Feeding Value of Screenings From Annual Ryegrass

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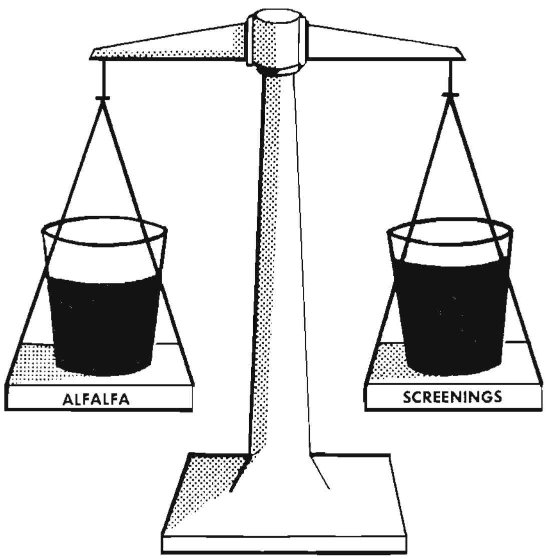

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D. C. Church, F. R. Snyder and Gary E. Smith

The trend by livestock feeders in recent years has been to utilize to a greater extent feed sources previously considered to be waste material. Screenings from the grass-seed industry represent such a source which is available in appreciable quantities adjacent to the site of seed production or processing. In the Willamette Valley it has been estimated that a yearly volume of approximately 20,000 tons of screenings is available from the production of annual ryegrass seed (*Lolium multiforum*), exclusive of screenings resulting from the seed production of other grass or legume crops. The heavy end of the screenings has been sold in the past at 20 to 24 dollars per ton, and the light end or mixtures anywhere from nothing to 10 dollars per ton.

Even though we might assume that the bulk of these screenings are useful feedstuffs, there are some problems connected with their use that should be mentioned. From a nutritional point of view, the composition of such a by-product is apt to be quite variable in regard to the plant material contained and, as a result, in nutrient content. Such variability makes maximum utilization quite difficult to achieve since every batch may need different supplementation. Along with chemical variability, the supply available to a feeder may be extremely variable from season to season and from year to year.

In addition to the items mentioned above, there is the hazard of spreading undesirable weed seeds in the process of transporting the screenings to the feedlot and, later, to agriculturally productive land when manure from the feedlot is utilized as a fertilizer. It is most likely that many small, hard weed seeds will pass through the digestive tract of most animals and still be viable. However, by fine grinding, steaming, and pelleting, it is probable that the germ of most of these small seeds would be killed.

One other problem should be mentioned—the potential hazard that such screenings may contain toxic materials. Some varieties of ryegrass, particularly the perennial ones, are susceptible to ergot infestation. In some years this infestation may be rather heavy. Several reliable reports have been made of death loss due to feeding various screenings, but the authors of this bulletin are not aware of such a problem when feeding annual ryegrass screenings.

The recommended way to feed such material is to dilute it with other feedstuffs; if toxic compounds are present, this would tend to dilute them to the point that the risk would be greatly reduced. In cases where poisoning has occurred, it is surmised that the screenings were fed by the sack. In such a case, one or more sacks might have a high content of toxic compounds; however, if the whole batch had been mixed, the problem might not have developed. Although this is a speculation, it is a known fact that many people who feed screenings handle them sack by sack.

With these problems in mind, the experiments described in this bulletin were conducted to evaluate annual ryegrass screenings. The screenings have been evaluated primarily in terms of digestibility when fed alone or with a variety of common feedstuffs.

Experiment I

Experimental procedure

Since feedstuffs such as screenings are not usually fed alone, this experiment was designed to determine the digestibility of ryegrass screenings (RGS) when fed at two different levels with three different feeds. An alfalfa pellet and two mixed rations (Table 1) varying in composition were fed alone and with 25 and 50% RGS. The RGS were a mixture of various batches of screenings from a commercial seed plant. The bulk of the screenings appeared to be light, broken, or blind seed plus chaff, stems, and weed seeds. Prior to feeding, the RGS were mixed and coarsely ground.

Digestion trials were conducted with wether lambs maintained in metabolism stalls. The lambs were fed twice daily at a constant level for at least five days prior to starting collections and throughout the collection periods. Preliminary periods were either 9 or 16 days in duration, and collections were made for 5 days.

Results and discussion

Data presented in Table 2 show digestion coefficients for organic matter (OM), crude protein (CP), cellulose, and energy (similar to TDN) for each of the rations fed alone and in combination with RGS. Coefficients shown in parentheses are calculated digestion coefficients for RGS when fed in the various combinations. With alfalfa alone, for example, the digestibility of crude protein is found by determining the amount of protein fed, the amount excreted in the feces, and from these figures, the percentage digested or absorbed — in this case, 67.3%. When a combination of $\frac{3}{4}$ alfalfa and $\frac{1}{4}$ RGS was fed, the digestibility was 70.5%. Now we multiply the amount of crude protein contained in the alfalfa in the mixture by 100-67.3 or 32.7% to determine the amount of excreted protein which originated from alfalfa. This figure is then subtracted from the total amount of protein in the feces, giving an estimate of how much protein originates from RGS. Since we know how much protein in the feed came from the RGS, we can calculate the digestibility (80% in this case).

$$\frac{\text{(Amount in feed-amount in feces)}}{\text{Amount in feed}} \times 100 = 80\%$$

When we examine the data in Table 2, we see that a combination of RGS and alfalfa was, in all cases, superior to alfalfa alone when our evaluation is based on maximum digestibility. We also note that $\frac{1}{2}$ RGS is very little better than $\frac{1}{4}$ RGS, and that the calculated coefficients for RGS are lower in each case when the larger amount of RGS was fed. This change in digestibility when different amounts of a feedstuff are fed is called the associative effect and simply means that some combinations give more desirable results than others. The reasons are unknown, but certain combinations probably provide a more favorable environment in the rumen for the microbial activity that occurs there.

Table 1. Composition of Ration Ingredients As Fed

Feedstuff	Dry matter	Organic matter	Crude protein	Cellulose	Gross energy
	%	%	%	%	*Kcal/g*
Alfalfa pellet	91.9	81.5	12.0	25.9	3.974
Mixed ration No. 2	88.9	82.4	11.8	8.3	3.782
Mixed ration No. 3	88.7	83.1	11.1	8.3	3.767
Ryegrass screenings (RGS)	90.0	85.1	11.8	11.0	3.944

Table 2. Digestion Coefficients Obtained With Experimental Rations

Ration	No. lambs	Digestion coefficients[1]			
		Organic matter	Crude protein	Cellulose	Energy
		%	%	%	%
Alfalfa	4	57	67	51	56
+ ¼ RGS	2	63 (83)	70 (80)	51 (52)	61 (78)
+ ½ RGS	2	65 (74)	72 (76)	46 (34)	64 (72)
Ration No. 2	4	75	76	36	73
+ ¼ RGS	2	75 (73)	79 (85)	29 (15)	72 (70)
+ ½ RGS	2	72 (68)	72 (68)	27 (21)	68 (63)
Ration No. 3	3	75	74	43	72
+ ¼ RGS	2	74 (70)	72 (66)	38 (26)	70 (66)
+ ½ RGS	2	68 (63)	67 (63)	23 (9)	64 (58)
Average for RGS					
when ¼ of ration		(75)	(77)	(31)	(71)
when ½ of ration		(68)	(69)	(21)	(64)

[1] Data shown in parentheses are coefficients for RGS calculated by difference.

When we look at the coefficients for rations 2 and 3 when fed with RGS, we note that, with one exception (crude protein of ration 2 + ¼ RGS), digestibility declined when RGS was added. Only a slight decrease occurred when ¼ RGS was added, but a rather marked reduction when ½ RGS was fed. Also, the calculated digestibility of RGS was less when fed with ration 3 than with ration 2. The principal difference between rations 2 and 3 was that No. 2 contained 20% alfalfa and No. 3 only 5%. This may explain the reduced digestibility, since an alfalfa-RGS combination seems to be a favorable one.

The average calculated coefficients for RGS are shown at the bottom of Table 2. These figures illustrate that RGS were quite digestible, although this batch of screenings may not have been typical of all RGS. The data also illustrate the problem of assigning a fixed nutritive value to a feedstuff. This situation probably is the case for most feeds, although data are not usually available to demonstrate this problem.

Experiment II

Experimental procedure

This experiment was designed to further evaluate RGS by determining the digestibility when fed with a wider variety of feedstuffs. Screenings, both light and heavy samples, were obtained from a commercial seed processing plant near Corvallis. These screenings were obtained from seed produced by a grower considered to be average in cultural and management practices. The lights consisted of materials such as chaff, stems, shriveled and blind seeds, and the heavy screenings consisted of mostly small and cracked seeds and some weed seeds. The weed seeds were primarily sheep sorrel (*Rumex acetosella*), horsetail rush (*Equisetum arvense*), annual sweet vernal (*Anthoxanthum aristatum*), and rattail fescue (*Festuca myuros*). The screenings were sacked off from separate spouts of the seed cleaner and each batch mixed and ground through a ⅛-inch screen prior to feeding.

Other feeds fed along with the screenings were: ⅜-inch alfalfa pellets made from locally produced alfalfa and 5% molasses; corn silage produced on the OSU farm from plants with immature ears; and a high quality mixed ration designated as ration No. 7, which was 55% rolled barley with the balance made up of beet pulp, wheat mill run, molasses, and alfalfa. Some of the analytical data obtained on these feeds are shown in Table 3.

The light and heavy RGS, alfalfa pellets, and ration No. 7 were fed alone. In addition, the light and heavy RGS were fed in combination with the other feedstuffs, including corn silage, so that the screenings represented either 40 or 60% of the total ration. Digestibility data were obtained with lambs fed these various rations as in Experiment I, and some of the data collected are shown in Table 4.

Results and discussion

It should be noted that at no time during the course of either Experiments I or II was there any evidence of toxicity due to consumption of screenings. This is not to say, of course, that this can never happen.

A brief comment or two should be made with regard to the data presented in Table 3. The reader will note that the light RGS are much higher in ash and cellulose (similar to fiber) and lower in crude protein and nitrogen-free extract than are the heavy RGS. These characteristics (for light RGS) are typical of low-quality feeds. The heavy screenings, however, compare quite favorably in chemical analysis with ration No. 7. In fact, with this type of chemical analysis, it would be difficult to differentiate between No. 7 and the heavy RGS.

Turning now to the top of Table 4, note the digestibility of various chemical components (under the A columns) of the screenings, alfalfa, and No. 7 when fed alone. Although the heavy screenings were quite similar to No. 7 in chemical composition, it can be seen that digestibility was inferior to No. 7 for every item listed. Data for the major items of organic matter and energy also show that heavy screenings were much more digestible than light screenings or alfalfa.

The data on digestibility of the various mixtures containing the heavy screenings clearly show that heavy screenings made an excellent combination, both with alfalfa and ration No. 7. Alfalfa pellets with 60% heavy RGS, particularly, resulted in a highly

Table 3. Chemical Composition of Ration Ingredients (Dry Basis)

Feedstuff	Organic matter	Ash	Crude protein	Cellulose	Nitrogen-free extract
	%	%	%	%	%
Light ryegrass screenings	90.3	9.7	8.0	24.2	54.6
Heavy ryegrass screenings....	95.2	4.8	12.0	9.8	70.1
Alfalfa pellet	89.7	10.3	16.2	27.6	43.5
Corn silage	93.3	6.7	11.3	33.2	47.3
Ration No. 7	95.1	4.9	12.9	10.3	69.4

Table 4. Digestion Coefficients From Experiment II

Ration	Organic matter		Crude protein			Cellulose			Energy		
	A	B	A	B	C	A	B	C	A	B	C
	%[1]		%[1]			%[1]			%[1]		
Heavy RGS	71		68			25			68		
Light RGS	54		43			52			52		
Alfalfa pellets	61		72			55			60		
+ 40% heavy RGS	65	65	69	71	63	44	49	-4	61	63	64
+ 60% heavy RGS	78	67	80	70	87	58	45	64	77	65	88
+ 40% light RGS	55	58	60	65	23	56	54	57	52	57	40
+ 60% light RGS	51	57	53	60	27	51	53	47	47	55	39
Mixed ration No. 7	79		75			51			76		
+ 40% heavy RGS	76	76	73	72	69	42	41	29	74	73	70
+ 60% heavy RGS	76	74	70	71	66	43	38	34	73	71	71
+ 40% light RGS	64	70	58	66	16	47	52	44	59	66	33
+ 60% light RGS	57	65	48	60	19	41	52	37	51	61	35
Corn silage											
+ 40% heavy RGS	68		61			23			61		
+ 60% heavy RGS	74		68			25			63		
+ 40% light RGS	56		52			24			49		
+ 60% light RGS	51		48			25			51		

[1] Coefficients under A are the actual digestibilities for the feedstuffs and mixtures shown in the table. Those under B are estimated digestibilities based on calculations when the various feeds were fed alone. Those under C are coefficients for RGS only, calculated by difference as explained in the text, p. 6.

digestible mixture. The calculated digestibilities of the mixtures, based on the digestibility of the feedstuffs when fed alone, are shown under column B of the table. It will be noted that most of the actual digestion coefficients are equal to or greater than calculated values when heavy RGS were fed, either with alfalfa or No. 7. These values cannot be calculated for corn silage since it was not fed alone.

The estimated digestibilities of the screenings when fed in a mixture are shown under column C. These coefficients are calculated by difference as shown previously. The coefficients for 40% heavy screenings are less in each case than when fed alone, indicating that the digestibility of one or both feedstuffs was depressed slightly. However, when 60% heavy screenings were fed with alfalfa, the estimated value was higher than when fed alone, indicating that digestibility of one or both feedstuffs was markedly improved.

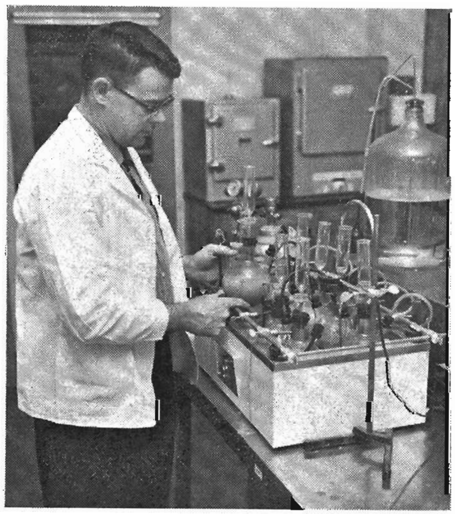
When mixtures of the light RGS were fed, actual digestibility (column A) was less in almost every case than calculated values (column B), with the exception of cellulose with the 40-60 blend of screenings and alfalfa pellets. The calculated value of the light RGS (column C) indicates that digestibility values for crude protein and energy are rather low.

With corn silage, the data tend to bear out the results obtained with alfalfa; namely, that digestibility of a mixture of heavy screenings and silage was improved by increasing the amount of screenings from 40 to 60% of the total ration. In the case of light screenings, digestion coefficients were low; however, going from 40 to 60% light RGS did not seem to depress digestibility to as great an extent with silage as with the other feeds.

Miscellaneous Experiments

Artificial rumen trials

An artificial rumen is a laboratory device frequently used to evaluate forage. Essentially, what is done is to add some mineral solution and rumen liquor containing rumen microorganisms to a sample being evaluated and ferment this mixture for a period of time. After fermentation the results are expressed as dry matter or cellulose digestion. Results with forage are very useful in evaluating animal digestibility of many forages.



Artificial rumen apparatus used to evaluate feeds.

The artificial rumen was used here to evaluate a wider range of mixtures of the feedstuffs than was feasible in the sheep digestion trials. The results obtained are briefly summarized below:

1. *Screenings and alfalfa.* The data with heavy RGS indicate that total digestibility increased gradually and was at a maximum with 70% screenings. With light RGS, digestibility was at a maximum with 30% screenings and declined rapidly with further additions.

2. *Screenings and ration No. 7.* With heavy RGS, there was a gradual decrease in digestibility as screenings were increased from 30 to 70%, but the decline was not marked. Eighty percent screenings resulted in a marked decrease. With the light RGS there was a gradual decrease in digestibility as the screenings were increased from 20 to 80%.

3. *Screenings and corn silage.* With heavy RGS there was a gradual increase in digestibility as percentage of RGS increased. With light RGS, the level of digestibility remained about constant throughout. The data obtained here with silage may or may not be valid. In the artificial rumen procedure, samples are dried and ground prior to use. Drying would volatilize most of the organic acids found in silage and this might have some detrimental effect on digestion.

Composition of screening samples

In order to determine if our samples used in the digestion studies were fairly representative of Valley sources, screening samples were obtained at a number of cleaning establishments in the Willamette Valley and were subjected to chemical analysis (see Table 5). The analyses indicated that most samples would likely be between 8 and 10% in crude protein (dry basis), and that most would probably have 20% or more fiber, although the fiber content of some samples was as low as 8%. The light screenings used in the digestion studies would be representative of the poorer quality available, whereas the heavy screenings were certainly better than most. In addition to evaluation based on chemical analysis, the dry matter digestibility of the samples was estimated with the aid of the artificial rumen technique (Table 5). These data show that dry matter digestibility is, in general, related positively to crude protein content and relative sample weight. That is, as the crude protein content goes up and as sample weight per unit volume goes up, digestibility increases. Conversely, as crude fiber content goes down, digestibility increases. This type of relationship is fairly typical of most feedstuffs, but the relationships here

Table 5. Chemical Analysis and Estimated Dry Matter Digestibility of Screening Samples

Source of sample	Relative sample weight	Chemical analysis: Crude protein	Crude fiber	Ash	Estimated dry matter digestibility
		%	%	%	%
Tangent	19.2	8.7	24.6	7.3	59
Junction City	19.2	8.8	24.1	7.1	54
Brownsville	19.2	8.2	21.4	7.2	58
Lebanon	19.3	7.9	22.5	8.1	55
Jefferson	19.4	9.0	22.2	8.4	52
Albany	19.7	7.8	22.2	9.2	55
Corvallis	20.1	9.4	22.4	10.5	55
Junction City	24.0	8.9	12.3	6.6	62
Jefferson	24.1	9.2	21.6	8.6	48
Plainview	24.8	10.8	12.3	6.4	61
Shedd	28.6	10.1	11.2	4.6	57
Harrisburg	30.8	9.9	8.0	4.1	61
Digestion trial samples					
Light	21.2	8.0	24.8	9.7	52 (51)[1]
Heavy	29.4	12.0	10.5	4.8	66 (68)[1]

[1] Actual dry matter digestion.

are not high enough to make reasonably accurate estimates of feeding value on the basis of chemical composition. The use of the artificial rumen, however, does give a reasonably good estimate of feeding value.

Feeding experiments with cattle

In two different feeding trials we have used annual RGS in rations fed to fattening steer calves. The trials were not designed to evaluate screenings, but the performance of the cattle was satisfactory in each instance, and use of the screenings resulted in a relatively inexpensive ration. Results from one recent experiment are shown below:

	Avg. daily gain, lb.	Feed conversion	Cost of gain
Ration containing ⅓ RGS..	2.56	7.18	$20.37
Rolled barley ration	2.86	5.61	$23.25

Conclusions

Screenings from annual ryegrass seed were evaluated by means of digestibility trials with sheep and in the laboratory by chemical analyses and digestion in an artificial rumen. Data obtained indicated that they had a variable feeding value, depending upon the amount in the ration and the nature of the other feedstuffs when fed in various combinations. Alfalfa, particularly, seemed to enhance the value of a combination of feedstuffs and screenings. Screenings such as those fed in Experiment I and the heavy screenings fed in Experiment II were quite digestible and had a feeding value similar to that of lightweight barley when fed alone or in combination with other feeds. Screenings of this quality, however, are probably not available in any great quantity if samples taken in the Willamette Valley are indicative of the normal supply available.

The lightweight screenings fed in Experiment II were quite bulky, high in fiber, and much lower in digestibility than the heavier screenings. On a comparative basis, such screenings as these would be worth about two-thirds the value of the alfalfa pellets or about one-half the value of the heavy screenings. Such a feedstuff would be suitable when included in small amounts (30% or less), along with other high quality ingredients in a fattening ration as a means of reducing the feed cost because of their low selling price. If maximum performance is desired, however, such lightweight screenings would not be recommended. Screenings of this quality would be more suitable when used in a wintering program along with other feeds normally available in the area.

Data presented show that it is difficult to assign an exact nutritive value to a feed such as ryegrass screenings, since the nutritive value is influenced by composition of the screenings, the amount fed, and by the other feedstuffs when fed in a mixture.