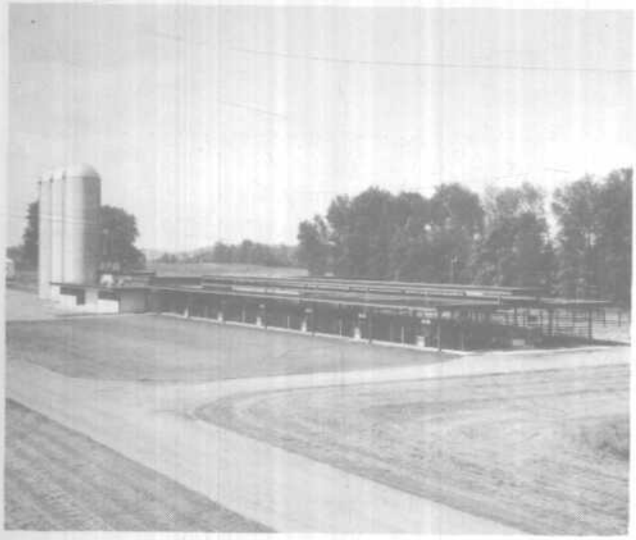

RESEARCH SUMMARY 43

AUGUST 1970

BEEF CATTLE RESEARCH-1970

OHIO AGRICULTURAL RESEARCH AND DEVELOPMENT CENTER

Wooster, Ohio

CONTENTS

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7-70-7M

ALL-SEASON GRAZING FOR BEEF COWS

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In Ohio, beef cow herds of 20 to 40 cows are common, with a few herds up to 400 cows. These are generally family operations, either full or part-time.

In contrast, the number of animals handled per man is considerably greater in Australia and New Zealand. There, on improved pastures, two men on one property (ranch) are handling about 800 cows with a 90% calving record. On another property, three men are taking care of 3,500 cattle being grass-fattened, plus 1,000 brood cows. Cattle and sheep often are found on the same property. One man and his son near Melbourne handle 225 cattle and 2,500 ewes. Similar examples can be given for New Zealand.

One reason for the greater number of livestock per man is the year-round grazing possible in Australia and New Zealand. The growing period is much longer than in Ohio, although little or no growth may occur during the mid-summer dry period and growth is also slowed during winter when frosts occur. However, most of the feed is supplied by grazing and none or only limited harvested feed is provided for beef cattle and sheep. No buildings for livestock are necessary, although hay sheds are used.

The Australian and New Zealand producer contracts for more farm jobs than the Ohio producer. Fertilization is commonly done commercially, either by aircraft or ground rig. Land clearing, including seeding, is commonly hired. Hay baling, if done, and major fencing may also be contracted. The cost and scarcity of labor have contributed to these developments.

Although many factors enter into the ability of the Australian and New Zealand cattlemen to handle more livestock than Ohio farmers, recent Research Center studies indicate that Ohio beef herds can be handled with less labor and less expense with careful planning and management of forages to provide year-round grazing.

Ohio Winter Grazing Studies

Under Ohio conditions, with a relatively short growing season and cold winters, considerable stored feeding and winter housing have always been considered necessary. Ohio winter grazing studies have shown that the pasture season can be extended year-round with a planned program. This has important implications in terms of reduced costs and increased productivity per man. Feed harvesting, storing, and feeding account for a large percentage of the winter feed costs. By eliminating or reducing these costs, together with the elimination of manure handling and livestock housing (except for occasional overnight shelter for a few animals calving during bad weather), total costs can be reduced substantially.

Preliminary results indicate that labor for the winter period can be reduced to 25% of that for conventional wintering of beef cows in Ohio.

The use of fertilizer and improved pastures will greatly increase productivity and thus markedly reduce the land needed per cow. Although pasture improvement, including annual fertilization, represents increased cost per acre, cost per cow will be less because of less land, fencing, and other costs.

Research on all-season grazing is being conducted at the Eastern Ohio Resource Development Center (EORDC) and at the Southern and Southeastern Branches. Although the economics of such a system are being included in the study, the first effort has been to evaluate the effect of such a program on the livestock and pastures.

The results to date show that beef cow herds can be kept outdoors year-round, with feed coming from growing pastures in summer and from stockpiled pastures in winter. The winter feed is provided by first-crop hay as round bales left on the ground in the field, together with the late summer and fall regrowth. Round bales provide a cheap method of storing peak forage growth in the pasture until the winter period.

Winter Pastures Nutritionally Adequate

The stockpiled pastures have been found to be nutritionally adequate for wintering pregnant beef cows. For the past four winters, tall fescue round bales at the Southern and Southeastern Branches averaged 9.8% crude protein and the standing regrowth 9.5% crude protein. Cows on this material have consistently gained weight during the wintering period until calving time. With late winter calving, the cows reach spring grass about the time the nursing calves are able to handle the increased milk flow resulting from the higher quality spring pasture. The calf birth weights for the winter pasture herds have been the same as those for the herds wintered in the barn.

The amount and duration of snow cover has been of concern. The long snow cover period for the winter of 1969-70 has shown that the cattle can get along very satisfactorily. The duration of snow cover was one of the longest in recent history. Even though the snow crusted heavily, cows reached the round bales with no difficulty. After the snow disappeared, cows went back over the pastures and cleaned up the

During brief periods of snow, cattle feed on the round bales of hay left in the winter pastures. Photo taken at the Southeastern Branch, Meigs County.

standing forage. The combination of round bales and standing forage thus is better than depending only on the standing regrowth. In addition, a supply of stored feed is advisable in the event of unusually deep snows or some other emergency.

While winter weather has not been a problem from a feed standpoint, unusually severe weather may occur during calving. Cows due to calve during such periods should be provided shelter, particularly first-calf heifers.

The data from the past four winters at the Southern and Southeastern Branches indicate that about 0.7 acres of a vigorous fertilized stand of tall fescue will carry a mature beef cow from November 15 to April 15. This includes the first crop left in the field as round bales, together with the regrowth. A greater acreage per cow has been needed at the EORDC. The winter pasture at EORDC was seeded in a badly eroded field and the soil conditions need improvement for optimum forage yields. It takes time to improve a field in as poor a condition as this one, which had large areas of clay subsoil exposed.

It has been found best to handle the winter pasture as a separate field from the summer pastures. Although the cattle graze the forage closely during the winter and expose the plants to adverse conditions, the fields used for winter grazing are not showing measurable damage. Some of the areas have been cut up by animals during periods of thawing, but no apparent damage has been evident. Not grazing the field during the summer may enable the stand to regain its vigor.

In late March and early April, the pastures may be subject to cutting up, particularly as the frost goes out of the soil or during periods of heavy spring rain. It may be advisable to remove the cattle to a lot during these periods, rather than let them severely damage the pasture. They could be fed hay or allowed on the pastures only long enough to graze.

Tall fescue has been found to be the best grass for winter pasture to date. It is highly productive and holds its quality well both in the bales and as the standing regrowth. During the winter period, its quality and palatability are very adequate for beef cows.

To obtain good production, the stands are fertilized with 200 lb. of ammonium nitrate in early spring. Another 200 lb. are applied in August to boost fall growth. A spinner spreader is used to permit rapid spreading of fertilizer with the bales in the field. In addition, periodic applications of potash and phosphate fertilizer are made.

Control Winter Grazing

To control the winter-pasture grazing, it is desirable to divide the winter area into four to six smaller pastures, requiring the cattle to clear up each area before being moved to the next. Cattle tend to consume more feed than necessary if it is available. The practice of controlled grazing has been shown by research to substantially increase carrying capacity. The fields can be easily and cheaply divided with electric fence. This method has worked very satisfactorily at the three locations where the research is being done.

Ohio research has shown that an entire season's growth cannot be left as standing forage without a great loss of the feed. The results have shown that the feed available by late fall (Nov. 1) if left standing is about equal to the fall growth only. The summer production is largely lost. To realize feed from the spring and summer growth, it must be either grazed or cut and baled before the fall growth starts.

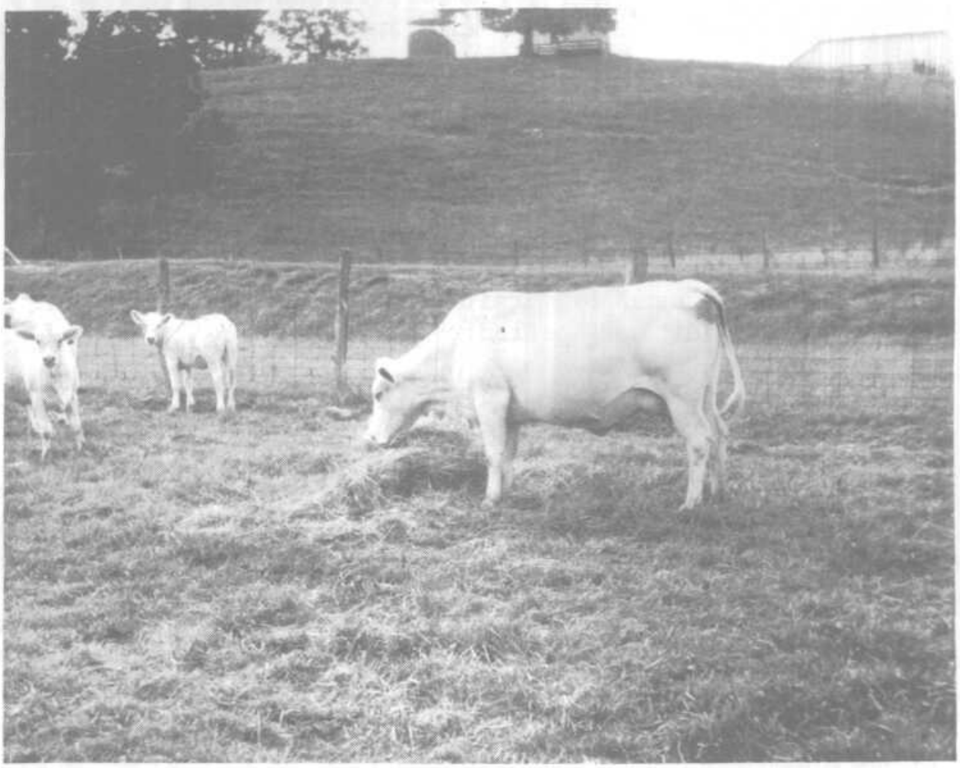
In selecting the winter pasture area, several items must be considered. The winter pasture field should be well-drained because cattle will be on it during the periods of thawing and rain. The cattle should also have some protection from winter winds, either a windbreak or a protected draw. Some means of supplying water is also necessary. The winter pastures in these studies are supplied with water by tanks fed from farm ponds. A slow movement of water into the overflow pipe generally keeps the water from freezing, except in very cold weather when it becomes necessary to occasionally remove the ice.

Summer Pasture

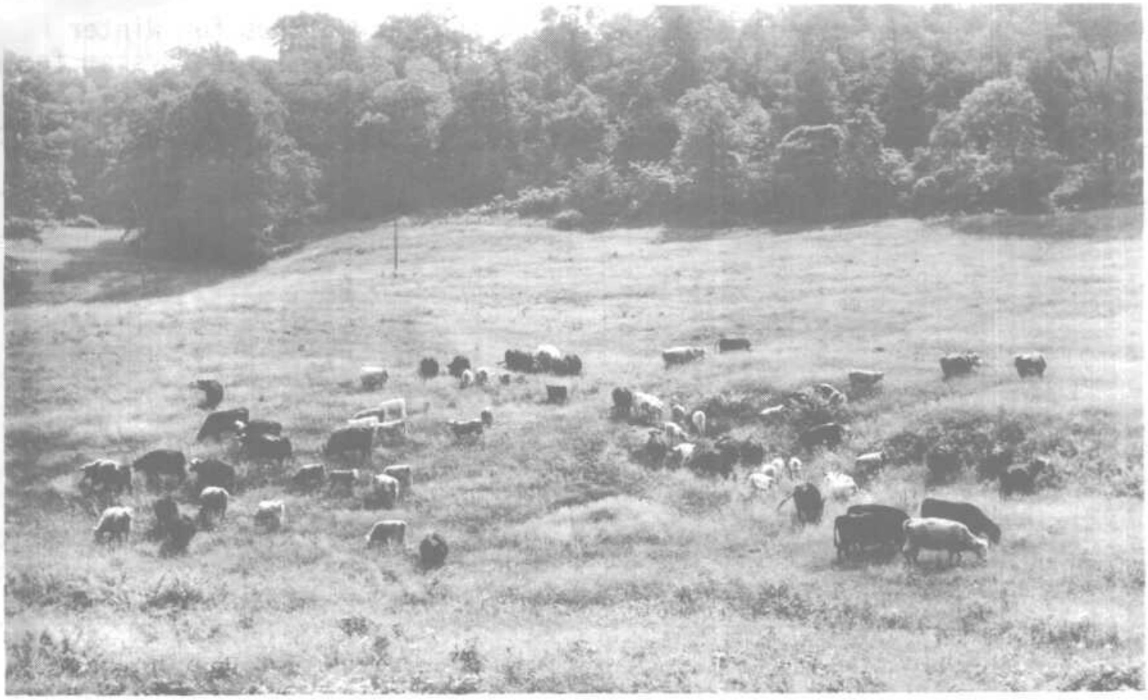
Orchardgrass and bluegrass are both satisfactory summer pasture. Research has shown that about an acre of orchardgrass or 1.3 acres of bluegrass will carry a beef cow for the 7-month summer pasture period. This is based on vigorous stands receiving adequate fertilization, including nitrogen.

Although the summer pasture could be based on either species alone, using both species provides easier management. In such a program, cattle graze the orchardgrass early during the period it begins to produce seedheads. By early June, grazing has largely controlled the orchardgrass seedhead formation and the cattle are moved to the bluegrass. The bluegrass can be deferred grazed and still retain reasonably good quality and palatibility.

For the remainder of the summer season, cattle are rotated between the orchardgrass and bluegrass pastures. The aftermath of field with the first crop cut for stored feed is included in the late summer grazing. This summer pasture system has been found to be feasible at the Eastern Ohio Resource Development Center.



Round bales left in the pasture can be used to supplement summer pastures, as shown in this photo taken at the Southeastern Branch, Meigs County.



Beef cows and calves grazing deferred Kentucky bluegrass pasture at the Eastern Ohio Resource Development Center in Noble County.

The fertilizer program with the research summer pastures includes 200 lb. of ammonium nitrate in early spring on all pastures. The orchardgrass gets another 200 lb. of ammonium nitrate later in the year. The potash and phosphorus levels are maintained with periodic fertilization.

Clipping pastures once a year removes tall growing weeds such as ironweed, bull thistle, and multiflora rose. When such weeds as ironweed appear in considerable numbers, an application of 2,4-D in May or June is applied after the field has been grazed and the cattle removed.

More details on summer pastures for beef cows are given in *Ohio Report*, Vol. 55, No. 3, May-June 1970.

Total Pasture Program

A year-round program is projected in Table 1. The averages are based on excellent vigorous stands with a good fertilizer program. Although this level of production has not been reached with the beef unit at the Eastern Ohio Research Development Center, this is the goal as the pasture fertility and productivity levels increase.

Another goal is an average fall weaning weight of 500 lb. This weight has been reached with a number of calves but not all of them. Some of the cows are calving too late and it is difficult to change this breeding schedule to an earlier date.

Ohio has great potential for feeder calf production. To realize that potential, all-season grazing offers producers a system of providing feed with considerably less labor. From preliminary data, it appears that feeder calves can be produced more cheaply with this system than with present winter-stored feed methods. Greater profits are needed to encourage producers to expand feeder calf production.

TABLE 1.--Projected Acreages Needed per Cow and for 40 Cows for Winter Pasture, Summer Pasture, and Emergency Stored Feed for an All-Season Grazing System for a Beef Cow-Calf Operation.

Pasture	Species	Acres Needed	
		Per Cow	Per 40 Cows
Winter pasture	tall fescue	0.7	28
Summer pasture	orchardgrass	0.6	24
	bluegrass	0.6	24
Emergency stored feed (aftermath grazed)	orchardgrass	0.1	6
Total acreage		2.0	82

THE RELATIONSHIP OF VISUAL SCORES, LINEAR MEASUREMENTS, AND COW WEIGHTS TO PRODUCTION

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Introduction

At the present time, there is much concern in the beef cattle industry about the type of animal which will meet the requirements of the consumer and still be th most economical for the producer to raise. Along with this question, there is the problem of determining optimum cow size to maximize profit for the beef cow and calf operator.

Throughout the years visual appraisal has been used as one of the major guides for selection in determining which cows will remain in a herd and which will be culled. There has been discussion both pro and con of the validity of visual appraisal as a tool for selection.

In the past few years, much emphasis has been placed on production records as an aid to selection in the beef industry. A common form that production testing has taken in the industry is using an adjusted calf weight at 205 days of age and the type score of the calf to arrive at a single index. Individual cows in a herd can then be compared on the basis of the index values of their calves.

It seems logical that one would be able to use a combination of production records on calves and visual appraisal of the cow for selecting among cows in a particular herd. Taking these factors into consideration, the purpose of this study was to:

1. Compile production records on the Shorthorn, Angus, and Polled Hereford herds at The Ohio State University.
2. Calculate the most probable producing ability (MPPA) for each cow in the Angus, Polled Hereford, and Shorthorn herds.
3. Study the correlations which exist within the different visual scores, linear measurements, and cow weights.
4. Make visual scores on the cows and compare the relationship of these score to their production records.
5. Take certain linear measurements and weights of the cows and study their relationships to their production records.
6. Draw conclusions which would enable a cattleman to describe the kind of beef cow which has higher production, thus using both visual appraisal and production records as tools of selection in the beef cattle industry.

Literature Review

When considering production of cows, several factors can cause variations in production. Considering the repeatability of visual scores, Gifford, *et al.* (5) pointed out that the repeatability of judges was 0.41, 0.42, and 0.50 for an overal rating in the Hereford herd at the Arkansas Agricultural Experiment Station. He also suggested that temporary conditions, such as stage of lactation, stage of pregnancy, and age of cow would tend to lower the repeatability scores on different dates of classification, since the three judges in this experiment seemed to be affected roughly in the same matter. In general, Gifford found the correlation between judges was highest for overall rating, followed by general appearance, breed type, hindquarters, and forequarters in that order.

Brown, *et al.* (2) also stated that variation in stage of lactation, stage of pregnancy, and age of the cows tend to lower the repeatability of scores on the same animals on different dates. Considering *weights of calves related to dam's weight,* Tanner, *et al.* (11) reported that calf weights at 200 days averaged 8.0 lb. heavier for each additional 100 lb. increase in weight in dams on 518 Angus calves. Data on 385 Hereford calves showed an increase of about 16 lb. in an 180-day calf weight with each additional 100 lb. increment in the 600 to 900 lb. range and that the cows in the 900 to 1500 lb. range averaged 4.9 lb. increase in calf weight for each additional 100 lb. increment of dam weight.

Tanner, *et al.* (11) pointed out that 16-20 lb. additional calf weight would be required to pay the extra cost associated with 100 lb. additional weight of dam when both feed cost and other cow costs are taken into consideration.

Cartwright, *et al.* (4) reported that calves from cows in the range of 1200 to 1499 lb. were slightly lighter than calves produced by 1100 to 1199 lb. cows.

Marlowe (9) reported no increase in the average calf weight in a herd of Herefords from cows weighing over 1200 lb. Melton (10) revealed that the average increase in calf weaning weight was 24 lb. per 100 lb. increase in cow weight up to 1000 lb. cows, but only 6 lb. increase in weaning weight per 100 lb. increase in cow weight from 1000 to 1099 lb. Calf weaning decreased an average of 4 lb. per 100 lb. increase in cow weight over 1200 lb.

This would lead to the belief that any additional increase in cow size in regard to weight much over 1000 lb. would not be beneficial in producing additional pounds of weaning in a calf if her additional feed costs are considered. In considering cow's weight/wither height ratio, Brody (1) called the ratio of the cow's weight to her height at withers a measure of the cow's environment. Klosterman, Sanford, and Parker (7) reported a highly significant correlation of 0.89 between condition score and the ratio of weight to height at hooks in beef cows. Kress, *et al.* (8) reported that cows with smaller values of weight over wither height ratio may be more efficient, suggesting that efficiency is negatively related to fatness.

Procedure

A study was made of the Angus, Polled Hereford, and Shorthorn cows in The Ohio State University brood cow herd. It included 87 cows with at least one calf in the Production Testing Program with weaning performance. An index was used to combine the 205-day weight ratio and the type score ratio for weaning calves. Visual scores were made on each cow as well as the weight to the nearest 5 lb. A height measurement from the ground to a point midway between the hooks and from the ground to the top of the withers (or shoulders) was recorded. A weight-height ratio was computed in pounds per centimeter. The primary interest in the analysis of these data was to find which specific variables would influence a particular production criteria.

Results

The purpose of this study was to evaluate the relationships of various visual scores, linear measurements, and cow weights to cow production as measured by calf performance. These data were collected on 36 Angus cows, 21 Polled Hereford cows, and 20 Shorthorn cows in The Ohio State University beef herd.

Breed difference was found to affect only two out of the six visual scores. These were the cow's condition score and amount of bone score. The Shorthorn cows were found to be in the highest condition while the Polled Herefords had the least. Both the Polled Herefords and Shorthorns ranked higher in the visual appraisal of bone than the Angus cows. Breed difference also affected the height at hook measurements. It was found that the Shorthorns were the highest at this point while the Angus herd was somewhat shorter than either of the other breeds.

The production criteria compiled for this study were weight of last calf, average weight of all calves from a particular cow, type score of last calf, average type score of all calves, MPPA for weight, MPPA for type score, and MPPA index. After preliminary analysis it was decided to examine the effects of only those scores or measurements which had a significant effect on at least one of the production criteria.

It was found that the weight of the last calf was influenced by breed, sex, condition of the cow, weight/hook ratio of the cow, and the cow's weight. The Angus cows produced calves at weaning (205 days) which were 55 lb. heavier than the Shorthorn calves and 42 lb. heavier than the Polled Hereford calves. The bull calves outweighed the heifer calves by 34 lb. It was also found that as the cow's condition

Typical Angus cows and calves included in this study. Photo courtesy of American Angus Association.

score became higher, there was a reduction in weaning weight. A cow with a weight/hook ratio of 10 to 11 would have a calf with the highest weaning weight. Cow's weight was found to have a linear relationship to weaning weight of the last calf.

Figure 1 shows that cows with an increasing condition score have a reduction in calf weight at weaning time. In this study, cows with the least finish weaned the heaviest calves and cows with more fat weaned lighter calves. This would support the assumption that the cows in higher condition had poorer mothering ability, thus accounting for their calves weighing less than the calves from the thinner cows.

The cow's weight/hook ratio ranged from 9 to 13 with an average ratio of 10.0. The equation $\hat{y} = 446 + 12.9\ (x - \bar{x})\ -11.4\ (x - \bar{x})^2$ is graphed in Figure 2, showing the relationship of weaning weight of last calf to the cow's weight/hook ratio.

Figure 2 shows that the cow with a weight/hook ratio of 10 to 11 will have a calf with the highest weaning weight. This weight/hook ratio points out that cows should be selected which are structurally large but not carrying excess weight in the form of finish in relation to their structural size.

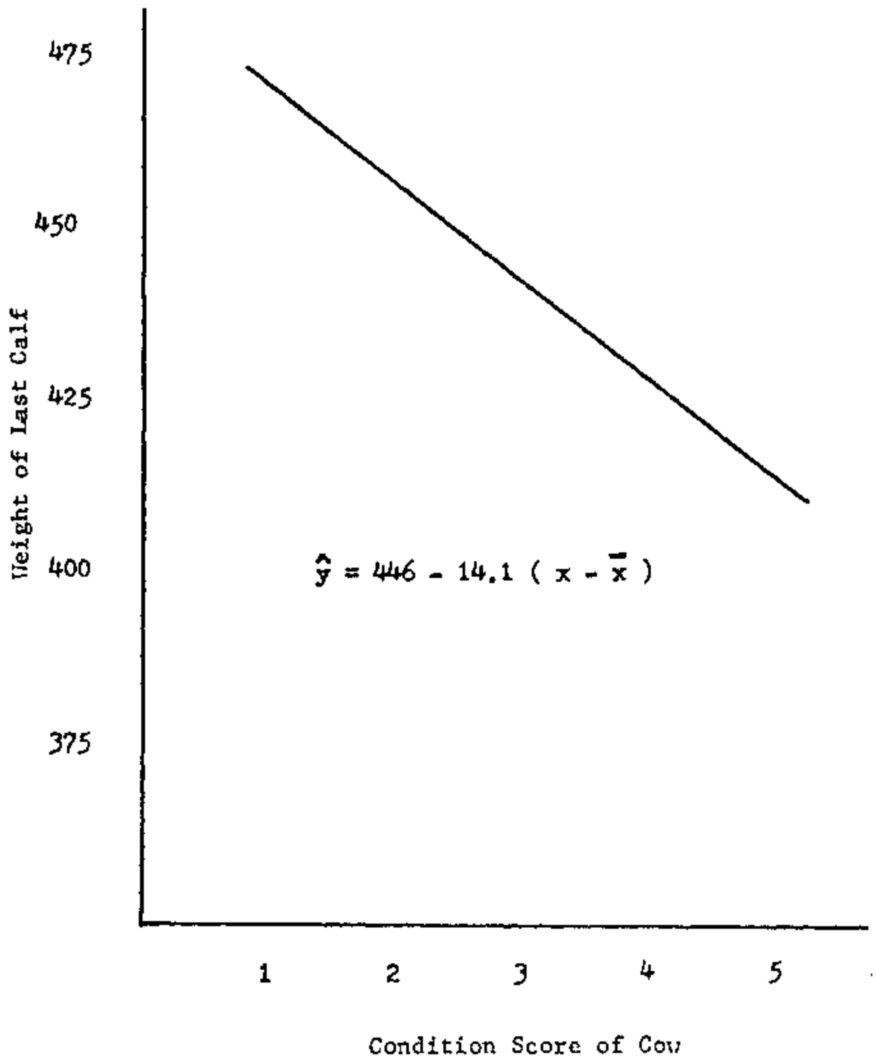

Fig. 1.--Regression line showing the relationship between a cow's condition and the weaning weight of her last calf.

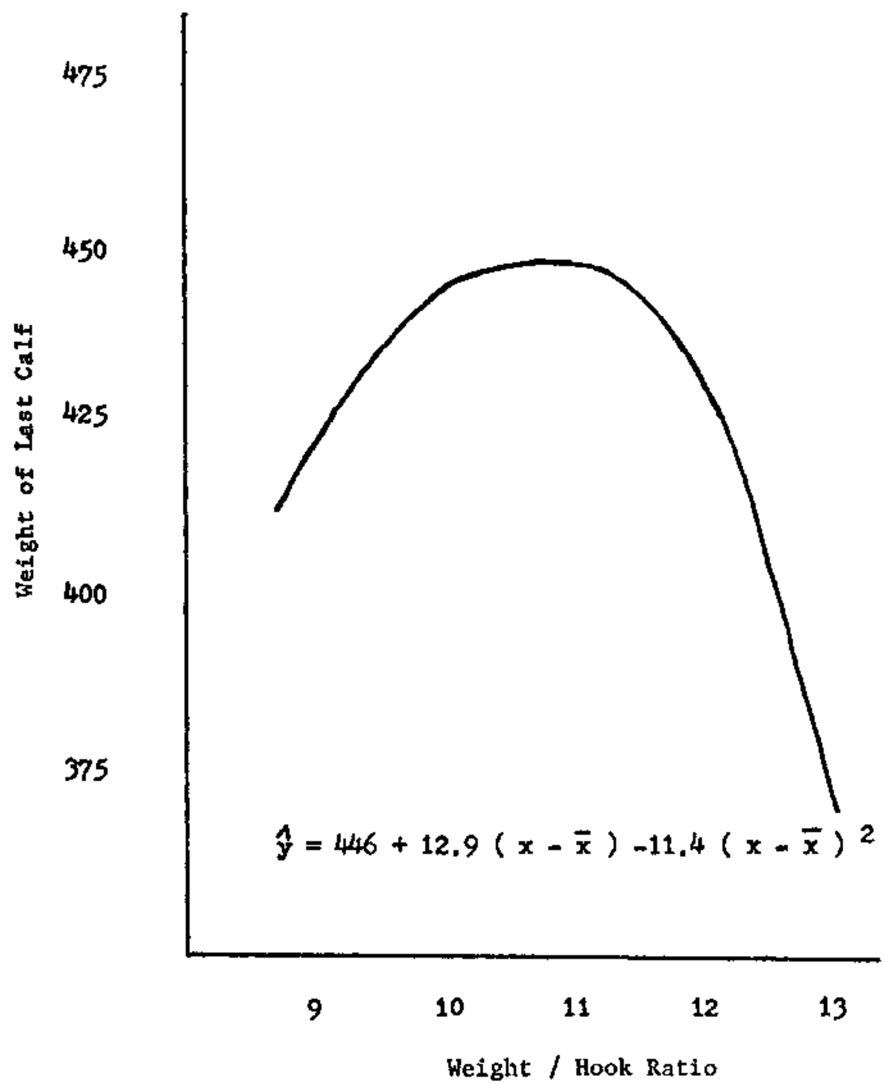

Fig. 2.--Regression line showing the relationship between a cow's weight/hook ratio and the weaning weight of her last calf.

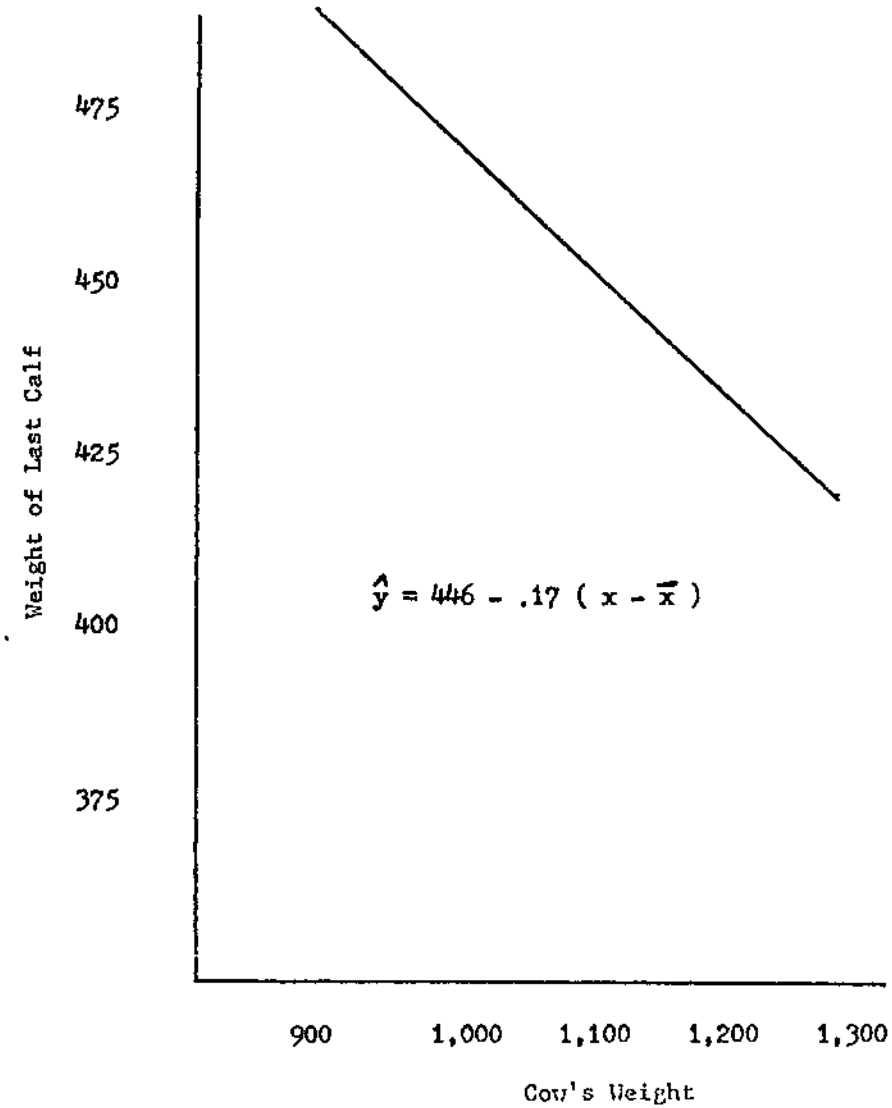

Fig. 3.--Regression line showing the relationship between a cow's weight and the weaning weight of her last calf.

The weight of the cows in this study ranged from 900 to 1,350 lb., with an average weight of 1,153 lb. The equation $\hat{y} = 446.0 - .17\ (x - \bar{x})$ is graphed in Figure 3, showing the relationship of weaning weight of last calf to the cow's weight.

In this particular group of cows, it was found after correcting for breed, sex of calf, cow's condition score, and a weight/hook ratio that the cow's weight was in a linear relationship to the weaning weight of her last calf, with the 900 to 999 lb. cows weaning heavier calves than the 1,200 to 1,350 lb. cows by an average of 68 lb.

It was found that breed and weight/hook ratio had a significant effect on the average weight of all calves produced by a particular cow. The Angus cows weaned calves which weighed 465 lb., Shorthorn cows 438 lb:, and Polled Herefords 433 lb. The cow with the weight/hook ratio of 9 lb. per centimeter was found to wean the heaviest calves when considering the average weaning weight of all the calves produced by a particular cow.

There was a difference found in the type score of the last calf due to breeds, weight/hook ratio, and cow's conformation. It was found that the Angus cow herd weaned calves with the highest type score. The cows with a weight/hook ratio of 10.0 seemed to produce calves with the higher type score. The higher conformation scoring cows produced higher type scoring calves.

When considering the average type score of all calves produced by an individual cow, the Angus had again weaned the calves with the highest type score. As with the type score of the last calf, the cow with a weight/hook ratio of 10 lb. per centimeter produced calves with the highest type score.

MPPA for type score was affected by cow's conformation and weight/hook ratio. As the cow's conformation score increased, there was also an increase in the MPPA for type score. It also was found that the cows with a weight/hook ratio of 10 lb. per centimeter had the higher MPPA type score.

MPPA for weight and the MPPA index were found to be affected by the weight/hook ratio of the cow. Both of these production criteria were found to be highest when the weight/hook ratio was around 9 lb. per centimeter. After looking at which variables had the largest effects on the different production criteria, it seemed that the weight/hook ratio would be the best single factor which could be used as a selection aid.

One of the major objectives of this study was to draw conclusions which would enable a cattleman to describe the kind of beef cow which has higher production. From the limited number of cows and the three breeds studied, the kind of cow needed is one which has structural size and scale, and weight in relation to this size and scale. Extra weight due to excess condition is not a desirable characteristic. It is not beneficial to the cow's productivity or calf's performance. Conformation scores of the calves are related to the cow's conformation scores if the cow's conformation is due to genes and not environment. Excess finish is detrimental in the true appraisal of a cow's conformation.

It should be noted that only production criteria which involved the production of feeder calves were considered in this study. It would be interesting to examine the effect of these variables on production at 365 and 550 days of age.

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SUPPLEMENTAL FEEDING OF MAGNESIUM OXIDE WITH SALT FOR BEEF CATTLE

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The incidence of grass and winter tetany in cattle in Southeastern Ohio has been on the increase for several years. It has been found that the magnesium level was low in the blood serum of these affected cattle.

One method of supplementing magnesium is by adding magnesium oxide to the salt fed. Different ratios have been tried with various results in the daily consumption per animal. Mixtures of 5% to 50% magnesium oxide added to trace mineral salt have been used in combating tetany. Little information was available on the total average consumption by animals supplemented with different levels of magnesium over a period of time. Some farmers reported they were getting no mineral consumption on the 1-to-1 salt-magnesium oxide ratio.

For these reasons, a study using four different ratios of magnesium oxide and trace mineral salt was undertaken. The four mixtures were:

85% T.M. salt--15% magnesium oxide (heavy powdered form)
50% T.M. salt--50% magnesium oxide (heavy powdered form)
20% T.M. salt--80% magnesium oxide (heavy powdered form)
50% T.M. salt--50% magnesium oxide (granular form).

Each mixture was fed free choice along with free choice steamed bonemeal.

In the fall of 1969, a 3-month duration trial was initiated at the Eastern Ohio Resource Development Center at Caldwell. Four groups of beef cows consisting of 170 head were used to compare total daily intake of two different ratios. These cows were Hereford, Angus, Charolais, and their crosses.

The two mixtures used were an 85% T.M. salt--15% magnesium oxide and a 50% T.M. salt--50% magnesium oxide. Both were fed free choice with free choice steamed bonemeal.

Each cattle group was on a mixture for 1 month, with salt mixtures and bonemeal weighed weekly. At the end of 1 month, the mixtures were switched and weekly consumption was again measured for 1 month.

The average daily intake of all groups on the 85-15% mixture (Table 1) was 0.65 ounces or 0.56 ounces of salt and 0.097 ounces of magnesium oxide per head per day. They also consumed 0.2 ounces of steamed bonemeal per head per day.

The groups on the 50-50% mixture had an average daily consumption of 1.24 ounces or 0.62 ounces of salt and 0.62 ounces of magnesium oxide per head per day. The bonemeal intake was 0.72 ounces per head per day.

In January 1970, a group of 40 head of beef cows on winter pasture (consisting of first cutting fescue in round bales and standing second growth fescue) were fed a mixture of 20% trace mineral salt and 80% magnesium oxide. This group (Table 2) had an average total daily intake of 0.84 ounces of the mixture or 0.17 ounces of salt and 0.67 ounces of magnesium oxide per head per day. They also consumed 0.56 ounces of steamed bonemeal per head per day.

TABLE 1. Daily Consumption of Two Groups of Cows on 85-15 Percent Mixture and 50-50 Percent Mixture

	Group I	Group II
	85-15 Percent mixture (oz./head/day)	50-50 Percent mixture (oz./head/day)
Total consumption	.65	1.24
Salt	.56	.62
Magnesium oxide	.097	.62
Steamed bonemeal	.2	.72

TABLE 2. 40 Head of Cows on the 20-80 Percent Mixture for Thirty Days

	20-80 Percent mixture (oz./head/day)
Total consumption	.84
Salt	.17
Magnesium oxide	.67
Steamed bonemeal	.56

TABLE 3. Two Groups (32 head) on 50-50 Percent Mixtures (Powdered and Granular Form)

	Group I	Group II
	Powdered magnesium oxide (oz./head/day)	Granular magnesium oxide (oz./head/day)
Total consumption	1.84	1.80
Salt	.92	.90
Magnesium oxide	.92	.90
Steamed bonemeal	.09	.09

The 50-50% mixture (Table 1) gave nearly as much magnesium oxide intake as the 20-80% mixture (Table 2) without any reduction in the salt consumption.

The magnesium oxide used in all of the above trials was a heavy powdered feed grade and quite dusty to mix. This grade had a 52% magnesium level.

In the spring of 1970, it was decided to compare consumption of two different forms of magnesium oxide: the heavy powdered form mentioned above and a granular form.

At the Southeastern Branch, Albany, two groups of 32 cows (64 total) were put on the 50-50% powdered and 50-50% granular forms on April 24 when turned out to pasture. Both groups were of equal age and breeding--2, 3, and 4-year-old Hereford, Charolais, and Hereford-Charolais crosses. The only difference in the trial was the two forms of magnesium oxide. The heavy powdered grade had a 52% magnesium level and the granular form a 26% magnesium level.

The cows on the heavy powdered form of magnesium oxide consumed more mineral initially. After the first month, however, consumption by the two groups was equal.

The cows on the powdered magnesium oxide mixture (Table 3) had an average intake consumption of 0.92 ounces of both salt and magnesium oxide.

The group on the granular form (Table 3) consumed 0.90 ounces per head per day for both the salt and the magnesium oxide. Both groups had an intake of 0.09 ounces of steamed bonemeal per head per day.

The salt consumption increased in the spring with the grass being more succulent and the material moving through the animals' systems more rapidly.

The cattle on the salt-magnesium mixtures showed no signs of grass tetany. A control group of 17 old cows (10-16 years old) which did not receive magnesium oxide in their rations also had no signs of grass tetany.

As a general management practice, all Research Center beef cows (except the small control group mentioned above) were fed a mixture of trace mineral salt and at least 50% magnesium oxide during the spring of 1970. With the 375 cows included in this experiment, there were no problems of consumption with these mixes.

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SUMMARY OF FEEDER CATTLE PERFORMANCE AFTER SHIPMENT WHEN RECEIVING MEDICATED WATER TREATMENTS AND FED IN TWO TYPES OF FACILITIES

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Abstract

Sixty bull and sixty steer calves were shipped from Texas, housed in two types of barns, and given two types of medicated water after arrival. Cattle placed in a slotted floor barn ate more corn silage and gained faster than cattle placed in a conventional barn, using straw as bedding. Consumption of straw by these cattle may have decreased their consumption of corn silage, which in turn reduced their weight gains.

The incidence of respiratory disease was very much higher (7%) in the conventional barn compared to the slotted floor barn (0%). This response may have been related to the consumption of contaminated straw. Treatment of the drinking water did not greatly influence feedlot performance, although cattle receiving water treated with the *Bacillus* sp. preparation gained somewhat faster than controls, especially in the slotted floor barn. Sulfamethazine treatment of the water in the slotted floor facility appeared to decrease gains somewhat, especially during the fourth week when medicated water had been withdrawn.

Procedures

On Sept. 29, 1969, 60 bull and 60 steer calves were shipped from a ranch near Wichita Falls, Texas, to the Research Center in Wooster. Twelve of the bull calves had been weaned approximately 30 days prior to shipment, the remaining bull calves had been weaned about 1 week prior to shipment, and all of the steer calves were weaned the morning they were shipped. None of the cattle were pretreated in any way, except that the bulls were fed Sudan hay from a bunk while they were on pasture between weaning and the time of shipment.

The cattle were shipped in two trailer trucks and arrived in Wooster 34 hours after being loaded. They were immediately weighed and divided into experimental groups before receiving their first feed.

Two water treatments were studied during the first 28 days after the cattle arrived. These treatments were: (1) the addition of 1 lb. of sulfamethazine per 120 gallons of drinking water, fed on an intermittent schedule for a 3-week period, and (2) the daily addition of live cultures of a *Bacillus* sp. organism which would inhibit the growth of *Pasteurella* sp. in the drinking water. The feeding regime for the sulfamethazine in the drinking water was:

Period in Days	Water Treatment	Period in Days	Water Treatment
1-2	No medication	13-14	No medication
3-8	Sulfamethazine*	15-17	Sulfamethazine
9-10	No medication	18-19	No medication
11-12	Sulfamethazine	20-21	Sulfamethazine

*Sulfamethazine 1 lb. per 120 gallons of drinking water.

TABLE 1. Supplement Formula

Ingredient	Amount
	(%)
Soybean meal (44% CP)	86.1
Urea (281% CP)	3.8
Dehydrated alfalfa meal (17% CP)	5.0
Salt, trace mineralized[a]	5.0
Vitamin A premix (30,000 USP/gm.)	0.1
Total	100.0

In addition, two forms of housing were compared--conventional housing on dirt using straw bedding and a covered, slotted floor facility. The cattle were placed in these facilities immediately upon arrival.

All cattle were full-fed the same ration. It consisted of limestone-treated corn silage and a pelleted supplement (Table 1) fed at the rate of 1 lb. for every 30 lb. of corn silage consumed. At the end of the 28-day experimental period, the cattle were re-allotted to other experiments.

Results

The time which elapsed between weaning and shipment did not affect the weight loss during shipment. A greater length of time was required for the calves to recover the weight lost during shipment when they were weaned just prior to shipment than when weaned 7 or 30 days prior to shipment. These comparisons are shown in Table 2.

TABLE 2. Influence of Time Between Weaning and Shipment Upon Weight Loss of Cattle During Shipment and Time Required to Recover this Weight Loss

Days Between Weaning and Shipment	Sex of Calf	Shipping Weight	Shipping Loss	Days Required to Recover Shipping Loss
		(lbs.)	(%)	
30	Bulls	562	11.3	17
7	Bulls	482	12.7	22
None	Steers	558	10.6	25

The feedlot performance of these cattle during the initial 28 days after shipment is summarized in Table 3. The largest difference observed in daily gain was between the two forms of housing. Cattle fed in the slotted floor facility gained 10% more rapidly than cattle fed in conventional housing. This was even true during the first 7 days that the cattle were placed in these facilities. Part of the reason for this response may have been due to the consumption of straw by the cattle in the conventional barn, which in turn reduced their consumption of silage and supplement.

Treatment of the drinking water with *Bacillus* sp. increased gains somewhat, especially in the slotted floor facility. On the other hand, sulfamethazine treatment of the drinking water increased gains only slightly in the conventional barn

TABLE 3. Feedlot Response of Cattle During the First 28 Days After Shipment

		Housing			
		Conventional		Slotted Floor	
Item	Drinking Water Treatment	Bulls	Steers	Bulls	Steers
Avg. daily gain, (lb.)					
	Control	2.71	2.27	3.09	2.55
	Sulfamethazine	-	2.33	-	2.32
	Bacillus sp.	2.75	-	3.19	-
Avg. daily silage intake, (lb.)					
	Control	20.7	20.1	22.5	20.5
	Sulfamethazine	-	19.9	-	20.6
	Bacillus sp.	20.7	-	22.6	-

TABLE 4. Incidence of Respiratory Disease During the First 28 Days Following Shipment

	Housing		
Drinking Water Treatment	Conventional	Slotted Floor	Average
	(%)	(%)	(%)
Control	3	0	2
Sulfamethazine	0	0	0
Bacillus sp.	22	0	13
Average	7	0	4

but decreased gains rather markedly in the slotted floor facility. This reduction in rate of gain occurred largely during the fourth week after the medicated water had been withdrawn.

Table 4 shows the incidence of respiratory disease observed in these cattle. There was a striking difference between the two forms of housing. Cattle placed immediately in the slotted floor facility did not show any incidence of respiratory disease, whereas 7% of the cattle in the conventional barn showed signs of respiratory disease. This may have been due to the consumption of contaminated straw by these cattle. In the conventional barn, the sulfamethazine treatment of the drinking water appeared to reduce the incidence of respiratory disease somewhat; however, *Bacillus* sp. treatment increased the incidence.

Conclusions

Feeder cattle placed immediately on slotted floors gained weight more rapidly than cattle placed in a conventional barn, using straw for bedding. Part of this difference may have been due to the consumption of contaminated straw, which in turn increased the incidence of respiratory disease and decreased the consumption of corn silage and supplement. Treatment of the drinking water with *Bacillus* sp. or sulfamethazine did not greatly influence feedlot performance, although cattle drinking water containing *Bacillus* sp. gained somewhat faster than controls. However, reduced gains may result when sulfamethazine treatment of the drinking water is discontinued under some conditions.

VALUE OF PROTEIN, ENERGY, AND MEDICATED SUPPLEMENTS FOR NEW FEEDER CALVES

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Abstract

One hundred fifty-two feeder calves (434 lb. initial weight) were used to study the influence of aureomycin and the combination of aureomycin and sulfamethazine (Aureo-S-700), as well as various levels and ratios of protein and energy on the performance of feeder calves for the first 28 days after shipment. Both medicated supplements improved feedlot performance, with the combination of aureomycin and sulfamethazine being superior to aureomycin alone. These feeder calves responded to supplements of energy and protein, but the optimum ratio between protein and energy was similar to that required by growing-finishing cattle.

Introduction

Medicated feed supplements for incoming feeder calves have proven beneficial in many cases for enhancing sub-clinical health, thereby increasing feed intake and weight recovery. Aureo-S-700 is a new supplement for this purpose. In this experiment, this product was compared to results obtained when calves were not fed any medication. Since this product contains aureomycin and sulfamethazine, a third group of calves were fed aureomycin alone to determine the role that each of these compounds plays in the early performance of feeder calves.

In addition to proper medication, proper nutrition of incoming feeder calves is important. Protein and energy requirements of growing-finishing cattle have been largely determined, but the requirements of new feeder calves during the first phase of their feeding program are not known. Therefore, four combinations of corn and soybean meal were fed to determine if either protein or energy are more critical in the rations of newly received feeder calves.

Procedures

On October 22, 1969, 152 steer calves were purchased at the Barnesville, Ohio, Feeder Calf Sale. They arrived at the Research Center in Wooster following a 3-hour ride in two semi-trailer trucks. They were fed limestone-treated corn silage and supplement for 4 days, at which time they were allotted to this experiment.

The cattle were divided into 12 lots of 12 or 13 steers each. The rations tested compared three medicated treatments fed with each of four nutritional treatments. The medicated treatments were:

Controls
350 mg. aureomycin per steer per day
350 mg. aureomycin plus 350 mg. sulfamethazine per steer per day (Aureo-S-700)

Premixes containing these materials were supplied by the American Cyanamid Co.

The nutritional treatments compared the feeding of various amounts of crimped yellow corn and soybean meal to yield various dietary ratios of protein to energy. The nutritional treatments were:

For every 30 lb. of limestone-treated corn silage consumed by the steers, the following amounts of crimped corn and/or soybean meal were fed:

Treatment	Crimped Corn	Soybean Meal	Protein:Energy Ratio of Total Ration
1	None	1.6 lb.	28
2	1 lb.	1.6 lb.	27
3	None	2.6 lb.	35
4	4 lb.	2.0 lb.	26

The protein:energy ratios shown above are grams of digestible protein per megcal. of digestible energy; for optimum feedlot gain and efficiency, this ratio should be near 26-28.

All calves were fed a pelleted supplement, shown in Table 1. The medicated treatments were added to this supplement for the lots receiving these treatments. All calves received 0.5 lb. of this supplement per steer per day. This was part of the total amount of soybean meal fed, as shown above.

The cattle were fed these experimental treatments for 28 days, at which time they were re-allotted to other experiments.

Results

Initial feedlot performance (28 days) of these feeder calves was greatly improved by feeding either medicated treatment, as shown in Table 2. Aureo-S-700 markedly improved rate of gain and feed efficiency. Aureomycin alone, when fed at the same level per steer as contained in the Aureo-S-700 product, also markedly improved rate of gain and feed efficiency, but not to the extent observed in the cattle fed Aureo-S-700. The improved performance was accompanied by an increased

TABLE 1. Supplement

Ingredient	Amount
	(%)
Soybean meal (44% CP)	89.7
Salt, trace mineralized[a]	10.0
Vitamin A[b]	0.3
Total	100.0

[a] Morton's trace mineralized salt.

[b] Premix which supplied 20,000 USP units/steer/day.

TABLE 2. Feedlot Performance of Feeder Calves Receiving Various Medicated Treatments for 28 Days

Item	Medicated Treatment		
	None	Aureo-S-700	Aureomycin
Number of calves	52	52	48
Avg. initial weight, lb.	440	425	436
Avg. daily gain, lb.	1.32	2.16	1.89
Avg. daily feed:			
Corn silage, lb.	19.9	22.0	22.3
Corn , lb.	1.5	1.6	1.8
Soybean meal, lb.	1.3	1.4	1.4
Air-dry feed/lb. gain, lb.	7.4	5.1	5.8
Incidence of respiratory disease, %	13	10	10

TABLE 3. Feedlot Performance of Feeder Calves Receiving Various Nutritional Treatments for 28 Days

Item	Nutritional Treatment			
	1	2	3	4
Number of calves	38	38	38	38
Avg. initial weight, lb.	426	435	439	435
Avg. daily gain, lb.	1.49	1.83	1.82	2.01
Avg. daily feed:				
Corn silage, lb.	22.3	22.0	21.8	19.5
Corn, lb.	-	0.7	-	2.5
Soybean meal, lb.	1.2	1.2	1.9	1.3
Air-dry feed/lb. gain, lb.	6.0	5.3	5.2	5.3
Incidence of respiratory disease, %	5	8	13	18

feed intake. Both medicated treatments appeared to reduce the incidence of respiratory disease somewhat.

Table 3 shows the effects of various nutritional treatments on feedlot performance. It is apparent that feeder calves respond quite well when small amounts of energy (corn or soybean meal) are added to a full feeding of corn silage. Compared to the cattle fed 1.6 lb. of soybean meal, the addition of either 1 lb. of corn or soybean meal for every 30 lb. of corn silage increased gains and feed efficiency to the same extent. When additional corn was added (4 lb. of corn plus 2 lb. of soybean meal), gains were further increased. These results further substantiate that protein should be fed as a ratio to energy intake and also indicate that this ratio is no higher in feeder calves than for growing-finishing cattle. The incidence of respiratory disease appeared to increase with increasing plane of nutrition. None of these cattle were considered to be seriously affected, however.

Conclusions

Aureomycin and sulfamethazine can greatly enhance the early performance of feeder calves. The combination was more effective than aureomycin alone.

The protein requirements of feeder calves appear to be similar to growing-finishing cattle. Soybean meal fed at the rate of 1.6 lb. for every 30 lb. of corn silage supplied adequate protein. When greater amounts of soybean meal were added, the response was no greater than with a similar amount of corn. It is suggested that protein be supplied to feeder calves in proportion to their energy intake. The desired protein to energy ratio appears to be similar to that required by growing-finishing cattle.

THE INCIDENCE OF SHIPPING FEVER AMONG FEEDER CALVES DISPERSED FROM GRADED DEMONSTRATIONAL SALES*

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Abstract

The incidence of shipping fever was observed among 447 (45%) of a total of 988 cattle sold at a graded demonstrational sale in the fall of 1969. Two additional smaller groups of cattle from two other sales were also included in the observational group. Five groups of cattle under observation were purchased by individual operators and two groups were maintained at OARDC farms.

The incidence of shipping fever among the feeder calves varied from 68% to 0% in the different feedlots. Chemotherapeutic agents added to the ration tended to reduce the incidence of disease. The use of sulfamethazine in the drinking water markedly reduced or eliminated the disease.

Procedures

The incidence of shipping fever was observed among 447 (45%) of a total of 988 cattle sold at a graded demonstrational sale in the fall of 1969. Two groups of calves obtained from two additional sales were observed as companion groups to the main lots of calves. The feeder calves were consigned to the sale and divided into 71 sale order pens in groups ranging from 1 to 51 head. All cattle were weighed and graded upon arrival at the yard the day prior to the sale. Within a 2-day period following the sale, the calves were removed to the various feedlots.

No attempt was made to influence or alter the management practices or treatments on any of the five cooperating farms. Controlled experiments were designed and carried out at the two OARDC locations (Wooster and the Northwestern Branch, Hoytville). All cattle were reported to be in normal health while at the sale and after arrival at the individual feedlots. All cattle were either mixed with or housed adjacent to feeder calves from other sales or native cattle.

The individual owners of the feeder calves were contacted after the sale and asked to record the incidence of shipping fever, body temperature, clinical signs, and treatments used for any affected cattle. Farms were visited three to four times during the first 4 weeks following the sale.

One hundred fifty-two feeder steers assigned to OARDC (Wooster) were divided into 12 lots of 12 or 13 animals. They were fed corn silage and a supplement and 4 days after arrival were allocated to one of the following medicated feeding regimes:

1. Control.
2. 350 mg. Aureomycin and 350 mg. sulfamethazine per head per day.
3. 350 mg. Aureomycin per head per day.

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*The authors express gratitude to the feedlot operators who made the collection of data for this study possible.

The 39 steers assigned to the Northwestern Branch were divided into two groups of 20 and 19 head each. One group was fed sulfamethazine in the drinking water according to the following schedule:

Period in Days	Water Treatment
1-5	Sulfamethazine*
6-7	No medication
8-9	Sulfamethazine
10-11	No medication
12-13	Sulfamethazine
14-15	No medication
16-17	Sulfamethazine
18-19	No medication

*Sulfamethazine--1 lb. per 120 gallons of water.

These steers were fed silage throughout the experimental period.

A second group of 56 steers was purchased at the Chillicothe sale and these steers were used at the Northwestern Branch. These calves were divided into two groups of 28 each and received the same medicated water treatments and fed as the group described above.

Results

The incidence of shipping fever varied from 68 to 7.5% at the private cooperating feedlots (Table 1).

Feedlot A: This feedlot experienced the highest incidence of shipping fever (68% with two deaths). These cattle did not receive any prophylactic treatment and were added to a group of feeder cattle obtained from an auction sale 10 days previously. The cattle purchased at the previous sale were breaking with shipping fever when the new cattle were added. All cattle treated in this group were medicated individually. All animals were initially housed in a closed barn and later turned outside to a dry lot pasture.

Feedlot B: The animals in this feedlot were obtained from two sales on the same day. They received IBR-PI-3 Vaccine upon arrival at the feedlot. The overall incidence of disease was 62.5% with 10 deaths among 179 animals. The outbreak of disease was acute, occurring 5 days after arrival and continuing for 6 weeks. Sick animals were quartered separately and treated on an individual basis. It was the owner's opinion that the steers were overcrowded and poorly managed at one of the sales. These steers were maintained in a large open feedlot with adequate shed-type shelter.

Feedlots C and E: These feedlots fed 17 and 66 head of cattle obtained at the sale. The calves were given vitamins, electrolytes and "sulfa" in the drinking water upon arrival and had been vaccinated for IBR at the sales' barn. The incidence of disease in these two lots was 24.8 and 7.5% respectively. They were housed in an open barn type of feedlot.

Feedlot D: These animals were fed a starter ration which contained Aureomycin and increased amounts of vitamin A. The overall disease incidence was 13.8%. They were housed in an open barn and dry lot.

Feedlot F (OARDC Wooster): The highest incidence of disease (13.5%) occurred among the four control pens of steers. Although the control group had the highest disease incidence and number of retreatments, it did not differ significantly from the incidence of the groups receiving medication. The groups receiving 350 mg. of Aureomycin and 350 mg. of sulfamethazine per day experienced a 9% incidence of disease and the group receiving the 350 mg. of Aureomycin per day had a disease incidence of 10.4% during the first 28 days. These animals were maintained in an open shelter with slotted floor and fed in groups of 12 or 13.

Feedlot G (Northwestern Branch, Hoytville): These animals were fed sulfamethazine in the drinking water at a rate to achieve approximately one-third to one-half of a therapeutic dosage per animal per day. The average intake was approximately 12 gm. (12,000 mg.) of sulfamethazine per animal per day. The disease incidence was 25% in the control (unmedicated group) and 5% (one case) among the animals receiving sulfamethazine in the drinking water. The animals were held in an open lot without shelter with the exception of a windbreak.

A second group of steers which had been obtained at the Chillicothe sale were fed in the same manner. The control (unmedicated) group experienced a 25% incidence

TABLE 1.--Incidence of Shipping Fever Among Feeder Calves Dispersed from Sales.

Feedlot		No. Calves	No. Treated	Percent	Deaths	Group Treatment
A		22	15	68	2	none
B		179	112	62.5	10	IBR-PI-3 vaccination upon arrival
C		17	4	24.8		IBR at sale Sulfa and Aureo
D		85	9	13.8		Aureo and Vit A
E		66	5	7.5		IBR at sale Sulfa and Aureo
F OARDC (Wooster)	1	52	7	13.4		none
	2	52	5	9.6		Aureo and Sulfa
	3	48	5	10.4		Aureo
G OARDC (Hoytville)	1	20	5	25		none
	2	19	1	5		Sulfamethazine
H OARDC (Hoytville)	1	28	7	25		none
	2	28	0	0		Sulfamethazine

of shipping fever while the group receiving the medicated water did not have any cases. This group of animals was housed inside a barn with window ventilation and adequate pen area.

Conclusions

The oral administration of chemotherapeutic materials tended to reduce, and in one case eliminate, the incidence of shipping fever. The animals receiving Aureomycin at the level of 350 mg. per head per day or Aureomycin and sulfamethazine at 350 mg. per head per day, respectively, tended to have a reduced incidence of respiratory disease. The animals receiving sulfamethazine in the drinking water on an interrupted schedule for a 3-week period showed a marked reduction in, or elimination of, the incidence of shipping fever.

These data indicate that the early and effective utilization of chemotherapeutic agents may enable the feedlot operator to control the incidence of disease in feeder calves.

SUPPLEMENTATION OF UREA-MINERAL TREATED CORN SILAGE FOR FINISHING STEERS

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In the summer of 1968, yearling steers and heifers were fed corn silage which had been treated with 20 lb. of urea, 10 lb. of pulverized limestone, and 2 lb. of defluorinated phosphate per ton at the time of ensiling. This silage was fed with approximately a half feed of ground shelled corn with and without other sources of protein. Final results of that experiment were presented in Research Summary 35, Beef Cattle Research--1969, May 1969.

Results of this previous experiment showed little advantage in supplementing a ration of shelled corn and corn silage with soybean meal, 17% dehydrated alfalfa, or a mixed supplement when the silage had been treated with 20 lb. of urea per ton. Neither did there appear to be any harmful effects when a high urea supplement was fed with such treated silage. However, this was a relatively short experiment with yearling cattle and so the experiment was repeated with steer calves during the winter and spring of 1968-69.

Objectives

The objectives of this experiment were the same as the preceding one:

1. To determine the feeding value of a ration composed of whole plant corn silage treated with 20 lb. of urea, 10 lb. of pulverized limestone, and 2 lb. of defluorinated phosphate per ton and approximately a half full-feed of untreated, dry, ground shelled corn.

2. To determine if the feeding value of this ration would be improved by supplementation with natural protein from various sources.

3. To determine if feeding a high urea, mixed supplement along with corn silage treated with 20 lb. of urea per ton would produce any harmful effects.

Procedure

A poured concrete silo was filled with well-matured, well-eared corn silage to which 20 lb. of urea, 10 lb. of pulverized limestone, and 2 lb. of defluorinated phosphate were added per ton. This silage was fed with dry, ground shelled corn without further supplementation or with 1 lb. per head daily of soybean meal, 17 percent protein, dehydrated alfalfa, or a 64 percent protein mixed supplement replacing an equal weight of shelled corn.

The cattle fed in this experiment were choice quality, Hereford steer calves shipped to Wooster in October 1968. For the first month after arrival, they were used in an experiment to study starter rations for feeder cattle. The results of this study were reported in Research Summary 35. These steers were moved to a new feeding facility with slotted floors in mid-November and were started on experiment November 26, 1968. All steers were implanted with 30 mg. stilbestrol.

TABLE 1.--Supplementation of Corn Silage Treated with 20 lb. of Urea, 10 lb. of Limestone, and 2 lb. of Phosphate per Ton.

	Control	Soybean Meal	Dehy. Alfalfa	Mixed Supplement[1]
No. steers	20	20	20	20
Initial wt., lb.	538	536	536	543
Final weight, lb.	978	1000	991	978
A.D.G. 181 days	2.43	2.56	2.51	2.43
Average daily ration, lb.				
Corn silage	25.5	26.8	27.4	25.3
Ground corn	7.8	6.8	6.8	6.8
Soybean meal		1.0		
Dehy. alfalfa, 17%			1.0	
Mixed supplement				1.0
Feed per cwt. gain, lb.				
Corn silage	1053	1046	1091	1044
Ground corn	321	267	271	287
Soybean meal		40		
Dehy. alfalfa, 17%			40	
Mixed supplement				42
Dressing percentage	62.4	63.2	62.5	62.6
Grade[2]	18.8	18.6	18.9	18.2
Fat thickness, in.	.55	.62	.58	.54
Percent kidney	3.4	3.4	3.2	3.4
Rib eye area, sq. in.	9.64	9.73	10.04	10.54
Yield grade	3.68	3.89	3.73	3.50

1 Supplement No. B-13-68

Ingredient	Percentage
Soybean meal	71.6
Urea "281"	11.2
Dehydrated alfalfa	6.0
Dicalcium phosphate	5.6
Trace mineral salt	5.6
	100.0

Fortified with 20,000 I.U. Vitamin A and 7,500 I.U. Vitamin D per pound.

2 High good--18, low choice--19.

In addition to the slotted floors, the feeding facility was roofed but open on all sides. Manure was collected in pits beneath the slotted floor. The silage, corn, and supplement were weighed, mixed, and delivered mechanically to each pen of cattle.

Replicate pens of 10 steers each were fed each of the four rations. Results of this experiment are given in Table 1, with an average of the two replicates presented.

Results

The results of this experiment are in agreement with the previous one with yearling steers and heifers. Statistical analyses showed no significant differences in average daily gains or amount of feed required per unit of gain among treatments when steer calves were fed to a low choice slaughter grade.

This series of experiments indicates that a combination of whole plant corn silage treated with 20 lb. of urea, 10 lb. of pulverized limestone, and 2 lb. of defluorinated phosphate per ton and approximately a half full-feed of untreated, dry shelled corn made a satisfactory ration for finishing yearling steers and heifers. This ration was not improved by adding supplemental natural protein from dehydrated alfalfa meal, soybean meal, or a mixed 64% protein supplement, all of which increased the cost of the ration. On the other hand, no harmful effects were noted from feeding the high urea supplement along with corn silage which had an added 20 lb. of urea per ton.

Previous research at the Ohio Agricultural Research and Development Center has shown that the addition of 10 lb. of urea per ton to corn silage at the time of ensiling was a safe, economical method of increasing the crude protein content of this important cattle feed. The present research shows that this can be safely increased to 20 lb. per ton and that such an addition will result in an adequate amount of protein when the silage is fed with corn grain.

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HIGH-MOISTURE BIRD-RESISTANT SORGHUM GRAIN vs. HIGH MOISTURE SHELLED CORN AND A COMPARISON OF ROLLED vs. WHOLE SORGHUM AND CORN FOR FINISHING STEER CALVES

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Results of experiments at the Northwestern Branch and at Wooster in 1969 showed that bird-resistant grain sorghum, fed either as silage or as grain, was less valuable than corn for finishing cattle. In these trials, dry grains were used in the comparisons of sorghum grain with shelled corn. Therefore, the objective of the trial reported here was to compare high moisture bird-resistant sorghum grain with high moisture shelled corn, when fed either rolled or unrolled.

Experimental Procedure

Bird-resistant grain sorghum (AKS-614) and corn, grown at the Northwestern Branch of the OARDC, were harvested when the grain dry matter had reached about 70%. Each grain was stored in a conventional concrete stave silo. Full stalk corn silage was harvested in September at about 35% dry matter and stored in a conventional concrete stave silo, with an additional supply stored in a ground pack covered with plastic.

The grains were fed either whole or rolled. Rolling was done by a standard roller mill with rollers 12 inches wide, 9 inches in diameter, and containing 11 grooves per inch. Grain was rolled as it came from the silo and previous to each feeding.

Choice steer calves were purchased at a graded feeder calf sale in southeast Ohio on Oct. 15, 1968. After 1 week at the Research Center, the calves were individually weighed, eartagged, and given the various vaccinations. On Nov. 11, they were again individually weighed and allotted into the treatment groups as uniformly as possible according to weight and general appearance. All calves were implanted at this time with 30 mg. of stilbestrol.

Between-Lot Treatments: The calves in all lots were full-fed corn silage and 1 lb. per head daily of a 64% protein supplement containing half of the protein equivalent from urea. This amounted to 0.112 lb. of urea intake daily per head. At the start of the experiment, the concentrates were fed at the rate of 1 lb. per 100 lb. body weight daily in each lot. These levels were increased as the experiment progressed in order to conserve the corn silage. A mineral mixture of 50 parts of trace mineralized salt and 50 parts of dicalcium phosphate was fed free choice.

Four of the lots were located inside a barn with natural ventilation and straw bedding. The other four lots were outside with a windbreak along the west side. These lots had a concrete base and were bedded with straw as needed.

The ration treatments were as follows (H.M.=high moisture):

Lot No.	Treatment
1	Inside housing; H.M. sorghum grain, unrolled
2	Inside housing; H.M. sorghum grain, rolled
3	Inside housing; H.M. shelled corn, unrolled
4	Inside housing; H.M. shelled corn, rolled
5	Same as lot 1, outside
6	Same as lot 2, outside
7	Same as lot 3, outside
8	Same as lot 4, outside

Within-Lot Treatments: Two animals in each lot were given one of the following treatments: CC, control or none; LV, live virus vaccine containing PI-3, IBR, and BVD (Respacine-3); B-3, a mixed vaccine containing a killed preparation of Parainfluenza-3 virus and Pasteurella bacterins (Bar-3); RR, pour-on grub control (Ruelene); TT, internal parasite medication (Thibenzole). The vaccinations were given on Oct. 21 or 6 days after the calves arrived at the Research Center. The remaining treatments were given at the start of the feeding trial on Nov. 11.

Results

Sorghum Grain vs. Shelled Corn: Feedlot performance of the steer calves fed high moisture sorghum grain vs. high moisture corn grain are presented in Table 1. After 199 days on feed, the cattle fed sorghum weighed an average of 82 lb. less than those on shelled corn. This was 0.4 lb. less daily gain which was a significant decrease ($P < .01$).

Feed efficiency followed gains, with the sorghum-fed cattle requiring 29% more feed per 100 lb. of gain than those on corn (1056 lb. vs. 816 lb.).

The differences in gains were reflected in carcass evaluation. The corn-fed cattle graded significantly higher ($P < .01$), had significantly more backfat and a higher dressing percentage. However, the sorghum-fed cattle had a higher cutability percentage due to less backfat and only 0.5 sq. in. less rib eye area.

Effects of Rolling Sorghum and Corn: High moisture sorghum grain and high moisture shelled corn were fed either whole or rolled. For the rolled groups, rolling was done as the grains came from the silo and just previous to feeding. Rolling the sorghum resulted in significant improvement in gains and feed efficiency over the unrolled groups (Table 2). However, rolling the corn did not change the feedlot performance to any significant degree. It should be pointed out here, however, that an estimated 25-30% of the high moisture corn kernels were cracked during the harvesting and storing process.

This experiment shows quite conclusively that grain sorghum must be rolled to achieve maximum utilization. It can be seen from Table 2 that the cattle on unrolled sorghum gained 25% slower than those on corn, but when sorghum was rolled the gains were only 9% less than the corn-fed cattle. Feed efficiency followed this same pattern. The cattle receiving the rolled sorghum required 43% more feed per unit of gain than those on corn, but when sorghum was rolled they required only 16% more.

Rolling sorghum improved carcass quality slightly, but rolling the corn had no significant influence on carcass evaluation.

The results of this experiment with sorghum grain and previous work at the Research Center with sorghum silage show quite conclusively that unless these feeds are rolled or ground, it is doubtful that they are practical as a feed for finishing cattle. However, if one assumes that rolling brings the feeding value of bird-resistant grain sorghum to within 10-15% of the value of corn, as this research indicates, and with comparable yields per acre, sorghum may well have a place in the cropping and feeding program for cattle in areas where bird damage to corn exceeds 10-15%.

Effects of Different Housing: All treatments discussed previously were duplicated in two different kinds of housing. Cattle were fed inside a barn with natural ventilation and other groups were fed outside with only a windbreak. The feedlot performance and carcass evaluation of the cattle under these two different housing conditions are shown in Table 3. Housing had no significant influence on daily gains, feed efficiency, or carcass evaluations.

TABLE 1.--High Moisture Sorghum Grain vs. High Moisture Corn (Nov. 11, 1968 to May 29, 1969, 199 days).

	High Moisture Sorghum	High Moisture Corn
Lot Nos.	1, 2, 5, 6	3, 4, 7, 8
No. steer calves	40	40
Av. initial wt., lb.	548	548
Av. final wt., lb.	935	1017
Av. daily gain, lb.	1.95	2.35**
Av. daily feed, lb.		
Corn silage, 38% D.M.	22.32	19.02
Shelled corn, 72% D.M.	--	11.41
Sorghum, 73% D.M.	10.85	--
Protein, 64% D.M.	1.00	0.99
Minerals	0.03	0.04
Total, 85% D.M. basis	20.33	19.20
Feed consumed/cwt. Gain, 85% D.M. basis	1056	816
Carcass evaluation:		
Carcass grade	10.8	11.6**
Marbling score	4.5	4.9
Fat thickness, in.	.33	.56**
Rib eye area, sq. in.	10.5	11.0*
Kidney, pelvic, heart fat, %	3.0	3.3**
Cutability	50.6**	48.9
Dressing percentage	60.4	63.1

**Significant increase (P <.01).
*Significant increase (P <.05).

Effects of Shipping Fever or Parasite Control Programs: As shown in Table 4, the various within-lot treatments for shipping fever or parasite control had no apparent effects on feedlot performance.

Incidence of Disease Following Vaccination: The incidence of disease and frequency of treatment of the 32 vaccinated animals and their control group are presented in Table 5. A total of 15 cases of clinical shipping fever was observed among the 48 animals. Five cases occurred among the control group, three cases in the group receiving the live virus, and seven cases among the group vaccinated with the killed preparation. The use of the vaccines at this time did not decrease the incidence of shipping fever and, in the case of the group receiving the killed vaccine, it tended to increase the number of cases as well as the severity as judged by the number of treatments required per animal.

TABLE 2.--Effects of Rolling High Moisture Sorghum and High Moisture Corn (Nov. 11, 1968 to May 29, 1969, 199 days).

	Sorghum Grain		Corn Grain	
	Unrolled	Rolled	Unrolled	Rolled
Lot Nos.	1, 5	2, 6	3, 7	4, 8
No. steer calves	20	20	20	20
Av. initial wt., lb.	548	548	548	548
Av. final wt., lb.	897	974	1025	1009
Av. daily gain, lb.	1.76	2.14**	2.39	2.32
Av. daily feed, lb.				
Corn silage, 38% D.M.	22.99	21.64	20.21	17.82
Shelled corn, 72% D.M.	--	--	11.40	11.43
Sorghum, 73% D.M.	10.61	11.10	--	--
Protein, 64% D.M.	1.00	0.99	0.99	0.99
Minerals	0.04	0.03	0.04	0.04
Total, 85% D.M. basis	20.42	20.24	19.71	18.69
Feed consumed/cwt. Gain, 85% D.M. basis	1164	948	825	808
Carcass evaluation:				
Carcass grade	10.7	10.9	11.7	11.5
Marbling score	4.6	4.5	4.9	5.0
Fat thickness, in.	.26	.40	.60	.53
Rib eye area, sq. in.	10.2	10.9	11.1	10.9
Kidney, pelvic, heart fat %	2.9	3.1	3.4	3.3
Cutability	51.2	50.1	48.7	49.1
Dressing percentage	59.5	61.4	63.1	63.1

**Significant increase over unrolled sorghum ($P < .01$).

TABLE 3.--Inside Housing vs. Outside Housing (Nov. 11, 1968 to May 29, 1969, 199 days).

	Inside	Outside
Lot Nos.	1, 2, 3, 4	5, 6, 7, 8
No. steer calves	40	40
Av. initial wt., lb.	547	548
Av. final wt., lb.	977	975
Av. daily gain, lb.	2.16	2.14
Av. daily feed, lb.		
Corn silage, 38% D.M.	20.31	21.02
Shelled corn, 72% D.M.	11.40	11.43
Sorghum, 73% D.M.	10.75	10.96
Protein, 64% D.M.	0.99	1.00
Minerals	0.04	0.04
Total, 85% D.M. basis	19.55	19.98
Feed consumed/cwt. Gain, 85% D.M. basis	929	944
Carcass evaluation:		
Carcass grade	11.1	11.2
Marbling score	4.6	4.8
Fat thickness, in.	.46	.43
Rib eye area, sq. in.	10.7	10.8
Kidney, pelvic, heart fat, %	3.0	3.3
Cutability	49.7	49.8
Dressing percentage	61.8	61.7

TABLE 4.--Feedlot Performance as Affected by Shipping Fever Vaccinations, Internal Parasite Medication, and Grub Control[1/] (Nov. 11, 1968 to March 17, 1969).

	Within-Lot Treatments[2/]				
126 days	CC	LV	B-3	RR	TT
No. steer calves	16	16	16	16	16
Av. initial wt., lb.	537.4	545.3	549.1	554.6	554.1
Av. final wt., lb.	830.1	807.8	823.5	843.3	823.6
Av. daily gain, lb.	2.32	2.08	2.18	2.29	2.14

1/ Daily feed intake and feed efficiency data are not available since these were within-lot treatments; e.g. two animals in each lot receiving one of the above treatments.

2/ CC, control; LV, live virus vaccine; B-3, Bar-3 vaccine; RR, Ruelene; TT, Thibenzole.

It may be concluded that neither the live virus vaccine nor the killed vaccine was effective in the prevention and alleviation of shipping fever. The use of a single dose of the killed vaccine appeared to sensitize the animals to a more severe form of the disease.

TABLE 5.--Occurrence of Shipping Fever and Frequency of Treatment of Vaccinated and Control Steers.

	CC	LV	B-3
No. with clinical disease	5	3	7
No. of treatments required	5	4	13

FACTORS ASSOCIATED WITH COMPENSATORY GAIN IN BEEF CATTLE

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Abstract

Steers (510 lb. initial weight) fed for little or no gain for 190 days (compensatory steers) gained faster and more efficiently when placed on full feed than continuously grown control steers. During the entire experiment, total feed required to reach 1000 lb. was similar for compensatory and control steers. Compensatory steers had a higher feed intake during full feed. However, an increase in efficiency of energy and protein utilization during compensatory growth appeared to be the factor most responsible for the ability of compensatory steers to reach 1000 lb. on a total feed intake similar to controls. Compensatory steers were not as fat at 1000 lb. and had higher cutability grades; however, final carcass grades of both groups were similar.

Feeding cattle for rapid and continuous growth would probably result in greater returns unless the producer can take advantage of compensatory growth by buying thin cattle or using a deferred feeding system which utilizes lower cost feeds such as pasture or other forage for the first part of the growing period.

Introduction

The term compensatory gain is used to describe the ability of cattle to recover from a period of undernutrition. When cattle whose growth has been restricted for a period of time are placed on a high level of nutrition, they respond by gaining more rapidly and efficiently than similar cattle which have been fed for continuous growth. This phenomenon is of considerable importance as cattle are often exposed to periods of reduced nutrition during the dry or wintering period unless supplemental feed is provided.

Cattle producers have observed that thin cattle make rapid gains when placed on spring pasture or on a high level of nutrition in the feedlot. They have long questioned the value of supplemental feeding to promote continuous growth when feed supplies are limited. Compensatory growth has been observed and measured in many studies but the reason for this response has not been satisfactorily explained.

The objectives of this experiment were:

1. To determine if compensatory growth in cattle occurs because of a greater feed intake.

2. To determine if compensatory growth occurs because the cattle are able to utilize energy and protein more efficiently.

3. To determine if final carcass composition and quality are affected by a period of restricted growth.

Procedures

Fifty-four Hereford steers averaging 510 lb. were purchased from a single ranch in northern Texas for this experiment. Upon arrival, the cattle were fed mixed hay

TABLE 1. Ingredients of the Rations

	Maintenance Ration	Corn Ration	Soybran Flakes Ration
	lbs. per cwt.		
Ground shelled corn	15.0	75.5	-
Ground corn cobs	65.0	10.0	5.0
Dehydrated alfalfa meal, 17%	10.0	-	-
" " " 21%	-	-	30.0
Soybran flakes	-	-	63.5
Soybean meal, 44%	10.0	-	-
" " 50%	-	10.0	-
Ground limestone	-	1.0	-
Trace mineralized salt	-	1.0	1.0
Dicalcium phosphate	-	0.5	0.5
Pellet binder	-	2.0	-
Vitamin A (A-30)	5.0 gm.	5.0 gm.	5.0 gm.
Vitamin D_2	1.0 gm.	1.0 gm.	1.0 gm.
Aurofac-10	-	68.0 gm.	68.0 gm.

TABLE 2. Proximate Analysis and Calculated Digestible Protein, Metabolizable Energy, and Protein-Calorie Ratios

	Maintenance Ration	Corn Ration	Soybran Flakes Ration
	as fed basis		
Dry matter, %	92.5	88.7	90.7
Crude protein, %	9.2	11.3	12.0
Cellulose, %	26.2	5.4	32.7
Ash, %	2.7	3.7	5.8
Digestible protein (DP), %[a]	6.1	8.8	7.5
Metabolizable energy, Kcal/lb.[b]	863	1173	752
Protein calorie ratio, gms. DP/Mcal DE[a,b]	25	28	34

[a,b] Digestible and metabolizable energy values were calculated from United States-Canadian Tables of Feed Composition, and digestible protein values were calculated from digestibility coefficients derived from these tables.

and treated for sickness when necessary. Approximately 45 days after arrival, 36 of the steers were allotted to four treatments, with nine each being individually fed either a pelleted corn or soybran flake based ration, continuously (full-fed controls), or following a 190-day maintenance feeding on a corn cob based ration (compensatory steers). The rations are shown in Table 1 and the nutrient content of these rations is shown in Table 2.

The comparative slaughter technique was used to determine the energy and protein gained by these steers. Three steers in each treatment were slaughtered as

TABLE 3. Performance of Compensatory and Control Steers When Fed Either a Corn or Soybran Flake Based Ration

	Corn Ration			Soybran Flake Ration	
	Compensatory	Limited Fed Compensatory	Full-fed Controls	Compensatory	Full-fed Controls
Number of steers					
to 750 lb.[b]	3	3	3	3	3
to 1000 lb.[c]	6	4	6	6	4
Avg. initial weight, lb.					
to 750 lb.	620		542	604	564
to 1000 lb.	584	605	539	599	544
Avg. final weight, lb.					
to 750 lb.	780		756	770	737
to 1000 lb.	1018	1034	976	1003	995
Avg. days on feed					
to 750 lb.	51		100	51	128
to 1000 lb.	125	162	200	161	221
Avg. daily gain					
to 750 lb.	3.34[a]		2.16	3.38[a]	1.45
to 1000 lb.	3.52[a]	2.67	2.16	2.54	2.05
Avg. daily ration, lb. D.M.					
to 750 lb.	13.6		12.2	14.7	12.8
to 1000 lb.	17.6[a]	14.0	14.9	19.8	20.9
D.M./100 pounds gain, lb.					
to 750 lb.	430		579	453[a]	957
to 1000 lb.	502[a]	527[a]	698	773[a]	1019

[a] Significantly ($P < .01$) different from controls

[b] Group slaughtered at 750 pounds.

[c] Group slaughtered at 1000 pounds.

they reached approximately 750 lb. and the remaining six were slaughtered as they reached 1000 lb. In addition, after 190 days of maintenance feeding, six steers were limited fed the corn-based ration and then slaughtered at 1000 lb. Six steers were slaughtered at the beginning of the experiment to determine initial body composition for the control steers and six steers were slaughtered after 190 days on the maintenance ration to determine initial body composition for the compensatory steers.

TABLE 4. Net Energy, Composition of Gain, and Efficiency of Protein Utilization Values of Compensatory and Control Steers when Fed Either a Corn or Soybran Flake Based Ration

	Corn Ration			Soybran Flake Ration	
	Compensatory	Limited Fed Compensatory	Full-fed Controls	Compensatory	Full-fed Controls
Net energy for maintenance(NE_m) (Mcal/100 lb. ration D.M.)					
to 750 lb.[c]	94.6		89.4	60.4	58.2
to 1000 lb.[d]	90.7	90.6	86.1	57.1	52.1
Net energy for production(NE_p) (Mcal/100 lb. ration D.M.)					
to 750 lb.	71.2		64.5	52.4	50.5
to 1000 lb.	60.5	68.8	55.0	46.8	35.7
Percent of available protein retained					
to 750 lb.	60.0[a]		44.9	70.0[a]	44.0
to 1000 lb.	41.9	46.0[a]	35.3	36.4	28.8
Percent of gain as protein					
to 750 lb.	18.8[b]		17.4	19.3	18.4
to 1000 lb.	16.9	17.1	16.5	17.4	17.3
Percent of gain as fat					
to 750 lb.	24.1[b]		34.6	10.1[a]	24.6
to 1000 lb.	37.4	35.9	36.4	34.7	31.6

[a] Significantly ($P < .01$) different from controls.

[b] Significantly ($P < .05$) different from controls.

[c] Group slaughtered at 750 pounds.

[d] Group slaughtered at 1000 pounds.

From the amount of fat and protein gained, the net energy values of the rations for the compensatory and control steers were determined. Protein utilization values were determined by dividing the pounds of protein gained by the digestible protein intake above the maintenance requirement for protein. The energy and protein requirements for maintenance were assumed to be 77 kilocalories and 2.79 grams per unit of metabolic weight (weight in kilograms to the three-fourths power), respectively.

Results

The feedlot performance of the steers in this experiment is shown in Table 3. The compensatory steers fed either the corn or soybran flake ration made significantly faster gains and were more efficient than their respective controls at both slaughter weights. Feed intake of compensatory steers was higher than controls in all treatment groups except those fed the soybran flake ration to 1000 lb., and was significantly higher for compensatory steers fed the corn ration to 1000 lb.

The compensatory steers obtained higher net energy values for maintenance and production from both rations and at both slaughter weights than controls, but in most cases these differences were not statistically significant (Table 4). The compensatory steers utilized the digestible protein available for growth more efficiently in both rations than their controls. This increase was highly significant for both rations up to the 750 lb. slaughter weight. There also was less fat in the gain made by the compensatory steers to the 750 lb. slaughter weight. It should also be noted that net energy and protein utilization values were higher for steers fed to 750 lb. than for comparable steers fed to 1000 lb. Steers slaughtered at 750 lb. had significantly higher net energy for maintenance and production and percent of available protein retained values than those slaughtered at 1000 lb.

When maintenance and full feeding periods were combined, compensatory steers had a lower average daily gain (Table 5). However, total feed required by compensatory or control steers to reach 750 or 1000 lb. was similar except for those fed the corn ration to 750 lb. Carcass grades of compensatory and control steers at 1000 lb. were similar. Compensatory steers had higher cutability grades at this weight, however.

Conclusions

The results of this experiment indicate that compensatory steers were able to make up for a period of growth restriction by increasing feed intake and utilizing energy and protein more efficiently when placed on full feed. Except for those fed soybran flakes to 1000 lb., compensatory steers had a higher feed intake during full feed than controls. This would tend to increase rate of gain and feed efficiency as a smaller proportion of the feed consumed would be needed to meet the steers' maintenance requirements. However, an increase in efficiency of energy and protein utilization during compensatory growth appeared to be the factor most responsible for the ability of compensatory steers to reach 1000 lb. on a total feed intake similar to controls. This is indicated by the higher rate of gain and feed efficiency made during compensatory growth by compensatory steers fed the soybran flake ration to 1000 lb. on a lower feed intake than their controls. Also, an increase in feed intake by compensatory steers full-fed the corn ration to 1000 lb. resulted in a higher rate of gain than controls or those limited fed the corn ration. However, compensatory steers full-fed the corn ration required as much feed to reach 1000 lb. as compensatory steers limited fed the corn ration.

Apparently the steers were able to utilize the soybran flake ration much more efficiently during the first part of compensatory growth. The increase in feed

TABLE 5. Performance of Compensatory and Control Steers over the Complete Experiment

	Corn Ration			Soybran Flake Ration	
	Compensatory	Limited Fed Compensatory	Full-fed Controls	Compensatory	Full-fed Controls
Avg. total days on feed					
to 750 lb.	241		100	241	128
to 1000 lb.	315	352	200	351	221
Avg. initial weight, lb.					
to 750 lb.	509		542	527	564
to 1000 lb.	501	495	539	496	544
Avg. final weight, lb.					
to 750 lb.	780		756	770	737
to 1000 lb.	1018	1039	976	1003	995
Avg. daily gain, lb.					
to 750 lb.	1.08[a]		2.16	1.01	1.45
to 1000 lb.	1.64[a]	1.53[a]	2.16	1.45[a]	2.06
D.M./100 pounds gain, lb.					
to 750 lb.	799[b]		579	926	964
to 1000 lb.	714	698	697	920	1027
Final percent body protein					
to 750 lb.	19.2		18.7	19.3	19.1
to 1000 lb.	18.3	18.4	17.9	18.7	18.3
Final percent body fat					
to 750 lb.	13.5[a]		19.1	10.4[a]	15.1
to 1000 lb.	21.9	21.2[b]	24.1	19.9	21.5
Carcass grade[c,e]					
to 750 lb.	9.5		10.7	6.4	9.0
to 1000 lb.	12.2	11.8	12.4	11.2	11.9
Carcass cutability[e,f]					
to 750 lb.	1.1		2.6	1.5	2.1
to 1000 lb.	2.9	3.4	3.5	2.9	3.0

[a] Significantly ($P<.01$) different from controls.

[b] Significantly ($P<.05$) different from controls.

[c] Carcass grade: 7, standard; 10, good; 13, choice.

[d] Cutability grade: An estimation of percent boneless, trimmed round, rib, loin and chuck (USDA formula).

[e] Statistical analysis not complete for carcass grade and cutability.

efficiency of compensatory steers fed the soybran flake ration to 750 lb. was relatively greater than the increase in feed efficiency of the compensatory steers fed the corn ration to 750 lb., when compared to their respective controls. Those fed the soybran flake ration were able to make up for the maintenance period and equal their controls in total feed required per 100 lb. of gain by the time they reached 750 lb. However, those fed the corn ration did not equal their controls in total feed efficiency until reaching 1000 lb. This increased feed efficiency may be due to the higher protein calorie ratio of the soybran flake ration. It may indicate an increased ability of compensatory steers to utilize a ration with a high protein calorie ratio for increased protein gain during the first part of compensatory growth.

Compensatory steers contained less body fat than control steers at 1000 lb. This was probably due, however, to a loss in body fat during the maintenance feeding period, as the composition of the gain made by compensatory steers after being full-fed the corn or soybran flake ration to 1000 lb. following the maintenance period was similar to controls.

The higher net energy values derived by compensatory steers indicate that the net energy value of a ration for a particular group of cattle may depend on their previous nutritional treatment. It appears that cattle which have been exposed to a period of limited or low nutrition will receive higher net energy values from a ration when placed on full feed than cattle previously fed a high level of nutrition.

The results of this experiment also indicate that a ration may have higher net energy values for maintenance and production for cattle during the first part of the feeding period. Further work is needed to determine if the net energy value of a ration declines as cattle increase in body fat, or if this higher net energy value occurs early in the feeding period as a result of compensatory growth made by all cattle when placed on full feed.

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ALL-CONCENTRATE RATIONS FOR GROWING-FINISHING CATTLE

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Abstract

Ninety Holstein yearling steers were used in a 3 x 3 factorial experiment to study the effects of different forms of corn in all-concentrate rations fed with or without both natural and artificial roughage supplementation. The forms of corn used were whole shelled corn, ground corn, and steam-flaked corn. Each of these were fed without any roughage, with 10% ground corn cobs, or with 4% Perlite. Perlite is a nutritionally inert material currently being investigated as an artificial roughage. The steers were adapted to the high concentrate diets and were subsequently full-fed their respective rations during the 98-day experimental period.

Feedlot performance and carcass traits were not significantly affected by the form of corn fed or by the addition of either 10% ground corn cobs or 4% Perlite. NE_{m+p} values showed that the steam-flaked corn rations were most efficient in the utilization of energy. Intra-ruminal observations indicated that the addition of corn cobs reduced rumen wall damage. Perlite tended to have an intermediate effect on most ruminal characteristics.

Introduction

In recent years many cattle feeders have moved toward the use of high or all-concentrate rations for growing-finishing beef cattle. This has been brought about by increased feedlot mechanization, improved feed formulation, and increased costs, along with decreased availability of good quality roughage. Generally speaking, however, it has been found that when finishing cattle are placed on roughage-free rations, various nutritional and metabolic problems often occur. These include:

1. Reduced feed intake.
2. Increased incidence of digestive disturbance such as bloat, founder and gastric impaction.
3. Increased occurrence of rumen papillae degeneration.
4. Increased incidence of abscessed livers.

Research has shown that these problems can largely be alleviated by the inclusion of low levels of natural roughage materials in the ration. Long hay, ground corn cobs, cottonseed hulls, and rice hulls are examples of roughages which have been used successfully for this purpose. Apparently the rumen requires a roughage factor to remain healthy.

Artificial roughages have been used recently to furnish this roughage factor in lieu of natural roughage sources. Roughage substitutes which have been tried include ground oyster shells, sand, polyethylene squares, and silicate-based materials such as Dynafac, Bentonite, and Vermiculite.

Finishing rations based largely on dried whole shelled corn are also presently receiving considerable attention. Some researchers have demonstrated that performance of cattle fed whole shelled corn is better or at least equals the performance of cattle fed all-grain diets containing ground, cracked, or steam-flaked corn. In addition, whole shelled corn rations without any roughage have been found to compare favorably with other high energy rations containing corn plus hay.

The reasons why this form of corn works so well in all-concentrate rations are not fully understood. It is believed by some workers that the coarse, fibrous nature of the hulls may function in the rumen as a built-in roughage factor which protects the rumen wall. This proposal has been substantiated recently in an Illinois study which showed that steers fed whole shelled corn had appreciably fewer abscessed livers (8%) when compared to steers receiving ground corn (44%).

The objectives of this experiment were:

1. To evaluate the performance of steers finished on high concentrate rations based on different forms of corn, fed with and without natural or artificial roughage supplementation.

2. To compare the effects of both types of roughages when included in all-concentrate diets on some intra-ruminal characteristics.

3. To measure the feeding value of rations containing corn fed alone or in combination with low roughage levels.

Procedures

Ninety Holstein yearling steers averaging 744 lb. initially were randomly allotted into nine groups. All steers were implanted with 30 mg. of stilbestrol (DES) after the initial weighing.

The design of the experiment (Table 1) was a 3 x 3 factorial in which three different forms of corn were used in rations containing three roughage treatments. The forms of corn were whole shelled corn, ground shelled corn, and steam-flaked

TABLE 1. Experimental Design

	Roughage Treatment		
Form of Corn	No Roughage	10% Corn Cobs	4% Perlite
Whole shelled corn	10[a]	10	10
Ground shelled corn	10	10	10
Steam flaked corn	10	10	10

[a] Ten steers per treatment

TABLE 2. Basal Ration[a]

Ingredient	% of Ration
Corn[b]	87.5
Supplement	12.5
Soybean meal, 50%	10.0
Ground limestone	1.0
Trace mineralized salt	1.0
Dicalcium phosphate	0.5
Vitamin A-30 premix[c]	+
Vitamin D_2 premix[d]	+
Aureofac-10 premix[e]	+

[a] Ground corn cobs or Perlite substituted for corn at 10 and 4 percent, respectively.

[b] Either whole shelled corn, ground shelled corn or steam flaked corn.

[c,d,e] The ration was supplemented with 1,500 I.U. Vitamin A, 350 I.U. Vitamin D_2 and 15 mg. Aureomycin per lb., respectively.

corn. The roughage treatments were no roughage, 10% ground corn cobs (natural roughage source), and 4% Perlite (artificial roughage material). Perlite is a siliceous volcanic rock material which is nutritionally inert. It is largely composed of the compounds silicon dioxide and aluminum oxide.

Rations involving these treatments were mixed at the time of feeding using the appropriate form of corn, corn cobs, or Perlite and a supplement containing soybean meal, minerals, vitamins, and antibiotic. The composition of the basal (all-concentrate) ration is shown in Table 2.

To avoid as many problems as possible, the cattle were gradually adapted to the high energy rations over a period of 21 days. Prior to the test period, all animals were receiving corn silage. Therefore, during the period of adaptation, silage was gradually removed while the experimental rations were being added until the cattle were on full feed. The trial was terminated at 98 days when the average weight of the steers was 1060 lb.

Feedlot performance was evaluated by measuring average daily gain, feed consumption, and feed conversion. Carcass traits studied included quality and cutability grades. Intra-ruminal characteristics were studied by measuring samples of rumen content for pH, volatile fatty acid (VFA) concentration, and protozoal identification and population.

TABLE 3. Feedlot Performance

	Whole Shelled Corn			Ground Shelled Corn			Steam Flaked Corn[a]		
	No Roughage	10% Corn Cobs	4% Perlite	No Roughage	10% Corn Cobs	4% Perlite	No Roughage	10% Corn Cobs	4% Perlite
Number of steers	10	9[b]	10	10	10	10	10	9[c]	10
Initial weight, lb.	752	746	738	736	743	746	747	743	744
Final weight, lb.	1057	1093	1044	1040	1074	1069	1081	1051	1058
Avg. daily gain, lb.	3.12	3.48	3.13	3.10	3.37	3.30	3.40	3.08	3.20
Lb. ration/lb. gain[d]	8.43	8.23	8.06	8.15	8.85	8.55	7.33	8.06	7.27
Lb. corn/lb. gain	6.01	5.55	5.91	6.37	6.36	6.26	4.64	4.72	4.62

[a] During the first 21 days some whole shelled corn was fed with the steam flaked corn. This amounted to about 10% of the corn fed during the trial.

[b,c] One steer on the WSC-CC ration died from rumen impaction, while one steer receiving SFC and CC foundered and was therefore removed from the experiment.

[d] Air dry basis.

These criteria are important in the assessment of the effects of treatment on the nature of rumen fermentation taking place. When high energy rations are fed to cattle, the rumen content usually increases in acidity. This is often evidenced by cattle feeders when cattle go "off feed" for no apparent reason. Increased rumen acidity may partially be the result of increased VFA concentration. Rumen fatty acid production is important, however, since it accounts for approximately 70% of the total energy requirement of cattle. One of these acids, propionic acid, is believed to increase markedly when cattle are fed high concentrate rations. Several types of rumen protozoa, especially the entodinomorphs, are known to rapidly ingest and utilize starch material. Cattle adapted to all-concentrate rations frequently have high numbers of entodinia. In many instances, however, when the acidity of the rumen increases, the protozoal population is reduced to zero. Although the overall importance of protozoa to the normal rumen function is still not clear, it has been shown that when digestive disturbances occur, protozoal types and numbers are greatly affected.

Two animals from each treatment were stomach-tubed at five 14-day intervals (the same animals throughout) during the study to obtain samples of rumen content. pH determination was made immediately. Separate sub-samples were then taken for VFA and protozoal analysis in the laboratory according to established procedures.

It is well known that cattle fed all-concentrate rations often develop serious rumen wall damage, called rumen parakeratosis of RPK, which has largely been characterized in the chronic phase by the occurrence of papillae degeneration. Therefore, at the time of slaughter, rumen wall samples were taken from each steer to be evaluated in terms of the treatment effect on rumen papillae. Each specimen was evaluated for papillae color, length, width, clumping, sloughing, and hair accumulation.

The feeding values of the rations used in this experiment were evaluated by measuring the net energy available from the rations for maintenance plus gain (NE_{m+p}). At the beginning of the experiment, six steers were slaughtered and their chemical composition estimated from the specific gravity of their carcasses. At the end of the feeding trial, the same information was obtained on two steers from each treatment. From the composition of the carcasses at the beginning and end of the experiment, the number of calories stored (NE_p) was determined. The amount of energy required for maintenance was assumed to be constant.

Results

Feedlot Performance and Carcass Traits: Steers receiving whole shelled corn or ground corn with corn cobs gained surprisingly fast when compared to their counterparts receiving no roughage or Perlite (Table 3). When steam-flaked corn was fed, the all-concentrate cattle gained the fastest. The reasons for this apparent lack of pattern within corn treatment is unclear. However, when average daily gain was calculated by excluding weight gain made during the adaptation period, these differences were narrowed to the point where steers in each treatment gained at the rate of approximately 3.0 lb. per head daily. Differences among treatment means for rate of gain were not significant ($P > .05$).

Steers fed steam-flaked corn were most efficient in converting feed to gain. In general, steers receiving whole shelled corn were slightly more efficient than those on ground corn. The amount of corn alone required per pound of gain was about the same when fed with or without roughage supplementation.

TABLE 4. Carcass Characteristics

	Whole Shelled Corn			Ground Shelled Corn			Steam Flaked Corn		
	No Roughage	10% Corn Cobs	4% Perlite	No Roughage	10% Corn Cobs	4% Perlite	No Roughage	10% Corn Cobs	4% Perlite
Hot carcass weight, lb.	619.4	642.8	612.0	618.0	654.6	640.8	649.8	628.4	605.4
Dressing percentage	58.6	58.8	58.6	59.4	60.9	59.9	60.1	59.8	57.2
Carcass grade[a]	10.2	10.9	10.1	10.0	11.0	10.4	10.7	10.3	10.2
Fat thickness, in.	0.17	0.17	0.14	0.15	0.14	0.16	0.17	0.16	0.15
Loin eye area, sq. in.	10.1	10.1	10.2	9.6	10.3	10.1	10.4	9.6	9.9
Yield of retail cuts,%[b]	50.9	50.9	51.4	50.9	50.9	50.9	51.4	50.9	51.2

[a] Medium good = 10; high good = 11.

[b] Percent of the carcass weight in boneless, closely trimmed retail cuts from the round, loin, rib and chuck. Estimated using the USDA carcass yield grade finder.

Carcass traits (Table 4) were not significantly (P >.05) affected by the form of corn fed or by the addition of corn cobs or Perlite. In general, the carcasses graded average to high good with less than 0.2 in. of rind thickness and more than 10 sq. in. of rib-eye area. The yield of retail cuts averaged about 51% which is equivalent to an average USDA cutability grade No. 2.

Net Energy Evaluation of Rations: Data on the amount of fat, protein, and energy gained and estimates of the net energy values of the rations are presented in Table 5. The addition of corn cobs to the all-concentrate diets resulted in a notable increase in the percent of gain which was fat and a slight decrease in percent of protein gain. These differences were statistically significant (P <.01) when either whole shelled or ground corn was fed. In comparing corn treatments, the steers receiving whole shelled corn gained significantly (P <.01) more fat than the cattle consuming ground or steam-flaked corn. The net energy values for maintenance plus gain were greatest for the steam-flaked corn rations and lowest for the diets based on ground corn.

When either whole or ground corn was fed, the all-concentrate controls had higher NE_{m+p} values than the diets containing roughage. Apparently one effect of corn cobs and Perlite is a dilution of feed conversion and NE value. This was obviously not the situation, however, when steam-flaked corn was fed, where the addition of corn cobs and Perlite to the basal ration significantly (P <.01) increased the feeding value of the all-concentrate control. The reason for this is not clear, except that cattle on these treatments had appreciably higher average daily energy gains in relation to their feed intake. It should be remembered in interpreting these net energy data that only two steers were used per treatment.

Intra-Ruminal Observations (Table 6): In general, deletion of roughage from the rations made the rumen content more acid. This effect was most pronounced when whole shelled corn was fed. In the ground corn treatment, both corn cobs and Perlite significantly (P <.05) reduced rumen acidity in comparison to the all-concentrate control diet. There were no significant (P >.05) differences in rumen pH among steers receiving the different forms of corn when no roughage was fed. However, when whole corn was fed with corn cobs, the pH was significantly (P <.05) higher than when this roughage was included in the ground or steam-flaked corn rations. Perlite appeared to reduce rumen acidity in the ground and steam-flaked corn diets, but not when whole corn was fed.

Generally, the all-grain diets resulted in higher concentrations of total volatile fatty acids than the rations containing roughage. The only differences which were statistically significant, however, were found within the whole shelled corn treatment. In this case, the addition of corn cobs significantly (P <.01) reduced total VFA concentration when compared to the addition of no roughage or Perlite. Between forms of corn, the whole shelled corn no-roughage diet resulted in a significantly (P <.05) higher total VFA level than either the ground or steam-flaked corn all-concentrate rations. Differences between the corn cob treatments were not significant. Means for the Perlite treatments did not follow a definite trend, but it may be concluded that total VFA levels were more similar to the all-concentrate diets than to the corn cob rations. In general, changes in VFA levels were consistent with pH values with an increase in total VFA concentration resulting in an increase in rumen acidity.

Trends toward molar percentages of acetic and propionic acid were consistent for all treatments. With each form of corn, percent acetic acid was greatest when

TABLE 5. Net Energy of the Rations for Maintenance Plus Gain

Net Energy Evaluation	Whole Shelled Corn			Ground Shelled Corn			Steam Flaked Corn		
	No Roughage	10% Corn Cobs	4% Perlite	No Roughage	10% Corn Cobs	4% Perlite	No Roughage	10% Corn Cobs	4% Perlite
Initial empty body weight, lb.	678	678	665	664	670	672	674	675	671
Final empty body weight, lb.	968	982	948	950	1014	1008	957	984	937
Gain in fat, %	25.5	29.8	24.4	20.2	23.7	20.4	22.3	23.1	22.0
Gain in protein, %	18.2	17.7	18.2	18.7	18.4	18.7	18.6	18.4	18.5
Avg. daily energy gain, Mcal	4.57	5.33	4.28	3.91	5.17	4.60	4.08	4.58	4.55
Avg. daily maintenance requirement, Mcal	6.53	6.58	6.44	6.44	6.65	6.64	6.49	6.58	6.57
Avg. daily ration intake, lb.[a]	20.2	23.2	20.0	20.5	24.5	22.4	18.7	19.1	17.6
NE_{m+p}/100 lb. ration, Mcal	54.8	51.4	53.5	50.4	48.2	50.0	56.5	58.3	63.3

[a] One hundred percent dry matter basis.

TABLE 6. Intra-ruminal Observations

	Whole Shelled Corn			Ground Shelled Corn			Steam Flaked Corn		
	No Roughage	10% Corn Cobs	4% Perlite	No Roughage	10% Corn Cobs	4% Perlite	No Roughage	10% Corn Cobs	4% Perlite
Rumen pH[a]	5.58	6.24	5.47	5.48	5.97	5.86	5.67	5.92	5.78
Total VFA, μ M/ml.[a,b]	155.2	114.7	147.6	132.1	122.7	122.1	134.4	129.9	138.2
Acetic, molar %	39.9	51.7	40.5	37.0	47.2	44.4	40.2	45.5	43.0
Propionic, molar %	45.5	30.5	43.9	44.1	35.3	39.8	44.5	36.9	38.0
Butyric, molar %	7.3	10.4	8.9	10.7	9.0	8.6	8.0	11.1	10.5
Isovaleric, molar %	2.8	4.0	2.3	2.2	4.5	3.1	3.0	2.6	3.3
Valeric, molar %	4.2	3.2	4.2	5.7	3.7	3.9	4.0	3.7	5.0
Rumen Papillae									
Clumping[c]	3.9	4.7	4.0	3.0	4.7	3.5	3.5	4.6	3.6
Sloughing[c]	5.0	5.0	5.0	4.9	4.9	4.9	5.0	5.0	4.9
Hair accumulation[c]	4.0	4.8	4.0	2.9	4.7	4.3	3.6	4.7	3.9

[a] Data are an average of 18 observations per treatment. Samples were taken by the stomach tube method.

[b] Total VFA concentration expressed as the sum of individual acids.

[c] Extreme = 1, moderate = 2, medium = 3, little = 4, none = 5.

corn cobs were fed and lowest with the non-roughage ration. The reverse situation was true for percent propionic acid, resulting in a higher percentage of propionate relative to acetate when all-concentrate diets were consumed. Form of corn had no statistically significant ($P > .05$) effect on percent of acetic or propionic acid in the roughage-free rations. When corn cobs were fed with whole shelled corn, the percentages of acetic and propionic acids were significantly higher ($P < .01$) and lower ($P < .05$), respectively, than when fed with ground or steam-flaked corn. Perlite appeared to have an intermediate effect on molar percentages of VFA's.

The rumen ciliate protozoal population prior to the test period was approximatel 4.00×10^5 protozoa per cc. of rumen content, with 3.51×10^5 of these identified as entodinia and 2.18×10^3 as holotrichs. After 35 days on test (or 14 days past the adaptation period), stomach-tubed samples of rumen content showed that the animal receiving either no roughage or Perlite were essentially protozoa-free. From this point forward, no protozoa were found in any of the cattle being fed the all-concentrate treatments.

On the other hand, steers which were receiving Perlite were observed occasional to have varying concentrations of both entodinia and holotrichs, but there was no pattern to this type of occurrence. For example, protozoa were found in one steer on days 49, 77, and 91 of the trial but were missing on days 35 and 63. It is possible that these animals may have become defaunated and subsequently re-inoculated through their close contact with other animals in the same or neighboring pens.

In general, the animals with corn cobs in their ration contained large numbers of protozoa (primarily entodinia) throughout the experiment. Entodinia ranged in population from $1.02 - 21.33 \times 10^5$, while the holotrichs varied in number from $0.80 - 9.20 \times 10^3$ per cc. of rumen content. Frequently only one of the two steers sampled in each roughage treatment was found to be populated.

Treatment means for papillae clumping and hair accumulation clearly showed the beneficial effects of coarse roughage material on the health of the rumen wall. Within each corn treatment, the addition of 10% corn cobs significantly ($P < .05$) reduced the severity of papillae clumping and the accumulation of hair within the rumen. Hair accumulation was also significantly ($P < .01$) reduced in the ground corn treatment by the addition of Perlite. A comparison of the all-concentrate diet showed that whole shelled corn significantly ($P < .01$) reduced the degree of papillae clumping and hair accumulation in relation to ground corn, and that steam-flaked corn caused significantly ($P < .05$) less hair accumulation than ground corn. Little or no sloughing of papillae was observed in the rumen walls of the steers. This was possibly the result of the short feeding period, with insufficient time having passed for excessive sloughing to occur.

Color, length, and width of rumen papillae were also observed. Generally, the papillae were grey in color (in comparison to black found in six steers slaughtered at the beginning of the experiment) and were of medium length and width. None of these factors appeared related to the other rumen observations or to the treatments.

Conclusions

The feedlot results and carcass measurements indicated that cattle perform very satisfactorily when fed all-concentrate rations based on corn. Statistical analysis showed that neither form of corn nor the addition of 10% corn cobs or 4% Perlite significantly affected average daily gain or carcass traits.

The net energy values for the rations suggested more efficient utilization of energy in steam-flaked corn than in whole shelled or ground corn. Composition of the gains showed that steers receiving corn cobs had appreciably more body fat and slightly less body protein. Cattle within these treatments, however, were heavier at slaughter.

All-concentrate feeding generally resulted in higher total VFA levels, more propionate relative to acetate, greater rumen acidity, fewer protozoa, and marked pathological changes in the rumen papillae. The addition of corn cobs to the basal diet reduced both rumen acidity and the severity of rumen wall changes. Perlite appeared to have an intermediate effect on most rumen characteristics.

EFFECTS OF VARIOUS HORMONES ON FEEDLOT PERFORMANCE AND CARCASS TRAITS OF GROWING-FINISHING HEIFERS

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The primary objective of the modern feedlot is the economic production of lean beef which is tender and flavorful. Rate of gain and feed efficiency have been increased through improved nutrition, feeding high energy rations, etc. If the general metabolism of the animal is not altered, however, this increase in gain is likely to be through the deposition of fat with little or no change in the deposition of protein. Increased efficiency of energy use does not necessarily result in an increase in efficiency of production of the product preferred by the American consumer. Finishing heifers are especially notable for their deposition of fat when fed high energy rations at young ages. Significant interactions among rations, sexes, and breeds have been observed in research at the Ohio Agricultural Research and Development Center.

Stilbestrol, whether administered orally or by subcutaneous implantation, has been proven to be a growth stimulant to cattle fed finishing rations. That is, protein deposition is increased without a corresponding increase in body fat. Stilbestrol brings about changes in growth and carcass traits similar to differences noted between breeds and sexes. These changes due to stilbestrol have been larger and more consistent in steers than in heifers or bulls. Changes through breeding, although permanent, are slow and sex alterations are limited. Therefore, further research is needed to study the effects of growth stimulants on the feedlot performance and carcass traits of the different sexes of cattle.

Objectives

The objectives of this experiment were:

1. To determine the effects of various hormones and combinations of hormones on growth rate, feed efficiency, and carcass composition of growing-finishing cattle.

2. To compare the effectiveness of oral and subcutaneous administration of certain hormones.

Procedure

The treatments[1] investigated in this experiment were:

1. Control, no hormone treatment.

2. Stilbestrol, 10 mg. per head daily in the feed.

3. Synovex-H implant.

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[1]The hormone treatments used in this experiment are available on the market. However, the combination of Synovex-H implantation and stilbestrol in the feed has not been approved by the Food and Drug Administration.

4. Synovex-H implant plus 10 mg. stilbestrol in the feed.

5. Rapigain implant plus 10 mg. stilbestrol in the feed.

6. Stilbestrol implant, 30 mg. per head.

7. MGA, 0.4 mg. per head daily in the feed.

The experiment was conducted in two sections, one with 20 heifers fed in individual pens and the other with 14 pens of 12 heifers each fed in groups. The individually fed heifers were purchased as heavy calves in October of 1968. Facilities for feeding them were completed in late November and they were started on experiment Dec. 10, 1968. Heifers fed in the group pens were purchased in early March 1969 from the winter wheat pasture areas of Kansas and Oklahoma. They were started on experiment March 18. All heifers were fed on slotted floors with the individually fed heifers in a closed barn and the group pens in the open.

The first four listed treatments were the only ones used with the individually fed heifers. They were full-fed a complete mixed ration as indicated in Table 1. Five heifers were fed on each treatment. At the completion of this phase of the experiment, all heifers were slaughtered in the Meat Laboratory at Columbus.

Two pens of 12 heifers each were fed each of the seven treatments. One pen on each treatment was fed a high corn silage, limited concentrate ration and the other a limited silage, high corn grain mixture. The silage used had been treated with 20 lb. of urea, 10 lb. of limestone, and 2 lb. of phosphate per ton at the time of ensiling. The rations were weighed, mixed, and delivered mechanically to each pen of cattle.

Heifers which received the various hormone implants were implanted with the recommended dosages at the start of the experiment. The stilbestrol and MGA which were administered orally were mixed at the proper level with ground shelled corn to be fed at the rate of 2 lb. of corn per head daily.

Results

Results obtained with the individually fed heifers are presented in Table 1. Synovex-H is recommended for implantation during the last 60-150 days of the feeding period. Only one implantation was made when this experiment was initiated and it continued for a total of 198 days. Hence, average daily gains for the first 105 days are presented along with final results in Table 1.

Statistical analyses of average daily gains for the first 105 days showed gains among treatments to be different at the 10 percent level of significance. Synovex-H and oral stilbestrol each increased average daily gains and the combination of the two appeared to be additive. These treatments also reduced the amount of feed required per unit of gain.

Due to the limited number of heifers on each treatment and the variation within treatments, final 198-day results showed no significant differences among treatments in average daily gains or feed efficiency. Although not statistically significant, Synovex H and oral stilbestrol tended to increase gains and feed efficiency. However, these effects were not additive in that oral stilbestrol did not increase gains in the presence of Synovex-H nor Synovex-H in the presence of stilbestrol.

TABLE 1.--Performance of Individually Fed Heifers Implanted with Synovex-H with and without Stilbestrol in the Feed.

	Control	Synovex-H Implant	10 mg. Stilbestrol Daily	Synovex-H and Stilbestrol
Number of heifers	5	5	5	5
Average weight, December 10, lb.	450	443	454	445
Average weight, March 25, lb.	684	715	720	730
Average daily gain, 105 days, lb.	2.23	2.50	2.54	2.71
Average final weight, lb.	870	912	947	916
Average daily gain, 198 days, lb.	2.11	2.36	2.48	2.37
Average daily ration, lb.[1]	18.4	19.9	20.0	19.0
Feed per pound gain, lb.	8.78	8.41	8.06	8.03
Dressing percentage	60.9	60.4	61.1	61.4
Marbling score[2]	6.2	5.2	5.2	5.4
Quality grade[3]	19.2	18.6	18.6	18.8
Fat thickness, in.	0.48	0.49	0.63	0.50
Kidney fat, %	2.9	2.5	2.6	2.4
Rib eye area, sq. in.	9.5	10.2	9.8	10.5
Cutability grade	3.04	2.98	3.64	2.74

[1]Ration B-3-67

Ingredient	Percent
Ground shelled corn	49
Soybean meal, 50%	12
Ground corn cobs	35
Pulverized limestone	1
Trace mineral salt	1
Pellet binder	2
	100

Vitamin A - 1,500 I.U. per lb.
Vitamin D - 350 I.U. per lb.
Aureomycin - 10 grams per lb.

[2] 5--Small, 6--Modest.

[3] 16, 17, 18--low, average and high good, respectively. 19, 20, 21--low, average, and high choice, respectively.

All of the individually fed heifers were slaughtered in the Meat Laboratory at Columbus. Synovex-H significantly (5% level) increased rib eye area and cutability grade (10% level). Although some variation in other carcass traits among treatments may be noted in Table 1, none of these differences were statistically significant. There was a tendency for the hormone treatments to lower marbling score and quality grade but these differences were not statistically significant and the average grade for all treatments was approximately low choice.

Results obtained from the group-fed heifers are presented in Tables 2 and 3. There were highly significant differences in average daily gains due both to rations fed and hormone treatments. Heifers fed the more liberal amount of corn grain (Table 3) gained significantly faster and reached low choice grade 3 weeks earlier than those fed limited amounts of corn with corn silage (Table 2). There was no significant interaction between rations fed and hormone treatments, indicating a similar response to the hormones used irrespective of the ration fed.

Average daily gains of the group-fed heifers were increased by all hormone treatments. However, the increase due to oral stilbestrol alone was not significant. Most rapid gains were obtained from the combined treatment of Synovex-H and oral stilbestrol but these were not significantly greater than Synovex-H alone or the combination of Rapigain and oral stilbestrol. The Synovex-H plus oral stilbestrol treatment significantly increased gains above the oral stilbestrol, MGA, and stilbestrol implant treatments.

The group-fed heifers were slaughtered in commercial packing plants in Ohio. Identifications of a number of the heifers from the first group were lost during slaughter so the carcass data presented are only for those animals for which positive identification could be made. Differences in carcass data between ration treatments were small and differences among hormone treatments were not consistent with the two rations. The average carcass grade of all groups was approximately low choice.

TABLE 2.--Performance of Group-Fed Heifers with Various Hormone Treatments When Fed Limited Corn Grain with Corn Silage.

	Control	10 mg. Stilbestrol Daily	Synovex-H Implant	Synovex-H and Stilbestrol	Rapigain and Stilbestrol	Stilbestrol Implant	0.4 mg. MGA
Number of heifers	12/11	12	12	12	12	12	12/11
Average weight, March 18, lb.	535	535	541	528	530	538	546
Average weight, August 13, lb.	767	788	800	796	791	802	791
Average daily gain, 148 days, lb.	1.71	1.84	1.91	1.94	1.89	1.84	1.83
Average daily ration, lb.							
Ground shelled corn	2.2	2.0	2.0	2.0	2.0	2.4	2.0
Corn silage[1]	33.0	34.4	34.1	33.5	34.2	35.8	35.8
Feed per cwt. gain, lb.							
Ground shelled corn	126	108	105	103	106	123	113
Corn silage	1925	1864	1788	1728	1815	1870	1979
Number of carcasses	11	12	12	12	12	10	11
Dressing percentage	60.2	61.0	60.4	59.8	58.1	61.2	60.8
Marbling score[2]	5.1	5.7	5.2	5.6	5.2	4.8	5.5
Quality grade	18.3	19.1	19.0	18.8	18.7	18.5	19.0
Fat thickness, in.	0.36	0.56	0.46	0.43	0.40	0.47	0.52
Kidney fat, percent	2.7	2.8	2.7	2.8	2.7	2.9	2.9
Rib eye area, sq. in.	10.7	10.0	10.7	10.3	10.2	10.4	9.8
Cutability grade	2.3	3.2	2.7	2.7	2.6	2.9	3.1

[1]Corn silage was treated with 20 lb. of urea, 10 lb. of pulverized limestone, and 2 lb. of defluorinated phosphate at the time of ensiling.

[2] 5--small, 6--modest.

[3] 16, 17, 18--low, average, and high good, respectively. 19, 20, 21--low, average, and high choice, respectively.

TABLE 3.--Performance of Group-Fed Heifers with Various Hormone Treatments When Fed Corn Grain and Silage

	Control	10 mg. Stilbestrol Daily	Synovex H Implant	Synovex H and Stilbestrol	Rapigain and Stilbestrol	Stilbestrol Implant	0.4 mg. MGA
Number of heifers	12	12	12/10	12	12/11	12	12
Average weight, March 18, lb.	539	538	534	530	534	538	539
Average weight, July 23, lb.	792	804	830	846	828	831	823
Average daily gain, 127 days, lb.	2.03	2.18	2.50	2.62	2.35	2.33	2.31
Average daily ration, lb.							
Ground shelled corn	8.3	8.3	8.5	8.5	8.7	8.5	8.4
Soybean meal	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Corn silage[1]	20.8	21.0	21.5	23.2	22.8	22.5	22.6
Feed per cwt. gain, lb.							
Ground shelled corn	407	380	344	324	370	364	362
Soybean meal	49	45	41	38	42	43	44
Corn silage[1]	1021	962	866	885	966	964	980
Number of carcasses	9	10	7	9	7	9	7
Dressing percentage	60.1	59.1	59.9	60.0	59.5	61.2	61.7
Marbling score[2]	5.4	5.5	5.0	5.8	6.0	5.2	5.7
Quality grade[3]	19.0	18.9	19.0	18.7	18.7	18.9	19.0
Fat thickness, in.	0.37	0.46	0.57	0.43	0.51	0.43	0.47
Kidney fat, percent	2.8	2.9	2.9	3.2	2.9	3.0	3.3
Rib eye area, sq. in.	10.2	10.3	10.2	11.0	10.6	10.1	10.3
Cutability grade	2.6	2.7	3.1	2.6	2.8	2.9	2.9

[1]Corn silage was treated with 20 lb. of urea, 10 lb. of pulverized limestone, and 2 lb. of defluorinated phosphate at the time of ensiling.

[2] 5 - small, 6 - modest.

[3] 16, 17, 18--low, average, and high good, respectively. 19, 20, 21--low, average, and high choice, respectively.

TRANS AND CIS FORMS AND LEVELS OF STILBESTROL FOR STEERS

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Abstract

Sixty steer calves were used to study the effectiveness of 10, 20, and 40 mg. of trans-stilbestrol and 10 and 20 mg. of cis-stilbestrol per steer per day. These treatments were compared to control steers which did not receive stilbestrol. The average initial weight of the steers was 622 lb. and they were fed a finishing ration (10-15 lb. corn silage, supplement, and a full feed of corn) for 167 days at which time they were slaughtered for carcass measurements.

Trans-stilbestrol was more effective in stimulating gains and feed efficiency than cis-stilbestrol. The optimum level of trans-stilbestrol for maximum gain stimulation appears to be 20 mg. per steer per day. When steers were fed this level of trans-stilbestrol, there was no effect on carcass grade, marbling score, or cutability grade; carcass weight was significantly increased.

Introduction

It is well recognized that stilbestrol (DES), when fed or implanted in growing-finishing cattle, increases rate of gain and improves feed efficiency. Recently it has been shown that when crystalline stilbestrol is mixed into feed, it may be unstable and lose hormone potency. Part of this loss may be due to a change in molecular structure from a form which has potent estrogenic activity, called trans-stilbestrol, to an inactive form, called cis-stilbestrol.

The purpose of this experiment was to compare the activity of these two forms of stilbestrol for stimulating gain and feed efficiency in cattle and to determine the optimum level of stilbestrol to be fed to growing-finishing cattle.

Procedures

Sixty steer calves were purchased for this experiment from a single ranch near Wichita Falls, Texas. After a preliminary feeding period on corn silage and supplement, they were allotted to six pens of 10 steers each. The daily ration consisted of a fixed amount of limestone-treated corn silage (15 lb. per head per day for the first 91 days and 10 lb. per head per day for the last 76 days), 2 lb. of the supplement shown in Table 1, and a full feed of coarsely crimped shelled yellow corn.

The two forms of stilbestrol (high-trans and high-cis) were incorporated into the supplement to give daily intakes of 10, 20, or 40 mg. of trans-stilbestrol and 10 or 20 mg. of cis-stilbestrol. Both forms of stilbestrol were supplied as premixes by the Eli Lilly and Co. Several assays indicated that the trans-stilbestrol supplement contained 95.0 to 99.3% trans-stilbestrol and 0.7 to 5.0% cis-stilbestrol; the cis-stilbestrol supplement was found to contain 77.2 to 78.9% cis-stilbestrol and 21.1 to 22.8% trans-stilbestrol. Supplements containing stilbestrol were prepared every 3 to 4 weeks during the experiment. During this time, the form of stilbestrol in the supplements remained quite stable.

After the steers reached slaughter weight and condition, they were slaughtered and the carcasses were evaluated.

TABLE 1. Supplement Formula

Ingredient	Amount
Soybean meal (44% CP)	80.6%
Urea (281% CP)	5.4%
Limestone, ground	7.5%
Salt, trace mineralized[a]	5.4%
Dehydrated alfalfa meal (17% CP)	1.0%
Vitamin A[b]	0.1%

[a] Morton's trace mineralized salt.

[b] Premix which supplied 30,000 USP units/steer/day.

TABLE 2. Influence of Level and Form of DES on the Feedlot Performance of Steers

	Level and Form of DES					
		10 mg.		20 mg.		40 mg.
Item	None	Trans	Cis	Trans	Cis	Trans
Pen number	15	16	24	19	14	23
Number of steers	10	9	10	9	10	10
Initial weight, lb.	618	621	620	628	629	616
Final weight, lb.	1002	1086	1051	1114	1075	1102
Avg. daily gain, lb.	2.30	2.79	2.58	2.90	2.66	2.92
Avg. daily feed:						
Corn silage, lb.	13.0	13.5	13.1	13.3	12.9	13.0
Corn, lb.	10.6	11.1	11.1	12.3	11.4	12.0
Supplement, lb.	2.0	2.1	2.0	2.0	2.0	2.0
Air-dry feed/lb. gain, lb.	7.70	6.59	7.05	6.71	6.90	6.54

Data from two steers are not included in this summary. One steer in Pen 16 was a poor-doing steer throughout the experiment (average daily gain of 1.04 lb. per day). One steer in Pen 19 foundered after approximately 120 days on feed.

Results

The feedlot results from this experiment are presented in Table 2. Daily gain was increased 21, 26, and 27%, respectively, by feeding 10, 20, or 40 mg. of trans-stilbestrol per steer per day. Feed efficiency was also improved 14 to 16% by these levels of trans-stilbestrol. On the other hand, cis-stilbestrol improved gains only 12 or 16% when fed at the rate of 10 or 20 mg. per steer per day. This difference in response was statistically significant.

Since the cis-stilbestrol supplement contained 22% of the trans-form stilbestrol, the response to this supplement may have been due to the presence of some trans-stilbestrol. To determine if this explanation is valid, the daily trans-stilbestrol intake was computed for all groups of steers and plotted against the feedlot response of the cattle. Figure 1 shows that the gain and feed efficiency responses are related to the trans-stilbestrol intake and that the response observed with the cis-stilbestrol supplement was probably due to the presence of some trans-stilbestrol.

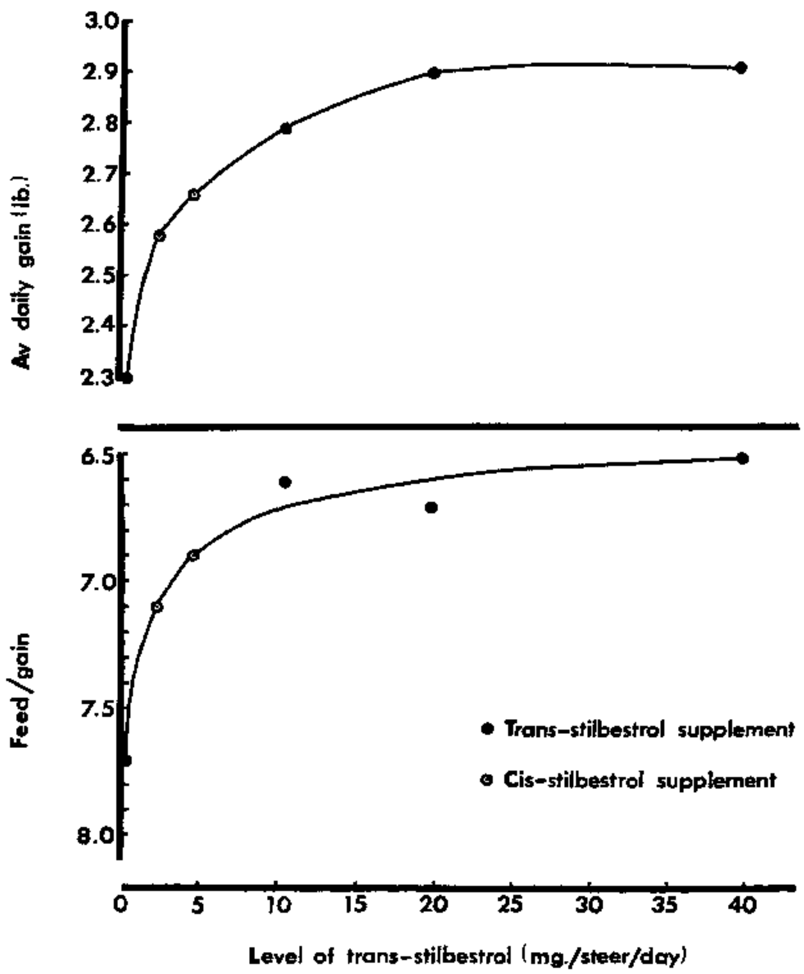

Fig. 1.--Relation of gain and feed efficiency responses to trans-stilbestrol intake.

Table 3 shows the carcass data observed in this experiment. Hot carcass weights were significantly increased by stilbestrol feeding, with maximum carcass weight obtained when 20 mg. trans-stilbestrol was fed per steer per day. The trans-stilbestrol was more effective in this regard than cis-stilbestrol. Other carcass factor were not significantly affected by feeding stilbestrol. When the carcass data were evaluated at equal carcass weight (equivalent to equal total gain between groups), only the percent kidney-pelvic-heart fat was affected, being decreased somewhat by stilbestrol feeding.

Conclusions

The trans-form of stilbestrol is the active form for stimulating weight gain, feed efficiency, and carcass weight in growing-finishing cattle. The optimum level to feed for maximum gain stimulation appears to be 20 mg. per steer per day, rather than 10 mg. per steer per day, which is presently the maximum level of stilbestrol currently approved by the Food and Drug administration for cattle feeding.

TABLE 3. Influence of Level and Form of DES on the Carcasses of Steers

	Level and Form of DES					
		10 mg.		20 mg.		40 mg.
Item	None	Trans	Cis	Trans	Cis	Trans
Hot carcass weight, lb.	608	668	648	696	661	679
Dressing, %	60.6	61.5	61.6	62.4	61.4	61.6
Conformation score[a]	19.5	20.2	19.9	20.6	19.9	20.2
Marbling score[b]	5.2	5.7	5.4	5.3	5.0	5.1
Quality grade[a]	18.4	19.4	18.7	18.9	18.4	18.7
Final grade[a]	18.8	19.8	19.0	19.4	18.9	19.2
Cutability grade	2.9	3.1	3.1	3.3	2.7	3.4
Primal retail cuts, %	54.8	54.3	54.2	53.3	54.8	53.5
Fat thickness, in.	0.4	0.5	0.5	0.6	0.4	0.6
Kidney, pelvic, heart fat, %	3.1	2.8	2.9	3.1	3.1	3.0
Rib eye area, sq. in.	11.2	12.0	11.7	12.2	12.2	11.7

[a] 18 = Good (+); 19 = choice (-); 20 = choice (avg.); 21 = choice (+).

[b] 5 = Small; 6 = modest.

HORMONE ADDITIVES FOR GROWING-FINISHING BULLS

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Abstract

Various hormones currently available for feedlot steers and heifers were tested to determine their effectiveness in growing-finishing bull calves. Synovex-H and Synovex-S implants were used alone and in combination with feeding of 10 mg. of stilbestrol per bull per day; stilbestrol was also fed alone. All treatments were compared to bull calves which did not receive any hormone additions. The average initial weight of the bulls was 568 lb. They were fed a finishing ration (10-15 lb. corn silage, supplement, and a full feed of corn) for 185 days, at which time they were slaughtered for carcass measurements. None of the hormone treatments caused a significant change in gain, feed efficiency, or carcass value of these bull calves.

Introduction

The superiority of growing-finishing bull calves compared to steer calves in feedlot performance and in the production of carcasses with a greater yield of lean meat has been shown at this and other research centers. Also, the use of stilbestrol in the feeding of bull calves has been shown to increase rate of gain.

Several hormone combinations are currently available for use in steers and heifers. The purpose of this experiment was to compare the response of bull calves which were fed or implanted with these hormones to bull calves which did not receive any hormone treatment.

Procedures

Fifty-seven Hereford bull calves were purchased for this experiment from a single ranch in Wichita Falls, Texas. After a preliminary feeding period on limestone-treated corn silage and supplement, they were allotted to three pens of ten bulls each and three pens of nine bulls each. The daily ration consisted of a fixed amount of limestone-treated corn silage (15 lb. per head per day for the first 91 days and 10 lb. per head per day for the last 94 days), 2 lb. of the supplement shown in Table 1, and a full feed of coarsely crimped shelled yellow corn.

The hormone treatments used in this experiment were:

- Control
- Synovex-H implant
- Synovex-S implant
- 10 mg. stilbestrol per bull per day
- Synovex-H implant plus 10 mg. stilbestrol per bull per day
- Synovex-S implant plus 10 mg. stilbestrol per bull per day

The synovex implants were supplied by the Syntex Corporation. Synovex-H is designed for feedlot heifers and contains 20 mg. estradiol benzoate and 200 mg. testosterone propionate. Synovex-S is designed for feedlot steers and contains 20 mg. estradiol benzoate and 200 mg. progesterone. The stilbestrol was supplied as a premix by Eli Lilly and Co. and was the trans-stilbestrol form.

After the bulls reached slaughter weight and condition, they were slaughtered and the carcasses were evaluated.

TABLE 1. Supplement Formula

Ingredient	Amount
Soybean meal (44% CP)	80.6%
Urea (281% CP)	5.4%
Limestone, ground	7.5%
Salt, trace mineralized[a]	5.4%
Dehydrated alfalfa meal (17% CP)	1.0%
Vitamin A[b]	0.1%

[a] Morton's trace mineralized salt.

[b] Premix which supplied 30,000 USP units/bull/day.

TABLE 2. Influence of Hormone Treatments on the Feedlot Performance of Bulls

	Hormone Treatment					
Item	None	S-H[a]	S-S[a]	DES[a]	S-H + DES	S-S + DES
Pen number	21	22	20	17	18	13
Number of bulls	10	10	9	10	9	9
Initial weight, lb.	562	570	577	562	565	575
Final weight, lb.	1066	1092	1104	1061	1062	1076
Average daily gain, lb.	2.73	2.82	2.84	2.70	2.69	2.71
Average daily feed:						
Corn silage, lb.	12.5	12.6	12.6	12.6	12.5	12.6
Corn, lb.	10.2	10.8	10.4	9.8	9.9	10.3
Supplement, lb.	2.0	2.0	2.0	2.0	2.0	2.0
Air-dry feed/lb. gain, lb.	6.25	6.26	5.94	6.19	6.24	6.33

[a] S-H = Synovex-H; S-S = Synovex-S; DES = stilbestrol.

Results

The feedlot results from this experiment are presented in Table 2. None of the differences in average daily gain are statistically significant. This is surprising since it is known that stilbestrol will stimulate the gain of bull calves, although the magnitude of this response is generally smaller than in steer calves. Implantation with either Synovex-H or Synovex-S appeared to give some response in daily gain (4% increase). Synovex-S appeared to improve feed efficiency somewhat but there was no response in feed efficiency when the bulls were implanted with Synovex-H. In this experiment, the feeding of 10 mg. stilbestrol per bull per day did not increase rate of gain or improve feed efficiency. When the Synovex implants were combined with the oral feeding of stilbestrol, the gains were essentially equal to the control bulls.

Table 3 shows the carcass data observed in this experiment. Hot carcass weights appeared to be increased somewhat by both Synovex implants, although the difference was not statistically significant. The remainder of the carcass data were not significantly affected by any of the hormone combinations. Bulls which received stilbestrol tended to have a leaner cutability grade and a higher percentage of primal cuts, however.

Conclusions

The results of this experiment do not permit any definite conclusions. For this reason, the experiment will be repeated next year.

The Synovex-S and Synovex-H implants appeared to stimulate the rate of gain and carcass weight of growing-finishing bull calves to a limited extent, but the response was not large enough to be statistically significant. The oral feeding of stilbestrol (10 mg. per bull per day) did not increase gains or feed efficiency in this experiment. This is not in agreement with previous work with bull calves. Steers which were also being fed the same supplement containing stilbestrol showed a typical gain and feed efficiency response to this hormone (see page 67). This would indicate that the lack of response in these bull calves was not due to inactivity of the supplement being fed.

None of the carcass criteria measured in this experiment were significantly affected by the hormone combinations used in this experiment.

TABLE 3. Influence of Hormone Treatments on the Carcasses of Bulls

Item	Hormone Treatment					
	None	S-H[a]	S-S[a]	DES[a]	S-H + DES	S-S + DES
Hot carcass weight, lb.	637	654	670	644	635	646
Dressing percentage	59.7	59.8	60.6	60.6	59.7	59.9
Conformation score[b]	20.7	20.2	20.6	20.6	20.3	21.1
Marbling score[c]	5.0	5.2	5.1	5.0	4.9	5.4
Quality grade[b]	18.5	18.7	18.9	18.8	18.4	18.9
Final grade[b]	19.2	19.1	19.7	19.5	19.1	19.4
Cutability grade	2.6	3.1	2.9	2.7	2.7	2.5
Primal retail cuts, %	55.7	54.6	54.5	55.4	55.5	55.6
Fat thickness, in.	0.4	0.6	0.5	0.5	0.5	0.4
Kidney, pelvic, heart fat, %	2.8	2.7	3.0	2.8	2.7	2.9
Rib eye area, sq. in.	12.5	12.2	12.3	12.6	12.4	12.6

[a] S-H = Synovex-H; S-S = Synovex-S; DES = stilbestrol.

[b] 18 = Good (+); 19 = choice (-); 20 = choice (avg.); 21 = choice (+).

[c] 5 = Small; 6 = modest.

COMPARISON OF STEERS AND BULLS
AND THE INFLUENCE OF STILBESTROL ON THIS COMPARISON

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Abstract

A comparison was made between the feedlot response and carcass characteristics of steers and bulls, and also the influence of feeding stilbestrol on these results. Bulls gained faster and were more efficient than steers, although the feeding of stilbestrol to steers increased their gains to that observed in the bulls. Feed efficiency of the stilbestrol-fed steers was somewhat less than in the bulls, however. Carcasses from the bulls were leaner than the carcasses from steers.

Introduction

Bull calves are known to have faster and more efficient gains in the feedlot when compared to steer calves. Their carcasses contain more meat and less fat than carcasses from similar steers.

Reports of two experiments where steer or bull calves were given various forms or combinations of hormone additives appear on pages 67 and 71. Since these cattle were purchased from the same ranch and fed the same ration at the same time for nearly the same length of time, their data can be compared to further evaluate the relative merits of steer and bull calves for the production of beef.

Procedures

The general procedures have been outlined on pages 67 and 71. The average starting weight of the bull calves (568 lb.) was somewhat lighter than the steer calves (622 lb.), primarily because they were approximately 1 month younger at the start of the experiment. All cattle were fed a daily ration of a fixed amount of corn silage (15 lb. per head per day for the first 91 days and 10 lb. per head per day for the last 76 days in the case of the steers and 94 days in the case of the bulls), 2 pounds of supplement, shown in both the steer and bull experiments, and a full feed of coarsely crimped shelled yellow corn. The steers were fed for 167 days and the bulls for 185 days. One pen of bulls and one pen of steers were each fed 10 mg. of stilbestrol per head per day and a similar pen of bulls and steers served as controls. The stilbestrol was supplied as a premix by the Eli Lilly and Company and was the trans-stilbestrol form.

After the cattle reached slaughter weight and condition, they were slaughtered and the carcasses were evaluated.

Results

The feedlot results from this experiment are presented in Table 1. Control bulls gained faster and were more efficient than control steers. The feeding of 10 mg. of stilbestrol per steer per day increased their rate of gain over that observed for the bulls. As noted elsewhere, no gain response was observed in the bulls to stilbestrol feeding, although their feed efficiency was improved slightly.

Table 2 shows the carcass data observed in this comparison. Hot carcass weights were significantly increased by feeding stilbestrol, especially with the

TABLE 1. Comparison Between Bulls and Steers in Feedlot Response and the Influence of Stilbestrol on this Comparison

	Steers		Bulls	
Item	Control	DES	Control	DES
Pen number	15	16	21	17
Number of cattle	10	9	10	10
Initial weight, lbs.	618	621	562	562
Final weight, lbs.	1002	1086	1066	1061
Days on feed	167	167	185	185
Average daily gain, lb.	2.30	2.79	2.73	2.70
Average daily feed:				
Corn silage, lb.	13.0	13.5	12.5	12.6
Corn, lb.	10.6	11.1	10.2	9.8
Supplement, lb.	2.0	2.1	2.0	2.0
Air-dry feed/lb. gain, lb.	7.70	6.59	6.25	6.19

TABLE 2. Comparison Between Bulls and Steers in Carcass Value and the Influence of Stilbestrol on this Comparison

	Steers		Bulls	
Item	Control	DES	Control	DES
Hot carcass weight, lb.	608	668	637	644
Dressing percentage	60.6	61.5	59.7	60.6
Conformation score[a]	19.5	20.2	20.7	20.6
Marbling score[b]	5.2	5.7	5.0	5.0
Quality grade[a]	18.4	19.4	18.5	18.8
Final grade[a]	18.8	19.8	19.2	19.5
Cutability grade	2.9	3.1	2.6	2.7
Primal retail cuts, %	54.8	54.3	55.7	55.4
Fat thickness, in.	0.4	0.5	0.4	0.5
Kidney, pelvic, heart fat, %	3.1	2.8	2.8	2.8
Rib eye area, sq. in	11.2	12.0	12.5	12.6

[a] 18 = Good (+); 19 = choice (-); 20 = choice (avg.); 21 = choice (+).

[b] 5 = Small; 6 = modest.

steers. Dressing percentage was higher in steers compared to the bulls; it was also higher in the cattle fed stilbestrol. Conformation scores were higher and marbling scores were lower in the bull calves compared to the steer calves. The quality grade and final grade were somewhat improved by the feeding of stilbestrol to either steers or bulls. The cutability grade indicated that the bulls had leaner carcasses, as did the percent of primal cuts in the carcass. Rib eye areas were markedly larger in the bull carcasses.

Conclusions

The results of the comparisons made in this experiment further substantiate the superiority of bull calves over steer calves in rate and efficiency of gain as well as in the production of lean carcasses. It should be noted, however, that the feeding of 10 mg. of stilbestrol per steer per day increased their rate of gain to that observed in the bull calves, although they were still somewhat less efficient. Since it has been found that 20 mg. of stilbestrol per head per day is the optimum level for maximum gain and feed efficiency stimulation in steers (see page 70), it may be that steers can be made equal to bulls in gain and feed efficiency with the proper level or combination of hormones.

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COMPARATIVE EFFICIENCY OF BULLS, STEERS AND HEIFERS WHEN FED VARYING LEVELS OF ENERGY

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Abstract

Twelve bulls, steers, and heifers were used to compare their efficiency of feed utilization when fed different levels of energy intake. Bulls gained faster and were more efficient than steers; steers gained faster and were more efficient than heifers. Bull carcasses contained more lean meat and were less well-marbled than steer or heifer carcasses. Cattle limited in their energy intake during the early part of the feeding period appeared to be able to derive more net energy from their ration over the entire feeding period than cattle fed on higher levels of energy.

Introduction

It is generally considered that bulls gain faster and are more efficient than steers, which in turn gain faster and are more efficient than heifers. Part of these differences may be due to differences in feed intake, although changes in the efficiency of nutrient utilization and differences in carcass composition may also be partially responsible.

In this experiment, nutrient utilization was studied in bulls, steers, and heifers. Rate and efficiency of gain were studied along with carcass composition measurements. In this way, the ability of bulls, steers, and heifers to derive energy from their ration for deposition in the carcass as protein and fat could be studied.

Procedures

Twelve Hereford bulls, steers, and heifers were divided into groups of four animals each. One group of bulls, steers, and heifers was full fed a complete high energy ration shown in Table 1. A second group of each sex was fed this same ration in limited amounts. A third group of each sex was limited fed a pelleted low energy ration shown in Table 1. After 17 weeks, the method of feeding the cattle in the second and third groups was switched for an additional 17-week period. All of the cattle were individually fed.

The cattle were slaughtered when the bulls weighed approximately 1100 lb., when the steers weighed approximately 1000 lb., and when the heifers weighed approximately 900 lb. After the two 17-week periods, any cattle which had not reached the desired final slaughter weight were finished on a full feed of the high energy ration.

Representative bulls (3), steers (6), and heifers (3) were slaughtered at the beginning of the experiment to determine the initial body composition of the cattle. When the experimental cattle were slaughtered, similar measurements were made to determine the composition of the gain made by the cattle. Specific gravity of the carcasses was used to estimate their composition. In addition, other carcass measurements were made to compare the carcasses of these sex classes and methods of feeding.

Initially, considerable digestive disturbance was experienced by those cattle being limited fed the high energy ration and three animals were lost from the experiment. Data from three other cattle are not included in this summary because of poor performance. As a result of these restricted numbers, only the data comparing bulls, steers, and heifers and data comparing the three feeding systems is discussed.

TABLE 1. Composition of Low and High Energy Rations

Ingredient	Low Energy Ration (NU17)	High Energy Ration (NU19)
	(%)	(%)
Corn cobs, ground	49.5	-
Corn, ground, shelled	15.0	60.5
Dehydrated alfalfa meal (17% CP)	20.5	15.0
Soybran flakes	-	15.0
Soybean meal	13.5[a]	7.0[b]
Salt, trace mineralized[c]	1.0	1.0
Limestone, ground	-	1.0
Dicalcium phosphate	0.5	0.5
Vitamin A[d]	yes	yes
Vitamin D_2[e]	yes	yes
Aurofac-10[f]	yes	yes

[a] 44% Crude protein.

[b] 49% Crude protein,

[c] Morton's trace mineralized salt.

[d] Vitamin premix which supplied approximately 21,000 USP units of vitamin A/head/day.

[e] Vitamin premix which supplied approximately 5,000 USP units of vitamin D/head/day.

[f] Premix which supplied approximately 210 mg. aureomycin/head/day.

Results

Table 2 shows the comparison between bulls, steers, and heifers. Bulls gained faster and were considerably more efficient than the steers or heifers. Likewise, the steers gained somewhat faster and were more efficient than the heifers. The bulls ate more feed; however, the steers and heifers consumed the same amount of feed per day in this experiment.

Chilled carcass weights reflect the final slaughter weights of the sex groups, since dressing percentage was not markedly different between the three groups. Bulls were about one-third grade lower in quality but gave a leaner yield grade than the steers or heifers. This occurred despite the fact that their carcasses weighed 100 lb. more than the steers and 150 lb. more than the heifers.

TABLE 2. Comparative Performance and Efficiency of Feed Utilization between Bulls, Steers, and Heifers

Item	Bulls	Steers	Heifers
Number of animals	10	9	11
Average initial weight, lb.	467	484	454
Average final weight, lb.	1117	966	872
Days on feed	275	284	270
Average daily gain, lb.	2.36	1.70	1.55
Average daily ration, lb.	15.2	14.3	14.3
Feed/lb. gain, lb.	6.4	8.4	9.2
Chilled carcass weight, lb.	692	596	542
Dressing percentage	62.0	61.7	62.2
Quality grade[a]	18.0	19.0	19.1
Yield grade	2.6	3.1	3.4
Final body composition:			
Protein, %	18.8	18.2	18.1
Fat, %	17.5	22.2	22.5
Net energy of ration (megcal/100 lb.):			
Maintenance (NE_m)	70.7	69.5	68.6
Production (NE_p)	52.8	51.5	46.9

[a] 18 = Good (+); 19 = Choice (-).

The initial composition of the steers and heifers was similar (19.3% protein and 12.4% fat), whereas the bulls did not contain as much fat initially (19.3% protein and 9.9% fat). The final composition of these three groups showed a similar trend, with the bulls being leaner and the heifers and steers having similar composition.

The ability of these three groups to derive net energy from their rations was similar, although the ability of the heifers to derive net energy for production may have been somewhat lower than for bulls or steers.

Table 3 shows similar data for the three methods of feeding. Cattle which were full fed the high energy treatment throughout gained faster and were on feed for a

TABLE 3. Comparative Performance and Efficiency of Feed Utilization Between Three Methods of Feeding

Item	Full-fed High Energy Ration	Limited Fed: High Energy then Low Energy Ration	Limited Fed: Low Energy then High Energy Ration
Number of animals	11	9	10
Average initial weight, lb.	469	466	470
Average final weight, lb.	986	982	978
Days on feed	236	313	278
Average daily gain, lb.	2.19	1.65	1.83
Average daily ration, lb.	16.1	14.0	13.6
Feed/lb. gain, lb.	7.4	8.5	7.4
Chilled carcass weight, lb.	622	602	598
Dressing percentage	63.1	61.3	61.1
Quality grade[a]	19.4	18.1	18.6
Yield grade	3.4	2.8	2.9
Final body composition:			
Protein, %	18.1	18.7	18.4
Fat, %	22.8	19.0	20.4
Net energy of ration (megcal/100 lb.):			
Maintenance (NE_m)	73.5	65.5	69.7
Production (NE_p)	48.8	46.8	55.6

[a] 18 = Good (+); 19 = Choice (-).

shorter period of time, as expected. Even though the final weight of the three groups was nearly the same, those which were full fed dressed higher and therefore had heavier carcasses. Their carcass quality grade was higher but their yield grade indicated that their carcasses were fatter. This was confirmed by the estimated fat and protein composition of their carcasses.

Comparing the two limited fed groups, those which were fed the high energy ration during the last half of the feeding period gained somewhat faster on less feed and therefore were more efficient. The dressing percentage, carcass grade, and yield grade were nearly the same between the two limited fed groups. There was only a small difference in carcass composition; those cattle fed the high energy ration during the last half of the feeding period tended to be somewhat fatter than those fed in an opposite manner.

Since the two limited fed groups were fed the same rations during the study, their ability to derive net energy from the ration can be compared. It appears that cattle fed on the lower level of energy during the early part of the feeding period were able to obtain more net energy from the ration than cattle fed in an opposite manner. This observation requires confirmation, but it indicates that the net energy value of a ration may vary depending upon the animals' nutritional history.

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A COMPARISON OF CHAROLAIS, HEREFORD, AND CROSSBRED STEERS AND BULLS FROM BIRTH TO SLAUGHTER

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The average consumer is interested in buying quality beef with a minimum of bone and fat at a reasonable cost. She wants red meat which will be tender, with little or no bone and not much fat covering. Very little preference is shown in marbling in the meat. The consumer is inclined to pay more per pound for this leaner meat.

Consumer preferences have confronted cattle feeders with the necessity of producing leaner meat for this top market. More and more researchers, in an attempt to help with this problem, have been showing increased interest in the production of meat from young bulls because of their superior feeding efficiency.

Most of the bull and steer comparisons have been with English breeds which tend to be slower in growth rate than Charolais. Work in Ohio by Klosterman (OARDC Research Bulletin 1011, May 1968) showed that when Hereford and Charolais breeds and their crosses were slaughtered at similar ages, there were highly significant differences in many traits measured. Charolais calves were heavier at birth and weaning, gained more rapidly, and produced heavier carcasses with more edible portion and less fat trim than the Herefords. Hereford carcasses had higher marbling scores and grades than the Charolais. There were no significant differences between the two breeds in tenderness of broiled steaks. Because of this faster growth rate, interest in the present comparison originated.

Objectives

1. To compare weights and rate of gain from birth to weaning of Charolais, Hereford, and crossbred steers and bulls.

2. To compare rate of gain and feed efficiency during the finishing period.

3. To compare carcass yields and quality.

Procedure

During the years 1966 and 1967, a group of 25 3/4 Charolais cows and 25 grade Hereford cows were divided and bred to registered Charolais and Hereford bulls so the resulting calf crop would be 1/4 straight Charolais, 1/4 straight Hereford, and 1/2 crossbred.

In each breeding group, every other male calf was castrated before 3 weeks of age. In early July the cows with heifer calves were removed and the bull and steer calves were given access to creep feed until weaning on November 1 the first year and October 23 the second year. The total times on creep feed were 118 and 105 days, respectively, for the 2 years.

The creep feed consisted of 50% oats and 50% shelled corn by weight. In the first year, the pastures were short and the calves consumed an average of 3.67 lb. of shelled corn and 3.46 lb. of oats per head per day. In the second year, pasture conditions were excellent and calves consumed 0.10 lb. per head per day of corn and oats while on creep. No comparison can be made of feed efficiency on creep because all calves had access to the creep feeder.

TABLE 1. Two Year Average Performance of Bulls and Steers

	Charolais		Crossbred		Hereford		All	All	All	All	All
	Bulls	Steers	Bulls	Steers	Bulls	Steers	Bulls	Steers	Charolais	Crossbred	Hereford
Number of animals	6	6	11	13	4	1	21	20	12	24	5
Birth weight, lb.	85.8	87.3	84.0	83.0	77.0	78.0	83.0	83.0	86.0	83.5	77.5
Weaning weight, lb.	588	613	644	574	536	547	603	577	600	609	541
260 Day adjusted weaning weight	673	640	645	624	538	618	642	627	656	651	579
Avg. daily gain, birth to weaning	2.25	2.11	2.28	2.08	1.82	2.08	2.16	2.09	2.18	2.17	1.95
Avg. daily gain, full feed	2.50	2.39	2.42	2.05	2.51	1.94	2.47	2.11	2.45	2.24	2.23
Final weight/day of age	2.32	2.21	2.32	2.06	2.11	1.96	2.28	2.07	2.27	2.20	2.04
Feed/cwt.											
Corn	553	587	573	775	507	630	544	664	570	674	568
Soybean oilmeal	58	60	58	82	56	73	57	72	59	70	65
Hay	80	83	80	112	76	102	79	99	82	97	89
Total feed/cwt.gain	691	739	711	969	638	804	670	837	715	840	721

At weaning, the calves were divided into groups by breed and sex. They were fed in these groups until slaughter.

The ration consisted of a full feed of ground ear corn, 1.5 lb. of soybean oilmeal, and 2 lb. of good mixed hay per head per day. Salt and mineral were given free choice. All feed was weighed and all cattle were weighed every 28 days.

When the calves reached 1000 lb. (+ or - 30 lb.), they were sent to the Meat Laboratory at Ohio State University for slaughter and carcass data.

Table 1 gives the 2-year least-squares analysis for live traits of bulls and steers in this trial. Table 2 expresses the carcass measurements compared for all cattle slaughtered.

Results

The results of this experiment verify previous experiments that more red meat of similar grade, flavor, and tenderness with less total feed can be produced by young bulls than steers of similar age.

The yearly differences between the groups of cattle in this experiment were significant for weaning weight, average daily gain birth to weaning, and carcass traits of flavor and final grade.

There was a significant difference in favor of bulls for average daily gain on full feed, slaughter and carcass weights, loin eye area, and feed per pound of gain. Bulls had significantly less fat covering and lower marbling score.

Both the year and sex of the cattle significantly affected the final weight per day of age, carcass weight, and marbling score in this experiment. The only difference approaching significance for breed of sire was fat thickness in favor of the Hereford.

There were no significant differences in birth weights or carcass tenderness for any variable analyzed.

TABLE 2. Two Year Average Carcass Traits of Bulls and Steers

	Charolais		Crossbred		Hereford		All	All	All	All	All
	Bulls	Steers	Bulls	Steers	Bulls	Steers	Bulls	Steers	Charolais	Crossbred	Hereford
Slaughter wt., lb.	973	941	967	929	988	919	974	930	957	948	954
Chilled carcass weight, lb.	595	572	584	554	592	553	588	559	584	569	572
Dressing percentage	61.1	60.8	60.3	60.0	59.8	60.0	60.4	60.2	60.9	60.2	59.9
Carcass grade[a]	16	17	17	19	18	17	17	18	17	18	18
Marbling score[b]	3.5	4.0	3.8	4.8	4.6	4.5	3.9	4.5	3.8	4.3	4.5
Fat thickness, in.	.15	.23	.22	.31	.36	.38	.24	.31	.19	.27	.37
Tenderness[c]	6.1	6.8	6.5	7.1	6.9	6.2	6.5	6.9	6.4	6.8	6.6
Rib-eye area, sq.in.	12.3	11.6	12.1	10.7	11.0	9.6	11.9	10.9	12.0	11.5	10.3
Flavor	6.1	6.6	6.6	6.8	6.7	6.7	6.5	6.7	6.4	6.7	6.7

[a] Low good = 16; avg. good = 17; high good = 18; low choice = 19; avg. choice = 20.

[b] Slight = 4; small = 5; modest = 6.

[c] Extremely tough 1 to 10 extremely tender.

PERFORMANCE OF CATTLE IN A STRIPMINE FEEDLOT

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Housing, manure disposal, mud, bedding shortage, stream pollution, and cattle performance are interrelated problems of the Ohio cattle feeder. Costs of construction, bedding, and labor; location of the feedlot; and numerous other considerations make the planning of new facilities extremely difficult. Results from around the nation have varied regarding a need for shelter for fattening cattle. This requirement is likely to be influenced by local conditions and hence needs to be studied under a variety of circumstances.

In late 1968, the Ohio Agricultural Research and Development Center completed a new cattle feeding facility at Wooster. In some research projects it is difficult to keep the cattle involved from eating bedding in varying amounts. To eliminate this source of experimental error and also because of bedding and labor costs, a slotted floor unit with liquid manure pits was constructed. The pens of this unit are covered with a flat roof but are not enclosed with walls.

The Eastern Ohio Resource Development Center at Caldwell is composed of two units. Unit 2 consists of slightly more than 1300 acres of land which has been strip mined. The method of mining consisted of uncovering a relatively narrow strip of the coal vein around the hills and then augering coal from beneath the sandstone overlay. Thus, the land below the coal vein was left in a very rough condition and a rock high wall remains immediately above the vein. However, the floor of the exposed vein is relatively smooth and contains a high proportion of stone. It was used as a haul road to remove the coal in large trucks. Several miles of this abondoned haul road remain at Unit 2 of EORDC. The high wall on the upper side serves as a very effective fence and also provides considerable wind protection.

Approximately 1/2 mile of this haul road was enclosed at the ends and lower side with a barbed wire fence. Water was supplied from a pond constructed on the undisturbed land above the coal vein and feed was supplied as a complete mixed ration in a self-feeder. No bedding was used and no effort is being made to remove the manure. The streams in this area are already badly polluted by run-off from the strip mines.

A group of 38 steer calves of mixed Charolais, Angus, and Hereford breeding raised at EORDC were used in this experiment. They were weighed and implanted with 30 mg. of stilbestrol per head on Nov. 18, 1968. The calves were separated at random within breed and weight classes into two comparable groups. One group was taken to the stripmine feedlot and the other was trucked to Wooster and placed in the new feeding unit with slotted floors. Both groups of cattle were full fed 2 tons of ration B-3-67 and were then switched to ration Nu-18. These mixtures were hauled by bulk truck to Caldwell and placed in the self-feeder.

The feed mixtures used and results obtained during a 200-day feeding experiment are presented in Table 1. No final conclusions should be drawn from these limited data. The number of animals used was relatively small and the results of such an experiment are difficult to compare. Initial weights were taken at the same time and place under the same conditions. However, the final weights were taken under different conditions on different days and may have involved varying amounts of fill. The shrinkage obtained in the initial hauling of the group to Wooster is included in the gain made by that group.

TABLE 1. Performance of Steer Calves Fed Under Two Environmental Conditions

1968-69 Experiment

	Stripmine Lot	Slotted Floor Pens
No. steers	17	18
Avg. initial wt., Nov. 18, lb.	450	449
Avg. final wt., lb.	944	922
No. days on feed	204	201
Avg. daily gain, lb.	2.42	2.35
Avg. daily ration, lb.	15.3	15.8
Feed per cwt. gain, lb.	630	672
Dressing percentage	58.9	60.6
Marbling score[a]	4.47	4.28
Fat thickness, in.	0.23	0.36
Kidney knob, %	2.42	2.79
Rib eye area, sq. in.	11.9	11.9
Quality grade[b]	18.1	17.6
Cutability grade	1.75	2.23

[a] Marbling score: Traces, 3; slight, 4; small, 5.

[b] Quality grade: Good, 17; high good, 18.

Ingredient	B-3-67	Nu-18
Ground shelled corn	51.0	78.0
Soybean meal, 50%	12.0	--
Soybean meal, 44%	--	9.5
Ground corn cobs	35.0	10.0
Pulverized limestone	1.0	1.0
Trace mineral salt	1.0	1.0
Dicalcium phosphate	--	0.5
	100.0	.00.0

Both rations are also fortified with 1,500 I.U. Vitamin A, 350 I.U. Vitamin D and 10 grams of aureomycin per pound.

Steers fed the high energy ration (Nu-18) in the stripmine lot chewed bark from the fence posts and chewed on branches of a dead tree in the lot. One steer died and upon post mortem was found to have a ruptured abomasum caused by a small, sharp stick which had been swallowed.

Although differences in hauling, weighing conditions, etc. make it difficult to compare the two groups, they both made satisfactory gains. Steers fed in the stripmine lot gained slightly faster but also had a slightly lower dressing percentage. If gains are calculated on a carcass basis, daily gains and feed requirements per unit of gain are nearly identical for the two groups.

In a second experiment in 1969-70, the stripmine feedlot was compared with a more conventional type feedlot located at the Southeastern Branch in Meigs County. This lot consisted of a shed bedded with straw and open to a stone paved lot to the east. Both groups were on a self-feeder on the same rations delivered by bulk truck. They were full-fed 3 tons of ration B-3-67 and then were switched to ration Nu-18 for the remainder of the feeding period.

The cattle used in this trial were raised at the Southern Branch, Brown County; Southeastern Branch, Meigs County; and EORDC, Noble County. They were weaned, weighed, and graded in late October and moved to the two feedlots where starting weights were taken on Nov. 4 and 5 at which time the steers were implanted with 30 mg. of stilbestrol and the heifers with 120 mg. testosterone and 24 mg. stilbestrol per head.

Twenty-three mixed Charolais, Hereford, Angus heifers and 37 steers consisting of 8 Angus, 6 Charolais and 23 mixed Charolais, Hereford, Angus were divided as equally as possible to make up the two lots of 30 head each.

The cattle at the Southeastern Branch experienced some temporary ruminitis at the time rations were switched. They ate some straw when they were bedded and were much more confined than the stripmine lot cattle. These were the only differences noticed or experienced between the two lots.

The cattle in the more confined, partly covered lot seemed to finish faster. They were slaughtered in three groups. One heifer was slaughtered March 25 at 975 lb. Nine steers and two heifers were slaughtered April 20 and the remaining nine steers and nine heifers were slaughtered May 26. The cattle from the stripmine lot were slaughtered in one group on June 12, 1970.

The performance of the cattle in the two feedlots is presented in Table 2.

The cattle were weighed on different scales, marketed at different times, and through different slaughter plants. However, the cattle in the conventional lot finished earlier with somewhat more desirable carcasses. Both lots performed satisfactorily with respect to rate of gain.

TABLE 2. Performance of Steer and Heifer Calves
Fed Under Two Environmental Conditions
1969-70 Experiment

	Stripmine Lot			Conventional Lot		
	Steers	Heifers	Lot	Steers	Heifers	Lot
No. of animals	19	11	30	18	12	30
Avg. initial weight, lb.	448	418	437	470	444	447
Avg. final weight, lb.	1075	851	942	948	835	892
Avg. no. days on feed	220	220	220	184	190	186
Avg. daily gain, lb.	2.49	1.97	2.30	2.60	2.05	2.37
Avg. daily ration, lb.			17.3			16.1
Feed per cwt. gain, lb.			753			677
Dressing percentage	60.6	60.2	60.5	60.8	60.9	60.9
Marbling score[a]	4.47	5.00	4.67	5.44	5.50	5.47
Fat thickness, in.	0.31	0.32	0.31	0.46	0.50	0.48
Kidney knob, %	2.41	2.60	2.48	2.79	3.13	2.93
Rib eye area, sq. in..	11.5	9.7	10.8	11.6	10.7	11.3
Quality grade[b]	17.7	18.0	17.8	18.9	19.3	19.1
Cutability grade	2.35	2.66	2.47	2.75	2.89	2.80

[a] Marbling score: Traces, 3; slight, 4; small, 5.

[b] Quality grade: Good, 17; high good, 18.

FEEDING PROCESSED GARBAGE TO RUMINANTS

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Department of Animal Science

A study has been conducted at the Ohio Agricultural Research and Development Center to explore the possibilities of feeding processed garbage to ruminants. An Ohio engineering firm has developed a method of removing metal, glass, and plastic from household garbage. The remaining organic content is then processed. The resulting dry product (Fairfield dehydrated tablage) has been marketed as a soil organic humus builder.

Garbage processed in this way contains considerable amounts of cellulose, protein, and other components found in feeds for ruminant animals. If suitable as a feed, it could contribute not only to the solution of a solid waste disposal problem but also to the production of food for human consumption.

A study was designed to determine the acceptance and palatability of processed garbage by beef cattle and sheep and to determine its digestibility by sheep. Three *cellulose* (no concentrate) and three *concentrate* (50% concentrate) rations were formulated, incorporating this material as shown in Table 1. During preliminary acceptance trials it was learned that this product could be fed in meal form when mixed with ground, shelled corn with no apparent sorting of ration components. However, in the studies reported here, all rations were pelleted.

Palatability Trials

Six individually fed beef steers (averaging 671 lb. at the start of the experiment) were assigned to the six rations investigated. The analyses of the rations are reported in Table 2. These trials were designed so that one set of three animals was fed the cellulose rations and another set of three animals was fed the concentrate rations. Within each set, each steer was fed one of the three rations for a 14-day period. Voluntary intake was determined for the last 4 days of each 14-day period. The rations were then switched until each animal had been fed each of the three rations within the set. The intake data for the cattle and sheep are reported in Table 3.

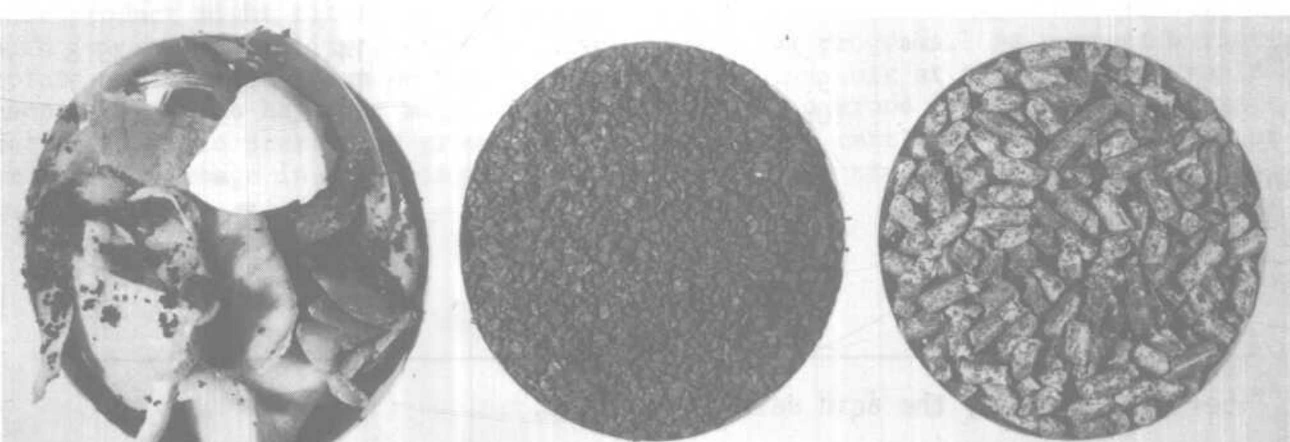

Table garbage (like that at left) is processed into organic humus builder (center). This product was fed in a pelleted ration (right) to ruminants.

TABLE 1.--Ration Ingredients in Studies of Palatability and Acceptance of Processed Garbage by Cattle and Sheep.

Ration Number	Ingredients (Percent)		
	13% Alfalfa	Processed Garbage	Ground Shelled Corn
Cellulose			
1	100	--	--
2	75	25	--
3	50	50	--
Concentrate			
4	50	--	50
5	25	25	50
6	--	50	50

TABLE 2.--Analysis of Processed-Garbage Rations Fed to Ruminants.

Ration Number	Dry Matter	Ash	Cellulose	Protein	Fiber*
Cellulose	Percent (Moisture-Free Basis)				
1	93.0	7.5	24.6	14.8	35.8
2	91.8	9.0	28.1	16.7	39.7
3	90.4	10.6	38.9	17.4	52.5
Concentrate					
4	96.0	4.2	12.9	11.8	18.5
5	93.9	6.5	19.3	13.4	27.8
6	92.2	8.5	25.4	14.1	33.1

*Fiber determined by the acid detergent method.

Voluntary intake was also measured with wethers (averaging 101 lb. at the start of the experiment) during the process of conducting a digestion trial. Voluntary intake was reported for the last 4 days of each 3-week period before the animals were switched to other rations.

Digestion Trial

The digestion trial procedure involves measuring the quantity of a nutrient consumed and subtracting the quantity of a nutrient lost in the feces during a short experimental period. The difference is considered to be the amount digested. Feces is collected for chemical analyses.

Digestibility coefficients are reported in Table 4. All feed refused by the sheep was weighed and recorded. Each morning the wethers were fed 10 percent more than they had eaten the previous day.

The design of this trial was similar to the palatability trial with cattle. The exceptions were that sheep were used and the length of the feeding period on each ration was 21 days rather than 14 days. Three animals were used for each set of rations, as in the palatability trials.

The voluntary intake data (Table 3) indicate that both cattle and sheep ate the processed garbage in quantities similar to that expected with more conventional rations. Intake of the concentrate rations was less than with the cellulose rations because the energy level was greater in the concentrate rations. The intake per unit of metabolic size has been included to remove animal size differences in comparing consumption of the several rations. It may be noted that the intake per unit of metabolic size for a particular ration was similar whether fed to cattle or sheep.

The dry matter digestibility of the concentrate rations tended to be higher than with the cellulose rations. Cellulose digestibility tended to increase with increasing levels of processed garbage. The fiber digestibility followed the same pattern as the cellulose digestibility with rations containing processed garbage.

From the work completed on this product, it would appear that processed garbage can be used in ruminant rations. Feeding recommendations cannot be made at this time, however, due to the limited research to date. It seems logical to assume that this product might fit in with practical feeding situations with a few modifications both in product quality control and type of feeding programs. At current market prices, this product can be produced and marketed in bulk at a price which would be competitive with hay. It might be incorporated into brood cow or ewe maintenance rations or into starter or grower rations for feeder cattle or lambs. The use of processed garbage in finishing rations should also be studied.

TABLE 3.--Average Daily Voluntary Intake by Ruminants of Rations Containing Processed Garbage.

Ration Number	Average Daily Intake		Intake per Unit of Metabolic Size*	
	(lb.) Steers	(lb.) Wethers	(gm.) Steers	(gm.) Wethers
Cellulose				
1	22.9	4.94	129.2	113.5
2	21.5	4.63	121.7	107.9
3	15.9	4.03	90.8	95.8
Concentrate				
4	12.4	3.71	77.1	90.8
5	16.6	3.81	104.1	92.8
6	13.4	2.85	82.1	80.4

*Metabolic size is a unit related to biological functions of the body which enables nutritionists to more accurately compare feed intake of animals of different sizes such as cattle and sheep.

TABLE 4.--Digestibility of Rations Fed to Cattle and Sheep.

Ration Number	Dry Matter Digestibility	Cellulose Digestibility	Protein Digestibility	Fiber* Digestibility
	%	%	%	%
Cellulose				
1	49.6	33.0	52.9	29.0
2	45.2	38.2	56.1	27.4
3	37.6	47.2	51.8	34.2
Concentrate				
4	65.3	28.1	55.9	20.6
5	62.2	41.3	55.7	35.5
6	63.6	55.7	60.0	42.0

*Fiber determined by the acid detergent method.

CHEMICAL ANALYSES OF INGREDIENTS USED IN BEEF CATTLE RATIONS

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Department of Animal Science

The ingredients used in beef cattle rations during the past year have been analyzed for the chemical constituents reported in Table 1. The proximate analyses plus some of the mineral analyses were conducted in the Department of Animal Science laboratories. The balance of the mineral analyses were conducted in the Plant Analysis Laboratory, Department of Agronomy.

An attempt has been made to analyze ingredients from all rations formulated for beef cattle during the year. Some of the ingredients have been omitted from this report due to insufficient data. The data reported are average values obtained from all analyses conducted on specific ingredients.

These data should be more useful than general "book values" to interested beef cattle producers in Ohio since the ingredients analyzed more nearly represent those available at the present time to area farmers.

An additional advantage of routine analyses of ration ingredients is the specific information obtained for each experimental ration employed. This allows the researcher to evaluate the results of his investigation more critically. When recommendations are to be made from research conducted, specific ingredient composition should be available rather than "average" values. This is more critical in some investigations than others.

This is the first year that this information has been available in the Ohio Beef Cattle Summary. However, it is anticipated that current data will be reported each year. More ingredients will be incorporated and more complete details on each ingredient will be possible in subsequent compilations.

TABLE 1. Chemical Analyses of Ingredients Used in 1969-70 Beef Cattle Rations[a,b]

Ingredient	Dry Matter	Protein	Ash	Fiber[c]	Calcium	Phosphorus	Potassium	Magnesium	Copper	Iron	Molybdenum	Zinc
	%	%	%	%	%	%	%	%	ppm	ppm	ppm	ppm
Alfalfa												
-Dehydrated,ground 17% protein	93.3	17.9	8.3	37.3	1.60	0.33	2.45	0.20	13.0	300	1.8	29.0
Corn												
-Cobs, ground	94.2	1.6	1.0	48.5	-	0.09	0.72	0.37	6.6	72	0.3	25.4
-Silage (0.5% limestone added)	31.9	2.6	1.4	10.0	0.14	0.36	0.95	0.14	9.0	206	0.4	34.0
-Ears, ground	88.4	8.0	1.3	12.4	-	-	-	-	-	-	-	-
-Grain	87.3	8.0	1.3	-	-	0.43	0.46	0.36	6.7	30	0.9	29.0
Dicalcium Phosphate	97.4	-	82.2	-	-	-	0.40	0.62	12.0	2613	-	34.0
Limestone (feed grade)	100.0	-	-	-	37.00	0.17	0.50	0.29	16.0	2044	-	23.0
Molasses (87+% Cane blackstrap-42% sugars or more - dried on soybean mill feed)	93.9	7.8	6.1	-	0.88	0.15	2.81	0.39	17.2	598	1.8	0.3
Soybean												
-Hulls (soybran flakes)	90.8	9.4	3.6	49.3	0.61	0.16	1.37	0.20	12.5	772	1.1	61.0
-Meal, 44% C.P.	88.8	42.8	5.3	-	0.32	0.69	2.26	0.23	25.0	314	3.4	71.0
-Meal, 49% C.P.	89.3	47.9	5.7	-	0.37	0.78	2.38	0.24	31.4	234	2.4	81.0

[a] All values are reported on an as fed basis.

[b] Blank spaces indicate that the value was not determined.

[c] Acid detergent fiber.

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American Cyanamid Co., Princeton, N. J.
International Minerals and Chemical Corp., Skokie, Ill.
Tuco Products Co., Kalamazoo, Mich.
Superior Packing Co., Massillon, Ohio
Ohio Packing Co., Columbus, Ohio
Diamond Laboratories, Des Moines, Iowa

The State Is the Campus for Agricultural Research and Development

Ohio's major soil types and climatic conditions are represented at the Research Center's 11 locations. Thus, Center scientists can make field tests under conditions similar to those encountered by Ohio farmers.

Research is conducted by 13 departments on more than 6200 acres at Center headquarters in Wooster, nine branches, and The Ohio State University.

Center Headquarters, Wooster, Wayne County: 1953 acres

Eastern Ohio Resource Development Center, Caldwell, Noble County: 2053 acres

Jackson Branch, Jackson, Jackson County: 344 acres

Mahoning County Farm, Canfield: 275 acres

Muck Crops Branch, Willard, Huron County: 15 acres

North Central Branch, Vickery, Erie County: 335 acres

Northwestern Branch, Hoytville, Wood County: 247 acres

Southeastern Branch, Carpenter, Meigs County: 330 acres

Southern Branch, Ripley, Brown County: 275 acres

Western Branch, South Charleston, Clark County: 428 acres