EXPERIMENTAL RESULTS

The lignin content of the lima-bean vines was slightly greater than that of the pea vines, the average lignin content being 6.42 and 6.05 percent, respectively. Owing to the fact that the sheep picked over the feed and left the coarser parts, the lignin content of the refused feed was higher in both cases than that of the original feed. This effect was more pronounced in the refused pea vines, which had an average lignin content of 8.2 percent as compared with 7.6 percent for the refused lima-bean vines.

The digestibility data are given in table 1. As shown in the table, the lignin in pea vines was digested more readily by sheep than the lignin in lima-bean vines. In every trial when the same sheep was fed both feeds, the digestibility of the pea-vine lignin was greater. Incidentally, as shown in the table, the average digestibility of the dry matter in the lima-bean vines was slightly higher than in the pea vines.

TABLE 1.—*Digestibility by sheep of dry matter and lignin in pea and lima-bean vines* [1]

Pea vines			Lima-bean vines		
Item	Dry matter	Lignin	Item	Dry matter	Lignin
Sheep No. 6V:			Sheep No. 6V:		
Fed.....grams..	16,000	924.8	Fed.....grams..	16,000	1,012.8
Consumed.....do....	13,046	693.8	Consumed.....do....	11,409	651.9
Digested.....do....	8,274	105.9	Digested.....do....	7,386	27.9
Digested.....percent..	63.4	15.26	Digested.....percent..	64.7	4.28
Sheep No. 17U:			Sheep No. 17U:		
Fed.....grams..	16,000	924.8	Fed.....grams..	16,000	1,012.8
Consumed.....do....	11,218	554.2	Consumed.....do....	9,886	567.1
Digested.....do....	7,354	89.4	Digested.....do....	6,341	64.4
Digested.....percent..	65.5	16.13	Digested.....percent..	64.1	11.36
Sheep No. 18V:			Sheep No. 18V:		
Fed.....grams..	16,000	1,011.2	Fed.....grams..	16,000	1,040.0
Consumed.....do....	13,795	820.5	Consumed.....do....	12,590	784.6
Digested.....do....	8,477	132.4	Digested.....do....	7,908	121.2
Digested.....percent..	61.4	16.14	Digested.....percent..	62.8	15.45
Sheep No. 42V:			Sheep No. 19U:		
Fed.....grams..	16,000	1,011.2	Fed.....grams..	16,000	1,040.0
Consumed.....do....	12,045	671.9	Consumed.....do....	8,817	484.0
Digested.....do....	7,568	117.2	Digested.....do....	5,976	55.6
Digested.....percent..	62.8	17.44	Digested.....percent..	67.8	11.49
Average percent digested by the 4 sheep.	63.3	16.2	Average percent digested by the 4 sheep.	64.8	10.6

[1] Included pods.

As shown also in the table, the sheep consumed a smaller quantity of lima-bean vines than of pea vines, presumably because the stems of the former were coarser and more woody. Less lignin was consumed in the lima-bean vines than in the pea vines in spite of the fact that the percentage of lignin in the former was slightly higher.

SUMMARY

In a study conducted at the Agricultural Research Center, Beltsville, Md., pea vines and lima-bean vines (including the empty pods) obtained as byproducts from a cannery were fed in the dehydrated state to four yearling and 2-year-old Hampshire ewes. The apparent digestibility of lignin in each of these products was determined in a 10-day test period during which these feeds were given to the same group of animals. The digestion coefficients of the lignin in the pea vines was 16.2 percent and that in the lima-bean vines, 10.6 percent.

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