MINNESOTA FEED SERVICE

University of Minnesota Agricultural Extension Service, St. Paul

September 30, 1957

Value of Grain Screenings in Cattle Feeding

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THERE HAS BEEN some use of grain screenings in cattle feeding. This summary is based on questions that have arisen over the past five years. The facts are gathered from research and field records.

Values of Raw Refuse Screenings

From October 1948 to the present, a long series of analyses have been carried out on run-of-elevator refuse screenings produced in the Port of Vancouver. Results were as follows:

Moisture content ranged from 8.7 to 15.3 percent; crude protein on a nitrogen x 6.25 basis, from 8.3 to 14.8 percent; crude fat from 3 to 7.8 percent; crude fiber from 7.8 to 24 percent; ash from 6.6 to 9.2 percent; and nitrogen-free extract from 41 to 52 percent. The average figures can be compared with other feeds in table 1.

Fractionation of refuse screening samples indicate that they will contain from 40 to 50 percent of weed seeds.

Ground Screenings

Screenings used for pellet production are partially cleaned to remove chaff, then ground to pass a screen. This facilitates pelleting and ensures uniformity in the final product.

Figures taken at random from a long series of analyses on refuse screenings pelletings show a range of 11.4 to 12.8 percent in protein; 5.1 to 7.4 in fat; and 11.7 to 15.3 in fiber. The fractionation removed a part of the crude fiber in the form of chaff and a part of the ash, yielding a very uniform product.

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THIS ISSUE OF Minnesota Feed Service presents some of the reports given during the annual Animal Nutrition Short Course, held recently on the St. Paul Campus, University of Minnesota.

Weed Seeds in Refuse Screenings

Raw refuse screenings contain appreciable amounts of various weed seeds. These contribute a major portion of the nutritive value of the final pellest. Recent analyses for amino acid content show weed seed proteins to be comparable with linseed, cottonseed, and soya meals in quality.

These results have been confirmed by net protein utilization trials, which indicate that many of the weed seeds contain protein of comparable biological value to those of the soybean.

Table 1. The composition of refuse screenings relative to wheat, oats, and barley

Feeding stuff	Moisture	Protein*	Fat	Nitrogen-free extract	Fiber	Ash
Refuse screenings	10.7%	10.5%	5.3%	47.5%	17.7%	7.9%
Wheat	10.5	13.2	1.9	69.9	2.6	1.9
Oats (Pacific)	8.8	9.0	5.4	62.1	11.0	3.7
Barley (Pacific)	10.2	8.7	1.9	70.9	5.7	2.6

* On a nitrogen x 6.25 basis.

Weed Seed Devitalization

The safe use of refuse screenings as feed depends upon complete devitalization of the weed seeds. The grinding process used in fractionation of the raw screenings reduces the viable weed seed count to levels commonly found in normal feeding stuffs. To ensure further that all vitality is destroyed, the fractionated screenings are heated to 250° F. with moist heat and held there for 1½ minutes.

Early in the research, it was discovered that weed seeds are very susceptible to heating carried out in the presence of moisture. This confirms previous results reported by the laboratories of the Canadian National Research Council. In the absence of moisture, prolonged heating is required. In fact, the amount of heat then required is so great as to make devitalization with dry heat uneconomical.

Extensive tests for weed seed vitality have been carried out on the devitalized pellets by the Plant Products Division of the Canada Department of Agriculture. Their studies show that the processing procedure is completely effective, ensuring a product free of vital weed seeds.

Feeding trials with raw, unheated, unground refuse screenings show that most of the weed seeds pass through the digestive tract of the bovine or sheep without breakdown. Thus any net nutritive value appears to be lost. This suggests that the net yield of nutrient energy to the animal will be much below that obtained on the processed material.

Feeding Trials

Acceptability of the Feed—Extensive laboratory and field trials show that the pelleted refuse screenings are completely palatable. It has been standard practice to give animals being placed on refuse pellets a very light feeding of hay the night before. Acceptance of the pellets the next morning has been excellent.

Where animals have been on a grain, or on other feed pellets, it has been our custom to substitute the refuse pellets at the rate of 20 percent a day. After 5 days, then, the animals are consuming

(Continued on page 2)

Concentrates, Roughages, and Rumen Microbiology

C. F. HUFFMAN*

The dairy industry hinges on the economical conversion of forages and grain supplements to milk and meat. This is made possible by the large size and the forward location of the fermentation vat (rumen, reticulum, omasum) where microbes live. These countless billions of bacteria that are present in this fermentation vat break down coarse feed into simple compounds that the host animal uses.

Actually there are two kinds of microbes in this vat, bacteria and protozoa. The bacteria are believed to be the most important form of microscopic life. The function of protozoa is not understood.

When old bossie swallows forage, it passes to the rumen where the bugs swarm over it hunting for cracks to penetrate. The microbes produce enzymes that do the actual digesting. The tough long pieces are brought back into the mouth for another going over. We call this cud chewing.

Probably the most important parts of the forage that are broken down by microbes are carbohydrates. These include crude fiber and nitrogen free-extract as well as sugars and starches. The cow does not produce enzymes which digest the fibrous part of forage that makes up more than 50 percent of the dry matter, but depend on those produced by microbes. This is of great economic importance, since the forages supply cheap energy.

These sources of energy are broken down by the rumen microbes to short chain fatty acids and gases. The acids are principally acetic, propionic, and butyric. These acids pass through the rumen wall into the bloodstream and then to the liver. The total energy supplied by volatile fatty acids plays an important role not only in energy relations but in other respects as well.

A certain amount of acetic and butyric acids are essential for optimum butter fat production. In experiments with high grain and limited hay, the percent of fat in milk declined. It appears that 8 to 10 pounds of hay per cow per day is needed for this purpose. There is some evidence, however, that the feeding of grain mixtures low in starch may not lower the test.

The cause or causes of ketosis is not known other than the effect of stress. There is some evidence that the feeding of rations that bring about the production of greater quantities of propionic acid may help in the prevention of ketosis. Lactates have been used for the treatment of this condition.

Ruman microbes make a great contribution to the cow, but the many good things they build up are also important. They are capable of taking low grade protein, and even nitrogen compounds such as urea, and making a high class protein for the cow. This explains why quality of protein is not so important in the nutrition of dairy cows.

The bugs of the fermentation vat, also have the ability to make many vitamins for her own use and to put into milk. Vitamins A, D, and E cannot be made by the microbes or by the tissues of the cow, but must be supplied in the ration.

The payoff in rumen studies is to know how to direct microbial fermentation so that the cow makes good use of roughage. Considerable progress has been made in learning how to supplement poor roughages such as cereal straws and corn cobs. When corn cobs are balanced with protein, cereal grains, minerals, and vitamins, there is still a factor lacking that is needed for proper digestion. Alfalfa ash or valeric and iso-valeric acids appear to supply the missing factor or factors.

Apparently, the necessary rumen factors are supplied with good forage crops and grain supplements. This is the possible explanation for the failure of many rumen preparations and yeast to bring about increased growth of milk production. As a matter of fact, the greater use of high-yielding forages with a lot of built-in-grain means a strong dairy business that should result in a stronger feed industry.

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MINNESOTA FEED SERVICE

Published by the University of Minnesota Agricultural Extension Service, Institute of Agriculture, St. Paul 1, Minnesota.

Feed Service Committee—Cora Cooke, chairman; Rodney Briggs; William Flemming; Lester Hanson; Hal Routhe; Harold Searles; Charles Simkins and Harold B. Swanson. Earl Brigham, editorial assistant for the committee.

CATTLE FEEDING

(Continued from page 1)

only the refuse pellets. This is done to allow at least a short time for adjustment of the rumen microflora to the new feeding stuff.

There have also been trials in which cattle were placed full feed on the refuse pellets immediately on entering the feed lot. In such cases, they are first offered 4 pounds of hay per head. Then when the hay is cleaned up, they are offered all of the refuse pellets they will consume. In no case has scouring been encountered.

Circumstantial evidence suggests that the normal fiber level of the refuse pellets (14-15 percent) is close to the optimum required to maintain normal ruminal activity without digestive upset. For commercial feed lot use, this feature of the refuse pellets has been most useful.

Growth Rate—A great many feeding trials have been carried out with cattle in various weight categories. Cattle 400 to 700 pounds maintain a gain of 1.8 to 2.0 pounds per day. Those 600 to 900 pounds maintain a gain of 2.0 to 2.3 pounds per day.

In these trials, hay intake was reduced to 0.6 pound per hundred pounds body weight a day. This level was selected to encourage maximum pellet consumption. There was also the more practical reason that under feed lot conditions hay is a fairly expensive commodity in terms of original cost and labor cost of handling.

In comparative trials with feed based on the regular grains, refuse-fed cattle in the lighter weights appeared to gain at the same rate, or nearly the same, as comparable animals on grain feeding.

There can be no doubt that the energy yield from the refuse pellets is slightly below the regular feed grains (probably about 10 percent). But under feed lot conditions this is compensated for by the avoidance of scouring and digestive upsets. On the basis of records for some 20,000 head fed on refuse pellets, no death has occurred that could be attributed to the feed.

Feed Efficiency—On young cattle, 400 to 700 pounds, the feed efficiency has averaged (under Vancouver conditions) 5.5 pounds of pellets and 2.0 pounds of hay per pound of weight gained.

(Continued on page 3)

Nutrition of Cage Layers

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The problems in feeding cage layers are different from those in feeding layers held under floor conditions. The layer ration fed to layers must be complete in all nutrients which are required for high egg production.

Hens confined to cages have no opportunity to pick up nutritents from the litter. In many cases, it is also difficult to supplement the ration with minerals such as calcium carbonate which under floor conditions can be fed free-choice in hoppers.

Layers hens held in cages are subjected to more severe stress than is normally encountered under floor laying conditions. The layers are confined in small cages isolated one from the other, which leaves them more sensitive to sudden changes in temperature.

They seem to suffer more from high temperatures, and perhaps require more nutrients to maintain body temperature when air temperatures are low. The abnormal conditions seem to intensify any nutritional deficiency or imbalance which the layer ration might have.

Cage operators try to obtain layer hens which have a high genetic potential for egg production. These hens require a nutrient intake which will support this high egg production potential. If it is not provided, the stress of heavy egg production soon brings about marginal nutrition deficiencies which cause a breakdown of the hen and lowered egg production.

Nutrient Levels

The ideal layer ration towards which all poultry nutritionists are working will have all of the essential nutrients in the proper amounts and balance. As we approach this goal, we have more and more nutrients to consider. Some which were not critical at lower levels of egg production become so as egg production is increased.

Nutritive requirements of cage layers, therefore, cannot be thought of as individual requirements. In all cases the ration level of a given nutrient will depend upon the level of other nutrients in the ration. The protein level in a layer ration will be determined by the energy level in the ration.

The same is true of minerals and vitamins. Thus requirements must be thought of in terms of the expected egg production and the level of other nutrients in the layer ration.

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Proteins

The protein requirement of layer hens has been expressed as a precent of the total ration. Since many factors must be considered in setting up this requirement level, percent of ration becomes meaningless insofar as protein requirements are concerned.

It would be much more logical to think in terms of the daily quantity of protein required by a layer hen. This daily quantity will be determined by size of the hen, rate of egg production, and quality of the protein being fed.

When these factors have been considered and the daily quantity of protein determined, the percent protein in the ration will depend primarily on the amount of feed which a hen will eat in a day. Thus the percent of protein in a ration should vary inversely with feed consumption.

Feed consumption does increase with an increase in rate of egg production. For this reason the protein intake of the hen would be increased with increased egg production.

However, if environmental temperatures are high, feed consumption tends to go down. This in turn limits the amount of protein intake per day. In addition, as the energy content of the ration is increased, the amount of feed which the hen will eat is decreased.

Unless these factors are considered, regardless of the protein level in the ration, the protein intake may be inadequate for maximum egg production.

Minerals

The mineral requirements of cage layers must be fully met if eggs are to be produced with good eggshells. Since the feeding of supplemental mineral is somewhat of a problem in cage layer fedeing, it is essential that all the minerals required for heavy egg production be included in the layer mash itself. Since all hens are not laying at the same rate and do not have the same mineral requirements this becomes a difficult problem.

It has been observed at the Oklahoma Experiment Station that phos-

(Continued on page 4)

CATTLE FEEDING

(Continued from page 2)

This was when the pellets were hand-fed at the full feed level and the hay fed at 0.6 pound per hundred pounds body weight.

On cattle 600 to 900 pounds, the corresponding figures have been 7.5 pounds of pellets and 2.2 pounds of hay per pound of gain.

Not enough research has yet been carried out to give efficiency figures for cattle 900 to 1,200 pounds. But preliminary figures suggest that those will be 9 pounds of pellets and 2.3 pounds of hay per pound of gain.

Digestibility—There have been no regular digestion trials with the refuse pellets. Estimates based on rate-of-gain data at various feed intake levels suggest that the total digestible nutrient content will be approximately 70 percent. It will vary around that point to some extent, depending on the level of fat. The digestible crude protein level appears to be between 8.5 and 10 percent.

Apparent Density—Increasing attention has been given to the density of feeding stuffs since the advent of pelleting. There is good evidence to suggest that rate-of-gain and feed efficiency can be improved by raising the apparent density of mass per unit volume of feeding stuffs.

The apparent density of refuse screenings pellets and other feeds runs as follows:

Ground raw refuse screenings, 23 pounds per cubic feet; pelleted devitalized refuse, 44; pelleted dehydrated grass, 44; pelleted grain base steer ration, containing oats, 33; pulverized oats, 28; pulverized barley, 33; soybean meal, 38; and linseed meal, 38.

The relatively high figure for the refuse pellets can be accounted for on the basis of the fine grinding they are given and, to a small degree, their higher ash content (7.0 percent).

The difference in apparent density between the raw ground screenings and the same material is pelleted form may explain, in part, why feeding results with the pellets have been superior.

Carcass Quality—On all trials to date, carcass quality has been completely comparable with that obtained on regular feeds. There is a tendency for the carcass fat to be whiter than on regular feeds. In most cases, however, this difference is most acceptable to the meat packer.

No evidence of taint or off-flavor has been encountered in cattle full-fed on refuse pellets right up to the day of slaughter. It has been usual to take the cattle off feed and on to hay 24 hours before slaughter, but this procedure is not essential.

WHY CORN LODGES

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Stalk breakage and lodging of corn has become one of the most serious problems in corn production in Minnesota. A conservative estimate of losses in 1956 was 10 percent of the 330 million bushel corn crop. A large loss in yield also resulted from the dropping of corn ears from rotted shanks.

In some instances, these losses can be minimized by pasturing livestock. However, when ears are in contact with soil, molds develop rapidly and rot the ears, making them unfit for livestock feed.

The extent of stalk breakage is also reflected in many of the crops which follow corn. It is common to see fields of soybeans which are almost hidden by volunteer corn; considerable labor is necessary to get soybean fields ready for harvest. When volunteer corn is not cut before harvesting soybeans, mixtures as high as 50 percent corn and 50 percent soybeans have been reported.

Research by pathologists and crops and soils workers here at the University of Minnesota has shown that there are several factors which may be responsible for lodging and stalk breakage. Usually one single cause for breakage is not responsible in any one field. The lodging is the result of several factors or their combinations.

The following are some of the factors known to contribute to stalk breakage and lodged corn.

Root and Stalk Rot—Various fungi, namely *Gibberella* and *Diplodia*, have been found to be the most important cause of root and stalk rot. Actual losses are difficult to determine, because root and stalk rot can cause a reduction in yield without conspicuous disease symptoms or corn lodging.

Insect Damage—Damage by corn borer, corn root worm, wireworm, and other insects may result in a weakened stalk which ultimately breaks and drops the corn ear. In addition, the damaged corn tissue, as a result of the insects' entrance, provides an easy entrance for root and stalk rotting fungi.

Nutrient Balance—When the fertility level of a soil is out of balance—in particular when the potash status is low—stalk rot develops more readily and consequently causes more lodged plants.

It has been found that application of nitrogen alone favors the stalk rot organism. Various investigations have found that addition of potash fertilizer to soils already rich in potassium had no effect on the yield or lodging of corn. But potash applied to deficient soils decreased the incidence of lodging and stalk breakage.

Plant Population—Stalk breakage and lodging increases rather sharply when plant populations exceed 18 to 20 thousand plants per acre. Stalks are smaller, generally taller, and more susceptible to mechanical breakage.

Variety—The standing ability of various hybrid corn varieties is an important factor in lodging. Researchers have found considerable difference among hybrids in this respect.

It has been demonstrated that some corn plants contain soluble substances which retard the growth of some of the stalk rotting fungi.

2,4-D Treatment—Corn is sometimes injured when sprayed with 2,4-D. Overdosage or improper application can result in brittle stalks, malformation of brace roots, and lodging.

The factors named above are only some of the causes for lodged corn. Soil and weather also affect the degree to which corn will lodge. The greatest hope for a solution to the lodging problem lies in the use of resistant hybrids, insect control, proper fertilizer application, optimum plant population, and sound crop management.

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CAGE LAYERS

(Continued from page 3)

phorus requirements for layer hens are perhaps more critical than calcium requirement. For this reason the proper amount of phosphorus, in a form which is available to the layer hens, must be provided. This means that in most cases the total phosphorus level in a ration should be approximately 1 percent, which provides an available level somewhere near that required.

Vitamins

In our studies, layer hens required vitamin levels in excess of NRC allowances, if egg production was to be maintained at a high level over a long period of time. Layer rations containing lower levels of B-complex vitamins did an excellent job during the first 3 or 4 months of the laying period. After that time, egg production gradually declined in those lots which were provided the B-complex vitamins at NRC allowance level.

The layers which were receiving vitamins at from 2 to 3 times the NRC allowances declined in egg production, but the decline was less pronounced and high egg production was maintained over a much longer period.

Recent observations at the Washington State College Experiment Station would indicate that breeder hens fed a ration containing adequate levels of B-complex vitamins produced chicks which showed symptoms of B-complex vitamin deficiences at some time during the growing period. This emphasizes the fact that NRC allowances, as recommended at the present time, are not adequate for maximum egg production.

The nutrition of cage layers therefore, is becoming increasingly complex. Nutrient requirements must be determined not as isolated requirements, but as each is related to other nutrient levels in the layer ration.

UNIVERSITY OF MINNESOTA, INSTITUTE OF AGRICULTURE, ST. PAUL 1, MINN.

Cooperative Extension Work in Agriculture and Home Economics, University of Minnesota, Agricultural Extension Service and United States Department of Agriculture Cooperating. Skuli Rutford, Director. Published in furtherance of Agricultural Extension Acts of May 8 and June 30, 1914.

UNIVERSITY OF MINNESOTA
Institute of Agriculture
Agricultural Extension Service
St. Paul 1, Minn.

SKULI RUTFORD, Director

Minn. 9—9-57—2M
Permit No. 1201

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FREE—Cooperative Agricultural Extension Work, Acts of May 8 and June 30, 1914.