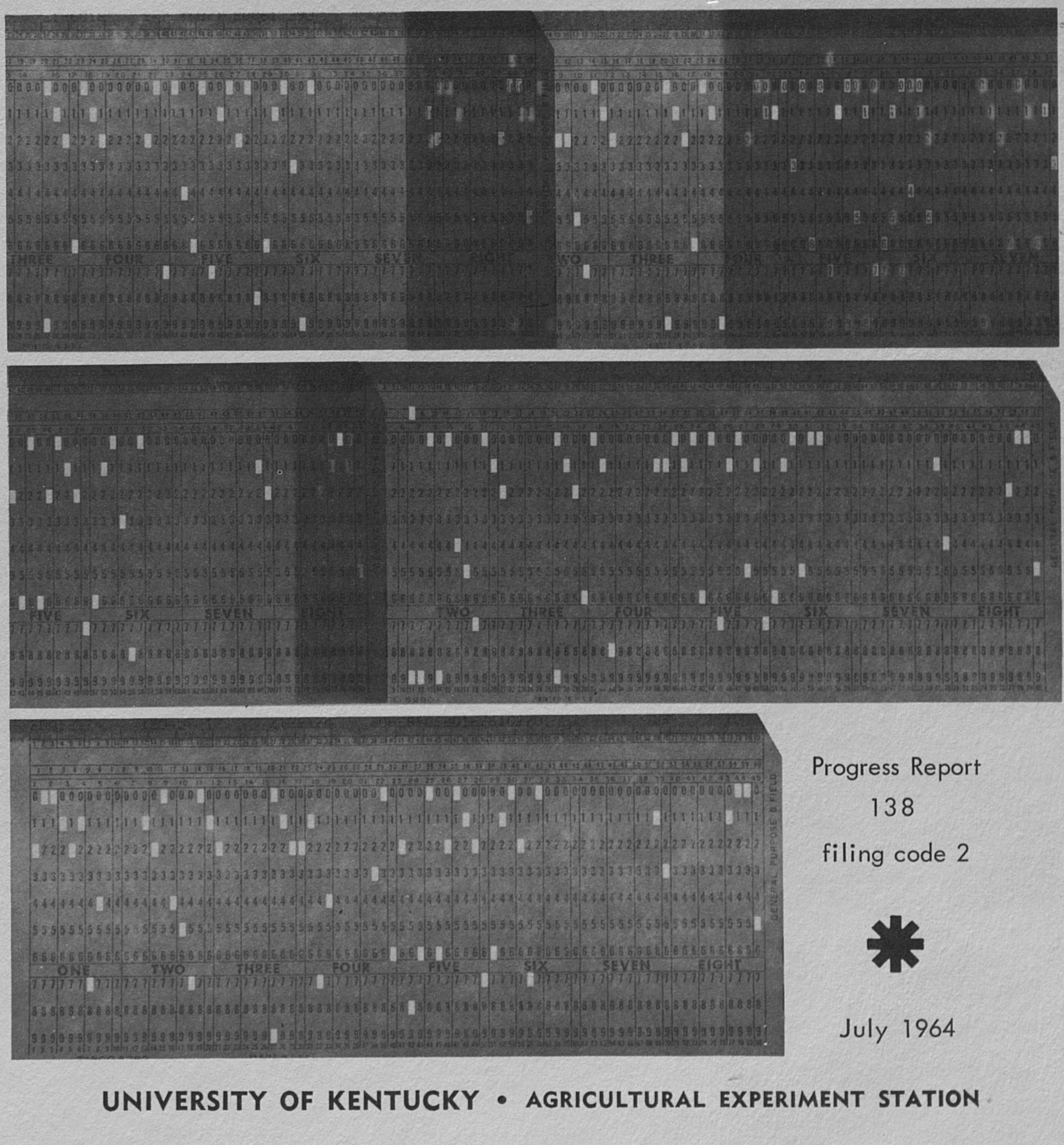
Kentucky ANIMAL SCIENCE RESEARCH REPORTS *1964*



Progress Report
138
filing code 2

July 1964

UNIVERSITY OF KENTUCKY • AGRICULTURAL EXPERIMENT STATION

PROGRAM FOR 1964 ANNUAL LIVESTOCK FIELD DAY

LEXINGTON

July 15, 1964

Morning

Chairman -- C. Frank Buck

Coldstream Farm -- Conducted tours showing beef, sheep and swine research will start at regular intervals, beginning at 9 a.m. (EST). Last tour starts at 10 a.m.

Noon

Lunch

Courtesy of G. W. Gardner, Bluegrass Stockyards, Lexington

PRINCETON

July 17, 1964

Morning

Chairman -- Paul P. Appel

Livestock Farm West Kentucky Substation. Conducted tours showing beef, sheep and swine research will start at regular intervals beginning at 9 a.m. (CST). Last tour starts at 10 a.m.

Noon

Lunch

Courtesy of Farmers Elevators, Inc. and Field Packing Company, Owensboro

Afternoon

Chairman -- W. P. Garrigus

1:15 Address -- "Livestock Production in a Changing Economy." J. A. Hoefer, Professor of Animal Science, Michigan State University

(Cover Illustration: The IBM punch cards, intended for computer processing, symbolize some of the newer techniques used in animal science research.)

KENTUCKY

ANIMAL SCIENCE RESEARCH REPORTS

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UNIVERSITY OF KENTUCKY

AGRICULTURAL EXPERIMENT STATION

CONTENTS

MEATS SECTION (Continued) Page

SWINE SECTION

BEEF CATTLE SECTION

VOLATILE FATTY ACID PRODUCTION AND PERFORMANCE OF STEERS FED DIFFERENT LEVELS AND PHYSICAL FORMS OF HAY AND CORN

James T. Thompson, N. W. Bradley and C. O. Little
University of Kentucky

Beef cattle have long been known to utilize high-grain rations for meat production less efficiently than simple-stomach animals. During the past few decades much work has been conducted to improve the efficiency of beef production. It has been found that carbohydrates are broken down to volatile fatty acids (VFA) by the rumen microorganisms and the acids are utilized as energy sources. Acetate and propionate are the two acids found in highest concentration in rumen fluid. Acetate is usually the more prevalent of the two, but propionate is believed to be utilized more efficiently under certain conditions. A shift in the production from acetate to propionate has been proposed as a means of increasing the efficiency of gains by ruminants.

Several factors have been found to shift the acetate-propionate ratio to favor a greater percent of propionate, including grinding, pelleting, or decreasing the roughage, increasing the concentrates in the ration, treating the feed with heat, and flaking of the grain portion of the ration.

This experiment was designed to study the VFA ratios in rumen fluid and feedlot performance of cattle consuming rations containing no hay, long hay, or ground hay with flaked corn or ground corn.

Forty-eight Angus steers of medium flesh, averaging 750 pounds each, were allotted to six different treatments with eight steers on each. They were as follows:

Ration 1 - No hay and flaked corn
Ration 2 - No hay and ground corn
Ration 3 - Long hay and flaked corn
Ration 4 - Long hay and ground corn
Ration 5 - Ground hay and flaked corn
Ration 6 - Ground hay and ground corn

All rations were supplemented to meet NRC requirements for crude protein, calcium and phosphorus. A complete trace mineral mix and 450 I. U. of vitamin A per pound of ration were also added.

At the beginning of the experiment each steer received a 24 mg implant of stilbestrol. The rations were self-fed, and ground alfalfa hay was mixed with the feed, whereas, the long alfalfa hay was hand fed, both at the rate of 4 pounds per head per day. After a 10-day preliminary period, the steers were fed for 111 days in lots of two steers each, during which time data on gains and feed consumption were collected. Rumen samples were taken by stomach tube at 0, 14, 28, 56, 84 and 111 days during the trial. Measurements of pH were made, and the samples were analyzed for VFA by use of gas chromatography. At the end of the trial the animals were slaughtered and data on carcass measurements were collected. Summaries of the results are given in Table 1.

Steers receiving ground hay and long hay gained an average of 0.7 and 0.5 lb more per head daily, respectively, than steers receiving no hay. During the first 56 days of the trial, the steers fed no hay gained 0.8 lb. per day less than did those on long or ground hay. There were no significant differences in ADG during the last 55 days of experiment. There were significant differences in feed consumption but not feed efficiency due to hay

Table 1 - Feedlot Performance, Carcass Measurements and Rumen Sample Data of Steers Fed No Hay, Long Hay or Ground Hay with Flaked or Ground Corn

	No hay F corn	No hay G corn	Long hay F corn	Long hay G corn	G hay F corn	G hay G corn
Feedlot Data						
No. steers	8	8	8	8	8	8
Initial wt, lb	751	749	741	741	748	752
Final wt, lb	983	969	1008	1036	1068	1038
ADG (0-56 day), lb	1.96	1.77	2.65	2.65	2.76	2.64
ADG (56-111 day), lb	2.48	2.32	2.15	2.66	3.01	2.50
ADG (0-111 day), lb	2.03	1.98	2.40	2.65	2.88	2.57
Feed cons., lb	16.2	17.0	20.6	22.1	21.9	21.6
Feed/cwt gain, lb	813.6	867.3	809.8	756.7	764.7	848.9
Average ration						
Corn, lb	13.8	14.5	15.1	16.5	16.5	16.2
Supplement, lb	2.4	2.5	1.5	1.6	1.5	1.6
Hay, lb	--	--	4.0	4.0	3.9	3.8
Carcass Data						
Dressing %	60.5	60.9	62.2	63.4	62.7	61.5
U.S. Grade [a]	11.6	11.1	13.4	12.8	12.6	11.9
Marbling score [b]	5.25	4.88	6.63	6.00	5.88	5.38
Dual grade [c]	3.00	2.75	3.00	3.00	3.25	3.38
Loin eye area, sq in.	11.0	10.9	11.0	11.7	11.4	11.4
Loin eye/cwt body wt	1.13	1.13	1.10	1.13	1.07	1.10
Fat over eye, in.	0.58	0.50	0.67	0.72	0.68	0.58
Kidney fat, %	2.63	2.88	2.94	3.25	3.13	3.06
Rumen pH						
Av pH (0-56 day)	5.99	5.69	6.40	6.25	6.06	6.00
Av pH (56-111 day)	5.51	5.53	6.25	6.36	6.09	5.60
Av pH (0-111 day)	5.81	5.61	6.34	6.29	6.07	5.81
VFA Concentration - (Average 0-111 Days)						
C_2 (molar %)	39.5	38.3	46.0	45.1	41.1	41.6
C_3 (molar %)	41.0	39.7	34.4	36.3	41.2	39.7
C_4 (molar %)	11.5	13.4	13.0	11.2	11.0	12.0
i - C_5 (molar%)	2.6	2.9	3.1	3.1	2.6	3.2
n - C_5 (molar %)	5.4	5.8	3.5	4.4	4.1	3.6
C_2/C_3	1.02	1.04	1.37	1.30	1.01	1.05
C_3/C_4	3.70	3.37	2.78	3.46	3.68	3.37
C_2/C_4	3.57	3.11	3.63	4.18	4.00	3.53
Total VFA (micromoles/ml)	141.9	169.6	118.6	134.4	137.0	170.4

a 11 = high good, 12 = low choice, 13 = av choice
b 4 = slight, 5 = small, 6 = modest
c The lower the dual grade the higher the percent of carcass wt that is lean cuts.

F = flaked; G = ground

treatment. The physical form of corn did not significantly effect feedlot performance. Dressing percentage and carcass grade of steers fed no hay were significantly less than steers receiving ground hay. Dual grade was significantly higher on steers fed ground hay than those fed no hay or long hay.

Steers receiving long hay had a significantly higher molar percentage of acetate with a correspondingly lower percentage of propionate (C_2/C_3 = 1.34) than steers fed no hay (1.02) or ground hay (1.03). They also had a significantly lower total VFA concentration (126.5 micromoles/ml) than steers fed no hay (155.7) or ground hay (153.7). Rumen fluid of steers fed flaked corn contained significantly less total VFA (132.5 micromoles/ml) than steers on ground corn rations (158.1). Arithmetic averages of ruminal pH were significantly affected by hay treatments. They were: no hay - 5.7, long hay - 6.3 and ground hay - 5.9.

Changes in the acetate-propionate ratio due to removing or grinding the roughage were similar to shifts reported by other investigators; however, contrary to most reported results there was no difference in the ratio produced from flaked compared with ground corn. The decreased ADG of steers fed no hay during the first 56 days of the experiment deserves further study.

TYLOSIN FOR BEEF STEERS ON PASTURE

Dennis Herd, N. W. Bradley and David McKechnie
University of Kentucky

Cattlemen are constantly alert for ways of improving the performance of steers used in grazing programs. The value of stilbestrol in such programs is well established. The values of antibiotics and various means of administering them are not so well established. Data reported by this Station last year suggested that the antibiotic tylosin, when administered in a sustained release bolus to grazing steers implanted with stilbestrol, would increase steer gains over those obtained with stilbestrol alone. The purpose of this experiment was to obtain further information on the response of grazing steers to tylosin boluses.

Forty 600-pound yearling Angus steers of medium flesh were allotted to four groups for the following treatments:

1. Control
2. STEP bolus
3. Tylosin bolus at 14-day intervals
4. Tylosin bolus at 42-day intervals

Each STEP bolus contained a total of 6 grams of antibiotic activity composed of 7 parts streptomycin, 7 parts tylosin, 7 parts erythromycin, and 4 parts penicillin. Steers on the STEP treatment received one STEP bolus each at the beginning of the experiment.

Each tylosin bolus contained 6 grams of tylosin activity. All steers receiving tylosin were bolused with one bolus each at the beginning of the experiment. One group was then rebolused at 14-day intervals, and the other group was rebolused at 42-day intervals.

All steers were implanted with 24 mg of stilbestrol and grazed together on two 25-acre bluegrass-white clover pastures which were rotated as pasture conditions dictated during the 154-day trial.

The steers were held off feed with access to water over night before each weighing. Weights were taken at 14-day intervals throughout the trial. Initial and final weights were the average of two weighings taken the same morning.

The results of this experiment are summarized in Table 1. No increase in average daily gain was obtained from using STEP boluses. Use of tylosin boluses at 14- and 42-day intervals resulted in increased daily gains of 0.20 and 0.26 lb per head daily,

Table 1 - Effect of Antibiotics on Grazing Steer Performance

	Control	STEP [a]	Tylosin [b] 14-days	Tylosin [c] 42-days
Number of steers	10	10	10	10
Initial weight, lb	600	596	599	601
Final weight, lb	768	771	797	808
Total gain, lb	168	175	198	207
Total A. D. G., lb	1.09	1.14	1.29	1.35
A. D. G. [d] by Periods				
0-14 days	1.53	.94	1.11	1.60
14-28 days	1.39	1.50	2.00	1.61
28-42 days	1.54	2.14	2.14	1.86
42-56 days	1.07	1.32	1.25	1.89
56-70 days	-.43	-.43	.18	-.21
70-84 days	-.14	.29	-.04	.50
84-98 days	1.71	1.50	1.71	1.82
98-112 days	1.61	1.36	1.75	1.96
112-126 days	1.36	1.21	1.61	1.54
126-140 days	1.93	2.39	2.36	2.36
140-154 days	.40	.29	.06	-.09

a/ STEP boluses were given at the beginning of the experiment only

b/ Tylosin boluses were administered at the beginning and repeated at 14-day intervals.

c/ Tylosin boluses were administered at the beginning and repeated at 42-day intervals.

d/ Average daily gain.

respectively. These differences were not statistically significant because of the large within-treatment variation that existed. Bolusing with tylosin at 42-day intervals was just as effective as bolusing at 14-day intervals. This would seem to indicate that the effective level of tylosin was being supplied for the 42-day period by one bolus and that additional tylosin supplied by bolusing at 14-day intervals was of little value. This is in contrast to results reported last year which suggested the effective life of the bolus was only two weeks.

In this experiment different period gain patterns were found for the 42-day tylosin treatment than were reported for a similar treatment last year. Gain by periods after bolusing is summarized in Table 2 for steers which received tylosin at 42-day intervals. In this experiment, bolusing with tylosin every 42 days produced substantial increases in gain the first and third two-week periods after bolusing and only a small increase in gain during the second two-week period. This lack of response to tylosin during the second two-week period after bolusing can be accounted for entirely by the negative gain of tylosin-treated steers during the last two weeks of the grazing season. It can be seen in Table 2 that this is a different gain pattern than that reported last year for a similar treatment where a substantial increase in gain was obtained only during the first two weeks after bolusing. Last year's response to tylosin during the first two weeks after bolusing and little or no response from 14 to 42 days after bolusing would indicate that the tylosin time-release bolus was effective only during the first two weeks. However, the results this year show as much response from 28 to 42 days after bolusing as for any of the other periods. This would indicate that the effective life of the bolus was at least 42 days and possibly longer.

Table 2 - Average Daily Gain of Steers at Different Times After Bolusing

	Time After Bolusing					
	0 - 14 days		14 - 28 days		28 - 42 days	
	C [a]	T [b]	C [a]	T [b]	C [a]	T [b]
First Bolus, lb	1.53	1.60	1.39	1.61	1.54	1.86
Second Bolus, lb	1.07	1.89	-0.43	-0.21	-0.14	0.50
Third Bolus, lb	1.71	1.82	1.61	1.96	1.36	1.54
Ninth Bolus, lb	1.93	2.36	0.40	-0.09		
Average of this experiment, lb	1.56	1.92	0.74	0.82	0.92	1.30
Average reported last year, lb	1.01	1.39	1.44	1.52	1.31	1.23

a/ Control
b/ Tylosin at 42-day intervals

The reason for the difference in gain patterns obtained for the two different years is not fully understood. Work is now in progress on a more intensive type of study which may provide answers to some of the questions which have arisen.

EFFECT OF CIODRIN-TREATED BACKRUBBERS AND RID-EZY (RONNEL) FED FREE CHOICE ON FLY CONTROL, GRUB CONTROL AND RATE OF GAIN

(Department of Entomology and Botany and Department of Animal Science Cooperative Project)

F. W. Knapp, N. W. Bradley and W. C. Templeton
University of Kentucky

In recent years considerable progress has been made in developing new and more effective insecticides for horn fly and grub control. Considerable effort has been expended in studying different methods of applying these insecticides to animals. Backrubbers treated with certain insecticides have proven to be very effective in controlling horn flies on cattle. Either oral administration or "pour on" application of other insecticides has very effectively controlled grubs. It would be highly desirable to find an insecticide and a simple method of application which would control flies during the summer and also prevent the occurrence of grubs in the backs of cattle the following spring.

During the past three or four years face flies have caused considerable discomfort to cattle in northern and central Kentucky. Any method of controlling this recent pest would certainly be welcomed. This experiment was conducted to study the effect of Ciodrin-treated backrubbers and Rid-Ezy (ronnel incorporated into a mineral block) fed free choice on horn fly control, face fly control, grub control and rate of gain of yearling steers.

Forty-eight lightweight yearling Angus steers were used in this study. The steers were randomly divided into two groups of 24 each. One group was provided access to a Ciodrin-treated backrubber, whereas the other group was given the Rid-Ezy blocks free choice. The group receiving Rid-Ezy blocks did not receive any other supplemental minerals. Plain loose salt, steamed bonemeal, and ground limestone were provided free choice to the other group. The burlap backrubbers were treated with 1 percent Ciodrin EC in No. 2 fuel oil. Each backrubber was saturated with about 1 gallon of the solution to every 20 linear feet at weekly intervals. The steers were divided and handled in such a way that forage quality and quantity were considered to be comparable for the two treatment groups. All animals had previously been treated for flies before this test started.

The experiment started on August 23. During the first 84 days the steers were on pasture, and during the last 103 days they were on a fattening ration in drylot. During the drylot phase of this study all steers were fed together without regard to previous treatment.

During the pasture phase face fly and horn fly counts were made at weekly intervals from August 23, 1963 to October 24, 1963. Grub counts were made on March 5, 1964.

Table 1 shows the results of face fly and horn fly counts made during the pasture phase. Little difference was noted between the treatments for face fly control. It should be pointed out that Ciodrin did gradually reduce face flies, whereas the numbers of face flies on cattle treated with Rid-Ezy were more erratic. Good horn fly control was achieved with both methods. As would be expected, it took Rid-Ezy longer to control flies since control is achieved through death of larvae in droppings whereas Ciodrin causes death of the adult fly upon contact with the treated animal.

Table 1 - Average Flies Per Animal at Weekly Intervals

Date	8-23 [a]	8-30	9-6	9-20	9-24	10-4	10-11	10-18	10-24
					Face Flies				
Ciodrin	4	3	3	2	1	1	1	1	1
Rid-Ezy	4	3	3	3	2	5	5	2	1
					Horn Flies				
Ciodrin	0	1	1	0	0	0	0	0	0
Rid-Ezy	4	4	2	1	0	3	1	0	0

[a] Pretreatment counts

Table 2 gives results of grub counts made on March 5, 1964. Ciodrin would not be expected to have any effect on grubs since it is not a systemic insecticide. Therefore, the group treated with Ciodrin during the summer served as a control for this comparison of the effectiveness of ronnel in controlling grubs. There were no grubs in cattle treated with ronnel, but an average of 20.5 grubs were counted in the control cattle.

Table 2 - Incidence of Grubs in Control and Ronnel-treated Steers

Rid-Ezy (Ronnel) Blocks				Ciodrin-Treated Backrubbers			
Animal No.	No. of Grubs	Animal No.	No. of Grubs	Animal No.	No. of Grubs	Animal No.	No. of Grubs
17	0	36	0	3	14	16	41
20	0	37 (died)	-	21	11	32	36
26	0	39	0	22	17	35	23
29	0	40	0	28	6	56	47
41	0	1	0	30	4	2	17
42	0	8	0	47	31	6	11
43	0	19	0	54	23	11	9
9	0	27	0	60	39	15	23
18	0	38	0	5	14	25	5
14	0	51	0	10	29	33	0
24	0	52	0	12	47	34	15
31	0	23	0	13	31	7	0
36	0						
Total Animals - 24	Av Grubs - 0			Total Animals -24	Av Grubs 20.5		

Table 3 gives rate of gain data for both the summer and winter phases of this experiment. There was a slight but nonsignificant trend for Ciodrin-treated cattle to gain faster during both phases. Obviously the absence of grubs in cattle treated with ronnel did not cause the cattle to gain faster during the 103-day feedlot period.

The results of this experiment indicate that good horn fly control and reasonably good face fly control can be achieved with either of the methods used in this comparison. Feeding the blocks containing ronnel for an 84-day period beginning the latter part of August, also resulted in excellent grub control.

Table 3 - Steer Performance

	Rid-Ezy (Ronnel) Blocks	Ciodrin-Treated Backrubbers
Pasture Phase - 84 days		
No. of Animals treated	24	24
Average initial weight, lb	646	619
Average weight off pasture, lb	691	670
Average gain on pasture, lb	45	51
A. D. G. on pasture, lb	0.53	0.61
Block, lb/head daily [a]	.12	---
Feedlot Phase - 103 days		
Average final weight, lb	889	880
Average feedlot gain	198	210
A. D. G. in drylot	1.92	2.04
Combined Pasture Phase and Feedlot Phase - 187 days		
Total gain	243	261
A. D. G.	1.30	1.40

[a] 2.94 gm of actual ronnel per head daily

SLAUGHTER BEEF FROM GRAIN AND GRASS - 1963 RESULTS

Dennis Herd, N. W. Bradley, David McKechnie and J. Ralph Overfield
University of Kentucky

This station has previously demonstrated that deferred feeding of grain to steers on pasture is a suitable system for making maximum use of pastures and producing the type of slaughter beef the market demands. It was the purpose of this experiment to confirm that high good and low choice slaughter beef could be produced by this program. A secondary objective was to study the value of supplemental protein and mineral feeding during the grain-grass phase of the program.

One of the comparisons made during the summer of 1963 was at the U. K. Coldstream Farm on bluegrass-white clover pasture. Two groups of 20 yearling Angus steers were used to compare ground shelled corn versus ground shelled corn plus 2 pounds of soybean meal per steer per day.

All steers were implanted with 24 mg of stilbestrol at the beginning of the experiment and grazed together from May 9 to July 4 during the pasture phase. At this time the steers were split into two groups, using a predetermined allotment, and placed in two 20-acre bluegrass white clover pastures with self feeders containing the appropriate rations. To equalize pasture quality and quantity, the two groups of steers were rotated on the two pastures at 14-day intervals. To reduce the possibility of founder, a mixture of 60% ground shelled corn and 40% ground corn cobs was self fed during the first week the cattle were on grain. The second week the ratio was changed to 80:20 corn to cob and after than ground shelled corn was fed. Once again this method of starting the steers on feed proved to be satisfactory.

The results of this comparison are given in Table 1. During the first 56 days of the experiment, daily gains for the two groups were quite different even though all of the cattle were treated alike up to this time. During the last 112 days the group receiving corn and supplement outgained the group receiving only corn, but for the entire 168 days there was very little difference in the daily gains of the two groups of steers. Although the steers receiving corn and supplement had a higher selling price per steer, this increase was offset by the added expense of the protein supplement which resulted in both groups of steers returning the same amount to pasture, labor and investment. It thus appears that ground shelled corn is sufficient in this program when pastures are properly managed and contain from 40 to 60% legumes.

A second experiment was conducted at the West Kentucky Substation at Princeton comparing free choice versus force feeding of minerals during the grain-grass phase of the deferred feeding program. Thirty-six yearling Angus steers were divided into two groups of 18 steers each for this trial. Nine steers of each group were implanted with 24 mg of stilbestrol, while the other nine were implanted with 36 mg. Both groups of steers were grazed together from April 10 to July 3 during the grass phase, which was approximately a month longer than the grass phase at Lexington. Pastures used were predominately fescue. The amount of trace mineral salt force fed was about 14 times as much as that consumed by the group offered salt free choice. The amount of bonemeal force fed was about 12 times higher than the amount consumed free choice. The rations fed during the grain-grass phase were as follows:

Minerals Free Choice	Minerals Force Fed
1,800 lb ground shelled corn	1,775 lb ground shelled corn
200 lb 44% soybean meal	200 lb 44% soybean meal
Trace mineral salt and bone meal were fed free choice	20.75 lb trace mineral salt
	4.25 lb bone meal

Table 1 - A Comparison of Steers Fed Corn and Steers Fed Corn and Supplement in a Deferred Feeding Program on Bluegrass-White Clover Pasture

	Corn	Corn & Supplement
First 56 days		
Number of steers	20	20
Beginning weight, lb	683	684
56-day weight, lb	802	781
56-day gain, lb	119	97
56-day A. D. G., lb	2.12	1.73
Last 112 days		
56 to 168-day gain, lb	245	280
56 to 168-day A. D. G., lb	2.19	2.50
Corn/steer, bu	37.4	35.1
Soybean meal/steer, lb	--	225
Entire 168 days		
Final weight, lb	1047	1061
Total gain, lb	364	377
Total A. D. G. lb	2.17	2.24
Carcass and Slaughter data		
Weight at packing plant, lb	1013	1025
Dressing percent	618	62.8
Carcass grade	11.1 (Good+)	11.2 (Good+)
Fat thickness over rib, in.	0.66	0.62
Cost and return per steer		
Initial steer cost at $26/cwt	$177.58	$177.84
Corn cost a/	45.23	42.44
Soybean meal cost b/	-----	9.00
Selling price/cwt	23.30	23.66
Selling price/steer c/	236.03	242.52
Returns to pasture, labor, & investment	13.22	13.24

a/ Includes cost of corncobs. Corn at $1.20/bushel.

b/ Soybean meal at $80/ton.

c/ Based on delivery weight at packing plant.
A. D. G. = average daily gain.

Results of this comparison are given in Table 2. There was little difference in the daily gains of the two groups of steers at any time throughout the experiment. The steers that were force fed minerals ate 1.6 lb more feed per day each and weighed slightly more when sold, but they graded slightly less and brought less per 100 pounds when sold. The steers that were force fed minerals returned less to pasture, labor and investment mainly because of the increased expense acquired by the larger amount of feed eaten and the increase in minerals consumed. Feeding minerals free choice appears to be sufficient in this deferred feeding program.

Table 2 - A Comparison of Steers Force Fed Minerals and Steers Fed Minerals Free Choice in a Deferred Feeding Program

	Minerals Free Choice	Minerals Force Fed
First 84 days		
Number of steers	18	18
Beginning weight, lb	706	706
84-day weight, lb	722	784
84-day gain, lb	66	78
84-day A. D. G.	0.78	0.93
Last 112 days		
84- to 196-day gain, lb	287	285
84- to 196-day A. D. G.	2.56	2.54
Feed/steer/day, lb	19.8	21.4
Corn/steer, bu	35.6	38
Soybean meal/steer, lb	222	240
Trace mineral salt/steer, lb	1.83	24.9
Bone meal/steer, lb	0.43	5.1
Entire 196 days		
Final weight, lb	1059	1069
Total gain, lb	353	363
Total A. D. G.	1.80	1.85
Carcass and slaughter data		
Weight at the packing plant, lb	1009	1022
Dressing %	63	62.6
Carcass grade	12.2 (Ch-)	11.4 (Good+)
Fat thickness over rib, in.	0.71	0.77
Cost and returns per steer		
Initial steer cost at $26/cwt	$183.56	$183.56
Supplemental feed cost, $ a/	51.67	56.08
Selling price/cwt, $	24.06	23.65
Selling price/steer, $ b/	242.77	241.70
Returns to pasture, labor and investment, $	7.54	2.06

a/ Corn at $1.20/bushel, soybean meal at $80/ton, bone meal at $100/ton and trace mineral salt at $50/ton.

b/ Based on delivery weight at the packing plant.

Table 3 gives the results of implanting with either 24 or 36 mg of stilbestrol. There were no significant differences in any of the performance or slaughter data for stilbestrol treatment. In view of these results as well as previous ones it still seems advisable to implant grazing steers with 24 mg. of stilbestrol.

Table 3 - A Comparison of Two Levels of Stilbestrol Implants for Grazing Steers Receiving a Deferred Feed of Grain

	24 Mg	36 Mg
Number of steers	18	18
Grass phase initial weight, lb	709	703
84-day weight, lb	782	773
84-day gain, lb	73	70
84-day A. D. G. , lb	0.87	0.84
Grain-grass phase		
84-196 day gain, lb	285	287
84-196 day A. D. G. , lb	2.54	2.56
Combined phases		
Final weight, lb	1067	1060
Total gain, lb	358	357
Total A. D. G. , lb	1.83	1.82
Slaughter data		
Carcass grade	12.1 (ch-)	11.8 (ch-)
Carcass conformation grade	12.8 (ch)	12.6 (ch)
Dressing %	63.0	62.5
Rib eye area, sq. in.	11.6	11.8
Rib eye area/cwt chilled carcass, sq. in.	1.8	1.8
Fat thickness over rib, in.	0.7	0.7
Marbling	5.2 (small)	5.0 (small)
Percent kidney fat, %	3.2	3.0
Color fat	2.0 (creamy white)	2.0 (creamy white)
Color lean	3.5 (normal)	3.6 (normal)
Hot carcass weight, lb	654	650
Cold carcass weight, lb	642	638
Carcass cooler shrink, lb	12	12.5
In transit shrink, lb	50	46

The results of both of these experiments confirm the results of last year which showed that desirable slaughter beef can be produced economically by this "grain or grass" program.

EVALUATING FORAGE CROPS FOR BEEF PRODUCTION

(Department of Agronomy and Department of Animal Science Cooperative Project)

W. C. Templeton, Jr., C. F. Buck, N. W. Bradley, and D. McKechnie

This project was initiated in 1962 to study the effects of several kinds of plants and certain mixtures on steer gains and on time and amount of feed production.

The treatments were: (1) 16 acres of Kentucky bluegrass-Ladino clover; (2) 8 acres of Kentucky bluegrass-Ladino clover, 4 acres of Piper sudangrass, and 4 acres of Korean lespedeza, and (3) 8 acres of renovated Kentucky bluegrass-Narragansett alfalfa, 4 acres of Piper sudangrass, and 4 acres of Korean lespedeza. Each treatment consisted of two replications of 8 acres each.

All pastures were limed at the rate of 2 tons per acre. During early spring the bluegrass-clover pastures were reseeded with 1 1/2 pounds Ladino clover and fertilized with 0-60-60 lb N -P_2O_5 -K_2O per acre. The renovated bluegrass-alfalfa pastures were obtained by disking old bluegrass-clover pastures, seeding 15 pounds of alfalfa, and fertilizing with 0-120-120 lb, with borax, per acre. Bluegrass-clover pastures were plowed and prepared for the sudangrass and lespedeza pastures. Sudangrass was seeded at the rate of 30 pounds per acre and fertilized with 200-60-60 lb; lespedeza was seeded at the rate of 30 lb per acre and received 0-60-60 lb of fertilizer per acre.

Annual fertilizer treatments during 1963 were the same as in 1962 except that no borax was used on the alfalfa, and 100 lb actual nitrogen per acre was applied to the lespedeza areas which were essentially pure crabgrass.

Good-to-choice Angus steer calves, weighing to 450 lb each, were used to study the pasture effects. Grazing was on a "put-and-take", rotational basis. Eight tester steers were used on each treatment-replication. Shade, fresh water, salt, ground limestone, and steamed bonemeal were provided in each pasture. No supplemental feed was fed. The steers were implanted with 12 mg diethylstilbestrol just prior to the commencement of grazing.

The start of grazing of bluegrass-clover pastures was delayed somewhat in 1962 because of difficulty in obtaining the steers, and, as a result, the degree of herbage utilization was not so high as it should have been.

In 1963 steers were not available for grazing rye until approximately one week past the optimum starting time. As a result, utilization of the rye was poor, and lespedeza stands were not at all satisfactory. Volunteer crabgrass contributed essentially all the grazing in these pastures during the summer and fall of that year.

Tester steers were scored for feeder and condition grades by three judges at the beginning and end of the experiment each year. At the end of the grazing season in 1962 the steers on treatment 3 (bluegrass-alfalfa, sudangrass, lespedeza) showed a higher condition grade than those on treatments 1 or 2. There were no significant differences in scores of either feeder or condition grade for the different pasture treatments in 1963.

A portion of the data obtained during the first two grazing seasons follows:

Year	Treatment	No. steer-days grazing per acre	Average daily gain, lb	Live weight gain per acre, lb
1962 [a/]	1	303	1.08	351
	2	258	0.90	272
	3	209	1.19	250
1963	1	406	1.11	450
	2	426	1.08	462
	3	462	1.11	516

a/ Rye was not used during 1962 as the experiment was not initiated until spring of that year. The daily gain data for 1962 are only for that portion of the grazing season after June 14 when grazing of the renovated bluegrass-alfalfa pastures was started.

Observations and Points of Interest

1. Balba rye has been ready for grazing two to three weeks prior to Kentucky bluegrass-Ladino clover. Rye changes from the leafy, vegetative stage to the stemmy, boot or head stage relatively fast, and failure to utilize the pasture in the leafy stage results in excessive wastage. Also it appears that a low degree of utilization of the rye is very detrimental to establishment of lespedeza seedlings (lespedeza stands are failures again this year). In addition, animal performance on too-mature rye is, undoubtedly, inferior to what it would be on rye grazed earlier.

2. Sudangrass made excellent growth during 1962 but in 1963 it grew very slowly during the first month after seeding. There was much wastage of feed in these pastures during both years.

3. Korean lespedeza was moderately successful in 1962 when seeded on a prepared seedbed, although the pastures were very weedy during most of the grazing season. Seeding in rye resulted in stand failures in 1963 and 1964.

4. Bluegrass-Ladino clover pastures are relatively easy to manage and provide moderate amounts of high quality feed. Wastage is quite low if the pastures are adequately stocked. Maintenance of clover in the pastures is favored by heavy grazing during spring, adequate fertilization with lime, phosphorus, and potassium, and reseeding.

5. Bluegrass-alfalfa mixtures are highly productive if properly managed. When the spring growth is grazed wastage is so high that it is doubtful whether the practice is a sound one. Harvesting of the first crop for hay or silage and rotational grazing of the succeeding crops if needed for pasture appears to be a good way to utilize this mixture.

6. The data on average daily gains indicate that all of the crops being studied provide satisfactory pasturage for growing beef steers. Crabgrass was eaten readily and was reasonably productive during the summer of 1963 when precipitation was favorable for its growth.

7. No steers have been lost because of bloat on either the bluegrass-clover or bluegrass-alfalfa pastures. A very few cases of mild bloat have been observed on both mixtures.

8. The results obtained during the first two years of this study indicate that sudangrass may be a relatively expensive pasture compared with well-managed bluegrass-Ladino clover. Because more data are needed to make valid conclusions, the experiment is being continued for one or two years.

UTILIZATION BY BEEF STEERS OF PELLETED OR CHOPPED DEHYDRATED SUDAX HARVESTED AT TWO STAGES OF MATURITY

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The purpose of this study was to evaluate Sudax (a sorghum-sudangrass hybrid) for its usefulness as a supplementary forage for the dry midsummer period and to determine its value for low-level wintering of feeder calves.

The Sudax was seeded at a rate of 20 lb per acre on June 20, 1961, and fertilization consisted of 500 lb of 0-20-20 and 60 lb of actual nitrogen per acre. By August 1 the forage was from 5 to 7 feet tall, and inflorescences of the most advanced plants were exposed approximately 4 inches. The forage was harvested at this time. After harvest the stubble was fertilized at the rate of 60 lb of actual nitrogen per acre. Before the second harvest, the forage was damaged by leafblight (Helminthosporium) which caused 40 to 60% of the leaf area to die; and frost damaged the upper leaves. When harvest began October 20, the latest tillers were from pre-bloom to full bloom, and the height of the forage was approximately 6 feet. Difficulty was encountered in harvesting owing to the high moisture content of the forage.

The pellet mill employed did not have a steam source, and pelleting the Sudax seemed to put excessive strain on the mill. The first and second harvests of the forage were designated as vegetative and mature states, respectively. Half of the forage from each harvest was finely ground and pelleted; the other half was fed in a chopped dehydrated form. The average chemical analysis of the Sudax on a dry matter basis is given in Table 1.

In the drylot phase of the experiment, 40 steer calves, averaging approximately 500 lb each, were divided into four lots of 10 steers each on the basis of weight and previous gain. The treatments for the 77-day trial were as follows:

Lot 1 - chopped, vegetative-state Sudax
Lot 2 - pelleted, vegetative-state Sudax
Lot 3 - chopped, mature-state Sudax
Lot 4 - pelleted, mature-state Sudax

The steers were fed Sudax ad libitum. In addition the animals received 1 lb of 44% soybean oil meal plus 10,000 I. U. of vitamin A per head per day in the last 39 days of the trial. Steamed bone meal and trace mineralized salt were available, free choice, to the steers at all times. The results of the feeding trials are shown in Table 2. It was necessary to supplement the ration with protein due to the extremely low gains in period 1. These low gains substantiated the chemical analysis which indicated a protein deficiency. When the supplement was added gains increased to as high as 2.09 lb per head per day. Lot 3, chopped mature state Sudax, produced gains which were significantly lower ($P < 0.05$) than the other three lots.

Digestion trials were conducted, using steers averaging approximately 750 lb. The steers were placed in crates and fed for a 10-day preliminary period. Total collections of urine and feces were taken the following 7 days for analysis. The ration consisted of 10 lb of Sudax and 1.5 lb of supplement which contained 10,000 I. U. of vitamin A. Nitrogen was equalized by addition of urea to the soybean oil meal supplement. The results of the digestion trials are given in Table 3. Pelleting significantly decreased ($P < 0.05$) the digestibility of dry matter, crude protein, crude fiber and gross energy in both vegetative

Table 1 - Proximate Analysis of Sudax at Various Stages of Growth (dry matter basis)

Date	Crude Protein	Crude Fiber	Ether Extract	Ash	N. F. E.	Gross Energy
	%	%	%	%	%	Btu/lb
Preliminary Samples [a/]						
July 27	17.64	25.75	4.81	11.21	40.59	8,053.4
July 29	16.80	26.31	3.69	16.88	36.32	7,251.5
August 1	15.01	29.14	3.94	11.73	40.18	7,863.4
First Harvest Samples [b/]						
August 3	9.11	32.83	3.08	14.70	40.28	6,647.6
August 4	9.34	30.17	2.98	15.51	42.00	6,660.3
August 5	9.06	30.64	3.12	15.28	41.90	6,814.1
August 7	8.95	28.60	3.26	17.02	42.17	6,797.6
Second Harvest Samples [c/]						
October 20	6.81	26.06	1.74	4.59	60.80	7,422.6
October 21	7.04	25.98	1.89	6.86	58.23	7,531.6
October 24	6.79	27.40	1.58	6.04	58.19	7,524.9
October 27	6.28	28.41	1.00	4.88	59.43	7,441.6

[a/] Samples of Sudax taken prior to first cutting.

[b/] Samples taken during the first cutting (vegetative state).

[c/] Samples taken during the second cutting (mature state).

and mature state Sudax. However, it decreased digestibility of nitrogen-free extract and total digestible nutrients in the vegetative state only. Crude fiber and gross energy digestibilities were significantly higher ($P < 0.05$) in both forms of the vegetative state Sudax than in the mature forms. Dry matter and crude protein digestibility values were significantly greater ($P < 0.05$) in the chopped vegetative-state Sudax than in the chopped, mature form.

These data indicate that pelleted Sudax when properly supplemented with protein makes a very satisfactory feed for stocker cattle. However, more research needs to be conducted with longer drylot trials and proper supplementation before the forage can be recommended without reservation. Emphasis should be placed on utilization of the forage in the vegetative state.

Table 2 - Steer Performance in Drylot When Fed Pelleted vs Chopped Sudax Harvested at Two Stages of Maturity

	Vegetative State		Mature State	
	Chopped	Pelleted	Chopped a/	Pelleted
Period 1 (unsupplemented)				
No. steers	10	10	10	10
No. days	55	55	55	55
Initial weight, lb	517	522	520	522
Final weight, lb	536	542	535	537
Period gain, lb	19	20	15	15
Average daily gain, lb	0.34	0.36	0.27	0.27
Average daily feed, lb b/				
Sudax lb	11.4	13.0	11.9	11.1
Feed/cwt gain, lb	3,395	3,652	4,490	4,192
Period 2 (supplemented)				
No. steers	10	10	10	10
No. days	22	22	22	22
Initial weight, lb	536	542	535	537
Final weight, lb	576	588	545	574
Period gain, lb	40	46	10	37
Average daily gain, lb	1.82	2.09	0.45	1.68
Average daily feed, lb				
Sudax lb	15.1	16.3	17.4	16.4
Soybean oil meal lb c/	1.0	1.0	1.0	1.0
Feed/cwt gain, lb	865	825	3,933	1,027
Summary Trial				
No. steers	10	10	10	10
No. days	77	77	77	77
Initial weight, lb	517	522	520	522
Final weight, lb	576	588	545	574
Gain, lb	59	66	25	52
Average daily gain, lb	0.77	0.86	0.32	0.68
Average daily feed, lb				
Sudax lb	12.5	13.9	13.5	12.6
Soybean oil meal lb	0.6	0.6	0.6	0.6
Feed/cwt gain, lb	1,711	1,646	4,317	1,968

a/ The steers tended to waste the chopped, mature state Sudax.

b/ During the last 17 days of this trial, one pound of 44 percent soybean oil meal was added to the ration per head per day.

c/ The soybean oil meal supplement contained 10,000 I. U. of vitamin A per pound.

Table 3 - Results of Digestion Trials with Beef Steers

Analysis	Digestion Coefficients			
	Vegetative State		Mature State	
	Chopped	Pelleted	Chopped	Pelleted
Dry matter a/	59.82	53.17	56.20	53.06
Crude protein b/	64.25	55.57	58.49	55.25
Crude fiber c/	64.75	55.04	55.31	43.93
Ether extract d/	77.26	68.71	79.03	79.10
Nitrogen-free extract e/	62.66	58.30	59.60	59.82
Ash f/	25.86	25.45	22.63	28.80
Gross energy g/	61.94	54.17	55.50	51.44
Nitrogen balance				
% digested retained h/	32.26	27.36	20.06	33.88
T. D. N. i/	54.26	48.21	51.32	49.31

a/ A difference (D) of 1.14 required for significance at 0.05 level

b/ D = 3.32

c/ D = 3.39

d/ No significant difference

e/ D = 3.59

f/ No significant difference

g/ D = 2.76

h/ No significant difference

i/ D = 3.24

A COMPARISON OF CORN SILAGE-SOYBEAN MEAL AND CORN COB-CORN-SOYBEAN MEAL RATIONS FOR WINTERING STEER CALVES

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A stocker program where lightweight calves are fed a balanced corn silage ration during the winter is one of the most profitable beef cattle programs for Kentucky. Many experiments have shown that corn silage is a very economical feed for beef cattle. In certain areas of Kentucky corn cobs are plentiful and cheap. Questions have arisen as to how corn cobs can best be used in beef cattle feeding programs. In this experiment a corn silage ration and a corn cob-shelled corn ration were compared for stocker calves.

In the fall of 1963, 40 steer calves weighing about 480 lb each were divided into two groups of 20 steers each. One group was fed corn silage according to appetite and 1.5 lb of soybean meal per head daily. The other group was fed a combination of corn cobs, ground shelled corn and 1.5 lb of soybean meal per head daily. The ratios of cobs and corn were changed to make the calves on the corn cob ration gain at the same rate as the calves receiving the corn silage ration.

The performance data and rations are shown in Table 1. Steers in both groups averaged gaining about 200 lb during the 120-day feeding period. Steers on the corn silage ration averaged eating 35 lb of corn silage and 1.5 lb of soybean meal. The average ration for steers on the corn cob-corn ration was 6.5 lb of corn cobs, 5.6 lb of ground shelled corn and 1.5 lb of soybean meal.

Table 1 - A Comparison of Corn Silage-Soybean Meal and Corn Cobs-Soybean Meal-Corn Rations for Wintering Steer Calves - 120 Days

	Silage Soybean Meal	Corn cobs Soybean Meal Corn
No. of steers	20	19
Initial wt, lb	484	482
Final wt, lb	680	684
Lb gained	196	202
A. D. G., lb	1.64	1.69
Feed per cwt gain, lb *	820	804
Feed/head daily		
C. silage (wet), lb	35	--
Soybean meal, lb	1.5	1.5
Corn cobs, lb	--	6.5
Corn, lb	--	5.6
Feed cost per 100 lb, gain	$ 11.99	$ 12.14

* Silage on air-dry basis.

When silage is valued at $8.00 per ton, cobs at $10.00 per ton, corn at $1.12 per bushel and soybean meal at $80.00 per ton, cost per cwt gain is about the same for the two rations. These results demonstrate that when cobs and corn are available at the prices used and fed as they were in this comparison these feeds can be used profitably for stocker rations.

SUPPLEMENTATION OF GROUND EAR CORN FOR FATTENING BEEF STEERS IN DRYLOT

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In a feeding trial reported in 1963, ground ear corn supplemented with corn distillers dried grains with solubles (DDG/S) produced excellent gains (2.91 lb per head per day) in yearling steers. When one-half of the DDG/S was replaced with urea and corn, gains were significantly depressed. Adding alfalfa meal, molasses or trace minerals to the urea supplemented ration resulted in sizable (0.14 - 0.29) but non-significant increases in average daily gain. A second experiment has been conducted to obtain additional information on the effectiveness of including these additives in ground ear corn rations supplemented with urea.

One hundred twenty yearling Hereford steers, averaging about 780 lb., were randomly allotted into 12 lots. The control steers in lot 1 were fed ground ear corn supplemented with DDG/S, salt, ground limestone and vitamin A. Steers in the other lots (except lot 11) were fed rations in which urea and corn were substituted for a portion of the DDG/S on a protein and energy equivalent basis. Trace minerals, alfalfa meal and molasses were added to these rations individually and in selected combinations. Dicalcium phosphate and a complete vitamin mix were also added to the ration fed to steers in lot 12. The ingredient composition of each ration is shown in Table 1 and results of nutrient analyses conducted after grinding and mixing are shown in Table 2. All rations were self-fed.

Results of the experiment are summarized in Table 3. The excellent performance of the steers in lot 1 agrees with the results obtained in 1963 and demonstrates the suitability of rations based on ground ear corn and DDG/S for finishing steers. Contrary to the 1963 results, substituting urea and corn for one-half of the DDG/S did not depress gain. Since the urea substitution did not affect performance, there was no detrimental effect for additions to the rations which contained urea to overcome. In fact, performance of steers receiving added trace minerals, alfalfa meal or molasses was actually slightly inferior to that of steers not fed these additives. However, none of the observed differences in rate of gain, feed efficiency or carcass grade was statistically significant.

It appears from the results of this and previous experiments that substituting urea and corn for DDG/S as a supplement for ground ear corn will sometimes,but not always, depress performance. Additional research is needed to define circumstances which will lead to depressed performance if urea and an energy source are substituted for intact protein in steer rations and, also, to develop methods of avoiding detrimental effects on performance when this substitution is made.

Table 1 - Ration Ingredients (lb/ton), Lots and Rations

Ingredients	1	2	3	4	5	6	7	8	9	10	11	12
Shelled corn	1291.0	1420.0	1420.0	1380.0	1380.0	1380.0	1380.4	1340.0	1340.0	1356.0	1211.0	1295.1
Corn cobs	323.0	355.0	355.0	345.0	345.0	345.0	345.2	335.0	335.0	339.0	303.0	324.0
DDG/S	359.0	179.0	170.9	179.0	179.0	179.0	179.4	179.0	179.0	269.0	359.0	179.4
Urea	--	18.0	18.0	18.0	18.0	18.0	18.0	18.0	18.0	9.0		18.0
Ground limestone	7.25	7.25	7.25	7.25	7.25	7.25	7.25	7.25	7.25	7.25	7.25	7.20
Salt	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	19.8
Stabilized Vit. A, I. U.	910,000	910,000	910,000	910,000	910,000	910,000	910,000	910,000	910,000	910,000	910,000	910,000
Trace minerals	--	--	0.5	--	--	0.5	0.5	--	0.5	--	0.5	0.5
Alfalfa meal	--	--	--	50.0	--	50.0	--	50.0	50.0	--	50.0	50.0
Molasses	--	--	--	--	50.0	--	50.0	50.0	50.0	--	50.0	50.0
Dicalcium phosphate	--	--	--	--	--	--	--	--	--	--	--	10.0
Vitamin mix	--	--	--	--	--	--	--	--	--	--	--	46.5

Table 2 - Composition Analyses of Rations

Ration	Percent					Gross Energy BTU/lb
	Water	Crude Protein	Ether Extract	Crude Fiber	Ash	
1	7.89	11.55	3.87	8.31	3.15	7546
2	7.68	11.65	3.42	8.29	2.96	7503
3	7.63	10.40	3.67	7.96	2.43	7481
4	7.58	11.80	3.42	9.56	3.27	7441
5	7.50	11.80	3.23	8.65	2.93	7480
6	7.46	12.65	3.55	9.50	2.61	7436
7	7.44	11.30	3.51	8.70	2.60	7410
8	7.27	11.65	3.31	9.53	1.84	7509
9	7.30	11.50	3.03	9.97	2.35	7390
10	7.45	11.90	3.80	8.58	2.64	7498
11	7.20	11.45	4.15	7.95	1.98	7708
12	7.25	11.95	3.75	8.39	1.73	7451

Table 3 - Feedlot Performance of Steers Fed Ground Ear Corn with Various Supplementations (124 Days)

	Treatments and Rations											
	Control a/ DDG/S 1	Urea b/ 2	Urea c/ Trace Min 3	Urea d/ Alfalfa Meal 4	Urea e/ Molasses 5	Urea, Tr Min Alf Meal 6	Urea, Tr Min Molasses 7	Urea, Alf Meal Molasses 8	Urea, Alf Meal, Molasses Tr Min 9	Urea f/ 10	DDG/S, Alf Meal, Molasses Tr Min 11	Complex g/ Supple-ment 12
No. of steers	10	10	10	10	10	10	10	10	10	10	10	10
Initial wt, lb	790	788	775	775	777	775	789	778	778	788	784	774
Final wt, lb	1155	1147	1125	1077	1111	1099	1148	1121	1117	1109	1114	1107
Total gain, lb	365	359	350	302	334	324	359	343	339	321	330	333
Av daily gain, lb	2.94	2.90	2.82	2.44	2.69	2.61	2.90	2.77	2.73	2.59	2.66	2.69
Feed/head/daily, lb	24.7	23.5	24.2	22.3	24.5	23.3	23.9	24.6	24.4	22.6	24.4	24.8
Feed/cwt, gain, lb	837	812	859	915	911	895	826	892	892	875	915	931
Carcass grade	11.6	11.3	11.2	11.0	10.7	11.3	10.5	11.0	10.6	10.9	10.5	10.2

a/ All supplemental protein was from DDG/S

b/ Urea and ground ear corn were substituted for one-half the distillers grains in the control ration on a protein equivalent basis.

c/

	% Element in Premix
Cobalt carbonate	0.220
Calcium iodate	0.264
Zinc sulfate	0.440
Copper carbonate	1.650
Ferrous carbonate	14.300
Manganese sulfate	2.420
Calcium carbonate	14.500

d/ Each steer received about 0.5 lb alfalfa meal daily.

e/ Each steer received about 0.5 lb molasses daily.

f/ Urea and ground ear corn were substituted for one-fourth of the distillers grains in the control ration on a protein equivalent basis.

g/ Urea and ground ear corn were substituted for one-half the distillers grains in the control ration on a protein equivalent basis. A erage daily intake of nutrients was increased as follows: Ca 14.9 gm, P 11.6 gm, lysine 11.26 gm, choline 4.52 gm, riboflavin 1.04 gm, pantothenic acid 2.08 gm, niacin 4.69 gm, B_{12} 0.62 mg, vitamin K 84.3 mg.

FEEDLOT ADAPTATION AND GAINS OF FEEDER STEERS TREATED WITH TRANIMAL, VITAMIN A AND SULFADIMETHOXINE

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Many calves are lost each year in this state after being shipped from farm to market, then to another farm or feedlot. Herd health and nutritional status of the calves on the originating farm, distance to market, treatment while in transit and at the stockyards, and time lapse from stockyards to the farm or feedlot affect the incidence of sickness and performance of the cattle in their new surroundings.

If one or more of these factors are unfavorable, poor-doing calves and often death losses can be expected. Numerous commercial products have been developed for treatment of cattle upon arrival at the farm to aid in getting them "on feed" promptly and to reduce sickness and death losses.

Two separate experiments were conducted at this Station in the late fall and winter of 1963-64, using three such products.

Experiment I

Thirty-nine Hereford steer calves, weighing approximately 450 lb each, were purchased at local stockyards in central Kentucky. As soon as the calves were delivered and assembled at Lexington, they were trucked 250 miles to the Western Kentucky Experiment Station Farm at Princeton. They were en route for about 10 hours and without feed or water for about 15 hours.

Upon arrival at the Western Kentucky Station, the steers were weighed and allotted randomly to four treatment groups as follows:

Group I -	Control (no treatment)
Group II -	100 mg. Tranimal/steer/day
Group III -	100 mg. Tranimal/steer/day plus 2 million I. U. vitamin A injected intramuscularly
Group IV -	100 mg Tranimal/steer/day plus sulfadimethoxine in drinking water for 4 days.

All steers were started on a roughage-type wintering ration and fed for 138 days. Soybean oil meal was fed at the rate of 1 lb per steer daily to all groups, and Tranimal was incorporated in the soybean oil meal for groups II, III and IV. Tranimal was fed at the rate of 100 mg/steer/day for 10 days, then discontinued.

Steers in Group III were injected with vitamin A the first day after arrival at the Western Kentucky Station. Group IV steers were given sulfadimethoxine in their drinking water at the rate of 25 mg per pound of body weight on the first day and 12.5 mg per pound of body weight the second, third and fourth days after arrival at the Station Farm.

Steers were observed closely the first few days after shipment, and rectal temperatures were recorded for any steers appearing gaunt, droopy or depressed in any way.

The average temperatures of all steers in each treatment group for the first and second day after shipment and the number of steers requiring treatment for shipping fever symptoms appear in Table 1.

Table 1 - Group Average Temperatures and Treatment of Steers During the First 10 Days After Shipment of Steers

	Group I	Group II	Group III	Group IV
Av temp on first day after shipment	102.9°	102.2°	102.0°	102.3°
Av temp on second day after shipment	102.2°	102.1°	102.4°	102.4°
No. steers requiring treatment on first and/or second day	5	3	5	4
Av temp of treated steers	103.8°	103.4°	103.3°	103.6°
No. steers requiring treatment between second and tenth day	1	4	4	1
Av temp of treated steers	102.9°	103.8°	103.7°	103.8°

Each steer was weighed periodically throughout the 138-day experiment and the average daily gains were recorded as shown in Table 2.

Table 2 - Steer Performance

	Group I	Group II	Group III	Group IV
No. of steers	10	10	10	10
Av initial wt, lb	437.6	436.0	437.8	434.0
Av final wt, lb	680.3	677.9	699.1	670.1
Total gain/steer, lb	242.7	241.9	261.3	236.1
Period A. D. G., a/ lb				
0 to 10 days b/	3.16	4.14	4.36	4.73
10 to 18 days	0.95	0.66	1.19	- 0.03
18 to 34 days	2.79	2.13	2.11	2.44
34 to 46 days	1.63	1.87	1.78	1.81
46 to 59 days	2.29	2.03	2.66	1.91
59 to 74 days	1.13	1.56	1.17	1.56
Cumulative A. D. G., lb				
0 to 18 days	2.18	2.59	2.95	2.62
0 to 46 days	2.25	2.24	2.35	2.35
0 to 74 days	2.03	2.07	2.17	2.11
0 to 138 days	1.76	1.75	1.89	1.71

a/ Average daily gain.

b/ High gains during this period were due to the initial weight of the steers being taken after the steers were hauled and before they had access to feed or water.

Steer gains varied from period to period throughout the experiment. The three treated groups of steers gained faster duringthe early part of the experiment; however, the gains for each group had practically equalized by 74 days after the initial treatment, as shown in Table 2. Steers in Group III gained slightly faster throughout the experiment and had an advantage of 0.13, 0.14 and 0.18 lb per day, average daily gain, A. D. G. over Groups I, II, and IV, respectively.

In conclusion, the treatments used in this experiment resulted in faster gains during the early periods of the experiment, but this advantage disappeared by the end of the feeding period.

Experiment II

Forty yearling Angus steers, weighing approximately 750 lb each, were used in this experiment. The steers were used for a pasture experiment during the summer, then randomly allotted to this conditioning experiment using the final pasture weights for allotment to 4 groups of 10 steers each.

The steers were moved from Coldstream Farm to a local stockyard where they were kept overnight, without feed or water and in unbedded pens. This was done after heavy runs of cattle had been through the local stockyards in an attempt to expose the cattle to shipping fever or other causative agents they might contact when moved through the usual channels.

After the cattle were left overnight at the stockyards they were loaded on a trailer truck and hauled for 6 hours and a distance of about 175 miles to further simulate normal conditions. After shipment these steers were unloaded at Coldstream Farm, weighed, and the same treatments used in Experiment I were imposed on these steers:

Group I	-	Control
Group II	-	Tranimal
Group III	-	Tranimal + vitamin A
Group IV	-	Tranimal + sulfadimethoxine

The steers were fed in drylot until the 10-day weight was taken. At that time they were put in sodded fields with little or no vegetation where they were fed a ground ear corn-soybean oil meal ration fed in a 9:1 ratio.

Groups II, III and IV had Tranimal incorporated in their ration, so as to receive approximately 10 mg/head/day throughout the 91-day feedlot phase of the experiment. Group I (control) steers received only the ground ear corn-soybean oil meal ration and were fed separately from Groups II, III and IV which were fed together. All steers were fed 10 mg of diethylstilbestrol per head per day and 20,000 I. U. of vitamin A per day.

These steers were weighed at approximately 28-day intervals, and feed consumption was recorded. Feedlot data appear in Table 3.

Results and Conclusions

No cases of shipping fever occurred in any of the treatment groups. Average daily feed intake, average daily gain and feed efficiency were approximately the same for all groups of steers during the feedlot phase of the experiment. Although slight differences occurred as shown in Tables 3 and 4, these are not statistically significant differences. Neither Tranimal fed alone at the rate of 100 mg/head/day, Tranimal plus 2 million I. U. of vitamin A, Tranimal plus sulfadimethoxine in the steers drinking water, nor Tranimal fed at the rate of 10 mg/head/day during the feedlot phase was effective in improving feedlot adaption, average daily gain or feed efficiency. Dressing percentage and carcass grade varied only slightly among the four groups of steers as shown in Table 3 B. The gains shown in Table 3 for 9 to 100 days give a more realistic picture of gains, since the 0- 9-day gains include fill or the regaining of intransit losses and are not actual gain.

Table 3 - Average Daily Gain by Periods and Carcass Measurements of Yearling Angus Steers Receiving Tranimal with Vitamin A or Sulfadimethoxine in Finishing Ration

Period A. D. G., lb	Group I	Group II	Group III	Group IV
0 to 9 days [a/]	8.89	9.61	9.67	8.50
9 to 44 days	3.03	2.93	2.90	2.99
44 to 72 days	1.14	- 0.14	0.21	0.11
72 to 100 days	2.21	2.89	2.95	2.89
0 to 100 days	2.80	2.66	2.77	2.65
9 to 100 days	2.20	1.97	2.09	2.07
Carcass Data				
Dressing percent [b/]	60.34	60.78	61.03	60.97
U. S. D. A. Grade [c/]	12.6	12.1	13.0	12.6

a/ These figures are unusually high since the initial weight was taken after the steers had been shrunk overnight and hauled for 6 hours without feed or water.

b/ $\frac{\text{Cold carcass wt.}}{\text{live wt}} \times 100 = \text{D. P.}$

c/ Based on - 11 = high good, 12 = low choice, etc.

Table 4 - Feed Consumption Data from Yearling Angus Steers Receiving Tranimal in Finishing Ration

Feed Intake	Control	Treated (10 mg Tranimal/head/day)
No. steers	10	30
Ground ear corn/steer/ day, lb	21.3	21.0
Soybean oil meal/steer/ day, lb	1.97	1.93
Diethylstilbestrol, mg/day	10	10
Tranimal, mg/day	0	8.9
Feed/cwt gain, lb	942	892

MEASUREMENT AND SELECTION OF ECONOMICALLY IMPORTANT TRAITS IN BEEF CATTLE

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The objectives of this long-range study are to use rate of gain, efficiency of gain, conformation and carcass characteristics in an overall selection experiment and to develop a method of estimating a bull's transmitting ability for carcass characteristics as well as rate of gain and conformation.

A purebred Hereford herd consisting of 227 head of varying ages is being used in this project. Seventy-four calves were dropped during the first three months of 1964. One hundred twenty-seven cows and heifers were bred to five different bulls, to calve during January, February and March of 1965. A progeny test of the first three herd sires has been completed for preweaning and postweaning performance and certain carcass characteristics. Results of the progeny test are presented in Tables 1 and 2. The reliability of the progeny test for the bull Silver Prince 194 (SP 194) might be questioned since this bull sired only eight calves. One heifer in this sire group was definitely inferior in appearance and performance to the other calves sired by SP 194; however, data for this heifer are included in the summary. The most notable differences in Tables 1 and 2 are the heavier weaning and slaughter weights of calves sired by HP Real Silver 15 (HP RS 15) and the lower shear force values for Silver Husker 15 (SH 15). Calves from three additional sires are presently undergoing preweaning performance tests. Twenty bull calves from the first calf crop have completed preweaning and postweaning performance tests and three have been selected for progeny testing. Preweaning and postweaning performance tests for rate of gain and conformation and progeny tests for carcass characteristics will continue and herd replacements will be selected on the results of these tests.

Table 1 - Preweaning and Postweaning Performance of Three Sire Groups

	Sire		
	SP 194	SH 15	HP RS 15
Preweaning:			
No. of calves	8	10	10
Sex of calf			
Steer	5	7	7
Heifer	3	3	3
Av age, days	252	255	258
Weaning wt, lb	411	400	440
ADG, lb	1.37	1.34	1.45
Adjusted ADG, lb [a]	1.54	1.50	1.63
Type Score	13.3	13.4	13.8
Index [b]	110	109	116
Postweaning - 217 days:			
No. of calves	8	10	10
Initial wt, lb	448	482	503
Final wt, lb	820	888	939
ADG, lb	1.71	1.87	2.01
Type Score	12.2	13.1	12.4

a/ Adjusted for age of dam, sex of calf and season of birth.
b/ Based on wt/day of age and type score (50:50).

Table 2 - Carcass Characteristics of Three Sire Groups

	Sire		
	SP 194	SH 15	HP RS 15
No. of calves	8	10	10
Sex of calf			
Steer	5	7	7
Heifer	3	3	3
Carcass grade	9.9	10.9	11.3
Cold carcass wt, lb	485	517	554
Carcass conformation	10.5	11.4	12.1
Dressing percent [a]	59.8	59.6	60.2
Fat thickness over rib-eye, in.	0.6	0.7	0.6
Rib-eye area, sq. in.	10.2	10.1	11.1
Rib-eye area/cwt, carcass, sq. in.	2.11	1.95	2.00
Marbling score [b]	4.0	4.6	4.9
Physical Separation, 9-10-11th Ribs:			
Fat, %	33.2	40.2	37.6
Rib-eye, %	19.7	18.6	20.3
Other lean, %	29.6	28.4	28.6
Total lean, %	49.3	46.9	48.9
Bone, %	14.2	12.1	12.9
H_20 in eye, %	73.1	72.7	72.2
Ether extract in eye, %	3.2	4.3	4.4
Flavor score [c]	7.7	8.2	8.3
Tenderness score [c]	7.5	8.2	8.1
Juiciness score [c]	8.0	8.1	8.2
Overall satisfaction [c]	7.9	8.2	8.2
W-B shear force, lb [d]	20.6	16.8	18.0

a/ 6-hour shrunk wt (3-hour haul) and 72-hour cold wt.

b/ 4 = slight, 5 = small

c/ The higher the number the more desirable.

d/ One-inch cores

ANIMAL NUTRITION SECTION

UTILIZATION OF CASEIN AND GELATIN BY WETHERS WHEN GIVEN ORALLY OR INTO THE ABOMASUM

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Ruminants are capable of utilizing many different nitrogenous substances through rumen function; however, protein nutrition is also dependent on utilization posterior to the rumen. Evidence suggests that significant quantities of dietary proteins may pass out of the rumen unaltered under certain feeding regimes. Both the quantity and quality of these proteins must be considered. Despite their importance, protein digestion in the abomasum and intestines and the utilization of the absorbed nitrogenous compounds have not been widely studied in ruminants. This work was initiated to obtain further information on the digestion of different purified proteins posterior to the rumen and its influence on nitrogen balance. Casein and gelatin, being distinctly different in physical and chemical characteristics, were selected for comparison.

Procedure

Eight cross-bred wethers, four with abomasal fistulas, with an average weight of approximately 100 lb, were used in a digestion and nitrogen balance experiment. A basal ration consisting of 400 grams of wheat straw and 200 grams of ground shelled corn was fed to all wethers in two equal portions daily. In addition, 50 grams of casein or gelatin were given orally to the intact wethers. The same quantity of these purified proteins was administered in a warm water slurry into the abomasum of the fistulated wethers. Approximately 60% of the total nitrogen intake was from the purified protein source. Five-day fecal and urine collection periods were preceded by 7-day preliminary periods. Treatments were arranged so that each wether received both protein sources during the experiment, making a total of 4 observations for each protein by each method of administration. Ration and fecal protein, as well as urinary nitrogen, were determined by standard Kjeldahl procedures.

Results and Discussion

The results are summarized in Table 1. No differences were noted in protein digestibility between the sources or between the methods of administrations. Administering either

Table 1 - Digestion and Nitrogen Balance in Wethers Receiving Casein or Gelatin Orally or Into Abomasum

	Oral Administration		Abomasal Administration	
	Casein	Gelatin	Casein	Gelatin
Protein digestibility, %	77.4	78.1	78.5	79.1
Nitrogen balance				
Grams retained/day	- 0.50	- 0.36	1.82	0.40
% intake retained	- 3.4	- 3.2	14.9	2.9

casein or gelatin into the abomasum resulted in greater nitrogen balance than oral administration. When the wethers were given casein through the abomasal fistula they retained significantly more nitrogen than when they were given gelatin through the abomasal fistula. These differences suggest that the quantity of proteins which reach the abomasum, as well as the quality of these proteins, may be of considerable significance in determining the efficiency of nitrogen utilization by ruminants.

IN VITRO TECHNIQUE FOR MEASURING STARCH DIGESTION BY RUMEN MICROORGANISMS

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Increases in rate and efficiency of grain production, feedlot mechanization, and other management practices which favor use of concentrated feeds have been significant factors affecting changes in cattle rations. Roughages are being fed in smaller amounts, and increasing quantities of grains are being fed. Grains and roughages have different carbohydrate compositions. Roughages contain large amounts of cellulose, while grains contain large amounts of starch. Voluminous literature has accumulated concerning the digestion of cellulose; in contrast, starch digestion and utilization by ruminants are poorly understood. Thus it is necessary for research techniques to be developed which will advance the knowledge of starch utilization by ruminants. This work was initiated to develop a simple, rapid and critical technique for studying in vitro starch digestion by rumen microorganisms.

Procedure

A series of in vitro trials involving estimation of starch digestion by washed cell suspensions of rumen microorganisms has been conducted. Starch was estimated by both the anthrone procedure and a gravimetric method that employs the principles and equipment of the Crampton and Maynard method for cellulose. Variables studied include time after feeding to obtain ruminal fluid, length of incubation period, pH, microbial concentration, substrate concentration, level of nitrogen, source of nitrogen, and the effects of nitrogen depletion.

Results and Discussion

Results obtained with the anthrone and gravimetric starch determinations were quite similar when the starch was washed with distilled water and air dried prior to incorporation in the incubation media. The gravimetric starch determination can be conducted much more rapidly than the anthrone starch determination.

The following conditions were required for optimum corn starch digestion in vitro when using an all-glass system and the gravimetric procedure for estimating starch: (1) rumen fluid taken $1\frac{1}{2}$ to 2 hours after feeding a high-concentrate ration; (2) an 8-hour incubation period; (3) adjustment of the bicarbonate and phosphate buffered suspension to pH 6.8 prior to incubation; (4) a microbial concentration of 2 ml of ruminal fluid per ml of washed cell suspension; (5) a substrate concentration of 0.5% or 100 mg per 20 ml of washed cell suspension; (6) mineral nutrient medium containing bicarbonate and phosphate buffers plus a readily available nitrogen source such as urea. An alternate step involving an 8-hour depletion of the washed rumen microorganisms in the presence of substrate and buffered nutrient medium void of nitrogen prior to inoculation facilitated demonstration of nitrogen level and source response differences. Sensitivity to differences and uniformity of response within treatments were adequate to demonstrate the usefulness of the procedure.

APPARENT PRE-INTESTINAL DESTRUCTION OF VITAMIN A FROM DIFFERENT SOURCES

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Previous work at the Kentucky, Illinois and Arizona stations has demonstrated pre-intestinal destruction of vitamin A in both intact animals and in vitro systems. The experiments reported here were designed to estimate the extent of this destruction when the vitamin A is furnished by various commercially available vitamin A supplements.

Procedure

Steers with ruminal and abomasal fistulas were fed an oat straw and soybean oil meal ration for 3 weeks. Mixtures of 20 grams of chromic oxide and 1 million units of vitamin A from one of the five commercial sources tested were administered to each steer through the ruminal fistula at one-week intervals. Twenty-four hours after dosing, abomasal contents were withdrawn through the abomasal fistula and immediately analyzed in triplicate for chromic oxide and vitamin A. The change in the ratio of chromic oxide to vitamin A from the ratio administered was used to estimate the percentage of the administered vitamin A reaching the abomasum.

Results and Discussion

Calculated recoveries of vitamin A from the abomasal fluid 24 hours after it was placed in the rumen are presented in Table 1. These data suggest extensive ruminal destruction of the vitamin A present in each of the supplements tested. The apparent

Table 1 - Vitamin A Recovery from Abomasal Fluid (%)*

	Source of Vitamin A				
Trial	A	B	C	D	E
1	58.9	7.9	17.7	53.8	55.0
2	16.3	18.6	36.6	23.0	19.8
3	18.0	24.6	24.6	11.6	18.0
4	19.3	22.9	11.7	29.8	41.0
5	27.2	18.6	21.7	27.0	32.6
6	41.5	26.8	17.5	26.8	15.2
Average	30.2	19.7	21.6	28.6	30.2
Standard Error	± 6.87	± 2.74	± 3.48	± 5.17	± 6.37

* Calculated from ratio of vitamin A to chromic oxide in abomasal fluid compared to the ratio administered in the rumen 24 hours earlier.

loss of vitamin A within 24 hours averaged 74%. This agrees closely with results obtained after incubating vitamin A acetate for 24 hours in sheep ligated at the pyloric value and is not greater than would be predicted from the results of 4-hour in vitro incubations which were reported last year.

Marked variations in estimated losses were observed between trials for each product tested. The apparent differences between products were not significant but suggest that it may be possible to decrease the amount of pre-intestinal destruction of vitamin A by improved formulation.

VITAMIN A SUPPLEMENTATION OF STEERS ON PASTURE

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Green summer forages contain large amounts of carotene which should furnish adequate vitamin A activity for optimum growth of pasture-fed cattle. Thus, vitamin A supplementation would not be expected to improve the performance of steers on pasture unless there is interference with the conversion of carotene to vitamin A. Pasture-fed cattle are sometimes discriminated against by packers because of a tendency for them to deposit carotenoids in their fat. The resulting yellow fat is less attractive to the consumer than the white fat of dry-lot cattle. In other experiments, it has been observed that blood carotenoids are often depressed when high levels of vitamin A are either fed or injected. Therefore, two trials have been conducted to determine whether supplementing pasture-fed steers with vitamin A would decrease carotenoid deposition in their fat.

Procedure

In experiment 1, 40 yearling Hereford steers with an average weight of 667 lb were divided into two groups of 20 steers each. Both groups received only blue grass pasture with salt free choice for 105 days and then were self-fed ground shelled corn on pasture for 91 days. The treated group had access to salt which contained 1000 I. U. of gelatinized vitamin A palmitate per gram while the control group received salt without vitamin A. The average daily intake of vitamin A salt for the entire period was 19.8 grams. In order to provide comparable pasture, the groups of steers were rotated between pastures every two weeks during the experiment. Fresh salt was provided every 3 to 10 days.

In experiment 2, 60 yearling Hereford steers with an average initial weight of 621 lb were divided into 3 treatment groups as follows:

1. Control
2. Those receiving subcutaneous injections of 500,000 international units of vitamin A each 28 days through the experiment (7 times)
3. Those receiving subcutaneous injections of 500,000 international units of vitamin A each 28 days for the final 84 days of the experiment (3 times)

The vitamin A experiment was superimposed on a pasture evaluation experiment. Five steers on each vitamin A treatment were placed on each pasture treatment.

Samples of jugular blood were taken on the first, 105th, and last days, and the serum was analyzed for vitamin A and carotene. At the end of both experiments, the steers were slaughtered at the Fischer Packing Co., Louisville. Samples of liver and kidney fat were taken for carotene analyses. After the carcasses were chilled, an experienced grader scored each carcass for degree of yellow color on a numerical scale, as follows: 1 - white (no yellow), 2 - creamy, 3 - yellow, 4 - very yellow.

Results and Discussion

The results of experiment 1 are shown in Table 1. The steers receiving vitamin A salt gained slightly slower during the first phase of the experiment and slightly faster during the grain feeding phase of the experiment. At the end of both phases there was only 0.05 lb difference in average daily gain. None of these differences in gain was statistically significant. The values for serum vitamin A were highly variable and showed a tendency to increase during the experiment but did not appear to be affected by treatment. The values for serum carotene were also highly variable and appeared to decrease during the experiment. There was some apparent reduction in the final serum carotenoid value for those steers receiving vitamin A salt. This difference was not statistically significant. The levels of carotenoids in the samples of liver and kidney fat were not reduced by feeding vitamin A salt. The subjective yellow fat score was actually slightly higher for the steers fed vitamin A salt.

Table 1 - Influence of Vitamin-A Salt [a/] on Steer Performance and Tissue Carotenoids (April 29 - November 11)

	Plain Salt	Vitamin A Salt (1000 I. U./g)
No. steers	20	20
Pasture only		
Days	105	105
ADG (lb)	1.26	1.23
Pasture + corn		
Days	91	91
ADG (lb)	1.84	2.00
Entire period		
Days	196	196
ADG (lb)	1.53	1.58
Serum vitamin A (mcg %)		
April 29	27.5	33.4
Aug. 19	46.0	33.4
Nov. 11	67.8	67.6
Serum carotenoids (mcg %)		
April 29	41.2	37.0
Aug. 19	31.8	32.8
Nov. 11	23.4	19.3
Liver carotenoids (mcg/g)	24.9	23.9
Kidney fat carotenoids (mcg/g)	0.81	0.82
Yellow fat score	2.19	2.33

[a/] 1,000 I. U. vitamin A palmitate per g. Average daily intake 19.8 g.

The results of experiment 2 are shown in Table 2. In this experiment vitamin A injection did not significantly affect gain and, actually, produced a non-significant reduction in serum levels of vitamin A. Carotenoids in the serum were not affected by treatment during the early portion of the experiment but appeared reduced somewhat at the end by vitamin A injection. This difference was not statistically significant. Levels of carotenoids in the liver were decreased 16% by monthly injections and 19% by injections near the end of the experiment. Carotenoid levels in kidney fat were reduced 24% by monthly injections and 44% by injections late in the experiment. These reductions approached significance ($P < 0.10$). The subjective yellow fat score was not similarly reduced.

Table 2 - Influence of Vitamin A Injection [a/] on Steer Performance and Tissue Carotenoids (April 29 - November 11)

	Control	Monthly Injection	Monthly Injection Starting Aug. 19
No. steers	20	20	20
No. days	196	196	196
ADG (lb)	1.63	1.69	1.70
Serum vitamin A (mcg %)			
April 29	35.2	46.8	38.1
Aug. 19	30.9	32.4	25.0
Nov. 11	79.1	64.4	49.6
Serum carotenoids (mcg %)			
April 29	59.2	60.3	71.9
Aug. 19	71.6	73.8	75.4
Nov. 11	65.8	53.8	53.3
Liver carotenoids (mcg/g)	30.0	25.2	24.2
Kidney fat carotenoids (mcg/g)	1.06	0.81	0.59
Yellow fat score	2.65	2.72	2.61

a/ Each injection consisted of 500,000 I.U. of vitamin A from paste furnished by Specifide, Inc.

These results suggest that higher levels of vitamin A might significantly affect carotenoid residues in the tissues of pasture-fed cattle. However, as far as the possibility of using this as a practical method of avoiding the yellow fat problem in concerned, the subjective yellow fat scores are not encouraging.

CONCENTRATIONS OF THIAMINE, RIBOFLAVIN AND BIOTIN IN RUMINAL FLUID OF STEERS FED DIFFERENT LEVELS AND FORMS OF HAY AND GRAIN

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Attempts to improve practical beef cattle rations by adding supplemental B-vitamins have been unsuccessful. This is usually attributed to B-vitamin synthesis by the microorganisms in the rumen. This synthesis is normally more than adequate to meet the physiological requirement for B-vitamins. Therefore, B-vitamins are not usually considered to be dietary essentials for beef cattle or other ruminants.

It has been well established that changes in level of concentrates in the ration and different types of feed processing produce major changes in the microbial activity in the rumen. The possible effects of these changes on B-vitamin synthesis have received little attention. This is a preliminary report on an experiment designed to furnish additional information on this subject.

Procedure

Samples of ruminal fluid from 48 yearling Angus steers, with an average weight of 875 pounds, have been assayed microbiologically for thiamine, riboflavin and biotin. All of the steers were fed a ground ear corn and soybean oil meal ration for 14 days before 8 steers were assigned to each of the following treatments:

I. Flaked corn
II. Ground corn
III. Flaked corn and long hay
IV. Ground corn and long hay
V. Flaked corn and ground hay
VI. Ground corn and ground hay

Corn was self-fed, and alfalfa hay was fed at the rate of 4 pounds per head per day. In rations III and IV, corn and hay were fed separately, while in rations V and VI the corn and hay were combined in a complete mixture. Soybean oil meal, vitamins A and D, and minerals were mixed with the corn at appropriate levels to balance the rations according to NRC requirements. Rations were adjusted at frequent intervals to equalize intake of these components and to regulate ground hay intake. Ruminal samples were taken on the first and 56th day of the experiment.

Results and Discussion

Initial and average vitamin concentrations at 56 days (mcg/100 ml ruminal fluid) are shown in Table 1. The concentration of thiamine in the ruminal fluid of steers that

Table 1 - B-vitamin Levels in Ruminal Fluid of Steers (mcg/100 ml ruminal fluid)

	Initial	Concentration After 56 Days on Respective Ration					
	Concentration	I	II	III	IV	V	VI
Thiamine	2.0	5.5	16.8	1.2	0.3	0.8	5.5
Riboflavin	56	40[c]	74[b]	29[c]	54[b,c]	106[a]	108[a]
Biotin	4.0	4.8	3.7	2.9	3.3	3.2	3.1

a, b, c, Means in the same line, excluding initial concentration, that have different superscript letters are significantly different ($P < 0.05$ for riboflavin comparisons of rations II, V and VI; $P < 0.01$ for all other comparisons).

received the ground corn ration was significantly higher than that of steers fed the other rations. In the case of riboflavin, steers receiving the two rations containing ground hay had greater concentrations of this vitamin in their ruminal fluid. Steers fed ground corn without hay also had significantly higher levels of riboflavin in the rumen than steers fed flaked corn without hay. The levels of biotin in the ruminal fluid were not significantly affected by the treatments.

These results demonstrate that ration changes can produce wide fluctuations in the concentrations of B-vitamins present in the rumen. Further research is needed to determine the practical implications of these findings.

BUTYRATE UPTAKE IN VITRO BY EPITHELIAL TISSUE FROM THE RUMEN OF STEERS FED DIFFERENT LEVELS AND FORMS OF HAY AND GRAIN

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Rumen function is a vital process in the nutrition of ruminants. Extensive digestion of feed and synthesis of essential nutrients take place in the rumen as a result of microorganisms which populate this section of the digestive tract. The rumen is also recognized as a site of nutrient absorption. For example, large amounts of metabolizable energy as volatile fatty acids are absorbed through the rumen wall. In the process of absorption, nutrients must pass through the epithelial tissue which line the rumen. There is some indication that absorption of certain metabolites across the wall of the rumen is an active process and may be related to the activity of this tissue. Thus, it may be reasoned that conditions which affect the activity of ruminal epithelium may also alter absorption and possibly animal performance. Ration concentrate: roughage ratios and physical forms of ration ingredients are factors which have been associated with changes in ruminal tissue. This experiment was conducted in an attempt to assess the relative activity of epithelial tissue from the rumen using *in vitro* butyrate uptake as the method of measurement.

Procedure

Samples of ruminal tissue were collected at time of slaughter from steers that had been on a 111-day feeding experiment. There were 8 steers on each of 6 treatments (I - flaked corn, II - ground corn, III - flaked corn + long hay, IV - ground corn + long hay, V - flaked corn + ground hay, and VI - ground corn + ground hay). Details of rations fed, steer performance and carcass data are presented in the Beef Cattle Section of these reports (Thompson *et al.*). Samples of ruminal fluid were collected on the day before slaughter and pH and volatile fatty acids determined.

Samples of ruminal tissue were incubated *in vitro* for 3 hours in a buffered medium containing a standard quantity of butyrate. Following the incubation period, butyrate remaining was determined and uptake calculated by comparing with control flasks. The dry matter and crude protein contents of the tissue samples were also determined and results calculated as micromoles butyrate uptake per gram of tissue dry matter and per gram of tissue protein. The papillae on the rumen tissue samples were measured and given a color score.

Results and Discussion

The results are summarized in Table 1. Butyrate uptake data suggest definite effects of rations on ruminal tissue activity. Tissues from the rumens of steers fed long hay with either flaked or ground corn (treatments III and IV) and from steers fed ground hay with flaked corn (treatment V) showed larger amounts of butyrate uptake than tissues from steers receiving no hay (treatments I and II) and ground hay with flaked corn (treatment VI).

Table 1 - Butyrate Uptake, Papillae Measurements and Color of Ruminal Tissue with pH and VFA's of Fluid From the Rumens of Steers

	Treatments					
Measurements	I	II	III	IV	V	VI
Butyrate uptake						
Micromoles/g D. M.	85.2	81.1	127.0	137.4	123.9	91.0
Micromoles/g Protein	110.3	105.5	161.8	170.3	154.0	116.4
Papillae measurements[a]						
Length, cm	1.06	1.06	0.96	1.00	1.14	1.12
Width, cm	0.37	0.38	0.38	0.38	0.41	0.44
LXW, cm^2	0.39	0.41	0.36	0.38	0.48	0.50
Tissue Color[b/]	7.2	6.4	6.3	5.3	5.1	7.2
Analyses of Rumen Fluid Samples (111th day)						
pH	5.56	5.66	6.40	6.60	6.38	5.74
Total VFA, micromoles/ ml	108.2	128.5	87.2	76.0	76.3	123.2
Acetate, molar %	40.5	43.3	49.9	47.6	42.8	42.9
Propionate, molar %	41.2	34.3	29.6	35.3	45.3	41.4
Butyrate, molar %	11.3	14.5	14.5	10.6	7.1	9.9
i-valerate, molar %	2.7	3.4	3.9	2.9	1.9	2.6
n-valerate, molar %	4.3	4.4	2.0	3.6	2.9	3.1

a/ Average measurements for 6 randomly selected papillae from each tissue sample.

b/ Average of 8 subjective scores, 1 = lightest, 10 = darkest.

Butyrate uptake was apparently related to the pH and total VFA content of ruminal fluid collected before slaughter. High butyrate uptakes were associated with high pH values and low VFA levels, whereas low butyrate uptakes were associated with low pH's and high total VFA's.

No apparent relationships were evident between butyrate uptake and papillae size, tissue color or molar percentages of the various VFA's. However, papillae from the rumens of steers receiving ground hay (treatment V and VI) tended to be larger than when no hay was fed or when long hay was fed.

PLASMA LEVELS OF ACETATE AND PROPIONATE IN SHEEP FOLLOWING RUMINAL OR ABOMASAL ADMINISTRATION

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Volatile fatty acids are produced during microbial fermentation of feeds in the rumen. Of these acids, acetate and propionate provide a large portion of the energy for maintenance and production of the ruminant. Considerable interest has been shown in measuring the utilization of these compounds. Research has established that large quantities of acetate and propionate are absorbed through the rumen wall. Levels of acetate in systemic blood have been correlated with rates of ruminal absorption; however, blood propionate is not readily affected by ruminal absorption. This experiment was conducted to study the levels of acetate and propionate in systemic plasma following ruminal or abomasal administration.

Procedure

Four mature crossbred wethers, with an average weight of 130 lb, were used in this experiment. Two wethers were previously fitted with ruminal fistulas and two with abomasal fistulas. The animals were maintained on a ration of ground alfalfa hay.

Equal caloric quantities (900 Kcal) of acetate and propionate in the forms of triacetin and tripropionin, respectively, were administered into the rumen or abomasum through the fistulas. Blood samples were taken in beparinized tubes from the jugular vein of each wether immediately before dosing and at 1, 2, 4, 8 and 12 hours after dosing. Ruminal fluid samples were collected from the wethers with ruminal fistulas at the same time blood was sampled. A double reversal treatment pattern was followed so that each animal received each fatty acid twice during the four sampling periods. A minimum of 7 days was allowed between sampling periods. Plasma was separated by centrifugation. Plasma and ruminal fluid were prepared for acetate-propionate analyses by treating with meta-phosphoric acid. Concentrations of these fatty acids in the samples were determined by gas chromatography.

Results and Discussion

The results are summarized in Tables 1 and 2. Acetate levels in plasma increased very rapidly during the first hour following both ruminal and abomasal administration of triacetin. In the sheep receiving ruminal doses, plasma acetate appeared to plateau between 1 and 4 hours, declined rapidly by 8 hours, and returned to the pre-treatment level within 12 hours. In the sheep given triacetin into the abomasum, plasma acetate plateaued between 1 and 8 hours, then a sharp decline occurred between 8 and 12 hours. Twelve hours after abomasal dosing plasma acetate was still several times higher than pre-treatment levels. Plasma acetate did not change significantly following either method of tripropionin administration.

Owing to the low levels of propionate in the blood and the low sensitivity of the procedure for measuring propionate, the response of plasma propionate to the treatments was less definitive. However, some observations can be made. Neither route of acetate administration produced detectable changes in plasma propionate. (Measurements were not sensitive enough to detect depressed levels of propionate.) Either method of propionate administration produced some increase in plasma propionate. The maximum levels obtained were much lower than the corresponding acetate levels. This observation is consistent with reports of efficient removal of propionate from the blood by the liver. Contrary to what might be expected if intestinal absorption of propionate is efficient, abomasal administration of propionate resulted in a less marked and more transient rise in plasma propionate than ruminal administration.

Table 1 - Acetate and Propionate Levels (Micromoles per ml) in Plasma of Sheep Following Ruminal and Abomasal Administrations of Triacetin and Tripropionin

Sampling Time (hours)	Administration			
	Rumen		Abomasum	
	Triacetin	Tripropionin	Triacetin	Tripropionin
Acetate				
0	1.16	0.80	0.67	0.81
1	10.00	0.73	11.85	1.16
2	9.92	1.08	12.40	1.00
4	8.38	0.88	11.32	0.98
8	2.80	0.77	10.88	0,76
12	1.09	0.58	4.38	0.73
Propionate				
0	0.16	0.17	0.16	0.16
1	+ [a]	0.80	+	0.64
2	+	1.02	0.16	0.26
4	0.16	0.47	+	0.16
8	+	0.17	+	+
12	+	+	+	+

[a]/ Propionate levels (+) were less than 0.16 micromoles per ml.

Table 2 - Acetate and Propionate Levels (Micromoles per ml) in Ruminal Fluid of Sheep Following Administration of Triacetin and Tripropionin Into Rumen.

Sampling Time (hours)	Source Administered			
	Triacetin	Tripropionin	Triacetin	Tripropionin
	Acetate		Propionate	
0	41.6	45.8	9.4	15.2
1	185.5	56.4	10.7	65.1
2	185.2	50.8	14.1	66.9
4	96.8	48.4	11.9	93.0
8	55.6	30.2	8.3	58.3
12	51.6	22.1	14.1	19.5

The analyses of ruminal fluid summarized in Table 2 show that ruminal administrations of triacetin or tripropionin did substantially increase the concentration of the corresponding volatile fatty acid in ruminal fluid. Comparison of Tables 1 and 2 reveals that acetate concentration in the rumen is more closely related to plasma acetate than propionate concentration in the rumen is related to plasma propionate.

SHEEP SECTION

CREEP RATIONS FOR LAMBS SUCKLING EWES FED CORN OR ALFALFA SILAGE

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Six lots of 20 or 21 crossbred ewes were assigned to a creep-feeding trial completed in 1963. Creep treatments were: (1) no creep in barn followed by creep feeding a simple creep mixture on pasture; (2) simple creep mixture; (3) complex creep mixture. The simple creep mixture included 89% shelled corn, 10% soybean meal pellets and 1% Aureomycin Crumbles. The complex mixture included 61.5% cracked yellow corn, 30% soybean meal pellets, 5% alfalfa meal, 1.5% bonemeal, 1% trace mineralized salt, and 1% Aureomycin Crumbles. Each of the three creep-feeding treatments was included in lots of ewes being wintered on either corn or alfalfa silage rations. The wintering period extended from December 12 to April 2. After April 2 all lots were grazed on permanent bluegrass-clover pastures and rotated to equalize pasture treatment.

Results are summarized in Table 1. Lamb gains were higher on the complex mixture as compared to the simple mixture for both twins and singles. In general, creep-fed groups were superior to control groups. Twin lambs responded more consistently to creep feeding than single lambs. No difference was noted in the two silage treatments. In previous work lamb performance on complex and simple creep mixtures has been approximately equal. Complex mixtures are generally more costly, and even with the differences noted in this trial in favor of the complex mixture it is doubtful that it can be recommended because of cost.

Table 1 - Summary of Lamb Weights

	Corn Silage			Alfalfa Silage		
	Control	Simple Creep	Complex Creep	Control	Simple Creep	Complex Creep
No. of ewes	21	21	20	20	20	20
No. of ewes lambing	21	19	18	19	19	19
No. of lambs raised	27	24	20	29	27	27
Av birth wt, lb						
Singles	10.1	11.2	10.5	9.8	9.4	9.2
Twins	7.4	8.7	8.6	8.4	8.9	8.6
Av 28-day wt, lb						
Singles	26.5	29.4	28.4	30.0	26.2	27.3
Twins	17.5	22.6	23.7	21.2	22.5	23.2
Av 56-day wt, lb						
Singles	40.0	47.9	46.0	47.2	44.6	47.5
Twins	25.3	39.8	41.6	32.6	38.6	39.2
Av 100-day wt, lb						
Singles	55.7	71.8	72.1	69.0	63.8	66.6
Twins	41.6	59.2	65.1	50.9	60.6	64.1

PERFORMANCE OF EWES ON CORN AND ALFALFA SILAGES AND TWO LEVELS OF GRAIN FEEDING

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University of Kentucky

Five lots of 20 or 21 crossbred commercial ewes each were fed in dry-lot from December 12 to April 2 in a comparison of corn and alfalfa silages and two levels of grain feeding. Ewes on the regular grain level were started on 0.5 lb daily per head and later increased to 1.0 lb. Ewes on the high grain level were started on 1.0 lb per head daily and increased to 1.5 lb. Ewes in silage lots were fed 1.0 lb of alfalfa hay per head daily plus all the silage they would consume. One lot of ewes on a standard alfalfa hay-shelled corn ration served as a control group. Bonemeal, salt, and ground limestone were available in all lots, and all lambs were fed a simple creep ration made up of 89% cracked yellow corn, 10% soybean meal pellets and 1% Aureomycin Crumbles. On April 2 ewes and lambs were placed on bluegrass-clover pastures.

Results are summarized in Table 1. Ewes consumed slightly less silage in the high-grain lots. They also tended to maintain their weight slightly better and produce heavier

Table 1 - Summary of Results

	Regular Grain			High Grain	
	Control Alfalfa Hay	Corn Silage	Alfalfa Silage	Corn Silage	Alfalfa Silage
No. of ewes	21	21	20	20	20
No. ewes lambing	21	19	19	16	17
No. lambs raised	29	24	27	22	26
Av ration, lb					
Silage	-	9.66	10.33	9.33	9.66
Alfalfa hay	5.33	1.00	1.00	1.00	1.00
Shelled corn	0.81	0.61	0.81	1.11	1.31
Soybean meal	-	0.20	-	0.20	-
Av ewe wt, lb					
Initial, Dec. 12	151	167	162	167	166
Final, Apr. 2	141	156	152	164	158
Wt loss	10	11	10	3	8
Fleece wt	7.1	7.1	7.4	7.6	7.6
Birth wt of lambs, lb					
Singles	10.4	11.2	9.4	10.5	10.7
Twins	8.5	8.7	8.9	9.1	9.2
28-day wt of lambs, lb					
Singles	30.1	29.4	26.2	26.0	30.2
Twins	23.4	22.6	22.5	23.5	22.4
56-day wt of lambs, lb					
Singles	45.3	47.9	44.6	41.6	51.7
Twins	37.8	39.8	38.6	38.6	38.3
100-day wt of lambs, lb					
Singles	69.4	71.8	63.8	65.6	72.5
Twins	61.4	59.2	60.6	58.7	61.6

fleeces than those on regular grain levels. However, the extra grain feeding did not result in any consistent improvement in lamb gains. The two silages produced similar results in all comparisons. Present grain feeding recommendations for ewes in Kentucky are probably adequate for optimum lamb gain.

EARLY WEANING OF SPRING LAMBS

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A group of 59 spring lambs at the West Kentucky Substation were allotted according to date of birth, type of dam, and whether twin or single to an early weaning experiment as follows: Lot I - control, not weaned early, continued on creep feed on pasture; Lot 2 - weaned early, continued in dry-lot on full feed of creep ration used prior to weaning plus alfalfa hay. The mixed ration used both as a creep feed and for the early weaned group included 90% cracked yellow corn, 10% soybean meal, and 50 grams of aureomycin added per ton. The experiment started on April 8 with all lambs that were over 56 days old at that time. Younger lambs were put on trial as they reached 56 days of age. Average initial weight for the controls was 56.0 lb and for the early weaned group, 54.9 lb. The trial was terminated on July 15 when all remaining control lambs were weaned and the two groups were finished together.

Results are summarized in Table 1. Lambs in the early weaned group gained slightly slower than the controls but tended to finish at lighter weights. As a result, a higher percentage of the early weaned group was marketed by July 16. Higher dressing percentage and both higher live and carcass grades for the early weaned group support the conclusion that early weaned lambs do tend to finish at lighter weights and is in agreement with work at other stations. Although the early weaned lambs sold for slightly more per cwt, their average market value was less owing to their lower market weight. If one disregards pasture, feed costs were over twice as high for the early weaned group. If it were possible to include pasture costs, average cost for the two groups would probably be more nearly the same. This is based on the assumptions that unweaned lambs need high quality pasture for finishing and that ewes from which lambs have been weaned early should be placed on a maintenance type pasture. The results demonstrate that lambs can be early weaned successfully, and although costs may be higher it is a method by which lamb production can be intensified.

Table 1 - Summary of Results, Early Weaning of Lambs

	Control Not Weaned Early	Weaned Early
Initial number lambs	28	31
Number sold by July 16	21	25
Initial weights, lb	56.0	54.9
Final weight, lb	98.9	94.3
Average daily gain, lb	0.54	0.50
Average dressing percentage	50.2	51.9
Live grades, No.		
Prime	7	10
Choice	12	15
Good	1	-
Commercial	1	-
Carcass grades, No. a/		
Prime	2	12
Choice	17	12
Good	1	-
Commercial	1	-
Market value per lamb	$19.72	$19.53
Feed cost per lamb b/	1.88	4.72
Feed cost per 100 lb gain	5.18	12.88

a/ One carcass in early weaned group not graded

b/ Pasture costs not included

SOUTHDOWN, HAMPSHIRE, AND SOUTHDOWN-HAMPSHIRE CROSSBRED RAMS AS SIRES OF SPRING LAMBS

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At the U.K. Eden Shale Farm in 1962-63, the performance of lambs sired by either a Southdown, Hampshire or Southdown-Hampshire crossbred ram was compared. After eliminating lambs whose performance was affected by a variable not a part of the trial, a total of 71 lambs were available for this comparison. All lambs were creep fed both in the barn and after being turned to pasture. All three groups of lambs were run together along with their dams and given the best management possible. On June 28 all lambs not sold were weaned and finished on pasture plus a full feed of the ration used as a creep feed prior to weaning.

Results are summarized in Tables 1 and 2. As in previous work, Hampshire-sired lambs gained fastest and were marketed earlier than the other two groups. Performance

Table 1 - Unadjusted Mean Observations for Lambs Sired by Southdown, Hampshire, and Southdown-Hampshire Crossbred Rams

	Southdown	Hampshire	Southdown-Hampshire
Number of lambs	25	28	18
Date of birth	Jan. 19	Jan. 21	Feb. 1
Birth weight, lb	9.8	10.1	10.1
Weaning weight, lb	87.0	92.0	80.7
Market weight, lb	96.3	96.9	93.1
Days to weaning	158.6	146.0	145.9
Days to market	187.2	164.8	186.8
Weight per day of age at weaning, lb	0.55	0.63	0.55
Weight per day of age at market, lb	0.52	0.59	0.50
Type of rearing a/	1.6	1.7	1.8
Sex b/	1.4	1.3	1.6

a/ Single = 1, Twin = 2

b/ Male = 1, Female = 2

of Southdown and Southdown-Hampshire crossbred-sired lambs was quite similar. However, it should be pointed out that in the crossbred-sired group there were both more twins and more ewe lambs than in either of the other groups. As shown in Table 2, twin lambs and ewe lambs gained approximately 0.1 lb slower than their counterparts in each comparison. Some adjustment upward because of this for crossbred sired lambs probably would put them intermediate between the other two groups in agreement with results reported last year.

Table 2 - Unadjusted Means for Ewe, Ram, Single and Twin Lambs

	Ewe	Ram	Single	Twin
Birth weight, lb	9.4	10.4	11.4	9.4
Weaning weight, lb	82.1	89.9	92.1	85.6
Market weight, lb	94.2	99.2	97.9	94.8
Days to weaning	153.7	150.1	139.5	155.0
Days to market	189.5	170.1	156.7	186.9
Weight per day of age to weaning, lb	0.53	0.60	0.66	0.55
Weight per day of age to market, lb	0.50	0.59	0.62	0.51

WESTERN CROSSBRED EWES MATED TO SLOW, MEDIUM AND RAPID GAINING HAMPSHIRE RAMS

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One hundred two yearling crossbred western ewes were divided into three equal groups and mated to either a slow-, medium- or rapid-gaining Hampshire ram at the Robinson Substation. Gaining ability of the Hampshire rams had been previously determined in a performance test at Lexington. The rapid-gaining ram had gained 0.59 lb; the medium-gaining ram, 0.54 lb and the slow-gaining ram 0.43 lb per day. All lambs were creep fed and allowed to run on pasture with their dams. During the early part of the lambing period, ewes suckling twins were fed separately from those with singles in order to give them an increased ration.

Results are summarized in Table 1. Gains of lambs sired by the medium- and fast-gaining sires were approximately equal and definitely higher than gains of lambs sired by the slow gainer. In the performance test there was only 0.05 lb difference in rate of gain between the medium and fast gainer, and it is doubtful that this is enough to note any difference in progeny. The results further emphasize the importance of selecting for rate of gain in commercial sires. In earlier reports fast-gaining sires have also sired meatier lambs on the average. This also is an advantage in light of present consumer preference.

Table 1 - Average Lamb Weights and Gains

	Sire Group		
	Slow	Medium	Rapid
Final weight, lb			
Singles	86.9	89.5	90.0
Twins	86.1	89.0	89.7
Average daily gain, lb			
Singles	0.37	0.45	0.44
Twins	0.35	0.39	0.41

GENETICS SECTION

PROGESTERONE AND 6-METHYL-17-ACETOXYPROGESTERONE AS INHIBITORS OF SPERMATOGENESIS IN RAMS

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Three Southdown rams were injected subcutaneously with 50 mg of crystalline progesterone in propylene glycol every other day, and three rams were given orally 100 mg of 6-methyl-17-acetoxyprogesterone (MAP) daily for 60 days. Weekly semen collections were obtained for laboratory study. From the third week after beginning treatment protoplasmic droplets were present on the sperm. In the progesterone group 31.3% of the cells contained droplets and in the MAP group 15.3%. Semen volume from the 4th through the 18th weeks in both groups was significantly lower than before treatment. Total sperm in pretreatment ejaculates averaged 1.84 and 1.80 billion cells, respectively, for the two groups. Thirteen weeks after beginning of treatment the progesterone group averaged 0.74 and the MAP group 0.34 billion cells per ejaculate. Total sperm cells per ejaculate were significantly ($P < 0.01$) lower after 8 weeks. The percentage of abnormal cells was significantly ($P < 0.01$) higher from the 4th through the 18th week in both groups. Histological sections prepared from testicular biopsies taken 6 days after end of treatment show atrophy of interstitial cells and seminferous tubules with sloughing and disorganization of germinal elements. Semen characteristics are shown in the following table.

Table 1 - Average Semen Characteristics of Rams Injected with Progesterone or Fed MAP

Weeks After Start of Treatment	Semen Vol (ml)	Motile Cells (%)	Total Sperm Cells (billion)	Abnormal Cells (%)
Progesterone-treated Rams				
Pretreatment	0.52	61	1.84	9.8
5	0.27	40	1.16	24.0
10	0.23	33	0.64	27.9
13	0.27	30	0.74	27.1
18	0.30	30	0.90	24.7
22	0.43	43	1.34	28.4
MAP-treated Rams				
Pretreatment	0.70	47	2.63	11.8
5	0.43	43	1.88	16.7
10	0.30	47	1.12	20.7
13	0.13	17	0.34	20.8
18	0.22	27	0.75	19.7
22	0.33	7	0.82	19.7

DEVELOPMENT OF THE REPRODUCTIVE ORGANS AND GROWTH RATE OF RAM LAMBS INJECTED WITH PROGESTOGENS

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Twenty-four ram lambs were randomly divided into four groups of six lambs each. One group served as a control, lambs in the second group were castrated, lambs in the third group were given three monthly subcutaneous injections of 50 mg of 6-methyl-17-acetoxyprogesterone (MAP), and lambs in the fourth group were given three monthly subcutaneous injections of 20 mg of 6-chloro-Δ 6-17-acetoxyprogesterone (CAP). Treatment was started when the lambs averaged 5 weeks of age, but age for individual lambs varied from 20 to 61 days. The lambs were slaughtered after reaching 80 lb in weight. Average age, weight at slaughter and weight of the reproductive organs are shown in the following table.

Table 1 - Age, Body Weight and Weight of Reproductive Organs of Ram Lambs

	Control Rams	Wethers	Rams Injected With MAP	Rams Injected With CAP
Av age at slaughter, days	149	160	149	160
Av wt at slaughter, lb	82.4	79.8	82.4	82.2
Wt testes, gm	264	--	91	165
Wt seminal vesicles, gm	8.4	0.7	1.2	3.4
Wt Cowper's glands, gm	2.5	0.6	0.9	1.7

Injecting immature rams with MAP or CAP significantly suppressed development of the testes and accessory reproductive glands but had no significant effect on body weight gain. These compounds interfere with the production or release of pituitary gonadotrophic hormones, which are responsible for growth of the reproductive organs. These or compounds with similar action may have potential use as hormonal castrators.

EFFECTS OF SHORT PERIODS OF HEAT STRESS UPON FERTILITY AND EARLY EMBRYO SURVIVAL IN EWES

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Sixty western crossbred ewes were randomly divided into 3 groups of 20 ewes each. One group served as controls, the second was placed in the heated room (90°F, relative humidity 60-65%) at time of breeding, and the third group was placed in the heated room one day after breeding. Ewes in the two treated groups were removed from the high temperature three days after they were bred and were placed with the control ewes. Thus, the groups were exposed to the heat for 3 and 2 days, respectively. Three days after being bred, one-half of the ewes in each group were slaughtered for ovulation and fertility data. The remaining ewes were kept for lambing data. Reproductive performance of the ewes is shown in the following table.

Table 1 - Reproductive Performance of Ewes Exposed to Short Periods of Heat Stress

	Control Ewes	Ewes Exposed to Heat: At Breeding	Ewes Exposed to Heat: 1 day Post-breeding
Abnormal ova, %	9.1	50.0	41.7
Fertilized ova, %	100.0	85.7	92.3
Ewes lambing, %	70.0	40.0	50.0
Embryo loss, %	9.1	58.3	41.6
Lambing rate	1.43	1.25	1.40

Estimated embryo loss was significantly higher ($P < 0.01$) for the ewes exposed to the high temperature. Earlier studies showed that embryo loss was high when ewes were exposed to the heat at times similar to those in the present study and kept in the high temperature for 20 days. Results from the study reported herein show that the damage to the young sheep embryo from exposing the ewe to high temperature occurs during the first few days after fertilization and is not the result of prolonged exposure.

SELECTING FOR EARLIER LAMBING DATE IN PUREBRED SOUTHDOWN SHEEP

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University of Kentucky

Results of selecting for earlier date of lambing and for higher reproductive efficiency are being studied. A flock of 60 purebred Southdown ewes is maintained and has been closed to outside breeding since 1956. Starting in 1961, ewes that fail to lamb and the latest ewes to lamb have been culled; they have been replaced with early-born ewe lambs. The flock is divided into three breeding groups, and three sires have been used each year. Sires used as yearlings are the earliest-born lambs from each breeding group. New sires are used each year. Inbreeding is kept to a minimum by avoiding parent-offspring and half-sib matings. To date there has been no indication of the appearance of recognized undesirable recessive traits.

Prior to 1960 the rams were put in with the breeding groups on August 15 and since 1960 on August 1. One week later, marking harnesses are outfitted on the rams to determine date of first estrus and number of heat periods exhibited by each ewe. The delay of one week in putting on marking harnesses reduces false markings by over-eager rams when first introduced into the breeding flock. A five-year summary of the breeding performance and percentage of lambs alive on July 1 (weaning date) are shown in Table 1.

Table 1 - Summary of Breeding Performance and Percent of Lambs Weaned

	Year				
	1959	1960	1961	1962	1963
Av date of first breeding	9/21	9/30	9/20	9/27	9/16
Av date of lambing	3/15	3/25	3/6	3/11	3/7
Av interval between first breeding and conception (days)	30	31	22	20	27
Percent of ewes lambing	77.1	85.7	93.3	96.8	90.0
Lambing rate	1.45	1.43	1.50	1.38	1.43
Percent of lambs alive at weaning, July 1	70.9	72.7	75.0	72.6	72.2

Small year-to-year differences are apparent in the various measures of reproductive performance. For the last three years the average date of lambing has been slightly earlier than in 1959 and 1960, but no marked change in date of lambing has occurred. Since 1961 some selection of ewes in respect to date of lambing has been possible; it is anticipated, however, that sufficient time has not passed to show any significant trend in date of lambing. It should be pointed out that since 1961 more than one-third of the ewes in the breeding flock have been yearlings. In earlier years few yearling ewes has been in the flock, and in some years there have been none. A summary of lambing dates for the past three years shows that the average date of lambing for yearling ewes has been 9 days later than for older ewes.

SEMEN CHARACTERISTICS OF YEARLING SOUTHDOWN RAMS

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Each year laboratory tests of semen from five early-born yearling rams by each sire are made during three consecutive weeks in July. An electroejaculator is used to collect semen. Approximately 1 ml of semen is taken at each collection and percent of motile cells, sperm cell concentration and percent of abnormal cells are determined.

Results of the semen tests for 1963 are shown in Table 1. Rams No. 27, 22 and 21 are being used in the breeding flock.

Table 1 - Semen Characteristics of Yearling Southdown Rams - July 1963

Sire	Ram	Vol per Collection, ml	Motile Cells, %	Sperm Cell Concentration, billion/ml	Abnormal Cells, %
606	27	0.93	10	.17	33.7
	218	0.90	67	1.76	5.6
	229	0.80	73	2.08	6.9
	231	0.90	53	1.57	10.7
	240	1.10	53	2.81	8.9
	Average	0.90	51	1.68	13.2
6035	22	0.86	77	2.65	8.7
	23	0.90	53	1.77	28.2
	25	1.06	50	.84	9.7
	215	1.00	57	1.66	14.2
	216	0.80	57	1.72	5.4
	Average	0.92	59	1.73	13.2
6040	21	0.96	63	1.24	28.3
	24	0.90	30	.34	40.4
	221	0.93	63	1.99	26.8
	252	0.97	80	2.14	5.1
	253	0.87	80	2.80	7.6
	Average	0.93	63	1.70	21.6

The average semen characteristics of the rams by sire groups shows little variation; however, individual rams within groups do vary. To date little relationship between semen traits, as determined during July and the subsequent breeding performance of the rams has been evident. Experience has shown that semen traits of rams are often subject to change between July and October, the months when most of the conceptions occur. Late summer shearing may influence conception date, but this has not been practiced in the flock.

MEATS SECTION

PARTIAL PUMPING OF HAMS

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Forty hams were purchased from a local packing house and divided into 4 groups of 10 hams each. Groups 4D and 6D were used as dry-cured controls, while groups 4P and 6P, paired mates of groups 4D and 6D, were pumped to 4% and 6% respectively of their fresh weight with a 50° pickle. All hams were rubbed with dry cure in 3 applications at 3-day intervals so that the control groups received an amount equivalent to 10% of fresh weight. The amount of dry cure used on groups 4P and 6P was reduced by the amount injected so that all hams received the same amount of curing ingredients.

Hams were left in cure for 2 days per pound, then removed from cure, soaked 30 minutes in lukewarm water, dried for 3 hours at 100°F, and smoked for 21 hours at 100°F. They were then placed in an aging room for 6 months at 65°F and having a relative humidity of approximately 60%. Weight losses were determined after curing, after smoking, and after each month of aging. Hams were cut after aging and examined for color, aroma and soundness. Center slices were broiled for palatability tests.

Average weight loss percentages are given in Table 1. Hams pumped at 6% lost less, followed by those pumped at 4% while the dry-cured controls shrank the most.

Table 1 - Average Weight Loss by Periods, Percent

Group	Weight Loss by Period							
	Cured	Smoked	1 mo.	2 mo.	3 mo.	4 mo.	5 mo.	6 mo.
4D	5.12	9.72	18.64	22.00	24.68	26.89	28.91	30.54
4P	.48	4.30	14.11	18.31	21.38	24.01	26.35	28.39
6D	4.92	8.94	18.02	21.43	24.04	26.25	28.19	29.84
6P	+2.64	0.97	10.57	14.43	17.46	20.06	22.30	24.48

When the hams were cut and observed the dry-cured controls were generally sound, red in color, and had a moderate or typical aged aroma. Most of the pumped hams were light red, and showed signs of deterioration from being slightly off in aroma to being spoiled.

Palatability scores were conducted on the controls and those pumped hams that were not spoiled. The panel markedly preferred the dry-cured controls.

Although weight loss can be reduced by partial pumping, its use is not recommended until a more satisfactory method to prevent spoilage loss can be devised.

COMPARISON AND RELATIONSHIP OF BEEF CARCASS CHARACTERISTICS

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University of Kentucky

During recent years considerable interest has arisen over the production and evaluation of the meat-type beef carcass. In view of this interest, carcass data from 20 choice steers were obtained to compare separable components of the carcass obtained by different methods and also to correlate these components to the yield of closely trimmed retail cuts. Table 1 gives the average and range for each of the carcass characteristics used to describe the cattle in this study.

Table 1 - Description of Carcass Characteristics

	Av	Range
Grade		
Quality	ch.	ch- to ch+
Dual	3.0	2 to 4
Carcass weight (lb)	672.0	612 to 760
Backfat (in.)	0.57	0.3 to 0.7
Rib-eye area (sq. in.)	12.26	8.80 to 15.84
Estimated yield (%)[a]	49.26	46.5 to 52.5

a/ Closely trimmed round, chuck, loin and rib determined by formula used by USDA for Dual Grading.

The percentage of physically separated fat from the 9th, 10th, and 11th rib sections was highly correlated ($P < 0.001$) with percentage of total fat obtained from planimeter tracings. The average percentage of fat contained in each of these three rib sections (9th, 10th and 11th), comparing the planimeter and separation methods, is shown in Table 2.

Table 2 - Comparison of Fat in Whole Rib Determined by Planimeter Tracing[a] and Physical Separation

	Rib Sections			
Comparisons	9th rib	10th rib	11th rib	Total
	(%)	(%)	(%)	(%)
Tracing	39.69	41.25	44.87	41.81
Separation	38.44	41.13	42.59	40.68

a/ Area of fat in square inches of cut surface.

Furthermore, averages, standard deviations and correlation coefficients (Table 3) were determined between the percentage of fat and lean of the rib and edible portion of the boneless round (trimmed to one-fourth inch of fat).

Table 3 - Averages, Standard Deviations and Correlation Coefficients of Fat and Lean of Round and Rib

Components	Closely trimmed boneless round [a]	9-10-11th rib separation	Correlation coefficient
Fat (%)	17.90 ± 3.30	44.38 ± 4.80	0.65
Lean (%)	67.57 ± 3.52	45.69 ± 4.38	0.63

Table 4 also shows the relationship of the separable lean of the 9th, 10th and 11th rib with the edible portion of the round and the percentage retail yield. Although these correlations do not explain all of the variation, they are of the magnitude to be of significant importance. The estimated yield of closely trimmed chuck, rib, loin and round, using the procedure described by the USDA for dual grading, was correlated 0.87, 0.80 and 0.87 respectively, with percentage of rib eye area at the 12th rib, percentage of total lean of the round and square inches of rib eye at the 12th rib. The results of these data suggested that a combination of several highly correlated carcass components from the rib and round, obtained either by tracings or separation can be used to predict reliably and rapidly carcass composition.

Table 4 - Simple Correlations of the Separable Lean of the 9th, 10th and 11th Rib with the Edible Portion of the Round and Percent Retail Yield

Separable lean of the rib	Percent edible portion of the round	Percent retail yield of edible meat [a]
9th rib	0.57	0.77
10th rib	0.59	0.80
11th rib	0.63	0.78
Total (9-10-11)	0.63	0.83

a/ Closely trimmed round, chuck, loin and rib determined by formula used by USDA for Dual Grading.

THE EFFECTS OF PANCREATIC LIPASE AND PAPAIN ON PALATABILITY, TENDERNESS AND RANCIDITY DEVELOPMENT OF QUICK-AGED COUNTRY-STYLE HAMS

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Sixty-four skinned hams, averaging 15.01 pounds, were divided equally into eight groups: L 85, L 95, DL 85, DL 95, P 85, P 95, DP 85, and DP 95. The four DL and DP groups were dry-cured and the four companion L and P groups were pumped to 4% of their fresh weight with a 0.012% solution of either pancreatic lipase (L) or papain (P), and then dry-cured at 36-40°F. The hams were cured 2 days per pound, average weight, allowed to hang 30 days at 36-40°F for salt (NaC1) equalizations, smoked and aged 12 weeks at either 85° or 95°F and approximately 60% relative humidity. Hams were weighed to the nearest 0.01 pound while fresh, after curing, after the salt equalization period, after smoking, and at 2-week intervals during aging. Outside fat samples were removed from hams when fresh, after smoking, and after 6 and 12 weeks aging. These fat samples were rendered and used for determining iodine numbers, peroxide values, free fatty acid content, thiobarbituric acid (TBA) values, and ranco values. After 12 weeks aging, the hams were cut and observed for color, firmness, and aroma. Seam fat samples were removed and used to determine peroxide values and free fatty acid content. Two adjacent one-half inch slices were broiled and subsequently scored by a palatability panel for flavor, saltiness, tenderness, and overall satisfaction. A third slice, 1 inch thick, was used to determine shear test values on one-inch cores.

Weight loss, as shown in Table 1, increased throughout processing and aging, with the greatest amounts occurring during the salt equalization period and the first 2 weeks of aging. Shrinkage values were in inverse proportion to the amount of external fat. Dry-cured hams aged at 85°F shrank significantly ($P < 0.05$) less than those aged at 95°F.

Table 1 - Mean Weight Loss Values for All Groups, Percent

Group	Treatment	Aging Temperature, °F	Cure	NaCl Eq. Pd	Smoke	Weeks Aging 2	4	6	8	10	12
L 85	Lipase	85	2.83	9.90	12.65	17.54	20.01	21.87	24.05	25.67	27.04
L 95	Lipase	95	1.68	8.66	11.36	16.28	19.02	20.93	23.26	24.85	26.39
DL 85	Dry-cure	85	4.94	10.67	13.21	17.85	19.98	21.73	23.64	24.94	26.24
DL 95	Dry-cure	95	4.69	11.20	13.90	19.18	22.17	24.04	26.20	27.55	29.18
P 85	Papain	85	2.26	8.90	11.63	16.90	19.60	21.70	23.78	25.40	26.97
P 95	Papain	95	1.98	8.42	10.77	16.04	18.65	20.63	22.46	24.17	25.56
DP 85	Dry-cure	85	4.75	10.65	13.15	18.12	20.52	22.37	24.06	25.54	26.88
DP 95	Dry-cure	95	5.36	11.03	13.53	18.85	21.76	23.54	25.40	26.95	28.57

Iodine number, peroxide value, free fatty acid content and thiobarbituric acid (TBA) values of the external fat were not apparently affected by enzyme injection or aging temperature. The dry-cured hams had significantly higher ($P < 0.01$) ranco values than the enzyme treated hams. Table 2 shows the mean free fatty acid content and peroxide values for all groups.

Table 2 - Mean Peroxide Values and Free Fatty Acid Content of Seam Fat for All Groups

Group	Rancidity Measurement	
	Peroxide Values	Free Fatty Acid Content, %
L 85	14.76	9.46
L 95	15.42	10.21
DL 85	13.32	6.85
DL 95	15.92	4.33
P 85	13.47	5.80
P 95	11.08	5.87
DP 85	13.74	5.86
DP 95	12.27	5.80

Seam fat peroxide values were not affected significantly by either aging temperature or enzyme treatment. However, lipase injections caused significantly greater ($P < 0.01$) taste panel scores for flavor, saltiness and overall satisfaction.

The control dry-cured hams received more desirable scores for color, firmness and aroma as well or significantly higher ($P < 0.01$) taste panel scores for flavor, saltiness and overall satisfaction.

Papain-treated hams were significantly ($P < 0.01$) more tender as measured by a Warner-Bratzler shear device. Mean shear values for all groups are presented in Table 3.

Table 3 - Mean Shear Test Values for All Groups

Group	Muscle		
	Semimembranosus	Semitendinosus	Biceps Femoris
L 85	17.66	19.11	19.67
L 95	12.52	14.62	15.16
DL 85	15.33	19.27	18.82
DL 95	14.30	15.17	18.40
P 85	8.41	11.75	12.75
P 95	5.48	13.58	(5.92) [a] -9.65
DP 85	14.50	23.72	27.11
DP 95	14.25	16.83	19.26
Total Mean	12.81	16.76	(17.14) [a] -17.60

a/ When one ham was removed the mean for group P 95 and total mean were reduced as shown.

None of the rancidity measurements used were significantly correlated to taste panel scores.

Acceptable country-style hams were produced from the control groups; however, further work is needed to determine whether the two food grade enzymes, pancreatic lipase and papain, may be successfully applied to aged ham production.

PHYSICAL COMPOSITION OF PORK CUTS AND RELATIVE CUTOUT PERCENTAGES OF PORK CARCASSES FROM THREE DIFFERENT WEIGHT GROUPS OF HAMPSHIRE BARROW AND GILT LITTERMATES

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University of Kentucky

Relative cutout data and general carcass information were collected on 10 litters of Hampshire barrows and 10 litters of Hampshire gilts. Three pigs from each litter were used in this study; one littermate was slaughtered at 160±5 pounds, another at 190±5 pounds, and the last at 220±5 pounds. After the carcass information was obtained, each wholesale cut was physically separated into fat, bone, and lean. The results are reported in Tables 1-4.

These data tend to support previous work at this Station that lighter weight pigs have a higher percentage of lean cuts and a lower percentage of lard stock compared with hogs of heavier weights. Also, this work supports the principle that as a pig increases in weight it will deposit a greater amount of fat in relation to lean meat. With respect to sex differences, gilts deposited less intermuscular fat and had more lean meat at heavier weights (190 and 220 pounds). A comparison between barrows and gilts is shown in Tables 1 and 3.

At the present time chemical analyses are in progress to determine if there are any differences in proximate composition (ash, fat, moisture, and protein) and meat quality characteristics among the three weight groups and between the two sexes.

Table 1 - Live Animal and Carcass Data by Sex

Live Weight Groups (lb)	160		190		220	
Sex	Barrows	Gilts	Barrows	Gilts	Barrows	Gilts
Live weight (lb)	160.2	157.8	189.4	189.3	219.3	218.8
Adjusted live weight (lb)	159.4	158.5	189.7	191.9	221.9	221.4
Carcass yield (%)	69.7	69.4	70.9	70.0	70.9	70.8
Carcass length (in.)	27.9	27.9	28.8	29.4	30.1	30.4
Backfat thickness (in.)	1.04	1.00	1.22	1.22	1.43	1.37
Loin eye area at 10th rib (sq. in.)	3.60	3.84	3.76	4.12	4.14	4.46
Loin eye area/cwt carcass (sq. in.)	3.15	3.48	2.80	3.06	2.63	2.85
Ham fat thickness (in.)	0.58	0.66	0.83	0.78	0.99	0.95
Percent ham of carcass	22.53	22.60	20.76	21.20	19.66	20.96
Percent loin of carcass	17.65	17.65	16.08	17.50	15.99	16.55
Percent picnic of carcass	9.20	9.38	9.57	9.63	9.26	9.08
Percent boston of carcass	7.63	7.76	7.37	7.38	7.22	7.07
Percent four lean cuts	58.04	57.39	53.78	55.71	52.17	53.73
Percent belly of carcass	13.57	13.23	14.58	13.50	14.94	14.12
Percent primal cuts	71.61	70.63	68.36	69.27	67.11	67.82
Percent lard stock	13.48	13.76	16.60	15.48	18.46	16.94

Table 2 - Average Live Animal and Carcass Data

Live Weight Groups (lb)	160		190		220	
	Range	Mean	Range	Mean	Range	Mean
Live weight (lb)	154 - 169	159.0	185 - 195	189.4	215 - 226	219.1
Adjusted live weight (lb)	149.8 - 167.4	158.9	181.5 - 198.0	190.8	215.1 - 227.2	221.7
Carcass yield (%)	67.1 - 74.1	69.5	68.1 - 72.5	70.5	67.6 - 72.7	70.9
Carcass length (in.)	27.0 - 29.0	27.9	28.2 - 30.8	29.1	28.6 - 31.5	30.2
Backfat thickness (in.)	0.70 - 1.27	1.02	0.97 - 1.40	1.22	1.06 - 1.70	1.40
Loin eye area at 10th rib (sq. in.)	3.27 - 4.71	3.72	3.26 - 4.82	3.94	3.46 - 5.57	4.30
Loin eye area/cwt carcass (sq. in.)	2.85 - 4.28	3.32	2.38 - 3.62	2.93	2.18 - 3.40	2.75
Ham fat thickness (in.)	0.40 - 0.90	0.62	0.65 - 1.10	0.80	0.70 - 1.70	0.97
Percent ham of carcass	20.66 - 26.72	22.57	17.79 - 22.39	20.98	17.22 - 22.25	20.31
Percent loin of carcass	16.08 - 19.88	17.65	15.23 - 18.37	16.79	14.49 - 17.92	16.27
Percent picnic of carcass	8.19 - 11.20	9.29	8.46 - 10.88	9.60	8.00 - 10.30	9.17
Percent boston of carcass	6.56 - 8.35	7.70	6.10 - 8.81	7.38	6.33 - 8.06	7.14
Percent four lean cuts	53.67 - 62.97	57.72	49.35 - 57.59	54.75	46.44 - 56.58	52.95
Percent belly of carcass	11.46 - 16.76	13.40	12.20 - 15.07	14.06	13.23 - 15.74	14.54
Percent primal cuts	68.07 - 75.03	71.12	64.42 - 71.69	68.82	62.14 - 70.52	67.47
Percent lard stock	10.20 - 19.23	13.62	13.45 - 20.90	16.04	14.21 - 23.94	17.70

Table 3 - Physical Composition of Primal Cuts by Sex

Live Weight Groups (lb)	160		190		220	
Sex	Barrows	Gilts	Barrows	Gilts	Barrows	Gilts
Ham						
% Fat	18.72	18.88	20.74	19.77	23.38	22.70
% Bone	9.90	10.22	9.78	9.78	9.73	9.55
% Lean	71.17	70.75	69.14	70.28	66.64	67.50
Loin						
% Fat	17.00	16.25	18.75	15.54	20.93	17.72
% Bone	16.26	16.98	16.09	15.62	15.33	15.76
% Loin eye	31.25	31.96	28.62	29.91	29.15	30.19
% Total lean	66.31	66.26	64.19	68.84	62.99	65.96
Belly						
% Fat	59.35	56.88	66.79	58.23	64.11	61.43
% Lean	40.41	43.08	32.97	41.96	35.72	38.42
Boston						
% Fat	20.32	18.70	23.62	19.29	26.31	20.34
% Bone	5.36	5.81	4.99	5.34	4.92	5.28
% Lean	73.96	75.94	70.71	75.20	68.35	74.11
Picnic						
% Fat	23.09	21.66	26.88	22.58	28.81	25.08
% Bone	14.09	15.63	13.81	14.25	13.58	13.46
% Lean	62.52	62.63	59.14	62.94	57.26	61.24
Total of all cuts						
% Fat	28.06	26.42	32.66	27.55	32.81	30.69
% Bone	10.80	11.39	10.57	11.32	10.22	10.28
% Loin eye	6.52	6.76	5.79	6.57	6.05	6.24
% Total lean	60.89	61.85	56.23	60.92	54.45	58.73

Table 4 - Average Physical Composition of Primal Cuts

Live Weight Groups (lb)	160		190		220	
	Range	Mean	Range	Mean	Range	Mean
Ham						
% Fat	14.11 - 22.53	18.72	15.13 - 24.25	20.74	19.74 - 27.58	23.38
% Bone	8.46 - 11.47	9.90	9.08 - 10.67	9.78	9.07 - 11.06	9.73
% Lean	66.25 - 76.99	71.17	65.79 - 75.02	69.14	62.15 - 70.18	66.64
Loin						
% Fat	10.54 - 23.58	16.62	11.71 - 26.23	17.62	10.96 - 25.45	19.33
% Bone	13.72 - 20.60	16.62	14.59 - 21.47	16.51	13.75 - 18.69	15.54
% Loin eye	26.94 - 35.88	31.61	21.98 - 34.81	29.88	25.43 - 36.64	29.67
% Total lean	61.90 - 71.34	66.28	59.83 - 71.98	65.16	57.79 - 74.94	64.48
Belly						
% Fat	46.17 - 70.70	58.11	55.07 - 76.29	62.51	54.55 - 78.68	64.11
% Lean	29.30 - 52.78	41.75	23.71 - 44.93	37.33	21.24 - 45.00	35.72
Boston						
% Fat	14.21 - 27.32	19.50	13.54 - 28.47	21.46	13.17 - 30.29	23.32
% Bone	4.76 - 6.90	5.58	4.57 - 6.36	5.16	3.88 - 6.32	5.10
% Lean	67.67 - 79.55	74.95	63.36 - 79.37	72.95	65.61 - 76.86	71.23
Picnic						
% Fat	15.30 - 26.62	22.37	19.68 - 31.74	24.73	20.62 - 34.42	26.94
% Bone	12.78 - 21.00	14.86	12.65 - 15.20	14.03	12.48 - 15.23	13.52
% Lean	53.50 - 69.41	62.58	54.44 - 66.43	61.04	50.74 - 65.64	59.25
Total of all cuts						
% Fat	21.92 - 33.31	27.24	25.00 - 41.05	30.11	26.11 - 40.68	32.81
% Bone	9.35 - 13.02	11.10	8.96 - 13.63	10.94	9.64 - 11.02	10.22
% Loin eye	5.39 - 7.84	6.64	4.51 - 8.11	6.18	4.98 - 7.52	6.05
% Total lean	56.87 - 67.61	61.37	49.50 - 64.19	58.58	49.23 - 64.07	56.64

CARCASS EVALUATION OF LAMBS FROM SELECTED SIRES

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Complete carcass information was analyzed from 121 prime and choice spring lambs which represented the progeny of six performance tested sires (two Southdown and four Hampshires). A high-, average- and low-gaining sire was bred to similar groups of western black-faced ewes in each year of this study.

Lambs were slaughtered at approximately 90 lb and varied in age from 134 to 321 days, with an average of 196 $\pm$ 43. The carcass was cut into wholesale cuts and the right side physically separated into lean, fat, and bone. Predicted separable components, obtained from selected cuts, were highly associated with similar data from carcasses of different genetic background. These comparisons indicate that estimating euqations can be applied to different populations which are comparable in weight and grade. The percentage of lean in the carcass was highly correlated (0.95, 0.92, 0.91 and 0.90) with percentage of separable lean of the rib, leg, loin and shoulder, respectively. The percentage of separable fat in the leg gave the highest relationship (0.91) with total fat in the carcass. Lambs sired by faster gaining rams reached market weight sooner, had slightly leaner carcasses, and a higher percentage of bone. Single and wether lambs were younger at slaughter. Ewe and single lamb carcasses contained more fat while wether and twin carcasses were higher in percentage lean. The results of these studies are given in Table 1. The effect of year and breed has not been removed from these data.

Table 1 - Summary of Carcass Data

	Low Gaining				Average Gaining				High Gaining				All Lambs
	Twin		Single		Twin		Single		Twin		Single		
	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female	
No. of lambs	9	17	12	8	7	7	9	10	7	9	11	15	121
Av age at slaug, days	209	245	190	175	197	216	189	201	163	196	166	185	196
Carcass wt/day of age, lb	0.182	0.177	0.241	0.254	0.230	0.208	0.245	0.225	0.271	0.238	0.276	0.235	0.230
% yield of leg, loin and rib	48.35	48.78	48.00	48.00	47.55	47.99	47.31	47.25	48.58	48.61	47.39	47.74	47.46
Lean wt/day of age, lb	0.096	0.086	0.125	0.130	0.119	0.107	0.130	0.109	0.144	0.116	0.141	0.115	0.116
% Lean in carcass	53.74	51.19	54.88	54.67	56.17	54.76	55.10	51.91	56.71	52.55	55.21	52.47	53.28
% Fat in carcass	31.67	36.28	31.00	31.96	29.31	31.61	30.90	35.23	28.11	33.66	29.65	33.56	32.64
% Bone in carcass	13.71	11.77	13.24	12.52	13.86	12.76	12.93	12.64	14.28	12.41	14.23	13.05	12.93
Area of rib eye (adj to 45 lb carcass wt) sq. in.	2.14	1.93	1.98	1.98	1.99	2.03	1.98	1.83	2.13	2.04	1.98	1.92	1.98
Av fat thickness over R. E. mm	7.94	10.59	6.92	7.47	6.34	7.29	6.78	7.05	6.64	8.06	6.56	7.17	8.16

SWINE SECTION

A STUDY OF THE VITAMIN A REQUIREMENT OF THE GESTATING AND LACTATING SOW

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This experiment was conducted to re-evaluate the present recommended vitamin A levels for the gestating and lactating sow. Changing methods in swine production, as well as a limited amount of research in this area, seemed to justify the need for such a study.

Forty-eight purebred Hampshire and Yorkshire gilts were used in this experiment, which lasted the duration of two farrowings for the majority of the gilts. They were confined to concrete throughout the experiment.

The gilts were allotted to six different treatments which contained various levels of vitamin A, ranging from none to eight times NRC requirements, in addition to a basic ration formulated to be nearly devoid of natural sources of carotene or vitamin A. Stabilized vitamin A palmitate was added to the basic ration to provide the following levels of vitamin A per pound of total ration: Treatment I, none; Treatment II, 666.5 I. U.; Treatment III (control), 1,333 I. U.; Treatment IV, 2,666 I. U.; Treatment V, 5,332 I. U. and Treatment VI, 10,664 I. U.

Criteria used in evaluating the adequacy of the various levels of vitamin A were number and weight of pigs; levels of vitamin A in plasma, liver and milk; cerebrospinal fluid pressures; and any gross symptoms of abnormality. All of these determinations except that of cerebrospinal fluid pressure were made both at birth and again when the pigs were 14 days old.

The level of vitamin A which the gilts received had no apparent effect upon number or weight of pigs at farrowing or at 14 days. A summary of average litter performance is shown in Table 1. The pigs in one litter on Treatment II developed a paralysis of the hindquarters typical of vitamin A deficiency. Gilts on Treatments I and II also seemed somewhat more susceptible to infection than gilts fed higher levels of vitamin A.

Levels of plasma vitamin A from either gilts or pigs were too variable to be considered a good measure of the vitamin A status of the animals. Cerebrospinal fluid pressures for vitamin A deficient animals would be expected to be elevated. However, our readings averaged 67 and 52 mm respectively for the two farrowings, which was much lower than values reported by other workers. The younger age of these pigs (14 days) may have accounted for these lower readings.

Table 1 - Summary of Average Litter Performance

Treatment	First Litters				Second Litters			
	Total Pigs Farrowed, No.	Av Birth Wt, lb	Live Pigs at 14 Days, No. a/	Av Pig Wt at 14 Days, lb	Total Pigs Farrowed, No.	Av Birth Wt, lb	Live Pigs at 14 Days, No. a/	Av Pig Wt at 14 Days, lb
I	7.29	2.71	3.57	7.72	8.25	2.85	5.25	8.00
II	9.43	2.71	6.43	7.97	10.60	2.83	7.20	8.36
III	6.71	2.73	3.14	9.02	10.60	2.73	6.80	8.40
IV	9.63	2.47	5.88	7.24	10.60	2.72	7.40	9.09
V	9.00	2.37	4.29	7.38	6.80	2.99	4.20	9.43
VI	7.57	2.80	3.57	8.99	10.83	2.69	6.83	7.97

a/ Does not include two pigs in each litter which were sacrificed at birth.

Vitamin A levels in the colostrum and 14-day milk from the gilts, and in the livers from the pigs, were consistently increased by higher levels of vitamin A in the dam's rations. This indicates both good mammary as well as placental transfer. The results of these analyses are presented in Tables 2 and 3.

Table 2 - Summary of Vitamin A Content of Milk (mcg/100 ml)

Treatment	First Lactation		Second Lactation	
	Colostrum	14-Day	Colostrum	14-Day
I	69.5	24.3	73.1	21.0
II	162.5	30.1	88.1	25.9
III	119.4	28.1	90.0	30.4
IV	169.6	43.7	125.9	41.8
V	187.5	47.2	154.6	51.0 a/
VI	236.6 a/	69.0 a/	202.5 a/	71.8 b/

a/ Significantly ($P < 0.05$) greater than Treatment III.
b/ Significantly ($P < 0.05$) greater than Treatment III.

Table 3 - Summary of Average Liver Vitamin A Levels of the Pigs (mcg/gm)

Treatment	First Litters		Second Litters	
	Birth	14-Day	Birth	14-Day
I	2.83	4.11	2.16	1.38 a/
II	4.16	7.25	4.55	9.15 a/
III	5.30	8.59	7.19	14.83
IV	7.59	12.94	14.21	20.36 a/
V	9.52	16.66 a/	13.89	23.60 a/
VI	16.30	28.32 a/	16.11	45.58 a/

a/ Significantly ($P < 0.01$) different from Treatment III.

On the basis of this experiment, the present NRC requirement of 1,333 I. U. of vitamin A per pound of ration seems adequate for satisfactory reproductive performance of sows.

THE CALCIUM REQUIREMENT OF THE GESTATING GILT

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This study consisted of a series of four experiments and two gestation experiments with a feedlot trial following each.

Experiment I

Thirty-seven Hampshire gilts, averaging 260 lb each, were allotted according to size into 4 treatments, all having 9 gilts each except treatment III which had 10. Graded levels of calcium were fed to the 4 different treatments. These were: 0.60%, 1.00%, 1.50%, 2.00% and were added in the form of calcium carbonate. All gilts were limited fed 6 lb of feed throughout gestation and gained about 0.75 lb/day. The pigs were weighed and strength determined. They were weighed off the experiment at 21 days of age.

Table 1 - Summary of Average Litter Performance: Experiment I

	Pigs Farrowed			Strength			21 - day	
Treatment	Total (No.)	Live (No.)	Birth Wt (lb)	Strong %	Med %	Weak %	Live (No.)	Pig Wt (lb)
I	8.25	7.88	2.49	45.47	45.47	9.88	6.88 b/	10.37
	(2.17) a/	(2.18)	(0.42)				(1.95)	(2.65)
II	6.60	6.20	2.39	39.42	33.36	27.30	4.20 b/	10.70
	(2.87)	(2.87)	(0.50)				(2.52)	(2.88)
III	8.78	7.45	2.24	39.25	32.92	27.86	4.77 b/	10.60
	(2.08)	(2.34)	(0.58)				(2.86)	(2.34)
IV	7.50	6.50	2.32	56.70	20.00	23.37	6.25 b/	10.47
	(2.68)	(4.32)	(0.65)				(3.63)	(2.23)

a/ Standard deviations enclosed in brackets.

b/ One pig sacrificed at birth.

Gilts receiving 1.50% calcium farrowed 9.4% more pigs and those receiving 2.0% calcium farrowed 11.23% stronger pigs. A larger number of live pigs farrowed and a higher survival rate were observed in respect to gilts receiving 0.60% calcium. Plasma calcium, inorganic phosphorus, and alkaline phosphatase decreased with increasing calcium ingestion.

Experiment II

This experiment consisted of a feedlot trial with all pigs receiving the same basal ration. However, the pigs were allotted according to the treatment their dams received. Forty-eight Hampshire pigs were used. These pigs were 8-10 weeks old when placed on the experiment and remained on their respective treatments for 14 days. The pigs were bled when placed on the experiment for calcium, phosphorus, and alkaline phosphatase determinations. These data are presented in Table 2.

Table 2 - Summary of Pigs Performance on Experiment II

Treatment	Av Gain (lb)	ADG[a] (lb)	Initial Calcium (mg/100 ml)	Initial Phosphorus (mg/100 m.)	Initial Alkaline Phosphatase (Sigma units)
I	30.30	0.89	5.96	10.60	4.11
	(5.50)[b]		(0.73)	(0.49)	(0.89)
II	30.68	0.92	6.36	9.64	4.39
	(5.54)		(0.67)	(0.93)	(0.59)
III	19.43	1.39	6.56	10.18	5.02
	(2.52)		(1.60)	(1.16)	(0.65)
IV	15.00	1.00	6.36	9.42	4.76
	(5.19)		(1.02)	(0.78)	(1.07)

a/ Average daily gain.

b/ Standard deviations enclosed in brackets.

The pigs from dams on Treatment III had a 46% increase in growth rate over those in Treatment I. Plasma calcium and alkaline phosphatase increased with the increase in Ca level in the dams' diet.

Experiment III

In this second gestation experiment 30 Hampshire and 9 Yorkshire gilts were used. Their ages were from 5½ to 8 months, and they weighed an average of 278 pounds. The gilts were placed on the same rations as explained in experiment I except that 100 ppm zinc was added to each ration. They were placed on this ration 60 days prior to farrowing. After farrowing the pigs were weighed and their strength determined. Results are shown in Table 3.

The total number of pigs farrowed was 16.4% more when the calcium level was 1.5% and more live pigs were farrowed by gilts on this treatment. Stronger pigs were farrowed by gilts on 1.0 and 1.5% calcium, with very little difference observed in birth weight, survival rate and weaning weight.

Table 3 - Summary of Average Litter Performance: Experiment III

Treatment	Pigs Farrowed			Strength			21-day	
	Total	Live	Birth Wt (lb)	Strong	Med	Weak	Live Pigs	Pig Wt (lb)
I	8.00	7.44	2.34	57.50	27.50	6.25	4.78 [b]	9.88
	(2.11) [a]	(2.28)	(0.49)				(2.48)	(2.40)
II	9.00	7.29	2.44	76.80	16.28	6.90	5.67 [b]	10.29
	(3.07)	(3.19)	(0.72)				(2.13)	(3.63)
III	9.57	8.86	2.38	70.60	13.24	7.35	6.00 [b]	9.46
	(1.19)	(1.53)	(0.52)				(2.00)	(2.12)
IV	8.00	6.90	2.44	65.00	12.50	8.75	4.70 [b]	10.39
	(2.28)	(1.92)	(0.62)				(2.41)	(2.94)

[a] Standard deviations enclosed in brackets.

[b] One pig was sacrificed at birth.

Experiment IV

This experiment was conducted identically to experiment II except that only 28 pigs were used and they remained on the experiment for 25 days. Blood samples were taken at the beginning and the end of the experiment. Results are reported in Table 4.

Higher gain was observed from pigs whose dams were receiving 1.5% calcium. Very little difference was observed from the blood analyses.

Table 4 - Summary of Pigs Performance on Experiment IV

Treatment	Gain (lb)	ADG [a/] (lb)	Initial: Calcium (mg/100 ml)	Initial: Phosphorus (mg/100 ml)	Initial: Alkaline Phosphatase (sigma units)	Final: Calcium (mg/100 ml)	Final: Phosphorus (mg/100 ml)	Final: Alkaline Phosphatase (sigma units)
I	32.43	1.30	8.05	6.72	10.14	7.96	8.80	8.17
	(2.16) [b/]		(1.81)	(0.53)	(2.45)	(0.79)	(1.30	(2.48)
II	31.14	1.25	7.82	6.64	11.85	7.96	9.50	7.74
	(1.70)		(0.55)	(0.91)	(0.59)	(1.28)	(1.62)	(2.00)
III	35.71	1.43	7.82	6.72	11.31	7.80	8.20	7.72
	(0.63)		(0.55)	(0.35	(2.52)	(0.36)	(0.78)	(2.44)
IV	32.00	1.28	7.16	6.56	8.76	7.82	8.52	8.65
	(0.89)		(0.82)	(0.53)	(1.59)	(1.35)	(1.26)	(3.04)

a/ Average daily gain.

b/ Standard deviation enclosed in brackets.

THE EFFECTS OF VARIOUS CHELATES AND PROTEIN SOURCES ON THE INCIDENCE OF PARAKERATOSIS

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Forty Hampshire pigs, weighing approximately 21 pounds each, were randomly allotted by sex and weight to four ration treatments with two replicate lots of five pigs each; the purpose was to study the effects of phytic acid on the incidence of parakeratosis. A 16% protein basal ration was fed the entire experimental period of 9 weeks. The sources of supplemental protein were dried skimmed milk and distillers' dried solubles. Distillers' dried solubles was added at 5% of the total ration.

The ration treatments included: (1) the basal ration that contained 1.3% calcium and 40 ppm zinc, (2) basal + 0.76% phytic acid, (3) basal + 40 ppm zinc, and (4) ration 2 + 40 ppm zinc. These rations were self-fed throughout the experimental period and water was supplied with an automatic waterer. Daily inspections were made for parakeratosis.

The results of this experiment is presented in Table 1.

Table 1 - Pig Performance: Experiment I

Treatment	Initial Wt, lb	Final Wt, lb	Av Daily Gain, lb	Av Daily Feed Consumed, lb	Feed Per 100 lb Gain, lb
Basal	21.00	88.90	1.00	2.64	263
Basal + phytic acid	20.80	81.00	0.89	2.39	271
Basal + Zn	21.00	85.40	0.95	2.55	269
Basal + phytic acid + Zn	21.40	81.90	0.89	2.35	264

The analyses of variance test revealed there were no significant differences among the treatments of this experiment. Phytic acid, when added to the ration at the same level that phytin phosphorus is found in a corn-soybean meal ration, failed to produce parakeratosis in this experiment.

Experiment II

Fifty purebred Hampshire pigs, weighing an average of 20 pounds each, were allotted by sex and weight to six ration treatments to study further the causes of parakeratosis in swine. A basal ration calculated to contain 16% crude protein, 1.3% calcium and 40 ppm zinc was fed. The source of protein in this experiment was soybean meal. Again the duration of this experiment was for 9 weeks. The ration treatments used were the following: (1) basal ration, (2) basal + zinc added to give 80 ppm, (3) basal + 500 ppm EDTA, (4) basal + 0.25% glycine, (5) basal + 0.25 histidine and (6) basal + 0.25% leucine. EDTA (ethylenediamine tetraacetic acid), glycine, histidine, and leucine are chelates that were added to enhance zinc utilization.

During the first, fourth and eighth weeks of the experiment 0.3% chromic oxide was added to each ration to determine zinc excretion. The pigs were on chromic oxide feed for 2 days before collections were begun. Collections were made at 2-hour intervals at these weekly periods. Samples were then frozen for subsequent zinc analysis for zinc excretion determinations.

The results are presented in Table 2.

Table 2 - Pig Performance: Experiment II

Treatment	Initial Wt, lb	Final Wt, lb	Av Daily Gain, lb	Av Daily Feed Consumed, lb	Feed Per 100 lb Gain, lb
Basal [a/]	20.20	88.60	0.97	2.68	276
Basal + Zn [b/]	19.70	93.50	1.05	2.82	270
Basal + EDTA [a/]	20.10	94.50	1.09	2.75	252
Basal + Glycine [c/]	20.10	74.70	0.77	2.14	276
Basal + Histidine [d/]	19.60	79.80	0.85	2.19	256
Basal + Leucine [d/]	19.50	69.90	0.71	1.97	278

a/ Four pigs developed parakeratosis.
b/ Three pigs developed parakeratosis.
c/ Nine pigs developed parakeratosis.
d/ Eight pigs developed parakeratosis.

An analysis of variance test did not show any significant differences in rate of gain in this experiment. However, parakeratosis did appear on the 30th day of the experiment and occurred in every ration treatment. A total of 37 cases of parakeratosis were noted during the course of the experiment. Parakeratosis occurred more frequently and more severely in treatments 4, 5, and 6 where the basal was supplemented with glycine, histidine and leucine.

No definite pattern of zinc excretion was established as a result of the chromic oxide phase of the experiment.

A COMPARISON OF THE RESPONSE OF SPF AND NON-SPF PIGS TO ANTIBIOTICS AND SULFONAMIDES

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This study consisted of four experiments, two of which were conducted with SPF (specific-pathogen-free) pigs and in the remaining two, non-SPF pigs were used.

Experiment I

Thirty-six purebred Hampshire and twenty-four purebred Yorkshire (non-SPF) pigs were randomly allotted, according to sex and weight to six ration treatments. Each treatment was replicated with a light replicate averaging 27 pounds and a heavy replicate averaging 41 pounds. Each lot of 5 pigs each was provided adequate housing, a self-feeder, and an automatic waterer. The building and all equipment were thoroughly steam cleaned before the pigs were put on experiment. The pigs were vaccinated for hog cholera and ersipelas, and the males were castrated shortly after they were put on experiment. Pens were kept adequately clean at all times. The ration treatments were: (1) basal, (2) basal plus 10 eureomycin per ton, (3) basal plus 10 g zinc bacitracin per ton, (4) basal plus 10 g bacitracin M. D. per ton, (5) basal plus 10 g bacitracin per ton, and (6) basal plus 10 g terramycin per ton.

Results of this experiment are summarized in Table 1.

Table 1 - Results of Experiment I

Treatment	Av Initial Wt, lb	Av Final Wt, lb	Av Daily Gain, lb	Feed per 100 lb Gain, lb	Av Daily Feed Consumed, lb
Basal	34.1	182	1.35	365	4.90
Basal + 10 g Aureomycin/ton	33.1	182	1.42	356	5.06
Basal + 10 g Terramycin/ton	34.2	184	1.38	386	5.30
Basal + 10 g Bacitracin M. D./ton	34.4	188	1.42	369	5.21
Basal + 10 g Zinc bacitracin/ton	34.5	192	1.51	344	5.21
Basal + 10 g Bacitracin/ton	34.3	179	1.31	464	5.04

The pigs fed 10 grams of zinc bacitracin per ton of ration gained 10.6% faster, and were 6.1% more efficient than the controls. The bacitracin-fed pigs gained no better than the controls and were less efficient users of feed.

Experiment II

Sixty purebred Yorkshire (SPF) pigs were randomly allotted according to sex and weight to six ration treatments. Two replicate lots of five pigs each were assigned to each treatment. The light replicate averaged 24 lb and the heavy replicate averaged 32 lb. All management practices used were identical to those used in experiment I, except that the buildings and equipment used in this trial had been used previously only by SPF pigs. The ration treatments were as follows: (1) basal, (2) basal plus 20 g aureomycin, (3) basal plus 20 g terramycin per ton, (4) basal plus 20 g tylosin per ton, (5) basal plus 20 g taomyxin per ton and (6) basal plus 20 g zinc bacitracin per ton.

Results of experiment II are summarized in Table 2.

Table 2 - Results of Experiment II

Treatment	Av Initial Wt, lb	Av Final Wt, lb	Av Daily Gain, lb	Feed Per 100 lb Gain, lb	Av Daily Feed Consumed, lb
Basal	28.7	129	1.50	274	4.09
Basal + 20 g Aureomycin/ton	27.6	131	1.60	273	4.26
Basal + 20 g Terramycin/ton	27.8	128	1.58	276	3.92
Basal + 20 g Tylosin/ton	27.4	125	1.51	266	4.11
Basal + 20 g Taomyxin/ton	28.8	126	1.50	262	3.92
Basal + 20 g Zinc bacitracin/ton	27.4	127	1.54	272	4.09

There were no significant differences in rate of gain or feed efficiency between the pigs on the six ration treatments.

Experiment III

Twenty-four Hampshire and sixteen Yorkshire (non-SPF) pigs were randomly allotted according to sex and weight to four ration treatments. Each treatment was replicated according to weight. The light replicate averaged 22 pounds and the heavy replicate averaged 51 pounds. The same management practices were used for this experiment as were used in Experiment I. The ration treatments were: (1) basal, (2) basal plus 40 g terramycin per ton, (3) basal plus 100 g sulfadimethoxine per ton, and (4) basal plus 100 g sulfisoxazole per ton. Three pigs in each lot were bled every 2 weeks by puncture of the anterior vena cava, and hemoglobin and hematocrit values were determined. These blood values were determined in an effort to establish whether the two sulfonamides fed were antagonistic to B vitamins.

Results of Experiment III are summarized in Tables 3 and 4.

Table 3 - Results of Experiment III

Treatment	Av Initial Wt, lb	Av Final Wt, lb	Av Daily Gain, lb	Feed Per 100 lb Gain, lb	Av Daily Feed Consumed, lb
Basal	36.5	131.5	1.18	344.5	4.11
Basal + 40 g Terramycin	36.9	130.4	1.11	325.5	3.79
Basal + 100 g Sulfadimethoxine	36.5	125.5	1.13	378.5	4.17
Basal + 100 g Sulfisoxazole	36.2	128.0	1.23	352.0	4.35

Table 4 - Results of Blood Analyses of Pigs in Experiment III

Treatment	No. Pigs	Beginning of Experiment Hemoglobin g/100 ml	Beginning of Experiment Hematocrit %	Termination of Experiment Hemoglobin g/100 ml	Termination of Experiment Hematocrit %
Basal	10	10.5 (2.09) [a]	37.6 (5.41)	11.4 (0.989)	38.8 (2.46)
Basal + 40 g Terramycin/ton	10	10.3 (1.88)	38.5 (5.07)	11.3 (1.97)	37.7 (4.21)
Basal + 100 g Sulfadimethoxine/ton	10	8.8 (3.74)	35.0 (5.03)	11.2 (1.32)	40.0 (4.31)
Basal + 100 g Sulfisoxazole/ton	10	10.0 (1.14)	35.0 (4.03)	11.6 (1.69)	36.7 (4.08)

[a] Standard deviation.

Experiment IV

Forty purebred Yorkshire (SPF) pigs averaging 45 pounds were randomly allotted according to sex and weight into eight lots of five pigs each. The heaviest pigs were placed in four lots and the lightest in the other four, to be used in replicated treatments. The management practices used were similar to those used in experiment I, except that the building where these pigs were kept had housed only SPF pigs previous to this experiment. The ration treatments were as follows: (1) basal, (2) basal plus 40 grams terramycin per ton, (3) basal plus 100 grams sulfadimethoxine per ton and (4) basal plus 100 grams sulfisoxazole per ton.

Results of Experiment IV are summarized in Table 5.

Table 5 - Results of Experiment IV

Treatment	Av Initial Wt, lb	Av Final Wt, lb	Av Daily Gain, lb	Feed Per 100 lb Gain, lb	Av Daily Feed Consumed, lb
Basal	44.9	125.6	1.81	297	5.39
Basal + 40 grams Terramycin/ ton	44.7	132.2	1.96	293	5.19
Basal + 100 grams Sulfadimethoxine/ ton	45.0	128.5	1.84	300	5.51
Basal + 100 grams Sulfisoxazole	45.0	127.7	1.87	299	5.57

There were no significant differences in rate of gain or feed efficience between the pigs on the four ration treatments. However, the basal pigs on this experiment gained 34.8% faster than the basal ration fed pigs on Experiment 3.

EFFECT OF MALTOL ON CREEP RATION UTILIZATION BY EARLY WEANED PIGS

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Two experiments were conducted to evaluate Maltol, a possible sugar substitute, for early weaned pigs. In the first experiment 32 pigs, 3-4 weeks old, were individually fed in metabolism-type crates for 5 weeks. The sugar level was reduced from the usual level of feeding of 5 pounds to $2\frac{1}{2}$ pounds per hundred in the first experiment. The ration treatments were: (1) basal ration (2) basal + 5 ppm Maltol, (3) basal + 25 ppm Maltol, and (4) basal + 125 ppm Maltol.

The results of experiment 1 are presented in Table 1.

Table 1 - Pig Performance: Experiment I

Treatment	Average Initial Wt, lb	Average Final Wt, lb	Average Daily Gain, lb	Feed Conversion, lb
1	18.6	53.1	0.99	1.97
2	18.4	54.1	1.02	1.88
3	18.3	54.5	1.04	1.92
4	18.5	56.4	1.08	1.83

In the second experiment all of the sugar was replaced by ground yellow corn. The pigs, 10 per treatment, were group fed in this experiment, otherwise all practices were identical to the previous experiment including the levels of Maltol in each treatment.

Results of experiment 2 are presented in Table 2.

Table 2 - Pig Performance: Experiment II

Treatment	Average Initial Wt, lb	Average Final Wt, lb	Average Daily Gain, lb	Feed Conversion, lb
1	18.7	58.3	1.13	2.00
2	18.8	58.5	1.14	2.21
3	18.7	59.8	1.17	2.06
4	18.4	59.0	1.16	2.04

Summary An 8 percent improvement in feed efficiency and a 9 percent improvement in rate of gain were made by pigs on the highest level of Maltol when compared with those receiving the basal ration. In the second experiment, in which all of the sugar was replaced with ground yellow corn, the response was not nearly so great. Only a 3 percent improvement in rate of gain for treatment 4 and a 4 percent improvement in treatment 3. However, all pigs performed well in this experiment. More work should be done to determine the optimum sugar replacement value of Maltol.

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