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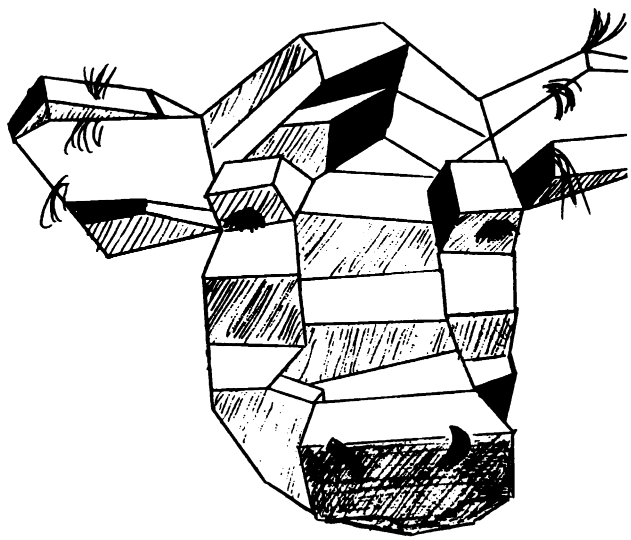

LIVESTOCK RESEARCH REPORT

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LIVESTOCK RESEARCH REPORT 1971-72

by the Research Staff, Animal Science Department, Virginia Polytechnic Institute and State University; edited by J. A. Gaines.

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EFFECT OF FEEDING PEANUT HULLS TO FATTENING CATTLE ON PESTICIDE RESIDUES[1]

J. P. Fontenot, M. B. Wise, R. F. Kelly and K. E. Webb, Jr.

Peanut hulls are not a particularly rich source of nutrients but quite acceptable performance has usually been obtained when limited levels of these have been incorporated in fattening rations for cattle and sheep. One of the deterrents to the use of peanut hulls as feed has been the potential pesticide contamination of the meat from cattle fed this product. The use of high energy complete rations for fattening cattle makes peanut hulls especially attractive. Perhaps, the use of low levels of hulls in such rations would result in desirable performance with no objectionable pesticide residue accumulation in the tissue.

An experiment was conducted beginning July, 1971 to determine the effect of feeding a limited level of peanut hulls to fattening cattle on the pesticide residue accumulation in the edible tissue and to assess the nutritive value of the hulls in a high energy fattening ration.

Experimental Procedure

A fattening trial was conducted at the Birdsong Feedlot, Suffolk, Va. From 34 head of fairly uniform Hereford feeder steers, 32 were selected. On July 9, 1971 perianal fat samples were obtained by biopsy and the 32 animals were divided into groups of four based on weight. The animals within each group were allotted at random to four pens which were fed the following rations: Pen 1 - Ration 2 (peanut hulls), Pen 2 - Ration 1 (corn cobs), Pen 3 - Ration 2 (peanut hulls), Pen 4 - Ration 1 (corn cobs).

The average ingredient composition of the rations is shown in table 1. The rations were ground and mixed and were stored in bins in each of the pens. Pens 1 and 2 had a concrete apron under the roof but pens 3 and 4 contained no concrete apron under the roof.

Initially, the cattle were fed a limited amount of the experimental rations plus hay. The hay was gradually removed over a period of 8 days and the amount of ration was correspondingly increased. After 8 days the cattle were fed no hay.

Samples of the feed were obtained and composited. The feeds were analyzed for proximate components and pesticide residues.

The steers were weighed at intervals. When it was estimated that the steers were approaching average choice in slaughter grade, they were slaughtered at a local packing plant in Suffolk. At slaughter, warm carcass weights were obtained. Also, samples of liver and omental fat were taken for pesticide residue analysis. After a two-day chill the carcasses were

[1]Supported in part by grant-in-aid from the Virginia-Carolina Peanut Association, Suffolk, Virginia.

graded by a Meat Specialist from V.P.I. & S.U. and a U.S.D.A. carcass grader. Loin-eye muscle area and backfat thickness were measured and samples of fat were obtained close by the biopsy site. The 9-10-11th-12th rib was obtained from each steer. A sample of the loin-eye muscle from the 9-10-11th rib was taken for pesticide residue analysis.

Results

The average chemical composition for all feed samples is given in table 2 and the pesticide residue content is given in table 3. Low levels of PCB and DDT and its break-down products were detected in all feeds. Peanut hulls contained low levels of dieldrin and heptachlor epoxide and corn cobs contained low levels of dieldren and endrin.

Results of the performance of the cattle are given in table 4. The daily gains are given for the first 67 days, for the first 90 days and for the entire trial, which lasted 109 days. At the end of the experiment there was a small difference in rate of gain, amounting to 0.13 lb. per day in favor of the cattle fed the corn cob ration. However, the gains of 2.74 lb. per day for the peanut hull fed cattle is very satisfactory. The difference in performance between the cattle fed the two rations was less during the entire experiment than it was for the first 67 days.

The carcasses had very good conformation, averaging between average and high choice. The average carcass grade varied between high good and low choice with no particular difference between the cattle fed the two rations. In fact, the score was 11.5 for the cattle fed the corn cob ration and 11.6 for those fed the peanut hull ration. Dressing percent was very good, averaging 65.8% for the cattle fed the corn cob and peanut hull rations.

Initially, biopsy samples from all lots contained low levels of DDT and its break-down products (table 5). There were occasional traces of dieldren and kelthane. At slaughter, the fat samples taken at the biopsy site or from the omentum showed a similar trend as for the initial samples. All lots contained low levels of PCB, DDT and its break-down products and occasional traces of kelthane. The loin-eye muscle and liver samples contained low levels of PCB and DDT and its break-down products. There were occasional traces of lindane in the muscle and liver and dieldren in the muscle. There was no substantial difference in pesticide residues in any of the tissues between the lots fed corn cobs and peanut hulls. Thus, feeding 15% peanut hulls did not contribute to substantial levels of pesticides in edible tissue.

TABLE 1. INGREDIENT COMPOSITION OF RATIONS

	Ration 1 (corn cobs)	Ration 2 (peanut hulls)
	%	%
Corn cobs	15.0	
Peanut hulls		15.0
Shelled corn	69.2	69.2
Soybean meal	10.0	10.0
Defluorinated phosphate	0.2	0.2
Limestone	0.6	0.6
Molasses	5.0	5.0
Vitamin A	+[a]	+[a]

[a]150,000 I.U. per 100 lb. feed.

TABLE 2. CHEMICAL COMPOSITION OF FEEDS

Description	Dry matter	Crude protein	Ether extract	Crude fiber	Ash	NFE
	%	%	%	%	%	%
Peanut hulls	88.85	7.50	1.65	34.38	3.16	42.15
Corn cobs	90.01	7.04	1.39	26.45	3.39	51.71
Shelled corn	89.55	8.72	4.49	3.62	1.79	70.93
Soybean meal	88.24	47.71	1.55	5.49	5.96	27.53
Avg. Ration 1 (corn cobs)	88.67	12.55	2.56	5.57	3.75	64.25
Avg. Ration 2 (peanut hulls)	89.65	12.61	2.51	7.34	3.58	62.94

TABLE 3. PESTICIDE RESIDUES (ppm) OF FEED SAMPLES (AVERAGE OF ALL SAMPLES)

Feed	PCB	DDE	OPDDT	PPDDT	Others*
Peanut hulls	0.116	0.008	0.017	0.023	Dieldren (0.001) Heptachlor epoxide (0.001)
Corn cobs	0.36	0.003	0.014	0.008	Endrin (0.002) Dieldren (0.001)
Shelled corn	0.17	0	0.001	0.005	
Soybean meal	0.29	0.003	0.003	0.029	
Avg. Ration 1 (corn cobs)	0.12	0.003	0.001	0.005	
Avg. Ration 2 (peanut hulls)	0.17	0.012	0.002	0.022	

*In some feed samples there were traces of lindane, chlordane, aldrin, kelthane, dieldren and DDT.

TABLE 4. EFFECT OF FEEDING PEANUT HULLS ON PERFORMANCE

	Corn cobs			Peanut hulls		
	Lot 2	Lot 4	Avg.	Lot 1	Lot 3	Avg.
No. of steers	8	8		8	8	
Avg. wt. data, lb.						
Initial wt. (7/9/71)	759	760	759.5	767	765	766
Wt., 9/14/71	965	959	962	958	925	941.5
Daily gain 67 days	3.07	2.98	3.03	2.93	2.40	2.67
Wt., 10/7/71	1051	1001	1026	1040	1011	1026
Daily gain, 90 days	3.25	2.68	2.97	3.03	2.74	2.89
Wt., 10/26/71	1088	1056	1072	1082	1047	1065
Daily gain, 109 days	3.02	2.72	2.87	2.89	2.59	2.74
Avg. daily feed intake[a], lb.	23.2	23.1	23.2	23.3	23.5	23.4
Feed/100 lb. gain[a], lb.	770	863	817	801	888	845
Carcass data						
Conformation[b]	13.6	14.0	13.8	13.9	13.4	13.7
Marbling[c]	3.9	3.9	3.9	3.9	3.6	3.75
Carcass grade[b]	11.6	11.4	11.5	11.9	11.3	11.6
Loin eye muscle area, sq. in.	11.79	12.23	12.01	12.45	11.66	12.06
Backfat, in.	0.70	0.76	0.73	0.82	.65	.73
Dressing %	64.4	67.1	65.8	66.3	65.3	65.8

[a]Includes small amount of hay fed at beginning of trial.
[b]Code: 11 = high good; 12 = low choice; 13 = avg. choice; etc.
[c]Code: 3 = slight; 4 = small; 5 = modest; etc.

TABLE 5. PESTICIDE RESIDUE OF BEEF TISSUE

Sample description	Ration	Pesticide residues in beef tissue, ppm				
		PCB	DDE	OPDDT	PPDDT	DDD
Initial fat biopsy	No. 1[a] (corn cobs)		0.212	0.011	0.036	0
	No. 2[b] (peanut hulls)		0.030	0.011	0.044	0.005
After slaughter						
Biopsy site	No. 1[c] (corn cobs)	0.069	0.014	0.009	0.014	
	No. 2[d] (peanut hulls)	0.054	0.015	0.005	0.018	
Omental fat	No. 1[a] (corn cobs)	0.03	0.086	0.004	0.011	
	No. 2[d] (peanut hulls)	0.02	0.015	0.005	0.012	
Loin eye muscle	No. 1[e] (corn cobs)	0.12	0.003	0.001	0.011	
	No. 2[f, g] (peanut hulls)	0.12	0.006	0.001	0.009	
Liver	No. 1[h] (corn cobs)	0.56	0.003	0.003	0.010	
	No. 2[h] (peanut hulls)	0.49	0.001	0.001	0.007	

[a]Trace of kelthane in 3 steers.
[b]Trace of dieldren and kelthane in 2 steers.
[c]Trace of kelthane in 3 steers and aldrin in 1 steer.
[d]Trace of kelthane in 2 steers.
[e]Trace of lindane in 2 steers.
[f]Trace of lindane in 4 steers.
[g]Trace of dieldren in 2 steers.
[h]Trace of lindane in 3 steers.

PREFERENCE STUDIES WITH RATIONS CONTAINING BROILER LITTER AND MOLASSES[1,2]

B. W. Harmon, J. P. Fontenot and K. E. Webb, Jr.

Research has shown that broiler litter has substantial nutritive value for cattle and sheep. Including litter in fattening rations at levels up to 25% has not seriously lowered feed intake and performance. Including 50% litter markedly depressed intake and adversely affected performance. One approach to prevent the feed intake depression might be to alter the ration composition in order to mask the undesirable taste or smell of litter. Blackstrap molasses, used for decades to improve palatability of livestock rations, was evaluated as an ingredient to increase consumption of litter containing rations.

Experimental Procedure

Seven yearling steers averaging 618 lb. were used in trials 1 and 2, and six yearling steers averaging 857 lb. were used in trial 3. During the trials the steers were kept in a partially covered lot where they had access to water and trace mineralized salt. The feed trough was divided into equal compartments so that all steers had equal access to all rations in a "cafeteria" arrangement. Rations were randomly allotted to the compartments daily to prevent pattern eating by the steers and feed was replenished to ensure ample feed in each box at all times. Each trial lasted 20 days.

The basal rations are shown in table 1. The basal ration for trial 1 contained 25% litter. Levels of molasses of 5, 10, 15, 20, 25 and 30% were incorporated by altering the amounts of ear corn and corn cobs to equalize calculated TDN among the seven rations at approximately 65%.

The basal ration for trial 2 contained 50% litter. Levels of molasses were the same as for trial 1 but calculated TDN was equalized among the seven rations at approximately 63%. The basal rations for trial 3 were formulated to compare the consumption of two levels of litter (25 and 50%) and three levels of molasses (5, 10 and 20%) when the mixtures were offered simultaneously. Calculated TDN was equalized among the six rations at 65%.

Prior to the beginning of each trial, a ration containing no litter nor molasses but similar in other respects was offered in all compartments of the feed trough. At the beginning of each trial, the experimental rations were offered abruptly so that there was no transition to litter or molasses.

The litter used in these trials had been processed by heating in a suspension air dryer with an outgoing temperature of 270°F, followed by grinding.

Results

The consumption of rations containing 25% litter (trial 1) is shown in table 2 and figure 1. Total consumption was quite substantial at 23.4 lb. per

[1]Supported in part by Public Health Service Grant No. EP-00034.
[2]The processed litter was supplied by Triangle E By-Product Co., Inc., Harrisonburg, Va.

head per day (3.7% of body weight). The ration containing 10% molasses was consumed in the greatest amount. Consumption was 5.9 lb. per head per day and accounted for 25% of the total intake. This intake was significantly higher (P<.01) than for all levels of molasses except the 15% level which was consumed at 5.1 lb. per head per day.

The consumption of rations containing 50% litter (trial 2) is shown in table 3 and the preference pattern is graphically shown in figure 2. Total intake for this trial was 22.5 lb. per head per day (3.1% of body-weight). Consumption of the ration containing 10% molasses was significantly greater (P<.01) than for all other rations. This intake amounted to 7.2 lb. per head per day and accounted for 32% of the total daily intake. The rations containing 25 and 30% molasses were also consumed quite readily, amounting to 38% of the total intake.

The results of offering steers two levels of litter and three levels of molasses simultaneously are shown in table 4 and figure 3. Total consumption for trial 3 was 28.2 lb. per head per day (3.5% of body weight). The steers selected 97% of their daily intake from the rations containing 25% litter. The ration containing 25% litter and 10% molasses was consumed in significantly greater amounts than all other rations and accounted for 51% of the total intake.

It appears from these trials that levels of molasses of 10 to 15% of the ration improved acceptability of rations containing processed broiler litter.

TABLE 1. COMPOSITION OF BASAL RATIONS

Ingredient	Trial 1 25% litter	Trial 2 50% litter	Trial 3 25% litter	 50% litter
	%	%	%	%
Litter	25.0	50.0	25.0	50.0
Molasses			5.0	5.0
Hay	10.0	10.0	10.0	10.0
Corn cobs	15.8	8.9	14.4	1.9
Ear corn	49.2	31.1	45.6	33.1
Vitamin A[a]	+	+	+	+
Estimated TDN	65	63	65	65

[a]Vitamin A was mixed to supply 1000 IU per pound of ration.

Level of molasses, %	0	5	10	15	20	25	30
Daily consumption							
Lb/head	0.3^{a}	$1.7^{a,b}$	5.9^{e}	$5.1^{d,e}$	$3.8^{c,d}$	$3.1^{b,c}$	$3.6^{b,c,d}$
Percent of total	1.1	7.5	25.2	21.6	16.1	13.4	15.1

[a,b,c,d,e] Means having different superscripts are significantly different ($P<.01$).

TABLE 3. PREFERENCE FOR RATIONS CONTAINING 50% BROILER LITTER AND DIFFERENT LEVELS OF MOLASSES

	0	5	10	15	20	25	30
Daily consumption							
Lb/head	0.8^{a}	2.4^{b}	7.2^{d}	$1.8^{a,b}$	$1.7^{a,b}$	4.8^{c}	3.8^{c}
Percent of total	3.5	10.7	32.0	8.0	7.5	21.4	16.8

[a,b,c,d] Means having different superscripts are significantly different ($P<.01$).

TABLE 4. PREFERENCE FOR RATIONS CONTAINING TWO LEVELS OF BROILER LITTER AND THREE LEVELS OF MOLASSES

Level of litter, %	25	25	25	50	50	50
Level of molasses, %	5	10	20	5	10	20
Daily consumption						
Lb/head	2.5[a]	14.4[b]	10.6[c]	0.2[a]	0.3[a]	0.2[a]
Percent of total	8.8	51.0	37.5	0.7	1.1	0.7

[a,b,c]Means having different superscripts are significantly different ($P<.01$).

FIGURE 1. CONSUMPTION OF RATIONS CONTAINING 25% BROILER LITTER - TRIAL 1

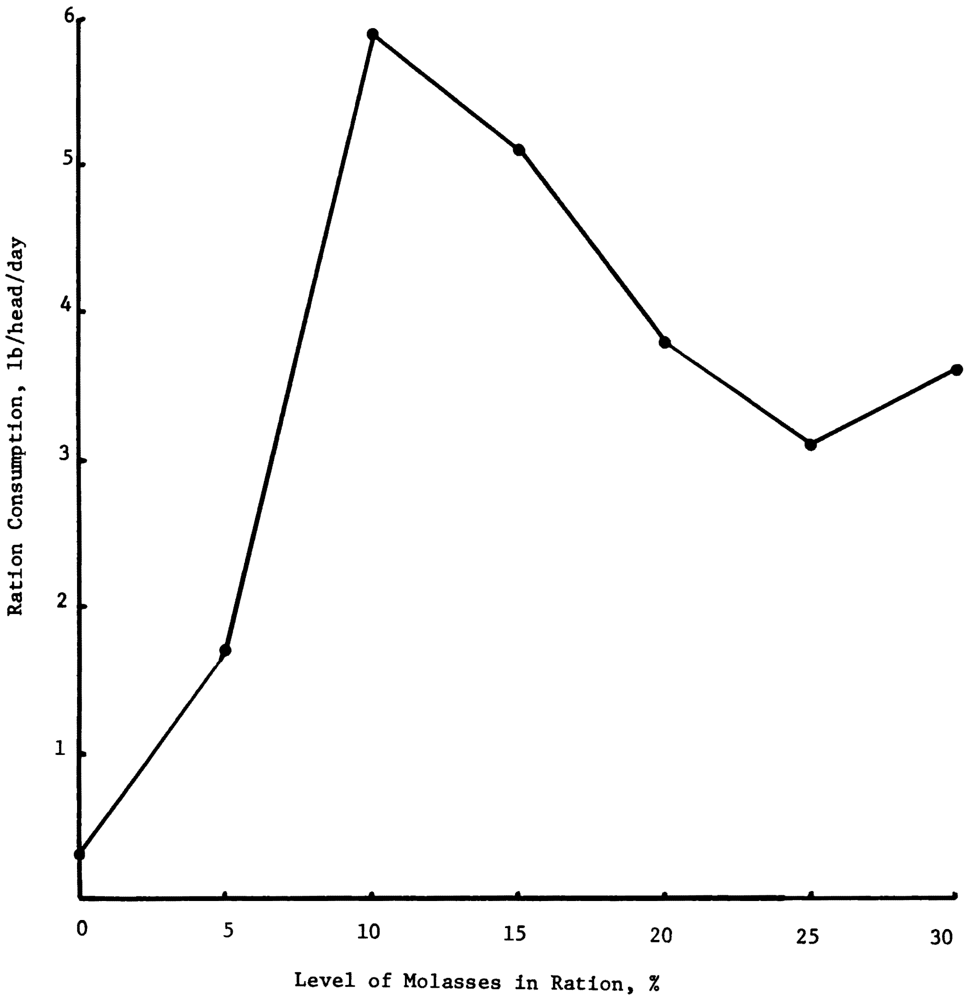


FIGURE 2. CONSUMPTION OF RATIONS CONTAINING 50% BROILER LITTER - TRIAL 2

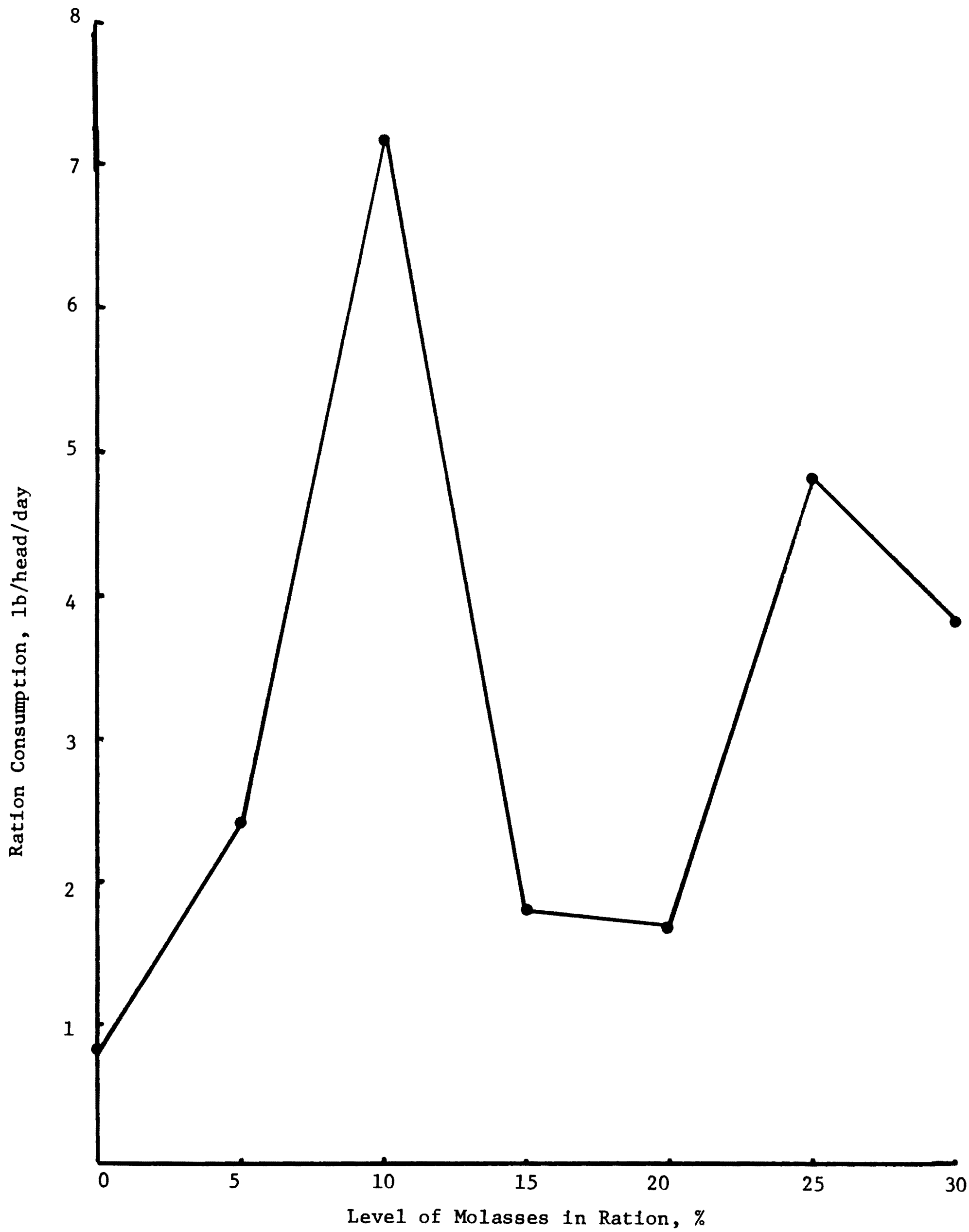
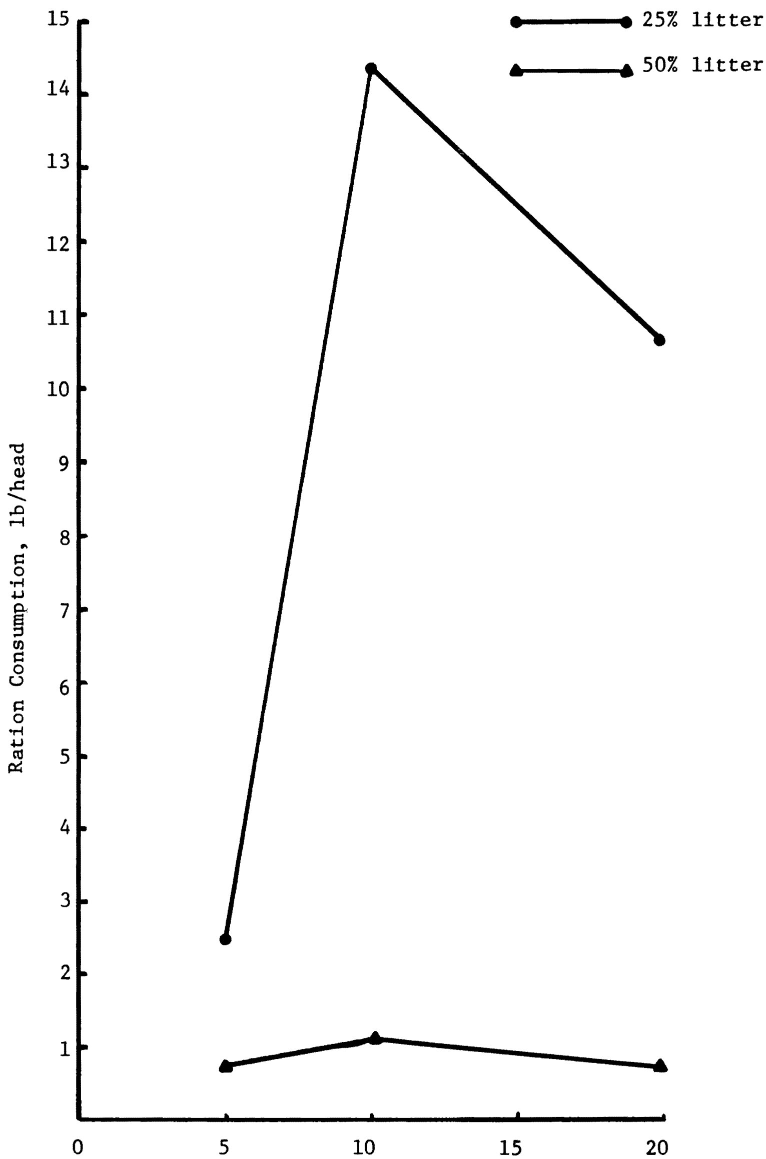


FIGURE 3. CONSUMPTION OF RATIONS CONTAINING TWO LEVELS OF LITTER AND THREE LEVELS OF MOLASSES



THE EFFECT OF FEEDING DIFFERENT LEVELS OF UREA TO EARLY WEANED FATTENING LAMBS[1]

W. H. McClure, J. P. Fontenot and R. C. Carter

Researchers at the Blacksburg, Glade Spring and Steeles Tavern Research Stations have been involved for a number of years in various projects designed to develop lamb fattening rations that approach the "ideal", both from a standpoint of performance and economy. In the past few years much of this emphasis has been placed on the development of rations for early weaned fattening lambs.

The practice of weaning lambs at an early age and finishing them in dry lot or on expanded metal floors is becoming increasingly popular and is especially designed for sheep operations that are concentrated or are on an accelerated breeding and lambing program.

In an effort to study a possible method of reducing the cost of rations for lambs fed under this system, a 2-year trial was conducted at the Shenandoah Valley Research Station at Steeles Tavern in the spring of 1970 and again in the spring of 1971 to study the effect of feeding different levels of urea to early weaned fattening lambs fed on expanded metal floors. The basal ration used in this trial is the result of data from a number of previous tests and has proved to be quite successful.

Experimental Procedure

The lambs were weaned at a minimum of 60 days of age or 30 lb. in weight and were allotted to four lots, according to weight, type of birth and sire group, and placed on expanded metal floors for the trial. Lot 1 was fed the basal ration with soybean meal as the source of supplemental protein. Feed grade urea was added to lots 2, 3 and 4 to supply about 10, 20 and 30%, respectively, of the total nitrogen. Ground shelled corn was added to the rations fed lots 2, 3 and 4 to equalize the energy levels in these rations. Prior to the beginning of the trial each lamb was treated for the prevention of enterotoxemia and injected intramuscularly with a combination of selenium and vitamin E as a preventative for "stiff lamb" disease. All rations were self-fed in a pelleted form.

Based on the results of past studies, the rations were equalized in crude protein at 15% and in TDN at approximately 70%. Calcium and phosphorus were equalized at approximately 0.4 and 0.3%, respectively. Trace mineralized salt was fed to the lambs free choice. The composition of the pellets is shown in table 1.

The lambs were weighed at 2-week intervals throughout the test and removed for slaughter at 2-week intervals when they reached a minimum weight of 93 lb. The test was continued until approximately 95% of the lambs had reached this minimum slaughter weight.

[1]Urea was supplied by Research Division, W. R. Grace and Co., Clarksville, Md.

Results

The results of the 1970 trial are published in the 1970-71 Livestock Research Report and the results of the 1971 trial are shown in table 2. Daily gains were similar for the lambs in lot 1, receiving no urea and those in lot 2, fed the lowest level of urea. Daily gains in lots 3 and 4 decreased slightly as the percentage of urea in the ration increased. Daily feed consumption tended to decrease as the amount of urea in the ration increased and pounds of feed per pound of gain increased with the percentage of urea in the ration but differences were small. There was no difference in the slaughter grade, with all lambs averaging in the prime grade.

Table 3 contains a summary of the trials for the 2 years. The lambs performed much better in the 1970 trial than they did in 1971, as is reflected in table 3. The lambs in lot 1 receiving no urea and the lambs in lot 2 had similar rates of gain. The lambs in lot 3 gained an average of 0.68 per day over the 2-year test and the lambs in lot 4 gained 0.65 lb. per day. Average daily gain and daily feed consumption tended to decrease and pounds of feed per pound of gain tended to increase as the amount of urea in the ration increased.

The gains were quite respectable for all lambs on the trial over the 2-year period and there was no difference in slaughter grades. No detrimental effects were evident in the lots receiving urea in the ration.

Results of this two year trial indicate that lambs can be successfully fattened to slaughter on rations where up to 30% of the total nitrogen is supplied by urea. Average daily gain may decrease slightly and more feed per pound of gain may be required as the amount of urea in the ration is increased. Since ground shelled corn is added to the rations proportionately as the percentage of urea is increased to replace energy supplied by soybean meal, the key economical factor to the use of urea in rations for fattening lambs could well be the relative prices of ground shelled corn, urea and soybean meal.

TABLE 1. COMPOSITION OF PELLETED RATIONS

Ingredient	Lot 1	Lot 2	Lot 3	Lot 4
	%	%	%	%
Ground native alfalfa hay	15.00	15.00	15.00	15.00
Ground ear corn	65.70	61.75	56.40	50.85
Soybean meal (44% protein)	16.00	11.80	7.60	3.40
Ground shelled corn		7.60	16.60	25.70
Urea, feed grade[a]		0.55	1.10	1.65
Dry molasses	3.00	3.00	3.00	3.00
Defluorinated phosphate		0.10	0.20	0.30
Limestone	0.30	0.20	0.10	0.10
Vitamin A[b]	+	+	+	+

[a]Contained 281% protein equivalent.
[b]Vitamin additions: 60,000 I.U. vitamin A, 5,000 I.U. vitamin E and 6,000 vitamin D per 100 lb. ration.

TABLE 2. PERFORMANCE OF EARLY WEANED FATTENING LAMBS FED DIFFERENT LEVELS OF UREA - 1971

	Lot 1 No urea	Lot 2 10% NPN[a]	Lot 3 20% NPN[a]	Lot 4 30% NPN[a]
No. of lambs	41	41	41	41
No. of days on test	51.9	52.1	53.3	54.2
Initial weight, lb.	62.6	62.8	63.1	63.3
Final weight, lb.	97.3	97.4	96.8	96.0
Daily gain, lb.	0.67	0.66	0.63	0.60
Daily feed, lb.	3.43	3.41	3.31	3.24
Lb. feed/lb. gain	5.12	5.17	5.25	5.40
Slaughter grade[b]	15.6	15.6	15.6	15.7

[a]Non-protein nitrogen supplied by urea.
[b]Code: 15 = low prime; 16 = avg. prime, etc.

TABLE 3. TWO YEAR SUMMARY - 1970 AND 1971

	Lot 1	Lot 2	Lot 3	Lot 4
No. of lambs	86	93	84	85
No. of days on test	55.7	53.9	58.2	60.7
Initial weight, lb.	57.9	58.9	57.5	58.3
Final weight, lb.	97.0	97.5	96.2	96.8
Daily gain, lb.	0.74	0.73	0.68	0.65
Daily feed, lb.	3.27	3.24	3.17	3.05
Lb. feed, lb. gain	4.46	4.50	4.69	4.76
Slaughter grade	15.7	15.8	15.7	15.8

STUDY OF THE NUTRITIONAL STATUS OF THOROUGHBRED HORSES IN VIRGINIA[1]

T. M. Leonard, J. P. Fontenot, K. E. Webb, Jr. and G. A. Morrow

The horse industry is a major contributor to the economy of Virginia. There are over 100,000 horses and ponies in Virginia. In 1971 the horse industry contributed an estimated $107 million to the economy of the state.

The horse industry is plagued with problems associated with keeping the horses sound and functional. Many horses are lost or wasted due to bone problems. Another major problem is poor reproductive efficiency of horses. Both of these problems are nutritionally related. Most of the nutritional requirements and recommendations for feeding light horses have been based on research with draft horses and cattle. These recommendations may be inadequate since draft horses are used for a different purpose and cattle have a different type of digestive system than horses.

A field study was conducted to evaluate the current nutritional status of horses in Virginia. This included measurement of various blood parameters and feed composition at different times of the year for horses on different horse farms.

Experimental Procedure

This research was conducted in cooperation with three thoroughbred farms, two in the Richmond area and one in the Charlottesville area. A total of 30 thoroughbred horses, 10 from each farm, were sampled. Five mares and five yearlings were used on two farms (farms A and B) and seven mares and three yearlings from farm C. All horses were fed and handled on the individual farms in the usual manner and were allowed water and salt *ad libitum*. The feed and blood samples were taken every 3 months for a period of 1 year. The samples were obtained in the summer, fall, winter and spring. For these corresponding times the sampling was in July, October, January and April except that on Farm A the last sampling was in March. The horses were weighed on each sampling date. At the time blood samples were taken, samples of feed and pasture forage, if available for grazing, were obtained.

The ration of the horses was estimated from the known concentrate intake and an estimate of the roughage intake.

The feed and pasture samples were analyzed for crude protein, ether extract, ash, moisture, calcium, phosphorus magnesium, copper, iron and carotene. The blood samples were analyzed for hemoglobin, hematocrit, blood glucose, blood urea, blood serum protein, calcium, magnesium, inorganic phosphorus, copper and iron and blood plasma carotene and vitamin A. Standard procedures were used in the analysis of the feeds and blood samples.

[1]Supported in part by grants-in-aid from Keswick Stables, Cobham, Va., Little Hawk Farm, Crozier, Va. and Meadow Stud, Inc., Doswell, Va., who also made available horses and facilities for the study. Dr. Daniel Flynn, Charlottesville and Dr. Olive Britt, Ashland cooperated and obtained the blood samples.

Results

The mares had higher hematocrit (table 1) values than the yearlings indicating a relatively higher percentage red blood cells in the blood (significant in July and April). Hemoglobin values also tended to be higher for the mares than for the yearlings (table 1). The blood glucose levels were usually in the normal range for horses and tended to fluctuate with the energy levels in the ration. Generally, the values were lower for the mares than for the yearlings.

The blood serum protein levels were similar for the mares and the yearlings and did not vary substantially among the horses from the three farms (table 2). The serum protein levels were lower for the fall sampling (October) than for any of the other sampling periods for the mares and yearlings at all three of the farms (tables 1 and 2). This might indicate that protein nutrition may have been sub-normal at that time. The blood urea levels which should be an indication of protein intake were also lower for the October sampling.

The blood calcium levels were not consistently different between mares and yearlings and among the horse farms. These were in the ranges usually considered normal for horses. Inorganic phosphorus levels in the blood serum were generally lower for mares than yearlings. Generally, serum phosphorus is higher in young horses than in older ones. The serum inorganic phosphorus levels were generally lower than what is usually considered normal levels for horses. However, there are not that many normal values available in the literature. In some cases some of the values were quite low. In fact, quite a number of the mares showed blood serum inorganic phosphorus levels of less than 3 mg. per 100 ml. This may indicate a critical area of nutrition. Perhaps the availability of the phosphorus from the rations was not sufficient to maintain higher levels of blood serum inorganic phosphorus.

Blood serum magnesium levels were usually below 2 mg. per 100 ml. The importance of serum magnesium in horses is not known. In beef cows usually a level of 2 mg. per 100 ml. of blood serum magnesium is considered the level needed to insure against grass tetany or hypomagnesemic tetany.

The blood serum copper and iron values did not indicate any deficiency of these two minerals. This, coupled with the normal values for hemoglobin and hematocrit would indicate that the levels of these trace minerals were adequate.

It is difficult to find published normal values for blood plasma carotene and vitamin A. The vitamin A values were not consistently affected by type of horse (mares vs. yearlings). The plasma level for vitamin A, except for the October bleeding which approached 40 mg. per 100 ml., was generally around 20 mg. per 100 ml. or lower.

Summary

A study was made of the nutritional status of thoroughbred horses by periodic sampling of blood and feed from three thoroughbred horse farms in Virginia. Most of the values appeared to be in the normal range although

normal published values for horses are rather limited. There was an indication that protein nutrition may have been marginal in the fall for mares and yearlings. The blood serum inorganic phosphorus levels appeared to be somewhat low at all times and may indicate a potential problem which needs to be studied further. The blood serum magnesium levels were generally lower than the values considered normal for cattle. Blood plasma vitamin A values, although not extremely low, were lower than the values usually seen in cattle in a good state of nutrition.

These are potential nutritional problem areas in horses in Virginia. It is suggested that particular attention be placed on maintaining adequate protein nutrition at all times of the year by feeding high quality hay and/or supplementing with an adequate level of protein. It is suggested that high phosphorus supplements be made available to horses and that the calcium to phosphorus ratio be maintained in proper balance. The study points out that there may be problems in apparently well fed horses due to the lack of knowledge of horse nutrition at this time.

TABLE 1. MEAN BLOOD AND BLOOD SERUM COMPOSITION FOR ALL MARES AND YEARLINGS SAMPLED

Sampling period	Type of horse[a]	Blood: Hematocrit	Blood: Hemoglobin	Blood: Glucose	Blood: Urea	Blood serum protein
		%	g/100 ml	mg/100 ml	mg/100 ml	g/100 ml
July	Mares	40.82[c]	15.58[c]	54.94[c,e]	17.82	7.06
	Yearlings	35.34	13.70	86.65	15.17	6.79
October	Mares	41.34	14.38	65.36[c,e,f]	9.07[g]	5.80[b]
	Yearlings	39.76	14.78	79.27[h]	10.39[h]	5.06
January	Mares[i]	39.26	21.64[c]	57.57	34.51	7.05
	Yearlings	36.53	16.69	54.43	31.07	7.03
April	Mares[j]	47.59[c,e]	18.38[c,e]	49.72[c,d]	39.38[b]	8.92[c,d]
	Yearlings	40.90	15.33	60.64	33.02	7.95

[a] Samples were taken from 17 mares and 13 yearlings.
[b] Mares significantly ($P<.05$) different from yearlings.
[c] Mares significantly ($P<.01$) different from yearlings.
[d] Interaction significant ($P<.05$) between farm and type of horse.
[e] Interaction significant ($P<.01$) between farm and type of horse.
[f] Average of 15 horses.
[g] Average of 14 horses.
[h] Average of 11 horses.
[i] Average of 16 horses.
[j] Average of 9 horses.

TABLE 2. MEAN BLOOD AND BLOOD SERUM COMPOSITION ON THOROUGHBRED FARMS SAMPLED[a]

Sampling period	Farm	Blood				Blood serum protein
		Hematocrit	Hemoglobin	Glucose	Urea[b]	
		%	g/100 ml	mg/100 ml	mg/100 ml	g/100 ml
July	Farm A	37.94	14.66	59.62[e]	18.86[c]	7.18
	Farm B	36.37	14.12	61.48[e]	18.14[c]	6.80
	Farm C	39.92	15.14	91.29[f]	12.48[d]	6.80
October	Farm A	43.54[e]	16.24[c]	65.27[f,g]	11.10[e]	5.57
	Farm B	41.55[e]	13.20[d]	84.85[f]	8.56	5.05
	Farm C	36.56[f]	14.30[c,d]	66.83[e,h]	9.52[i]	5.66
January	Farm A	36.11	18.65	55.63	31.90	6.57[e]
	Farm B[g]	35.34	17.66	57.22	32.40	7.82[f]
	Farm C	42.25	21.18	55.14	34.08	6.72[e]
March	Farm A[g]	47.83[e]	20.34[e]	41.29[e]	42.49[e]	7.78[e]
April	Farm B[j]	42.44[f]	15.59[f]	64.18[f]	32.18[f]	8.77[f]
	Farm C[k]	42.46[f]	14.64[f]	60.08[f]	33.93[f]	8.76[f]

[a]Samples were taken from 10 horses from each farm.
[b]Values for October significantly (P<.05) different than for March-April.
[c,d]Farms bearing different superscripts in the same column for a given sampling period are significantly (P<.05) different.
[e,f]Farms bearing different superscripts in the same column for a given sampling period are significantly (P<.01) different.
[g]Average of nine horses.
[h]Average of seven horses.
[i]Average of six horses.
[j]Average of five horses.
[k]Average of eight horses.

TABLE 3. MEAN BLOOD SERUM MINERALS AND PLASMA VITAMIN A COMPOSITION FOR MARES AND YEARLINGS[a]

Sampling period	Type of horse	Blood serum					Blood plasma	
		Calcium	Inor. phos.	Magnesium	Copper	Iron	Carotene	Vitamin A
		mg/100 ml	mg/100 ml	mg/100 ml	μg/100 ml	μg/100 ml	μg/100 ml	μg/100 ml
July	Mares	12.56[c]	3.49[e]	1.94	70.87	277.9[d]	27.70[b]	26.70[b]
	Yearlings	12.78	6.06	1.98	84.48[f]	171.3[g]	27.06	19.62
October	Mares	12.23	3.25[b,e]	1.83	56.45	264.8	28.60[h]	38.61[h]
	Yearlings	12.31	4.51	1.73	52.74	151.0	24.88[n]	38.85[n]
January	Mares	10.85[i]	3.94[e,i]	1.82[i]	48.87[h]	237.0[h]	51.77[c,e,i]	20.53[c,i]
	Yearlings	10.63	5.61	1.74	50.73	303.8[j]	26.98	19.11
April	Mares	11.92[k]	3.20[b,e,k]	2.31[c,e,k]	76.79[l]	266.7[m]	109.72[k]	17.59[k]
	Yearlings	11.47	5.17	2.00	73.77	217.3[h]	69.13	24.70

[a]Samples were taken from 17 mares and 13 yearlings.
[b]Interaction significant (P<.05) between farms and types of horses.
[c]Interaction significant (P<.01) between farms and types of horses.
[d]Mares significantly (P<.05) different from yearlings.
[e]Mares significantly (P<.01) different from yearlings.
[f]Average of 12 horses.
[g]Average of 11 horses.
[h]Average of 15 horses.
[i]Average of 16 horses.
[j]Average of 6 horses.
[k]Average of 9 horses.
[l]Average of 8 horses.
[m]Average of 5 horses.
[n]Average of 10 horses.

TABLE 4. MEAN BLOOD SERUM MINERALS AND PLASMA VITAMIN A COMPOSITION ON THOROUGHBRED FARMS SAMPLED[a]

Sampling period	Farm	Blood serum					Blood plasma	
		Calcium	Inor. phos.	Magnesium	Copper	Iron	Carotene	Vitamin A
		mg/100 ml	mg/100 ml	mg/100 ml	μg/100 ml	μg/100 ml	μg/100 ml	μg/100 ml
July	Farm A	12.66	4.83	1.87[d]	91.70	259.5[f]	20.67	26.43
	Farm B	12.20	4.68	1.86[d]	68.64[f]	259.5[f]	30.93	20.80
	Farm C	13.16	4.80	2.15[e]	72.69	154.7	30.54	22.25
October	Farm A	11.22[b]	4.15	1.70	71.65	145.8	16.89[d,g]	30.15[d,g]
	Farm B	13.10[c]	3.86	1.78	52.30	182.5	15.88[d,g]	53.70[e,h]
	Farm C	12.49[b,c]	3.62	1.86	39.84	295.4	47.43[e]	32.34[d]
January	Farm A	11.19	4.13	1.82	51.00	298.9[i]	43.01[d]	20.49[d]
	Farm B	11.22[f]	5.03[f]	1.69[f]	39.70[f]	209.5[h]	18.47[e,f]	22.70[d,f]
	Farm C	9.82	5.16	1.83	58.71[f]	302.8	56.63[d]	16.27[e]
March	Farm A	11.52[f]	5.23[d,f]	2.18[f]	70.72[f]	432.1[d,j]	51.41[d,f]	18.16[d,f]
April	Farm B[k]	12.01	4.14[e]	2.21	72.61	149.1[e]	52.79[d]	16.28[d]
	Farm C	11.56[g]	4.17[e,g]	2.08[g]	82.50[h]	144.8[e,j]	164.06[e,g]	29.00[e,g]

[a]Samples were taken from 10 horses from each farm.
[b,c]Farms bearing different superscripts in the same column for a given sampling period are significantly (P<.05) different.
[d,e]Farms bearing different superscripts in the same column for a given sampling period are significantly (P<.01) different.
[f]Average of 9 horses.
[g]Average of 8 horses.
[h]Average of 7 horses.
[i]Average of 4 horses.
[j]Average of 6 horses.
[k]Average of 5 horses.

FEEDING BIURET AND UREA TO BEEF CATTLE ON SUMMER PASTURES[1]

J. P. Fontenot and W. H. McClure

During the dry part of the grazing season, usually starting in July in Virginia, the protein content of the grass may diminish to critically low levels. A safe, economical supplemental nitrogen source which would require minimum labor may improve performance and returns from grazing cattle. Biuret is a relatively new non-protein nitrogen source on the market. It contains 230% crude protein equivalent. The use of this supplemental nitrogen source has been suggested for ruminants, especially when fed high roughage, low energy rations. It is non toxic to ruminants, even when fed at high levels. These studies were designed to determine the value of allowing cattle access to mineral mixtures containing biuret or urea. A total of three experiments were conducted, one with yearling heifers, one with pregnant 2-year-old heifers and one with cows nursing calves.

Experiment 1 - Yearling Heifers

Experimental Procedure

A total of 75 yearling heifers were divided into groups of three based on breeding and weight and the cattle within the groups were allotted at random to the following three mixtures: Lot 1 - mixture of trace-mineralized salt and dicalcium phosphate, Lot 2 - mixture of trace-mineralized salt, biuret, dry molasses, dicalcium phosphate and sulfur, Lot 3 - mixture of trace-mineralized salt, urea, dry molasses, dicalcium phosphate and sulfur. All cattle were allowed to graze native pastures.

The composition of the mineral mixtures at the beginning of the trial is shown in table 1. The proportions of urea and biuret used gave mixtures which were calculated to be of equal nitrogen content. Elemental sulfur was incorporated to yield a sulfur to nitrogen ratio of 1:12. The cattle had access to salt in addition. The cattle were started on experiment July 16 and the test was terminated November 19, 1970.

The cattle were weighed at 2-week intervals. The three pastures used provided similar grazing. The weather was generally dry so pastures usually provided poor grazing. The cattle were weighed at 14-day intervals and rotated among the three pastures in order to minimize differences in performance due to differences in pasture.

An attempt was made to obtain an intake of 4 oz. mineral mixtures containing the nitrogen sources. At intervals the composition of the mixtures was altered in attempting to obtain desired intakes. On August 13 the level of dry molasses was increased to 10%, and on August 27 to 15% at the expense of salt. On September 10 the dicalcium phosphate was removed from all mixtures and was replaced with trace-mineralized salt. On October 8 dry molasses was removed and 20% steamed bonemeal was incorporated in the mixtures

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[1]Supported in part by a grant-in-aid from Dow Chemical Company, Midland, Michigan.

for the lots fed the mineral-nitrogen mixtures. The composition of the mixtures from October 8 to November 19 is shown in table 2.

Results

As shown in table 3, gains were very low for all the cattle due to the poor quality of the pastures. Gains were 17 lb. higher for the cattle allowed access to the biuret mixtures than for those fed no supplemental nitrogen and the gains for the urea-fed cattle were intermediate.

The desired intakes of mineral supplements were never obtained. However, intake was highest for the biuret mixture and was lowest for the urea mixture. The biuret mixture remained relatively dry unless rain blew into the covered box. On the other hand, the urea mixture was hygroscopic and became visibly moist shortly after being put in the box.

Since the mineral consumption was very poor in this experiment, it was decided to conduct additional trials using a palatable commercial mineral mixture to mix with the biuret.

Experiment 2

Experimental Procedure

Forty 2-year-old pregnant heifers grazing native bluegrass pastures were used. They were allotted at random according to breed and initial weight to two lots which received the following mixtures: Lot 1 - mineral mixture containing no supplemental nitrogen; Lot 2 - mineral mixture containing biuret and sulfur. The mineral mixture for lot 1 was a commercial mineral mixture[2] and for lot 2 the mixture consisted of 50% biuret, 49.5% of the commercial mineral mixture[2] and 0.5% elemental sulfur.

The cattle were weighed at the beginning and end of the trial and at 28-day intervals. On weigh days, the cattle were rotated between pastures to minimize the effects of differences among pastures. Weekly records of the consumption of the mixtures were kept. The experiment was started on July 6 and terminated on November 23, 1971.

Results

The desired mineral mixture was achieved with no difficulty. As shown in table 4, the average consumption of the minerals was 4.2 oz. for both lots. This meant that the biuret consumption was slightly over 2 oz. which was the desired consumption. The pastures stayed very lush and green during the entire grazing season and undoubtedly were high in crude protein. Under these conditions one would not expect an increase in performance due to supplemental nitrogen. No response was noted in spite of the desired consumption. In fact, the gains were lower for the cattle fed biuret than for the control animals. There is no reason to suspect that the feeding of biuret would cause a depression in performance. The lower gains were probably due

[2] Southern States Livestock Mineral Supplement, Southern States Cooperative, Richmond, Va.

to variability in weight gains in pregnant heifers.

Experiment 3

Experimental Procedure

Thirty-one beef cows with young suckling calves and grazing native bluegrass pastures were used in this experiment. They were allotted to the two mineral mixtures as follows: Lot 1 - commercial mineral mixture, Lot 2 - commercial mineral mixture, biuret and sulfur. The composition of the mineral supplement for lot no. 2 was as given for experiment 2, that is, 50% biuret, 49.5% commercial mineral mixture and 0.5% elemental sulfur.

The cows and calves were weighed at monthly intervals and weekly records of the mineral consumption were maintained. On weigh days, the cattle were rotated between pastures to minimize differences in performance due to differences in pastures.

Results

Mineral consumption was 4 oz. per head per day in the biuret lot. The mineral intake for the control lot was 2.8 oz. per head per day.

There was a trend for higher gains in the cows in the control lot but this was probably due to chance since there is no reason to suspect that biuret would result in a depression in rate of gain. Rate of gain of the calves was similar with a slight trend for higher gains in the calves from the cows fed biuret.

Summary

Three experiments were conducted to study the value of biuret-mineral mixtures for supplementing summer pastures for beef cows and heifers. In the case of yearling beef heifers difficulty was encountered in achieving desired consumption. Mixing the biuret with a commercial mineral mixture solved that problem. In one year there was an increase in gain from supplementing with biuret and in the other year there was no such increase, but actually a decrease in gain. Probably these differences in both years were due to chance variation. In the one year in which the experiment was conducted with cows and calves adequate consumption of the biuret-mineral mixture was obtained but there was no appreciable difference in performance between the control cows and those allowed access to biuret.

No good measure of the value of biuret was obtained in any of these experiments. In the first year there was insufficient mineral consumption to test the nitrogen supplementation. In the second year the pastures were very lush and green due to ample rainfall during the entire grazing season so the pastures did not go through the normal drying after the first of July. Thus, it is obvious that nitrogen supplementation would not have been necessary under this kind of condition. There is still needed research to determine the value of biuret supplements under dry pasture conditions.

TABLE 1. COMPOSITION OF SUPPLEMENTS INITIALLY - EXPERIMENT 1

Ingredient	Control	Biuret	Urea
	%	%	%
Trace mineralized	60	23.5	32.4
Dry molasses		5	5
Dicalcium phosphate	40	20	20
Urea			41.1
Biuret		50	
Sulfur		1.5	1.5

TABLE 2. COMPOSITION OF SUPPLEMENTS DURING LAST 6 WEEKS OF TRIAL EXPERIMENT 1

Ingredient	Control	Biuret	Urea
	%	%	%
Salt	100	28.5	37.5
Steamed bonemeal		20	20
Urea			41
Biuret		50	
Sulfur		1.5	1.5

TABLE 3. EFFECT OF ALLOWING GRAZING CATTLE ACCESS TO MIXTURES CONTAINING UREA OR BIURET. EXPERIMENT 1

	Control	Biuret	Urea
Initial wt., lb.	665	663	655
Final wt., lb.	693	706	688
Gain/head, lb.	26	43	33
Mineral intake, oz. head/day			
Period[a] 1	1.51	1.10	0.96
Period 2	0.87	2.33	1.51
Period 3	1.10	1.32	1.00
Period 4	0.32	0.46	0.23
Period 5	0.91	1.37	1.37
Period 6	0.91	0.83	0.79
Period 7	0.65	1.02	0.93
Period 8	1.63	1.83	1.53
Period 9	1.08	1.78	0.76
Avg.	1.00	1.34	0.91

[a]Each period was 2 weeks.

TABLE 4. FEEDING BIURET TO PREGNANT BEEF HEIFERS. EXPERIMENT 2

	Control	Biuret
Initial wt., lb.	794	796
Final wt., lb.	973	946
Gain/head, lb.	179	150
Daily gain, lb.	1.28	1.07
Mineral intake, oz./head/day	4.2	4.2[a]

[a]Entire mixture.

TABLE 5. FEEDING BIURET-MINERAL MIXTURE TO
BEEF COWS WITH SUCKLING CALVES-140 DAYS. EXPERIMENT 3

	Control	Biuret
Cows		
Initial wt., lb.	986	978
Final wt., lb.	1033	1013
Gain/head, lb.	47	35
Daily gain, lb.	0.34	0.25
Calves		
Initial wt., lb.	232	263
Final wt., lb.	418	453
Gain/head, lb.	186	190
Daily gain, lb.	1.33	1.36
Mineral intake, oz./cow/day	2.8	4.0[a]

[a]Entire mixture.

EFFECTS OF FEEDING DIFFERENT LEVELS OF BROILER LITTER TO EWES FOR LONG PERIODS OF TIME ON PERFORMANCE AND HEALTH[1]

J. P. Fontenot, K. E. Webb, Jr., R. J. Buehler, B. W. Harmon and William Phillips

Broiler litter has been successfully included in the rations of beef cattle and sheep. Performance has generally been good for animals fed rations containing broiler litter and no adverse effects of feeding the litter on animal health have been reported. However, the feeding of broiler litter to animals is not sanctioned by FDA because of the potential presence of pathogenic microorganisms and harmful substances in the litter. An experiment was conducted to study the effects of feeding different levels of broiler litter for long periods of time on the health and reproductive performance of ewes.

Experiment 1

Experimental Procedure:

In the first experiment 32 cross-bred ewes bred to a Hampshire ram were started on experiment approximately 6 weeks prior to the time the first ewe was scheduled to lamb. The ewes were allotted at random to three rations containing 0, 25 and 50% broiler litter sterilized by dry heat treatment at 300°F for 4 hours. The rations were approximately equalized in TDN content. The composition of the rations and the amounts fed were altered in order to meet the NRC requirement for energy at all times. The composition of the rations fed at different times is given in table 1. The ewes were kept in confinement on wire mesh floors.

The performance of the ewes and lambs is given in table 2. There were only minor variations in the bodyweights of the ewes fed the rations containing different levels of litter with the exception of the period from mid to late lactation. At that time the ewes fed 50% litter had lower bodyweights than the other ewes.

The lambing performance was similar for the ewes fed the different rations. There were about 1.5 lambs born per ewe. At 30 days of age there were 1 to 1.1 lambs per ewe. The deaths of the lambs usually occurred shortly after birth and were primarily a result of extremely cold weather and the fact that the ewes were lambed on wire mesh floor. Birth weights of the lambs were similar for the three treatments and were not significantly different. The performance and carcass quality of the lambs were not markedly different. The lambs from the ewes fed 50% litter tended to be younger at slaughter than those from the ewes fed the other rations. This resulted mainly from the higher percentage of ram lambs in this group. The lambs were slaughtered when they reached about 95 lb. bodyweight. There was a trend for slightly higher weight per day of age for the lambs from the ewes fed 50% litter. The trend towards lower rate of gain and lower bodyweight per day of age of the lambs from the ewes fed 25% litter

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was probably due at least partly to low creep feed consumption for these lambs. Carcass grade adjusted for sex and twining, and fat thickness were similar for the lambs from the ewes fed the three rations containing different levels of litter.

On day 137 of the experiment one ewe in the pen fed 50% litter died and upon necropsy the cause was diagnosed as copper toxicity. The litter was assayed and found to contain an average of 195 ppm. copper. The rations containing 0, 25 and 50% litter analyzed 17.8, 57.1 and 109.1 ppm copper, respectively. The high copper content of litter resulted from relatively high levels of copper sulphate in the chick rations every other week. At the end of 254 days death from copper toxicity had occurred in 64% of the ewes fed 50% litter and in 55% of those fed 25% litter. At that time the experiment was terminated and the ewes remaining were slaughtered and tissue samples were taken for analysis and histological sections.

The liver copper levels at death or slaughter were significantly higher for the ewes fed 25 or 50% litter than for those fed the control ration (table 2). There was a trend for the lambs from the litter-fed lots to have higher copper levels in the liver, probably a reflection of their eating some of the ewe feed in addition to the creep feed. There were no significant differences in liver copper levels between the animals fed rations containing 25 and 50% broiler litter.

At intervals during the study blood and urine parameters were measured. There were no consistent trends among the ewes fed the different rations for any of the blood or urine parameters, which would indicate that the physiological condition of the ewes fed the different levels of litter was similar.

Experiment 2

Experimental Procedure

Since it became obvious that high copper levels in poultry litter could present a problem to sheep a second group of ewes (experiment 2) were started on test using litter with low copper levels. Thirty two cross-bred ewes were again allotted to three rations containing 0, 25 and 50% sterilized broiler litter. The exception is that the broiler litter used was monitored at intervals to make certain that it would contain low levels of copper. The objective was to determine if there were any toxicological substance in litter other than possibly high copper levels when fed to ruminants for a long period of time. The procedures used were similar to those described in the first trial. The composition of the ration is given in table 3.

Results

The ewes have been on experiment for approximatelv 15 months. The performance of the ewes and lambs up to November 10, 1971 are shown in table 4. There have been no particular trends concerning the bodyweights of the ewes. The ration consumption has been similar for the ewes in all lots. The quantity of ration fed has been adjusted based on NRC requirements for the ewes at different stages of production.

The number of lambs born per ewe was much lower than for the first year and there were no consistent effects of feeding litter on these. The number of lambs per ewe alive at 30 days as well as the number of lambs born per ewe were highest for the ewes fed 25% litter. There were no large differences in birth weights of the lambs. The weight per day of age and daily gain tended to be higher for the lambs from the ewes fed the control ration. The carcass grade and fat thickness of the lambs were similar regardless of the ration fed the ewes.

Until the ewes had been on experiment for approximately 14 months,[2] there had been no problems from feeding litter. At that time some of the ewes in the lots fed litter began to show symptoms and two have died in the lot fed 25 and four from the lot fed 50% litter. Diagnosis has again been copper toxicity. Upon analysis of the litter, it was found that the broiler litter which had been used for the previous 3 months accidentally contained high levels of copper. Thus, it appeared that copper toxicity was again being encountered. The ewes have been removed from the litter rations in an attempt for them to recover from the high levels of copper. If they overcome the toxicity, the ewes will again be placed on their respective rations and continued on experiment.

[2]March, 1972.

TABLE 1. INGREDIENT COMPOSITION OF RATIONS FED EWES. EXPERIMENT 1.

	Gestation[a]			Lactation[b]			Lactation[c]		
Lot no.	1	2	3	1	2	3	1	2	3
Broiler litter in ration, %	0	25	50	0	25	50	0	25	50
	%	%	%	%	%	%	%	%	%
Grass hay	70.0	52.5	35.0	75.0	56.2	37.5	70.0	52.0	35.0
Shelled corn	25.0	18.7	12.5	20.0	15.0	10.0	20.0	18.0	10.0
Soybean meal	5.0	3.8	2.5	5.0	3.8	2.5	5.0		
Blackstrap molasses							5.0	5.0	5.0
Broiler litter		25.0	50.0		25.0	50.0		25.0	50.0

[a]Fed Dec. 12, 1969 to Jan. 28, 1970
[b]Fed Jan. 28 to Feb. 15, 1970
[c]Fed starting Feb. 15, 1970

TABLE 2. EFFECT OF FEEDING BROILER LITTER TO EWES - EXPERIMENT 1

Item	Litter in ration, %		
	0	25	50
No. of ewes	10	11	11
Weight of ewes, lb.			
Initial, 12/12/69	148	146	153
Before lambing, 1/10/70	159	152	156
After lambing, 3/5/70	135	130	134
Mid lactation, 4/16/70	137	134	126
Late lactation, 7/9/70	144	136	127
Ration consumption by ewes lb./head/day			
Late gestation, 12/12 - 1/28	4.18	4.25	4.25
Lambing, 1/28 - 2/15	4.82	5.15	4.84
Lactation, 2/15 - 7/9	5.30	5.35	5.02
No. lambs born/ewe	1.50	1.54	1.45
No. lambs alive at 30 days/ewe	1.10	1.09	1.00
Birth wt. of lambs, lb.	10.1	10.2	10.9
Lambs			
Age at slaughter, days	137	138	117
Wt./day of age, lb.	0.75	0.70	0.84
Daily gain, lb.	0.70	0.62	0.70
Creep feed, lb./head/day	2.38	1.61	2.71
Carcass grade[a]	14.6	14.2	14.7
Fat thickness, in.	0.11	0.09	0.09
Liver copper level, dry basis, ppm			
Ewes	648[a]	1993[b]	2671[b]
Lambs	572	891	961

[a]Code: 13 = average choice; 14 = high choice; 15 = low prime; etc.
[a,b]Means on the same line with different superscripts are significantly different ($P<.05$).

TABLE 3. INGREDIENT COMPOSITION OF RATIONS FED EWES. EXPERIMENT 2

	Jan. 14-Mar. 22, 1971			After Mar. 22, 1971		
Lot no.	1	2	3	1	2	3
Broiler litter in ration, %	0	25	50	0	25	50
Grass hay	70.0	52.5	35.0	37.3	26.5	16.5
Shelled corn	20.0	15.0	10.0			
Ear corn				52.5	43.5	28.5
Soybean meal	5.0	3.75	2.5	5.0		
Molasses	5.0	3.75	2.5	5.0	5.0	5.0
Limestone				0.2		
Broiler litter		25.0	50.0		25.0	50.0

TABLE 4. EFFECT OF FEEDING BROILER LITTER TO EWES - EXPERIMENT 2

Item	Litter in ration, % 0	25	50
No. of ewes	10	11	11
Weight of ewes, lb.			
Initial, 1/14/71	117	119	119
Before lambing, 2/11/71	126	123	124
After lambing, 6/3/71	118	108	118
Wt., 11/11/71	143	131	134
Ration consumption by ewes, lb./head/day			
1/14-3/24/71	3.30	3.19	3.19
3/25-8/16/71	4.69	4.69	4.69
8/17-11/10/71	3.19	3.30	3.30
No. lambs born/ewe	1.10	1.18	0.81
No. lambs alive at 30 days/ewe	0.80	1.00	0.63
Birth wt. of lambs, lb.	10.7	9.9	11.2
Lambs			
Age at slaughter, day	128	141	140
Wt./day of age, lb.	0.77	0.68	0.70
Daily gain, lb.	0.68	0.62	0.62
Creep feed, lb./head/day	1.23	1.03	1.32
Carcass grade[a]	11.7	12.0	11.4
Fat thickness, in.	0.13	0.12	0.13

[a]Code: 11 = high good; 12 = low choice; etc.

EFFECT OF FEEDING HIGH LEVELS OF ANTIBIOTICS TO COWS ON INCIDENCE OF SCOURS IN CALVES[1]

J. P. Fontenot, K. P. Bovard and B. M. Priode

The problem of scours in calves, although not usually serious, can result in lower profits to the beef producer. If scours are severe, some of the calves may be lost, and if not severe enough to cause death, it may cause lower performance in the calves. Generally, antibiotics will reduce the incidence of scours in calves. However, in young suckling beef calves which consume little or no feed, administration of the antibiotics is difficult. One method which has been suggested to get antibiotic in the calves would be to feed high levels to the cows since some of the antibiotic administered is secreted through the milk.

An experiment was started to study the effect of feeding high levels of antibiotics to cows on the incidence of scours in the calves.

Experimental Procedure

The experiment was conducted at the Beef Cattle Research Station at Front Royal, Virginia. Forty pregnant beef cows (20 Angus and 20 Shorthorn) were allotted to four pairs of lots. The lots within each pair contained cows of similar breeding and bodyweight. One lot of each pair served as control and the other as the treated lot. Thus, there were 4 control and 4 treated lots of 5 cows each. The cows were placed in confinement in the concrete lots January 13, 1971. The rations fed the cows are shown in table 1. Until approximately one-half of the cows had calved, the calculated TDN level was 6.6 lb. TDN or about 84% of the NRC requirement. After about one-half of the calves were born, the energy level was increased to 11.2 lb. TDN which would have been about 90% of the NRC requirement. The cows were offered 7 lb. of hay per head daily. They refused to eat more than 5 lb. per day so after 4 days the amount of hay was reduced to 5 lb. The average ration shown in table 1 supplied about 10.3 lb. of TDN or 83% of the NRC requirement.

Starting February 17, the cows in the treated lots, (2, 4, 6, 8) were fed 1 gram oxytetracycline per head per day in the supplemental ear corn. The antibiotic feeding was continued until May 10 when the trial was terminated.

The first calf was born on March 2 and the last calf, May 3, 1971. The calves were weighed at birth and at 14-day intervals during the trial. The calves were individually scored for weakness and scours daily.

Results

As shown in table 2, weight loss for the cows was similar for the control and treated cows, averaging 214 and 210 lb., respectively.

Only one calf from one of the control lots and one from one of the treated lots died during the trial. Birth weights were 3.8 lb. less for the calves from the treated lots. It is doubtful if this was due to

[1]Supported in part by a grant-in-aid from Chas. Pfizer and Co., Inc., Terre Haute, Ind.

treatment since antibiotic treatment was started only about 2 weeks before the first cow calved.

Daily gains for the calves from birth to May 10 was 32% higher for the treated lots (1.35 vs. 1.78 lb.). On the average, the calves from the treated cows were a few days older than those from the control cows. However, the difference in daily gain does not appear to be due to a difference in age since the differences in gain were consistent even when no difference in age existed. For example, if lots 1 and 2 and lots 3 and 4 are compared, the ages were similar but there was a sizeable difference in daily gain.

There was not much weakness noted in the calves (table 3). However, there was a trend for weaker calves in the control lots. Some instances of scours were reported in all lots. On the average, the severity was greater in the control than in the treated lots. Generally, during each 10-day period the values were lower in the treated lots. The average values for the entire trial were 0.53 for the calves in the control cows and 0.35 for those from the treated cows. These values were based on 873 individual daily observations for the calves from the control lot and 882 observations for the calves from the treated cows.

TABLE 1. COMPOSITION OF RATIONS

	Jan. 13 - Mar. 22, 1971	Mar. 23 - May 10, 1971
	lb./day	
Corn silage	18	30.0
Grass hay	4	5.2
Ear corn	1	1.8

TABLE 2. EFFECT OF FEEDING HIGH LEVEL OF OXYTETRACYCLINE ON COW AND CALF PERFORMANCE

	Control					Antibiotic fed				
	Lot 1	Lot 3	Lot 5	Lot 7	Avg.	Lot 2	Lot 4	Lot 6	Lot 8	Avg.
No. cows	5	5	5	5	20	5	5	5	5	20
Cow weight data, lb.										
Initial wt., 2/17/71	1120	1024	1101	982	1057	1139	995	1135	1047	1079
End wt., 5/10/71	869	821	893	787	843	935	807	935	798	869
Loss/cow	251	203	208	195	214	204	188	200	249	210
Calf performance										
No. calves born alive	5	5	5	5	20	5	4	5	5	19
No. calves died	1	0	0	0	1	1	0[a]	0	0	1
Birth wt., lb.	76	75	70	67	72.0	72	72	69	60	68.2
Wt., 5/10/71, lb.	152	130	126	141	137	157	165	146	159	157
Age, 5/10/71, days	44.0	45.4	38.2	52.2	45.0	44.4	42.6	54.8	56.4	49.6
Da. ga., birth to 5/10/71	1.70	1.21	1.07	1.43	1.35	1.88	2.04	1.43	1.75	1.78

[a]One calf was removed from experiment because the cow did not produce sufficient milk.

TABLE 3. EFFECT OF FEEDING HIGH LEVEL OF OXYTETRACYCLINE TO BEEF COWS ON WEAKNESS AND SCOURS IN SUCKLING CALVES

	Control					Antibiotic fed				
	Lot 1	Lot 3	Lot 5	Lot 7	Avg.	Lot 2	Lot 4	Lot 6	Lot 8	Avg.
Weakness[a]										
3/2 - 3/11	-	-	-	0	0	-	-	0	0	0
3/12 - 3/21	0.10	0	0	0	0.03	0	0	0	0.05	0.01
3/22 - 3/31	0	0.26	0.03	.07	0.09	0.33	0.06	0.03	0.04	0.12
4/1 - 4/10	0.13	0.09	0.03	0	0.06	0	0.17	0.02	0	0.05
4/11 - 4/20	0.21	0	0	0	0.05	0.05	0	0	0	0.01
4/21 - 4/30	0.23	0	0	0	0.06	0.03	0	0	0	0.01
5/1 - 5/10	0	0	0	0	0	0	0	0	0	0
Entire trial	0.15	0.04	0.01	0	0.05[b]	0.04	0.04	0.01	0.01	0.03[c]
Scours[a]										
3/2 - 3/11	-	-	-	0	0	-	-	0.22	0	0.06
3/12 - 3/21	0	0.20	0.65	0	0.19	0	0	0.21	0.03	0.05
3/22 - 3/31	0.55	0.35	1.29	0.30	0.62	0.34	0.72	0.17	0.07	0.33
4/1 - 4/10	0.30	0.22	0.65	0.30	0.37	0.03	0.48	0.05	0.05	0.15
4/11 - 4/20	0.90	0.12	0.45	0.42	0.47	0.28	0.63	0.38	0.20	0.37
4/21 - 4/30	1.09	0.62	1.23	0.26	0.80	0.65	0.57	0.28	0.34	0.46
5/1 - 5/10	0.53	0.20	0.93	0.11	0.44	0.58	0.77	0.16	0.78	0.57
Entire trial	0.75	0.30	0.85	0.25	0.53[b]	0.34	0.61	0.19	0.24	0.35[c]

[a] Code: 0 = none; 1 = slight; 2 = moderate; 3 = severe.
[b] Represents 873 individual daily observations.
[c] Represents 882 individual daily observations.

INFLUENCE OF ZERANOL IMPLANTATION IN GRAZING AND FATTENING STEERS[1]

J. P. Fontenot and R. F. Kelly

For several years diethystilbestrol (stilbestrol) implants have been used to improve the performance of grazing and fattening steers. In previous research in Virginia it was found that the optimum levels of stilbestrol to implant were 12 mg. at the beginning of the pasture season and 24 mg. at the beginning of the feedlot fattening period. Recently there has been interest in another implant, zeranol which has an anabolic effect and has been shown to improve performance of growing and fattening beef cattle. It was decided to study the effect of implanting zeranol in grazing beef steers and the effect of implanting steers which had and had not received a previous spring implant at the time the cattle go into the feedlot. Two trials were conducted in two successive years to study the effect of implanting zeranol in grazing and feedlot fed fattening steers.

Experimental Procedure

During each of two years an experiment was conducted using cattle owned by and kept on Graves Brothers Farm, Madison, Virginia. Each year 60 Angus steers were allotted to the following six treatments according to weight: Lot 1 - control; Lot 2 - zeranol implant in the fall; Lot 3 - zeranol implant in the spring; Lot 4 - zeranol implant in the spring and in the fall; Lot 5 - stilbestrol implant in the spring; Lot 6 - stilbestrol implant in the spring and zeranol implant in the fall.

The levels of implantation were 36 mg. zeranol and 12 mg. stilbestrol. Steers were started on trial in late April or early May and grazed native pastures until November. At that time they were placed in the feedlot and fed a fattening ration. The steers were kept as a group on pasture and in the feedlot.

Prior to the beginning of the trial, at the end of the grazing season and at the end of the fattening period the cattle were individually weighed and scored for slaughter grade, mammary development and tailhead elevation. In February of each year the cattle which graded choice or higher in slaughter grade were sent to slaughter and the remaining steers were sent to slaughter in March. At the beginning and end of the grazing season the cattle were scored for feeder grade also. The following data were collected at slaughter: warm carcass weight, loin-eye muscle area, backfat thickness, conformation score, maturity score, marbling score and carcass grade.

Results

The results for trial 1 are given in table 1, for trial 2 in table 2 and the average results for both trials are given in table 3. The effect

[1]Appreciation is expressed to Graves Bros. Farms, Syria, Virginia for their cooperation and to Commercial Solvents Corp., Terre Haute, Indiana for supporting in part this study with a grant-in-aid.

of spring implants on pasture weight gain, averaged for lots receiving the same spring treatment is shown in table 4. Similarly, weight gains during the feedlot averaged for the lots receiving the same treatment in the fall are given in table 5. Implanting with zeranol in the spring resulted in a marked increase in pasture gain. It resulted in an average of 30 lb. increase during the grazing season. The figures were similar for the two years, the advantage being 32 lb. the first year and 28 lb. the second year for the spring zeranol implant. Contrary to previous results, from this station, we did not obtain a large response from stilbestrol. In the first year the response amounted to about 8 lb. during the pasture season and during the second year about 9 lb. In previous work we have consistently obtained about 30 lb. advantage for a 12 mg. stilbestrol implant at the beginning of the grazing season.

Implanting with zeranol at the beginning of the feedlot period generally resulted in marked increases in rate of gain regardless of whether the animals had received a previous implant of stilbestrol or zeranol. The average increase in rate of gain from the fall implant amounted to 0.31 lb. per day for the first year and 0.35 lb. per day for the second year. As shown in table 5, there was a shortening in the fattening period of an average of 4 days from using the fall zeranol implant, indicating that the steers were definitely gaining faster and were ready for market earlier.

The highest gains were made by the steers which had received a zeranol implant in the spring and again in the fall, prior to going into the feedlot. The increased gain, compared to the steers which received no implant, was 73 lb. (lot 1 _vs_. lot 4, table 3). Furthermore, the feedlot period was about 15 days shorter for the cattle implanted twice.

Carcass grade was not consistently altered by treatment. None of the implants substantially affected mammary development, tailhead elevation, feeder grade or slaughter grade at any time during the experiment.

TABLE 1. EFFECT OF IMPLANTING ZERANOL IN GRAZING AND FEEDLOT-FED STEERS - TRIAL 1.

Lot no.	1	2	3	4	5	6
Implant spring	None	None	Zeranol	Zeranol	Stilbestrol	Stilbestrol
Implant fall	None	Zeranol	None	Zeranol	None	Zeranol
No. of cattle	10	10	10	9[a]	9[a]	10
Weight data, lb.						
Initial wt., 4/30/70	666.7	678.0	705.1	674.7	706.4	693.7
Wt., fall, 11/10/70	811.7	845.7	874.2	882.3	869.8	857.4
Pasture gain	145.0	167.7	169.1	207.6	163.4	163.7
Da. ga., pasture	0.75	0.86	0.87	1.07	0.84	0.84
Final wt.	1120.0	1169.5	1184.5	1231.7	1183.9	1175.0
Feedlot gain	308.3	323.8	310.3	349.3	314.0	317.6
Da. ga., feedlot	2.80	3.32	3.28	3.68	3.26	3.26
Gain, pasture & feedlot	453.3	491.5	479.4	557.0	477.4	481.3
Da. ga., pasture & feedlot	1.47	1.68	1.66	1.95	1.64	1.65
No. days in feedlot	112.4	98.4	95.6	95.1	96.2	98.4
Tailhead elevation[3]						
Initial	0.15	0.15	0.15	0.17	0.17	0
End of pasture period	0.15	0.40	0.40	0.33	0.22	0.10
End of feedlot period	0.10	0.20	0.10	0	0.006	0.10
Mammary development[4]						
Initial	0	0	0	0.06	0	0
End of pasture period	0	0	0.10	0.11	0.06	0
End of feedlot period	0	0.05	0.10	0.11	0.17	0.20
Feeder grade[1]						
Initial	9.85	10.9	10.2	9.3	9.5	10.1
Fall	10.85	11.0	11.0	11.5	10.5	10.4
Slaughter grade[2]						
Initial	6.7	6.5	7.0	6.2	6.7	7.2
End of pasture period	7.9	8.4	8.8	8.8	8.4	8.1
End of feedlot period	12.1	12.4	12.6	12.0	12.2	12.5

TABLE 1. EFFECT OF IMPLANTING ZERANOL IN GRAZING AND FEEDLOT-FED STEERS - TRIAL 1. (Continued)

Lot no.	1	2	3	4	5	6
Implant spring	None	None	Zeranol	Zeranol	Stilbestrol	Stilbestrol
Implant fall	None	Zeranol	None	Zeranol	None	Zeranol
Carcass evaluation						
Conformation[2]	14.0	13.2	13.2	13.6	12.7	13.3
Maturity[5]	1.0	1.0	1.0	1.0	1.0	1.0
Marbling[6]	5.0	4.8	5.0	4.2	4.3	4.8
Carcass grade[2]	13.0	13.0	13.0	12.1	12.3	13.0
Dressing %	58.3	58.4	57.7	57.7	58.2	59.1
Loin eye area, sq. in.	11.4	11.8	11.4	12.4	11.9	12.3
Backfat, in.	0.73	0.80	0.87	0.91	0.76	0.72

[a]One steer from each lot was removed from the experiment from causes not related to treatments.

[1]Code: 8-high medium; 9-low good; 10-av. good; etc.

[2]Code: 7-av. utility; 8-high utility; 9-low good; etc.

[3]Code: 0-no elevation; 1-elevation; 2-marked elevation.

[4]Code: 0-no development; 1-development; 2-marked development.

[5]Code: 1= very young (A maturity).

[6]Code: 4= small; 5= modest; etc.

TABLE 2. EFFECT OF IMPLANTING ZERANOL IN GRAZING AND FEEDLOT-FED FATTENING STEERS - TRIAL 2.

Lot no.	1	2	3	4	5	6
Implant spring	None	None	Zeranol	Zeranol	Stilbestrol	Stilbestrol
Implant fall	None	Zeranol	None	Zeranol	None	Zeranol
No. of cattle	8	10	8	8	10	9
Weight data, lb.						
Initial wt., 5/6/71	622	639	636	621	652	631
Wt., fall, 11/16/71	742	814	809	803	814	779
Pasture gain	120	175	173	177	162	149
Da. ga., pasture	0.57	0.89	0.89	0.91	0.83	0.77
Final wt.	1070	1168	1126	1118	1125	1106
Feedlot gain	328	354	316	315	299	326
Da. ga., feedlot	2.77	3.36	2.77	3.00	2.80	2.86
Gain, pasture & feedlot	448	529	489	491	461	475
Da. ga., pasture & feedlot	1.44	1.76	1.59	1.64	1.53	1.55
No. days in feedlot	118.9	107.5	114.5	105.8	107.5	116.4
Tailhead elevation[3]						
Initial	0.12	0.25	0.01	0.13	0.10	0.22
End of pasture period	0.11	0.10	0	0.25	0.10	0.39
End of feedlot period	0	0.25	0.06	0.07	0.10	0.11
Mammary development[4]						
Initial	0	0	0	0	0	0
End of pasture period	0	0	0	0	0	0
End of feedlot period	0.18	0.20	0	0.44	0.20	0.17
Feeder grade[1]						
Initial	10.7	10.2	10.3	10.1	10.3	9.8
Fall	10.3	11.4	11.5	9.8	11.5	9.3
Slaughter grade[2]						
Initial	4.8	5.1	5.8	5.0	5.8	4.8
End of pasture period	7.6	8.5	8.5	8.4	8.2	7.1
End of feedlot period	11.4	12.5	12.1	12.1	12.3	11.9

TABLE 2. EFFECT OF IMPLANTING ZERANOL IN GRAZING AND FEEDLOT-FED FATTENING STEERS - TRIAL 2 (Continued)

Lot no.	1	2	3	4	5	6
Implant spring	None	None	Zeranol	Zeranol	Stilbestrol	Stilbestrol
Implant fall	None	Zeranol	None	Zeranol	None	Zeranol
Carcass evaluation						
Conformation[2]	13.1	13.4	13.3	13.8	12.9	13.0
Maturity[5]	1.1	1.0	1.1	1.0	1.0	1.1
Marbling	5.6	5.7	6.0	5.1	5.9	5.9
Carcass grade[2]	11.6	12.2	12.5	11.4	12.8	12.6
Dressing %	58.87	58.55	58.08	59.71	59.22	59.11
Loin eye area, sq. in.	10.7	11.4	11.3	10.1	11.3	11.3
Backfat, in.	0.78	0.71	0.82	0.70	0.81	0.83

[1] Code: 8-high medium; 9-low good; 10-av. good; etc.

[2] Code: 7-av. utility; 8-high utility; 9-low good; etc.

[3] Code: 0-no elevation; 1-elevation; 2-marked elevation.

[4] Code: 0-no development; 1-development; 2-marked development.

[5] Code: 1= very young (A maturity).

[6] Code: 4= small; 5= modest; etc.

TABLE 3. EFFECT OF IMPLANTING ZERANOL IN GRAZING AND FEEDLOT-FED FATTENING STEERS - AVG. OF TRIALS 1 AND 2.

Lot no.	1	2	3	4	5	6
Implant spring	None	None	Zeranol	Zeranol	Stilbestrol	Stilbestrol
Implant fall	None	Zeranol	None	Zeranol	None	Zeranol
Weight data, lb.						
Initial wt.	644	659	671	648	679	662
Wt., fall	777	830	842	843	842	818
Pasture gain	133	171	171	192	163	156
Da. ga., pasture	0.66	0.88	0.88	0.99	0.84	0.81
Final wt.	1095	1169	1155	1175	1155	1141
Feedlot gain	318	339	313	332	307	322
Da. ga., feedlot	2.79	3.34	3.03	3.34	3.03	3.1
Gain, pasture & feedlot	451	510	484	524	469	478
Da. ga., pasture & feedlot	1.46	1.72	1.63	1.80	1.59	1.60
No. days in feedlot	115.7	103.0	105.1	100.5	101.9	107.4
Tailhead elevation[3]						
Initial	0.14	0.20	0.08	0.15	0.14	0.11
End of pasture period	0.13	0.25	0.20	0.29	0.16	0.25
End of feedlot period	0.05	0.23	0.008	0.04	0.08	0.11
Mammary development[4]						
Initial	0	0	0	0.03	0	0
End of pasture period	0	0	0.05	0.06	0	0
End of feedlot period	0.09	0.13	0.05	0.28	0.20	0.19
Feeder grade[1]						
Initial	10.3	10.6	10.3	9.7	9.9	10.0
Fall	10.6	11.2	11.3	10.7	11.0	9.9
Slaughter grade[2]						
Initial	5.8	5.8	6.4	5.6	6.3	6.0
End of pasture period	7.8	8.5	8.7	8.6	8.3	7.6
End of feedlot period	11.8	12.5	12.4	12.1	12.3	12.2

TABLE 3. EFFECT OF IMPLANTING ZERANOL IN GRAZING AND FEEDLOT-FED FATTENING STEERS - AVG. OF TRIALS 1 AND 2. (Continued)

Lot no. Implant spring Implant fall	1 None None	2 None Zeranol	3 Zeranol None	4 Zeranol Zeranol	5 Stilbestrol None	6 Stilbestrol Zeranol
Carcass evaluation						
Conformation[2]	13.6	13.3	13.3	13.7	12.8	13.2
Maturity[5]	1.1	1.0	1.1	1.0	1.0	1.1
Marbling[6]	5.3	5.3	5.5	4.7	5.1	5.4
Carcass grade[2]	12.3	12.6	12.8	11.8	12.6	12.8
Dressing %	58.6	58.2	57.9	58.7	58.7	59.1
Loin eye area, sq. in	11.1	11.6	11.4	11.3	11.6	11.8
Backfat, in.	0.76	0.76	0.85	0.81	0.79	0.78

[1]Code: 8-high medium; 9-low good; 10-av. good; etc.

[2]Code: 7-av. utility; 8-high utility; 9-low good; etc.

[3]Code: 0-no elevation; 1-elevation; 2-marked elevation.

[4]Code: 0-no development; 1-development; 2-marked development.

[5]Code: 1= very young (A maturity).

[6]Code: 4= small; 5= modest; etc.

TABLE 4. EFFECT OF IMPLANTING ZERANOL IN GRAZING STEERS

Item	Implant in spring by trial								
	Trial 1			Trial 2			Avg. of trials 1 and 2		
	Control	Zeranol	Stilbestrol	Control	Zeranol	Stilbestrol	Control	Zeranol	Stilbestrol
Initial weight, lb.	672	690	700	631	629	642	652	660	671
Fall weight, lb.	829	878	864	778	806	797	804	842	831
Pasture gain, lb.	156	188	164	147	175	156	152	182	160
Daily gain, lb.	0.81	0.97	0.84	0.73	0.90	0.80	0.77	0.94	0.83

TABLE 5. EFFECT OF IMPLANTING ZERANOL IN FEEDLOT-FED FATTENING STEERS

Item	Implant in fall by trial				Avg. of trials 1 and 2	
	Trial 1		Trial 2			
	Control	Zeranol	Control	Zeranol	Control	Zeranol
Fall weight, lb.	852	862	788	799	820	831
Final weight, lb.	1163	1192	1107	1131	1135	1162
Daily gain in feedlot, lb.	3.11	3.42	2.78	3.07	2.95	3.25
Days in feedlot	101.4	97.3	113.6	109.9	107.5	103.6

FEED INTAKE AND FEEDLOT PERFORMANCE OF CATTLE FED DIFFERENT LEVELS OF BROILER LITTER[1]

J. P. Fontenot, K. E. Webb, Jr. and R. F. Kelly

In a previous trial it was found that feeding 50% broiler litter resulted in marked decreases in feed intake and rate of gain in fattening yearling steers. In that experiment the rations had not been equalized in TDN content. It was decided to study the effect of feeding different levels of broiler litter in rations with equalized TDN contents and to include molasses in the ration.

Experimental Procedure

Eighteen calves (12 steers and 6 heifers) were allotted at random according to sex, breed and initial weight to rations containing 0, 25 and 50% broiler litter. The litter had been processed in a commercial suspension air dryer with an outgoing temperature of approximately 270°F followed by grinding.[2] The composition of the rations is shown in table 1. Molasses was included in all rations at the level of 5% in an attempt to get maximum consumption of the rations. The calculated TDN contents of the rations were equalized which explains the differences in the ingredients used. All rations were supplemented with vitamin A.

The cattle were kept inside the barn in individual stalls for approximately 16 hours per day and turned into outside pens for exercise and water the remainder of the time. Individual daily feed records were kept. At the end of the trial the steers were slaughtered and carcass data were obtained.

Results

Feeding the ration containing 50% broiler litter resulted in marked reductions in feed intake and rate of gain (table 2). The lower feed intake and rate of gain for the animals fed 50% litter were especially marked during the first 56 days of the experiment. When the ration contained 25% broiler litter there was a small depression in average feed intake and daily gain but was not nearly as severe as when the higher level of litter was fed. Dressing percent and carcass grade tended to decrease with increasing level of litter. The area of the <u>longisimmus</u> muscle and the fat thickness were much lower for the cattle fed the high level of litter than for the cattle from the other two treatments.

[1]Supported in part by Public Health Service Grant No. EP-00034.

[2]Litter was processed and supplied by Triangle E By-Product Co., Inc. Harrisonburg, Va.

TABLE 1. COMPOSITION OF RATIONS

	Basal	25% Litter	50% Litter
	%	%	%
Corn cobs	16.0	3.5	
Ear corn	62.7	66.0	
Soybean meal	15.0		
Broiler litter		25.0	50.0
Shelled corn			44.5
Molasses	5.0	5.0	5.0
Trace mineralized salt	0.5	0.5	0.5
Limestone	0.8		
Vitamin A[a]	+	+	+

[a] 1500 I.U. per pound of ration.

TABLE 2. EFFECT OF FEEDING DIFFERENT LEVELS OF PROCESSED BROILER LITTER TO STEERS ON PERFORMANCE AND CARCASS CHARACTERISTICS

Item	Litter in ration, %		
	0	25	50
Initial wt., lb.	610	604	614
Performance			
Avg. daily gain, lb.			
Days 1-56	2.24	1.87	0.55
Days 57-112	1.80	1.89	0.90
Days 113-198	1.67	1.45	1.39
Days 1-198 (entire trial)	1.87	1.69	1.12
Avg. feed intake, lb./day			
Days 1-56	21.3	19.8	13.9
Days 57-112	20.5	19.6	15.0
Days 113-198	19.8	18.3	16.7
Days 1-198 (entire trial)	20.5	19.1	15.4
Carcass characteristics			
Carcass grade[a]	13.4	12.8	12.0
Dressing %	67.5	64.1	61.4
Longissimus muscle, sq in	11.6	11.6	10.2
Backfat thickness, in.	0.9	0.9	0.6

[a]Code: 12 = low choice; 13 = average choice; 14 = high choice, etc.

ACCEPTABILITY OF MAGNESIUM OXIDE SUPPLEMENTS BY GRAZING BEEF COWS[1]

T. M. Frye, J. P. Fontenot and K. E. Webb, Jr.

The metabolic disturbance, grass tetany, affects only ruminants. Research has shown that there exists a relationship between grass tetany and low magnesium level in the blood serum of cattle. Lactating beef cows grazing spring pasture frequently suffer from grass tetany. It appears that supplementing with magnesium is beneficial in maintaining normal magnesium levels in blood serum, thereby preventing the occurrence of tetany. The most practical method of supplementing cows during the danger period is by use of mineral supplements. A palatable mixture would ensure consumption of sufficient supplementary magnesium.

The purpose of this study was to study the relative acceptability of different magnesium oxide supplements for grazing beef cows in attempts to develop a mixture which would be sufficiently palatable for optimum intake of magnesium.

Experimental Procedure

Eighteen lactating beef cows with nursing calves less than 60 days of age (average age 36 days) were placed by age, weight, breed and calving date into six outcome groups and allotted at random to 3 pastures of 6 cows each. Each pasture had 7.2 acres and the forage was predominantly orchardgrass, bluegrass and white clover.

A covered mineral box with four identical removable compartments was placed in each pasture. The individual compartments contained the following supplements: (1) Trace mineralized salt and magnesium oxide- 1:1 ratio; (2) Trace mineralized salt, magnesium oxide and cottonseed meal - 1:1:1 ratio; (3) Trace mineralized salt, magnesium oxide, and dry molasses - 1:1:1 ratio; and (4) Trace mineralized salt, magnesium oxide and steamed bonemeal - 1:1:1 ratio. The compartments were randomly rotated daily to prevent cattle from developing a pattern of eating within the mineral box. These mixtures were available at all times and no other supplement was available. Facilities were employed to prevent consumption by the calves. The four magnesium oxide supplemental mixtures were collected daily from each pasture, dried for 24 hours in a forced air oven, air equilibrated for 12 hours and weighed to measure consumption.

Results

Data concerning intake per animal per day of the four magnesium oxide mixtu... for thirteen 10- dayperiods are shown in table 1. For each 10-day period more of the dry molasses mixture was consumed than any other mixture. Consumption of the cottonseed meal mixture and the steamed bonemeal

[1]Feed grade magnesium oxide ("Mag-Ox", Basic Chemicals) was supplied by Getkin Associates, Morristown, Pa.

mixture was less than for the dry molasses mixture, and both were consumed in similar amounts. The control mixture, which contained only trace mineralized salt and magnesium oxide, was consumed at a lower level than any of the other three mixtures in all periods.

Average consumption for the 130 day period is summarized in table 2. Greatest consumption of the four mixtures was the dry molasses mixture at a rate of 1.84 oz. per head per day which supplied approximately 0.61 oz. of magnesium oxide and 0.33 oz. of magnesium per cow per day.

The differences in consumption of the four mixtures were rather consistent between the groups of cows and between the 10-day periods. The data suggest that of the four supplements tested magnesium oxide was most palatable in a 1:1:1 ratio with trace mineralized salt and dry molasses ($P<.01$). The addition of either cottonseed meal or steamed bonemeal tended to improve palatability over a magnesium oxide and trace mineralized salt mixture in a 1:1 ratio.

TABLE 1. CONSUMPTION OF MAGNESIUM OXIDE SUPPLEMENTS BY GRAZING BEEF COWS

	Mixture designation							
	Control		Cottonseed meal		Dry molasses		Steamed bonemeal	
Period no.[a]	Mixture	Magnesium oxide	Mixture	Magnesium oxide	Mixture	Magnesium oxide	Mixture	Magnesium oxide
	oz. per head per day							
1	0.11	0.05	0.34	0.11	1.04	0.35	0.45	0.15
2	0.06	0.03	0.51	0.17	1.89	0.64	0.66	0.22
3	0.06	0.03	0.43	0.14	2.12	0.71	0.38	0.13
4	0.06	0.03	0.53	0.18	1.97	0.66	0.28	0.09
5	0.05	0.03	0.47	0.16	1.89	0.63	0.15	0.05
6	0.13	0.06	0.58	0.19	1.81	0.60	0.25	0.08
7	0.07	0.03	0.58	0.19	2.39	0.80	0.31	0.10
8	0.06	0.03	0.29	0.10	1.53	0.51	0.14	0.05
9	0.11	0.06	0.39	0.13	1.17	0.39	0.49	0.16
10	0.12	0.06	0.47	0.16	1.09	0.36	0.78	0.26
11	0.05	0.03	0.29	0.10	0.95	0.30	0.57	0.19
12	0.15	0.08	0.79	0.26	2.45	0.82	0.93	0.31
13	0.07	0.03	0.29	0.10	1.11	0.37	0.30	0.10

[a]Each was a 10-day period.

TABLE 2. CONSUMPTION OF MAGNESIUM OXIDE SUPPLEMENT FOR 130 DAY PERIOD BY GRAZING BEEF COWS

Item	Mixture designation			
	Control	Cottonseed meal	Dry molasses	Steamed bonemeal
	oz. per head per day			
Mixture	0.08	0.48	1.84	0.44
Magnesium oxide	0.04	0.16	0.61	0.15
Magnesium	0.02	0.09	0.33	.08

EFFECTIVENESS OF VARIOUS PROCESSING METHODS FOR THE PASTEURIZATION OF BROILER LITTER

L. F. Caswell, J. P. Fontenot and K. E. Webb, Jr.

In the past decade broiler litter has been shown to be of potential economic importance as a feedstuff. When incorporated into ruminant rations, in addition to supplying nitrogen, it will contribute an appreciable amount of energy. Uric acid, which represents a substantial portion of the total nitrogen present in litter, is a satisfactory nitrogen source for rumen microbes.

Presently, the use of broiler litter as an animal feed is not sanctioned by the Food and Drug Administration due to apprehension concerning potential hazards to human and animal health from various drugs and pathogenic organisms in poultry litter. Research has shown that fattening beef cattle make satisfactory daily gains and feed efficiency when fed low levels of broiler litter, as compared to a conventional source of nitrogen such as soybean meal. No health problems have been reported from feeding litter to cattle.

When considering the present position occupied by animal wastes in the feeding of livestock, it becomes apparent that broiler litter may never gain much impetus in the feed industry until methods are developed by which the potential hazards present in litter can be alleviated. With this in mind experiments were conducted in order to develop processing methods suitable for the destruction of pathogens present in broiler litter. In all of the methods examined pasteurization of the litter was the goal.

Experimental Procedure

The following methods of processing broiler litter were evaluated in this study: 1) heating in a forced draft oven (dry heat) at 302°F for 10, 15 or 20 minutes with the litter at a depth of 1/4 inch; 2) autoclaving at 250°F under steam pressure of 15 lb. per square inch for 5, 10, 15 or 30 minutes at a depth of 2 inches; 3) heating in a forced draft oven at 302°F for 15 minutes at litter depths of 1/4 and 1 in. immediately following the addition of 0, 1, 2 or 4 g of paraformaldehyde per 100 g of litter; 4) fumigation with ethylene oxide at 72°F for 30, 60 or 120 minutes.

In the ethylene oxide fumigation process a 4 oz. sample jar was filled to a depth of 3 in. with litter prior to subjection to treatment. Each sample jar of litter processed by the ethylene oxide method was placed in a desiccator devoid of desicant, and the desiccator was evacuated using a vacuum pump until the MacLeod Gauge showed 2.5 mm mercury pressure. Ethylene oxide was then injected into the evacuated desiccator until the pressure inside the desiccator equalled that of the atmosphere. A mercury filled U-tube 24 in. in length constructed from glass tubing having an outside diameter of 7/16 in. was connected to the evacuated desiccator between the desiccator inlet and the ethylene oxide source. Through this arrangement it was assured that the exact volume of air removed from the desiccator was replaced with an equal volume of ethylene oxide. The effect of vacuum alone on survival of the bacteria was also studied.

Metal pans measuring 6x6x2 in. with perforated bottoms were used to process the litter by the other three methods. In all cases measurement of time was begun when all of the above specified conditions for the appropriate processing method were satisfied.

Addition of the paraformaldehyde to the litter used in the paraformaldehyde process was performed immediately before heating was initiated by thoroughly mixing the appropriate amount of paraformaldehyde with the litter in a sealed 2 qt. glass jar.

Samples containing 0, 1, 2, 3 and 4 g of paraformaldehyde per 100 g of litter were plated with and without being heated 15 min. at 302°F. This procedure allowed determination of whether the pasteurizing effect of the paraformaldehyde was a function of volatilization of paraformaldehyde through heating at 302°F or whether the bacteria were destroyed by the solution containing formaldehyde which was created when the litter samples were homogenized in distilled water prior to plating.

Total bacteria counts as well as coliform counts were performed on each processed litter sample by incubating a homogenized preparation of the litter samples with prereduced anaerobically sterilized media for the detection of anaerobic and facultative bacteria. A qualitative test for the presence of the enteric bacteria genera of Salmonella, Shigella and Proteus was also performed on each processed sample. Bacterial determinations, both quantitative and qualitative, were performed in all cases on a sample of unprocessed litter, in addition to the processed samples. All of the broiler litter processed in this study was obtained from one broiler house and was ground through a 1/4 in. screen and thoroughly mixed prior to initiation of the study. The criteria for determining the effectiveness of each processing method developed were less than 10 coliforms and less than a total of 20,000 bacteria per gram by plate count. These are the standards used for pasteurized milk.

Results

As shown in table 1, unprocessed litter was found to be thoroughly contaminated.

The 30 minute fumigation with ethylene oxide shows marginal effectiveness with respect to total bacterial count, but the counts obtained with the longer fumigation periods were more desirable. The 30 minute fumigation treatment also permitted the survival of an average of 1.25 coliforms per gram, so this treatment is not considered effective. Fumigation for 60 minutes or longer was quite effective. Vacuum alone was not effective in pasteurizing the litter.

The paraformaldehyde treatment involving the addition of 1 gram of paraformaldehyde to 100 g of litter and heating for 15 minutes at 302°F at a depth of 1 inch produced a marginal response. The addition of higher levels of paraformaldehyde appear to be quite effective. Although heating the litter in a forced draft oven for 15 minutes at 302°F and a depth of 1/4 inch without paraformaldehyde treatment was not effective in reducing the total bacteria count to less than 20,000 per gram, the addition of 1 to 4 g of paraformaldehyde to litter processed under identical conditions did, however, depress the total bacterial count to acceptable levels at thicknesses of 1/4 or 1 in.

It was found that the addition of 1, 2 or 4 g of paraformaldehyde without heating gave total bacteria counts of greater than 300,000 bacteria per gram of litter for 1 and 2 g of paraformaldehyde per 100 g of litter and a count of 63,125 bacteria per gram of litter for 4 g of paraformaldehyde per 100 g of litter. One gram of paraformaldehyde per 100 g of litter also permitted the survival of 2,992 coliforms per gram of litter. From this it can be concluded that heating of the litter was necessary in order for paraformaldehyde to manifest its pasteurizing effect.

These experiments indicate the versatility existing among the numerous methods by which contaminated broiler litter can be pasteurized. The effective treatments included heating in a forced draft oven at 1/4 in. thickness at 302°F for 20 minutes; autoclaving for 10 minutes or longer; heating in a forced draft oven at 302°F with litter at a depth of 1/4 inch or 1 inch following the addition of 1 to 4 g of paraformaldehyde to 100 g of litter; and fumigation with ethylene oxide for 60 minutes or longer.

TABLE 1. EFFECT OF PROCESSING ON BROILER LITTER PASTEURIZATION

Processing method	Processing temperature	Processing time	Litter depth	Other conditions	Coliforms per gram[a]	Total bacteria per gram[a]	S.[b]	Sh.[c]	P.[d]
			in.						
Unprocessed					>30,000	>30,000	-	-	-
Dry heat	302°F	10 min.	0.25		0	61,750	-	-	-
		15 min.			0	20,059	-	-	-
		20 min.			0	5,247	-	-	-
Autoclave	250°F	5 min.	2.0	15 lb.	0	49,198	-	-	-
		10 min.		pressure per	0	9,348	-	-	-
		15 min.		square in.	0	873	-	-	-
		30 min.			0	185	-	-	-
Paraformaldehyde added	302°F	15 min.	0.25	0g/100 g litter	0	26,267	-	-	-
				1g/ " " "	0	3,463	-	-	-
				2g/ " " "	0	1,929	-	-	-
				4g/ " " "	0	1,630	-	-	-
			1.0	0g/ " " "	0	89,090	-	-	-
				1g/ " " "	0	18,837	-	-	-
				2g/ " " "	0	2,607	-	-	-
				4g/ " " "	0	352	-	-	-
Ethylene oxide fumigation	72°F	30 min.	3.0	Desiccator	1.25	18,117	-	-	-
		60 min.		evacuated	0	5,147	-	-	-
		120 min.		to 2.5 mm	0	700	-	-	-
				Hg pressure					

[a]Means of six replications per treatment.
[b]*Salmonella*
[c]*Shigella*
[d]*Proteus*

EFFECT OF LEVEL OF NITROGEN AND POTASSIUM ON MAGNESIUM UTILIZATION IN RUMINANTS

W. F. Moore, J. P. Fontenot and K. E. Webb, Jr.

Grass tetany or hypomagnesemic tetany occurs commonly in beef cows grazing cereal forages such as wheat. The wheat plant is characteristically very high in crude protein (nitrogen) and in potassium content. These two nutritional factors have been incriminated in causing grass tetany in ruminants. Also, fertilization with high levels of nitrogen or potassium will usually increase the incidence of hypomagnesemia.

Two experiments were conducted, one with wether lambs and the other with beef cows to study the effect of high levels of dietary nitrogen and potassium, alone and in combination on magnesium utilization in ruminants.

Experiment 1

Two metabolism trials were conducted with 12 wether lambs. For each of the two trials the lambs were allotted to the following four rations: 1) low nitrogen, low potassium (low N-low K; 2) low nitrogen, high potassium (low N-high K); 3) high nitrogen, low potassium (high N-low K); and 4) high nitrogen, high potassium (high N-high K).

The ingredient composition of the rations is given in table 1. The crude protein levels were 10.6 and 32.4%, dry basis, for the low and high nitrogen rations, respectively. The low and high potassium levels were 0.44 and 4.92%, dry basis. The lambs were fed one-half of the respective rations at 7:00 a.m. and 7:00 p.m.

Each trial consisted of a four-day transition period during which experimental rations were introduced, followed by four successive 5-day collection periods. During the collection period, total fecal and urinary collections were made. The urine samples were collected in dilute sulfuric acid. After each 24 hour collection period, the feces were weighed and sampled. The urine was diluted to constant weight and sampled. The samples were stored under refrigeration until analysis.

Results

The magnesium balance data are given in table 2. Apparent magnesium absorption was lower ($P<.01$) during all periods for the lambs consuming the high potassium rations than for those consuming the low potassium rations. The depression amounted to approximately 38%. The average absorption values, expressed as percent of intake for all trials,were 49% for the low-potassium rations and 31% for the high-potassium rations. Urinary magnesium excretion was lower for the high potassium fed lambs which was probably due to the lower absorption noted for these animals.

There were no significant differences in apparent magnesium absorption between the lambs fed the low and high nitrogen rations. Urinary magnesium excretion was significantly higher during all periods for the lambs consuming the high nitrogen rations than for those consuming the low nitrogen rations. These results agree with previous results reported last year from this station.

Blood serum magnesium levels (table 3) were lower after periods 2 and 4 for the lambs consuming the high potassium rations than for those consuming the low potassium rations. The average values for periods 2 and 4 were 2.22 and 1.98 mg. per 100 ml. for the low and high potassium rations, respectively. These differences were probably a reflection of the differences observed in magnesium absorption between the animals consuming the two different levels of potassium.

Experiment 2

Experimental Procedure

Two trials were conducted with 12 pregnant beef cows averaging 10 years of age. For each trial, the cows were allotted to the following four rations: Low N, low K; 2) low N - high K; 3) high N, low K; 4) high N, high K. The ingredient composition of the rations 'is shown in table 4. The low potassium rations contained 1.34% potassium and the high potassium rations, 4.90% potassium. The low and high nitrogen rations contained 11.2 and 28.1% crude protein, respectively.

The cows were placed in individual stalls inside the barn twice daily, from 7:00 - 9:30 a.m. and from 3:00 - 7:30 p.m. and fed one-half of the daily ration each time. During the remainder of the time, the cows were maintained in a dry lot with access to water. Each trial consisted of a 5-day preliminary period followed by a 5-day transition period and a 10-day experimental period. During the 5-day transition period, the experimental rations were introduced. Blood and urine samples were taken on every other day of the 10-day experimental periods.

Results

The urinary magnesium excretion levels expressed per unit of creatinine are given in table 5. Since creatinine excretion in the urine is usually fairly constant during the 24-hour period, the magnesium expressed as a ratio of magnesium to creatinine should give some indication of the total magnesium excretion per day. A reduction was noted in the urinary magnesium excretion per unit of creatinine for the cows consuming all rations on all sampling days, compared to the initial values. The higher initial values were due to the higher magnesium intake during the preliminary period.

Urinary magnesium excretion was lower on all sampling days of the experimental period for the cows consuming the high potassium rations than for those on the low potassium rations. The differences were established quite rapidly. For instance, the difference was evident after 2 days on the experimental rations.

There was a tendency for urinary magnesium excretion to be lower for the cows consuming the high nitrogen rations than for those consuming the low nitrogen rations but differences were not significant.

The blood serum magnesium data are given in table 6. The serum magnesium levels for the cows consuming all rations were within the normal range and were not significantly affected by treatment.

Summary

Two experiments were conducted to study the effect of feeding different levels of nitrogen and potassium, alone and in combination on magnesium utilization. It was noted that in wether lambs feeding a high potassium ration resulted in a 38% decrease in apparent magnesium absorption. The data on the cows indicated lower magnesium absorption also. Feeding high nitrogen rations did not have any effect on magnesium absorption but there was a small increase in urinary magnesium excretion.

It appears that the depression in magnesium absorption from feeding high potassium levels is sufficient to make potassium a suspect in the cause of grass tetany. In the case of feeding high levels of nitrogen, the slight increase in urinary magnesium appeared to be too low to be an important consideration in the production of grass tetany. It could be that fertilizer with high rates of nitrogen could cause an increase in hypomagnesemia from some other changes in the plant. For example, high levels of nitrogen fertilization usually result in fairly large increases in potassium content of the plant.

TABLE 1. INGREDIENT COMPOSITION OF RATIONS FED IN EXPERIMENT 1

Ingredients	Low nitrogen		High nitrogen	
	Low K	High K	Low K	High K
	g/day			
Grass-clover hay	120	120	120	120
Corn cobs	313.6	313.6	239.6	239.6
Ground shelled corn	314.8	314.8	126.0	126.0
Isolated soy protein[a]	36.1	36.1	268.4	268.4
Cellulose[b]	-	-	24.4	24.4
Defluorinated phosphate	7.0	7.0	7.3	7.3
Limestone	2.7	2.7	9.3	9.3
Sodium bicarbonate	1.6	1.6	-	-
Magnesium oxide	0.2	0.2	0.4	0.4
Trace mineralized salt	4.0	4.0	4.0	4.0
Vitamins A and D[d]	+	+	+	+
Potassium bicarbonate[c]	-	106.0	0.6	106.6

[a]Assay Protein C-1. Skidmore Enterprises, Cincinnati, Ohio.
[b]Solka floc, BW-20. Brown Co., Berlin, N. H.
[c]Potassium bicarbonate fed in addition to the 800 g. per day of the basal ration.
[d]Levels were 3361 U.S.P. units vitamin A and 421 U.S.P. units vitamin D per kilogram of ration.

TABLE 2. EFFECT OF LEVEL OF NITROGEN AND POTASSIUM ON MAGNESIUM BALANCE. EXPERIMENT 1

Collection period	Ration	Intake	Excretion Fecal	Excretion Urinary	Apparent absorption		Retention
		g/day	g/day	g/day	g/day	% of intake	g/day
1	Low N-Low K	0.94	0.50	0.27	0.44	46.81	0.18
	Low N-High K	0.94	0.65[a]	0.07[a]	0.29[a]	30.85[a]	0.17
	High N-Low K	0.95	0.49	0.37[b]	0.46	48.42	0.09
	High N-High K	0.95	0.66[a]	0.10[a,b]	0.29[a]	30.53[a]	0.15
2	Low N-Low K	1.01	0.58	0.28	0.43	42.57	0.12
	Low N-High K	0.99	0.64[a]	0.08[a]	0.25[a]	25.25[a]	0.14
	High N-Low K	1.02	0.60	0.36[b]	0.42	41.18	0.05
	High N-High K	1.02	0.72[a]	0.09[a,b]	0.30[a]	29.41[a]	0.11
3	Low N-Low K	1.01	0.51	0.29	0.50	49.50	0.21
	Low N-High K	0.98	0.71[a]	0.07[a]	0.27[a]	27.55[a]	0.22
	High N-Low K	1.01	0.44	0.37[b]	0.57	56.44	0.20
	High N-High K	1.01	0.61[a]	0.15[a,b]	0.40[a]	39.60[a]	0.25
4	Low N-Low K	1.01	0.52	0.26	0.49	48.51	0.23
	Low N-High K	1.00	0.71[a]	0.07[a]	0.29[a]	29.00[a]	0.22
	High N-Low K	1.01	0.39	0.37[b]	0.62	61.39	0.25
	High N-High K	1.01	0.67[a]	0.10[a,b]	0.34[a]	33.66[a]	0.24

[a]Values for the high-potassium rations were significantly ($P<.01$) different than for the low-potassium rations.

[b]Values for the high-nitrogen rations were significantly ($P<.01$) different than for the low-nitrogen rations.

TABLE 3. EFFECT OF LEVEL OF NITROGEN AND POTASSIUM ON BLOOD SERUM MAGNESIUM, CALCIUM, INORGANIC PHOSPHORUS AND POTASSIUM LEVELS. EXPERIMENT 1

Sampling period	Ration	Blood serum levels, mg/100 ml			
		Magnesium	Calcium	Inorganic phosphorus	Potassium
Initial	Low N-Low K	2.20	10.03	7.00	18.87
	Low N-High K	2.15	10.22	6.66	18.88
	High N-Low K	2.16	11.02	6.27	19.00
	High N-High K	2.25	10.31	6.38	18.70
2[a]	Low N-Low K	2.09	9.59	7.19	19.25
	Low N-High K	1.91[b]	9.95	8.77[b]	19.50
	High N-Low K	2.20	9.89	7.30	19.42
	High N-High K	2.00[b]	10.07	8.20[b]	19.38
4[a]	Low N-Low K	2.26	10.24	7.33	20.02
	Low N-High K	1.97[b]	9.99	8.42[b]	20.40
	High N-Low K	2.32	10.34	7.55	21.00
	High N-High K	2.04[b]	9.56	8.62[b]	20.25

[a]End of period.
[b]Values for the high-potassium rations were significantly (P<.01) different than for the low-potassium rations.

TABLE 4. INGREDIENT COMPOSITION OF RATIONS FED IN EXPERIMENT 2

Ingredients[a]	Low nitrogen		High nitrogen	
	Low K	High K	Low K	High K
	kg/day			
Hay	1.06	1.06	0.57	0.57
Ground ear corn	4.39	4.39	1.54	1.54
Soybean meal	0.51	0.51	1.88	1.88
Cottonseed meal	-	-	1.88	1.88
Molasses	0.06	0.06	0.29	0.29
Minerals[b]	0.25	0.25	0.11	0.11
Potassium bicarbonate	-	0.65	-	0.65
Total	6.27	6.92	6.27	6.92

[a]Stabilized vitamin A added at the level of 2,200 I.U. per kilogram of ration.
[b]Defluorinated phosphate, limestone, magnesium oxide, potassium bicarbonate and trace-mineralized salt.

TABLE 5. EFFECT OF LEVEL OF NITROGEN AND POTASSIUM ON URINARY MAGNESIUM EXCRETION (MG/100 MG CREATININE). EXPERIMENT 2

Day of treatment	Low nitrogen		High nitrogen	
	Low K	High K	Low K	High K
Initial	38.00	49.11	40.35	51.70
2	31.12[a]	21.27	28.03[a]	10.50
4	25.76[a]	10.43	22.31[a]	6.40
6	23.98[a]	19.84	24.37[a]	8.92
8	25.88[a]	18.58	23.87[a]	10.63
10	29.08[a]	16.56	27.32[a]	11.58

[a]Values for the low-potassium rations were significantly ($P<.01$) higher than for the high-potassium rations.

TABLE 6. EFFECT OF LEVEL OF NITROGEN AND POTASSIUM ON BLOOD SERUM MAGNESIUM LEVELS (MG/100 ML). EXPERIMENT 2

Day of treatment	Low nitrogen		High nitrogen	
	Low K	High K	Low K	High K
Initial	2.18	2.07	2.24	2.05
2	2.26	2.60	2.58	2.30
4	2.41	2.61	2.54	2.22
6	2.34	2.36	2.39	2.45
8	2.24	2.17	2.32	2.32
10	2.22	2.17	2.30	2.31

ADAPTATION OF BEEF CATTLE TO HIGH DIETARY LEVELS OF POTASSIUM NITRATE

K. E. Webb, Jr. and J. P. Fontenot

In previous studies conducted at this Station high levels of potassium nitrate were fed in an attempt to maintain blood methemoglobin levels at 20% of total hemoglobin. It was necessary to increase the level of potassium nitrate intake at frequent intervals to maintain this level of methemoglobin as the experiment progressed. It appears from these results that the animals may adapt to high dietary levels of potassium nitrate. The experiment reported here was designed to study the possible adaptation by beef cattle to high dietary levels of potassium nitrate.

Experimental Procedure

Sixteen cattle (8 steers and 8 heifers) were used in 2 trials. The average initial weights were 545 and 719 lb. for trials 1 and 2, respectively. The animals were placed into groups of 4 based on weight and sex and randomly allotted to individual stalls in the barn. Within each group, two animals were allotted to the control and two to the nitrate treatment. The cattle were fed twice daily at 7:00 A.M. and 4:30 P.M. and allowed 3 hours to eat. The remainder of the time they were placed in a lot where water was available. Feed was offered free choice except that within a group of four intake was limited to the least amount consumed by any animal within that group.

The composition of the basal ration for trials 1 and 2 is shown in tables 1 and 2, respectively. In trial 1 the ration was a ground mixed ration and in trial 2 the ration was pelleted. Potassium nitrate was added to the basal ration at increasing levels until an average methemoglobin level of at least 20% of total was reached in both trials 1 and 2. Potassium nitrate additions were made at levels of 0.4% per feeding up to 2.0% and at 0.5% per feeding up to 4.0% in trial 1. Blood samples were taken 2.5 hr after the A.M. feeding initially, when 2, 3 and 4% potassium nitrate was fed, then twice weekly through the duration of the trial. In trial 2, potassium nitrate additions were made at levels of 0.5% per feeding until a level of 4.0% was reached. Blood samples were taken 2.5 hr. after the A.M. feeding initially, when 1, 2, 3 and 4% potassium nitrate was fed, then twice weekly through the duration of the trial. Blood samples were analyzed for methemoglobin and total hemoglobin.

Results

In trial 1, blood samples taken 2.5 hr. after the first feeding which contained 4.0% potassium nitrate had methemoglobin levels of 22.9 and 1.1% of total hemoglobin for nitrate-fed and control animals, respectively. The highest average methemoglobin level was reached 2 days later, after which the levels gradually declined until at 50 days the methemoglobin levels of the nitrate-fed cattle were only slightly higher than the levels of the control cattle (Figure 1). Total hemoglobin levels for the nitrate-fed cattle increased and remained 1 to 2 g/100 ml. higher than the control cattle throughout the trial (Figure 2).

A ground ration was fed in trial 1 and the animals fed nitrate were able to sift out and refuse the fine components of the ration. The drop in methemoglobin levels may have been due, at least partly, to a decreased intake of nitrate with time rather than an adaptation to nitrate. So trial 2 was initiated where the rations were pelleted and the animals were not able to separate the ration components.

When the pelleted diet was fed in trial 2, blood samples taken 2.5 hr. after the first feeding which contained 4.0% potassium nitrate had methemoglobin levels of 30.0 and 0.9% of total for nitrate-fed and control animals, respectively (Figure 3). There was a gradual decline in methemoglobin levels to 32 days. On day 36 there was a sharp increase in blood methemoglobin levels followed by a decline to day 46. Again a sharp rise in methemoglobin levels was observed on day 53 and a drop on day 57 at which time the trial was terminated. As in trial 1, total hemoglobin levels rose in the nitrate-fed cattle and were maintained at about 2.5 g/100 ml. higher than the control cattle.

While the data obtained from these two trials are not conclusive, it does appear that there is some adaptation of beef cattle to high dietary levels of nitrate. The mechanism of this adaptation is not known but it would appear as if at least two responses are involved. First, methemoglobin levels are observed to be elevated initially followed by a decline with time. Secondly, total hemoglobin levels increase and are maintained at a higher level than the controls, possibly as a compensation for the reduced oxygen carrying capacity of the blood as a result of elevated methemoglobin levels.

TABLE 1. COMPOSITION OF BASAL RATION - TRIAL 1

Ingredient	%
Grass hay	14.0
Ear corn	72.0
Soybean meal	12.7
Trace mineral salt	0.5
Limestone	0.8
Vitamin A[a]	++

[a]Vitamin A added to supply 2000 IU/lb.

TABLE 2. COMPOSITION OF BASAL RATION - TRIAL 2

Ingredient	%
Grass hay	25.0
Shelled corn	57.9
Soybean meal	11.0
Molasses	5.0
Trace mineral salt	0.5
Limestone	0.6
Vitamin A[a]	++

[a]Vitamin A added to supply 2000 IU/lb.

Figure 1. Blood Methemoglobin Levels - Trial 1.

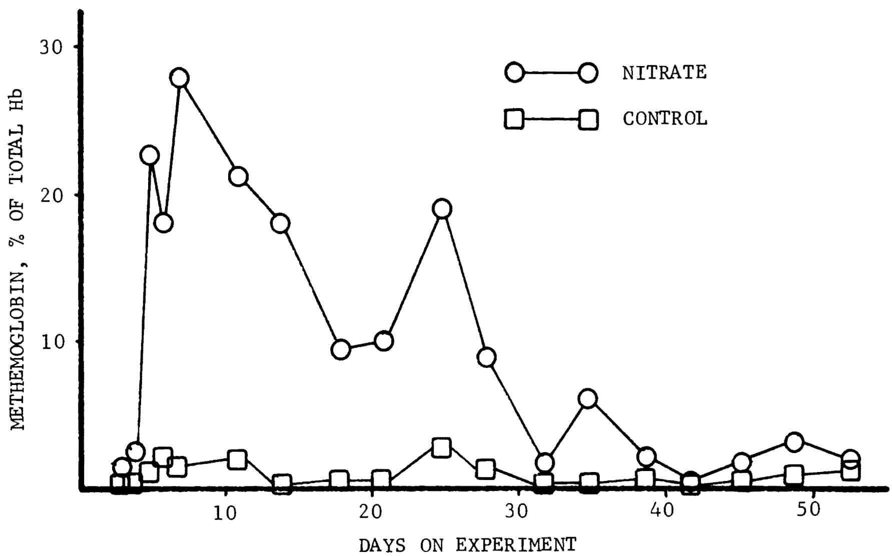


Figure 2. Blood Hemoglobin Levels - Trial 1.

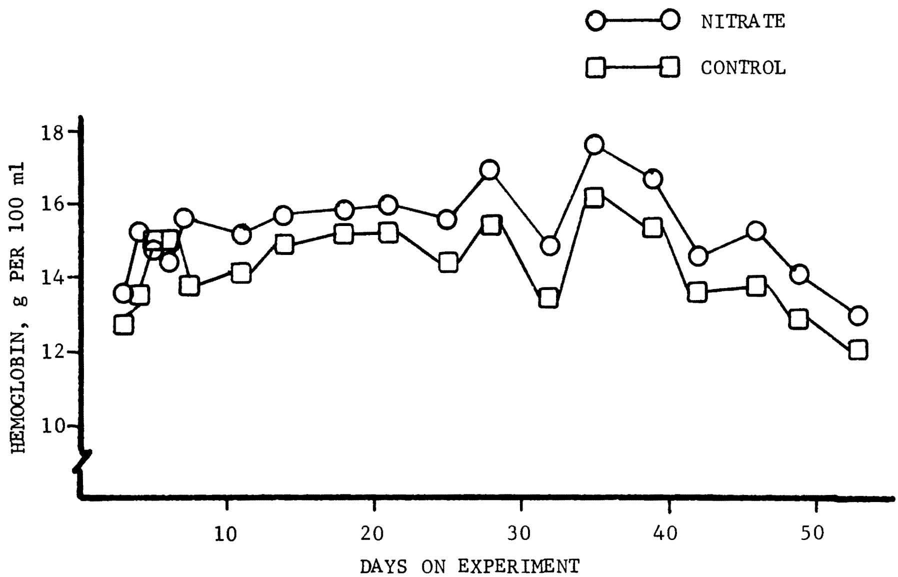


Figure 3. Blood Methemoglobin Levels - Trial 2.

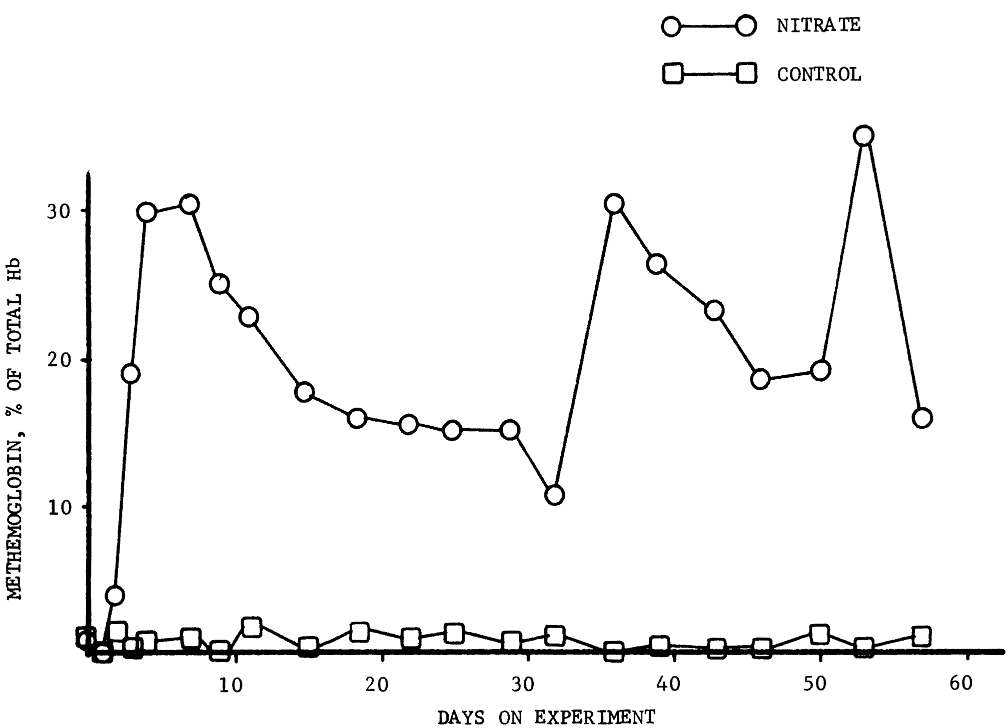
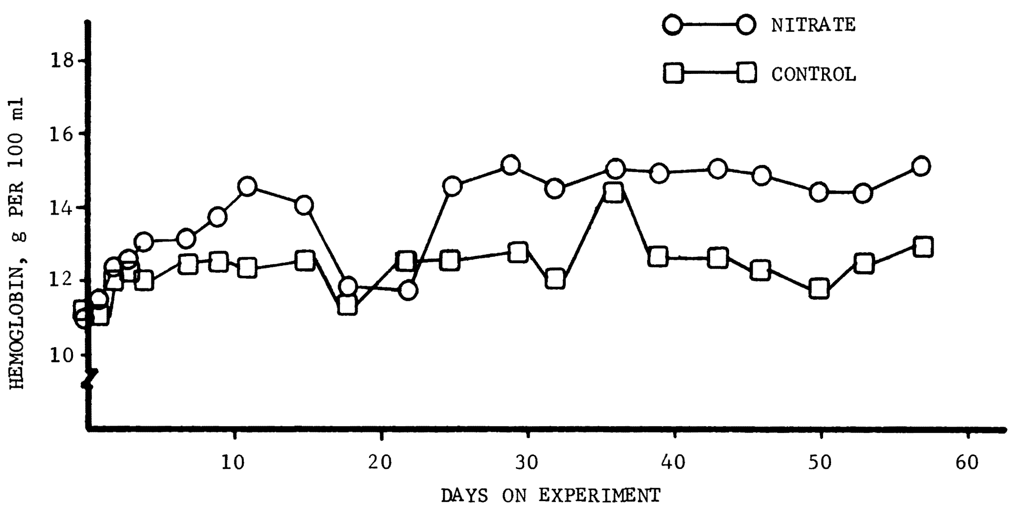


Figure 4. Blood Hemoglobin Levels - Trial 2.



MEDICINAL DRUG RESIDUES IN BROILER LITTER AND TISSUES FROM CATTLE FED LITTER[1]

K. E. Webb, Jr. and J. P. Fontenot

Virginia Tech researchers have been in the area of recycling broiler litter as a feed for beef cattle and sheep for 10 years. Experiments which have been conducted have shown that broiler litter can contribute substantially to the nutrient requirements of ruminants, that it does not affect the taste of meat from animals fed litter, that pesticide residues are not a problem from feeding broiler litter and that this material can be processed to render it free of disease causing organisms. At least one area of investigation remains yet to be completed before it can be determined whether this material will be a safe feed for cattle and sheep. This is the potential hazard of medicinal drug residues in litter and the possible deposition of these drugs in the tissues of animals which are fed litter. The present study was initiated to study medicinal drug residues in broiler litter produced in a number of areas in Virginia and to investigate the potential accumulation of these drugs in beef cattle fed litter.

Experimental Procedure

Samples of broiler litter were obtained from several houses in the main broiler producing areas of Virginia. These samples were analyzed for oxytetracycline, chlortetracycline, penicillin, neomycin, zinc bacitracin, nicarbazine and amprolium. Records were obtained from individual producers as to the drugs fed and the samples were analyzed accordingly.

Two feeding trials were conducted with beef cattle where broiler litter supplied either 0, 25 or 50% of the ration. In the first trial 12 animals were fed for 121 days and in the second trial 18 animals were fed for 198 days. In both trials litter was withdrawn from the ration 5 days before slaughter. Samples of loin eye muscle, liver and kidney fat were obtained from these cattle and assayed for chlortetracycline and amprolium.

Results

A summary of the drug analyses conducted on broiler litter samples is presented in table 1. When oxytetracycline was fed to broilers the litter contained an average of 10.9 ppm with a range of 5.5 to 29.1 ppm. Samples collected for the assay of chlortetracycline were divided into two groups. In some houses sampled chlortetracycline was used continuously in the diet of the birds and in others it was only occasionally added; the samples were divided accordingly. When this antibiotic was continuously fed a mean residue level of 12.5 ppm was detected with the range being 0.8 to 26.3 ppm. When chlortetracycline was only ocassionally used in the diet much lower residues were detected. The mean level was 0.8 ppm and the range was 0.1 to 2.8 ppm.

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[1]Supported in part by Food and Drug Administration Contract 70-82.

Only two samples were available for the analysis of penicillin residues. One sample contained 25 units per gram while none was detected in the other. Neomycin was the only drug investigated where no residues were detectable. A total of 12 samples were assayed and no neomycin activity was detected in any sample. Samples assayed for zinc bacitracin had a mean residue level of 7.2 units per gram with a range of 0.8 to 36.0 units per gram. Samples of litter produced by birds not fed zinc bacitracin had similar detectable activity. Therefore these residues are most likely not due to the presence of this antibiotic, but rather, to some other material which gives a response in the assav similar to zinc bacitracin.

Nicarbazine residues were detected in all samples assayed. The mean level detected was 81.2 ppm with a range of 35.1 to 152.1 ppm. Amprolium residues were not observed in all samples assayed. The range of detected residues was from 0.0 to 77.0 ppm. The mean level was 27.3 ppm.

It appears from the above data that residues of medicinal drugs fed to broilers do appear in the litter and that there is considerable variability in residue level. Since drug residues were observed in litter, tissue samples from two cattle feeding trials where litter was fed were collected and assayed for amprolium and chlortetracycline.

The results of tissue analyses for amprolium for trials 1 and 2 are presented in tables 2 and 3, respectively. Litter was fed at levels of 0, 25 and 50% of the ration in both trials. Residue levels of amprolium in loin eye muscle, liver and kidney fat were similar for the control group and the two litter levels in both trials. These values reflect background interference in the assay and indicate that while amprolium residues were detected in the litter no tissue deposition of this drug occurred.

In trial 1, litter was fed which contained a mean chlortetracycline residue of 12.5 ppm (table 1). Kidney fat from two steers fed the ration containing 50% litter and from one steer fed the 25% litter ration contained low levels of chlortetracycline activity. The levels were 0.041 ppm for the two cattle fed 50% litter and 0.034 ppm, dry basis, for the one animal fed 25% litter. No chlortetracycline was detected in the liver or loin eye muscle from any of these cattle. The mean chlortetracycline residue level of litter fed in trial 2 was 0.8 ppm (table 1). All tissues from these cattle tested negative for chlortetracycline.

TABLE 1. MEDICINAL DRUG RESIDUES IN BROILER LITTER FROM HOUSES IN THE MAIN BROILER PRODUCING AREAS OF VIRGINIA

Drug	Concentration of drug		Number samples
	Mean	Range	
Oxytetracycline, ppm	10.9	5.5-29.1	12
Chlortetracycline, ppm[a]	12.5	0.8-26.3	26
Chlortetracycline, ppm[b]	0.8	0.1-2.8	19
Penicillin, units/g	12.5	0-25	2
Neomycin, ppm	0.0	-	12
Zinc bacitracin, units/g[c]	7.2	0.8-36.0	6
Nicarbazine, ppm	81.2	35.1-152.1	25
Amprolium, ppm	27.3	0.0-77.0	29

[a]Chlortetracycline fed continuously in the poultry diet.
[b]Chlortetracycline fed intermittently in the poultry diet.
[c]Litter from birds not fed zinc bacitracin had similar detectable residues.

TABLE 2. AMPROLIUM IN BEEF TISSUE (TRIAL 1)[a]

Treatment	Amprolium (ppm)[b] Loin eye muscle	Liver	Kidney fat
Control	0.014	0.055	0.0015
25% litter fed	0.012	0.055	0.0038
50% litter fed	0.009	0.068	0.0008

[a]Animals were fed broiler litter for 121 days.
[b]Dry matter basis.

TABLE 3. AMPROLIUM IN BEEF TISSUE (TRIAL 2)[a]

Treatment	Amprolium (ppm)[b] Loin eye muscle	Liver	Kidney fat
Control	0.0049	0.029	0.00085
25% litter fed	0.0050	0.032	0.00093
50% litter fed	0.0072	0.033	0.00066

[a]Animals were fed broiler litter for 198 days.
[b]Dry matter basis.

REPRODUCTIVE PERFORMANCE OF STRAIGHT AND CROSSBRED BEEF COWS UNDER SEVERAL WINTER FEEDING SYSTEMS

T. N. Meacham

This project has recently been initiated. The project is designed to evaluate the performance of beef cows derived from crossing Charolais, Limousin, and Simmental sires with cows of the conventional beef breeds. These crossbred cows will be compared to straightbred Angus, Hereford, and Shorthorn cows.

Three wintering systems will be utilized in the study. "Standing hay," a tall growing sorghum which is allowed to mature and then is grazed in the field, plus a liquid supplement, makes up one wintering system. Fescue pasture which is grazed early in the grazing season and then rested until late fall constitutes the second system. A control program of aftermath grazing, hay and silage makes up the third system.

The straight and crossbred cattle are assigned across the three wintering systems so that each cow type can be evaluated on each wintering system. A total of approximately 50 cows will be developed and used in the study.

The objectives of the study are: (1) to determine differences in reproductive performance, conception rate, calving rate, and calving interval among the different crossbred and straightbred cows, (2) to evaluate the different winter management systems in terms of the reproductive traits mentioned above. Body weight changes in the cows and growth performance of the calves will also be determined for each wintering system.

A STUDY OF COW SIZE RELATED TO BEEF COW PERFORMANCE

J. A. Gaines, C. Hill, R. C. Carter and W. H. McClure

This report is based on a detailed analysis of phase two of an experiment designed to compare 60 straightbred (Angus, Hereford, and Shorthorn) and 60 crossbred (all six reciprocal two-breed cross) cows for producing beef in Virginia. The straightbred cows were mated to crossbred bulls, and the crossbred cows were mated to straightbred bulls, so all the calves were crossbred, half backcrosses and half three-breed crosses. The crossbred cows weighed 1052 pounds, 70 pounds heavier than the straightbred cows. The analyses of calf data that adjusted for this 70 pound difference reduced differences between calves from crossbred and straightbred cows as follows: birth weight (from 2.0 to 1.1 lbs.), weaning weight (from 18 to 14.5 lbs.), slaughter weight (from 22 to 12.5 lbs.), and carcass weight (from 14 to 8.6 lbs.). On the other hand, the 70 lb. difference in cow size had little or no influence on weaning, slaughter and carcass grades, ADG on feed (±200 days), dressing percent, loin eye area, and fat thickness.

Three indicators of total pounds yield at weaning were calculated: (1) Weaning percent (straightbred = 88 and crossbred = 87.8) times weaning weight (with no adjustment for cow weight) gave crossbred cows 400 pounds of calf per cow year versus 385 pounds from straightbred cows. (2) Weaning weight of calf divided by cow wt. gave straightbred cows 44.6 pounds of calf per 100 pounds of cow versus 44.3 pounds from crossbred cows. (3) Weaning weight divided by cow weight times the weaning percent showed straightbred cows producing 39.2 pounds of calf per 100 pounds of cow per cow year versus 38.6 pounds from crossbred cows. Therefore, in environments similar to Virginia, the two kinds of cows produce similarly as long as the calves are crossbred.

Larger differences were found between the three straight breeds of cows than between straightbred and crossbred cows, both for cow weight and maternal performance. Straightbred Angus cows ranked near the top of the nine kinds of cows in all measures of performance, and they ranked first in pounds of calf per 100 pounds of cow per cow year.

CROSSBREEDING FOR BEEF PRODUCTION

T. J. Marlowe, R. C. Carter and A. L. Grizzard

In the 1970-71 Livestock Research Report we outlined a cooperative research project between the Animal Science Department of Virginia Polytechnic Institute and State University and the Virginia Department of Welfare and Institutions for maximizing beef production in prison farm herds.

In that report we described the cattle and the mating plan at each location and presented the preweaning performance of the first calf crop at three locations - Beaumont, Bland and Southampton.

The specific objectives of this cooperative research are: (1) to evaluate several sire breeds, (2) to compare the productivity of several kinds of crossbred cows with each other and with straightbred cows, and (3) to determine the best combination of breeds and mating schemes for maximizing beef production within these herds.

The purpose of this report is to point out some revisions in the original plan, to discuss the source of bulls and management of the cattle, and to explain more clearly the procedures being used to accomplish the specific objectives listed above.

Number and Source of Bulls

Forty-one bulls are being used in the 1972 breeding season. They represent the Angus, Brown Swiss, Charolais, Hereford, Holstein, Polled Hereford, Shorthorn and Simmental breeds. An effort has been made to sample each sire breed as much as feasible by using a minimum of two bulls of each breed at each location each year and changing bulls annually either by rotating them or by obtaining new bulls.

Bulls have been obtained from the Virginia Beef Cattle Research Station at Front Royal, the Charolais herd at Southampton, the Hereford herd at Bland, Holsteins from the prison farms dairy herds, Simmental semen from commercial sources and Angus, Brown Swiss, Charolais, Hereford and Polled Hereford bulls from Virginia breeders.

Management of the Cattle

All cattle are identified by an ear tattoo and a rubber ear tag (Ritchey). Calves are identified at birth by a metal ear tag and prior to weaning by an ear tattoo. All females saved for herd replacements and all bulls are further identified by a rubber ear tag before going into the breeder herds.

Calves from all breeding groups are treated alike from birth to weaning and from weaning to slaughter, except that random samples of each group may be pulled out to make up a new group for special feeding, other special treatment, or for slaughter.

Cattle are weighed and scored on conformation and condition at approximately 7, 12 and 18 months of age and at slaughter. Except for those animals kept for breeding, all cattle will be slaughtered for use in the penal system. Where feasible, carcass data are obtained on the offspring of all experimental animals. These data include live and carcass weight; backfat thickness; loin eye area; kidney, heart and pelvic fat; and tenderness.

A record is kept of cows requiring assistance when calving, calves lost and why (born dead, died from pulling, injury, drowned, scours, etc.). Cows are pregnancy checked annually and a record kept of all open cows, cows pulled and why, died or slaughtered. Cows are weighed and scored on condition annually, usually at time calves are weaned. Cows are tested for TB and Bangs annually.

Evaluation of Sire Breeds on Straightbred Dams

The cows available at each location, along with the sire breeds to be evaluated at each location, are shown in table 1. Cows are allotted at random within age groups of 2, 3, 4, 5, 6-10 and over 10 years in approximately equal numbers to the desired number of breed groups at each location. At three locations (Beaumont, Bland and Hanover), the cows are rerandomized each year. At the other locations (Southampton and State Farm), the cows were allotted at random, within age groups, initially to the breeding groups and replacements allotted at random thereafter to keep the groups balanced as to numbers and ages. Sire breeds are allotted to the cow groups randomly each breeding season with the exception that the same sire breed does not go back to the same group of cows in consecutive years in those herds in which cows are not rerandomized each year.

TABLE 1. SIRE BREEDS EVALUATED BY LOCATION AND BREED OF COW

Location	Sire Breeds	Cow Breed	Approx. No. Head
Beaumont	Charolais, Holstein, Hereford	Hereford	75
Bland	Angus	Angus	25
	Charolais, Hereford, Simmental	Hereford	160
Hanover	Brown Swiss, Charolais, Hereford	Hereford	90
Southampton	Angus, Charolais, Holstein	Angus	90
	Charolais	Charolais	20
State Farm	Brown Swiss, Charolais, Hereford Holstein, Simmental	Hereford	400

Evaluation of the dam Breeds and Crosses

The cows used in phase II are produced in phase I. Exchanges of cattle are made between cooperating units as needed to obtain the desired numbers of cows within each breed group. The expected kind and number of females to be evaluated in phase II at each location are shown in table 2. Because of management problems, the Beaumont herd is being phased out at the end of phase I and the phase II females transfered to State Farm where they will be included with the State Farm cattle in the cow evaluation phase.

TABLE 2. COW BREEDS AND CROSSES TO BE EVALUATED BY LOCATION

Location	Approx. No. Cows per Breed Group	Breed or Breed Cross
Bland	40	Angus, Hereford, Charolais x Hereford Charolais x Holstein, Simmental x Hereford
Hanover	25	Hereford, Angus x Hereford, Brown Swiss x Hereford, Charolais x Hereford
Southampton	30	Angus, Charolais, Charolais x Angus Holstein x Angus
State Farm	50	Hereford, Angus x Hereford, Brown Swiss x Hereford, Charolais x Hereford, Holstein x Hereford, Simmental x Hereford, Shorthorn x Hereford

All heifers will be bred to Angus bulls to calves at two years of age. Thereafter, they will go into their respective breed groups.

Determining Best Combination of Breeds

The third objective of this research is to determine the best combination of breeds and mating schemes for maximizing beef production within these herds. In order to speed up the progress, it was decided to combine this objective with objective 2; that is, the evaluation of the dam breeds and crosses.

The procedure for accomplishing these two objectives simultaneously is outlined in table 3. Females produced in the sire breed evaluation phase will be saved until the numbers shown in table 3 are obtained. Thereafter, phase I will be discontinued. When 50 or more offspring have been obtained from each cow-breed group, the data will be analyzed to determine the most productive combination.

TABLE 3. GENERAL MATING SCHEME FOR EVALUATING DAM BREEDS AND DETERMINING THE BEST COMBINATION OF BREEDS OR BREED CROSSES

a. BLAND

Breed of Sire	Breed of Cow: Angus	Hereford	Char x Her	Char x Hol	Sim x Her	Total
Angus	30	0	0	0	0	30
Charolais	0	20	10	20	20	70
Hereford	0	40	10	10	10	70
Simmental	0	20	20	10	10	60
Totals	30	80	40	40	40	230

b. HANOVER

Breed of Sire	Breed of Cow: Hereford	Ang x Her	BS x Her	Char x Her	Total
Charolais	12	12	12	12	48
Hereford	24	0	0	0	24
Simmental	12	12	12	12	48
Totals	48	24	24	24	120

C. SOUTHAMPTON

Breed of Sire	Breed of Cow: Angus	Charolais	Char x Ang	Hol x Ang	Total
Angus	30	0	0	0	30
Charolais	15	30	15	15	75
Sim x Her	15	0	15	15	45
Totals	60	30	30	30	150

D. STATE FARM

Breed of Sire	Breed of Cow: Hereford	Ang x Her	BS x Her	Char x Her	Hol x Her	Sim x Her	SH x Her	Total
Charolais	60	8	8	12	8	12	12	120
Hereford	52	24	24	12	24	12	12	160
Simmental	60	8	8	12	8	12	12	120
Shorthorn	20	8	8	12	8	12	12	80
Totals	192	48	48	48	48	48	48	480

COMPARISON OF ANGUS, CHAROLAIS AND HOLSTEIN SIRES ON ANGUS COWS

T. J. Marlowe, R. C. Carter and E. M. Grizzard

This research was initiated in 1968 as part of a cooperative crossbreeding project for beef production by the Animal Science Department of VPI & SU and five correctional farms of the Va. Department of Welfare and Institutions. The objectives, cattle used, and general mating schemes are described in the article entitled "Crossbreeding for Beef Production" immediately preceding this report.

Management of Cattle

In December 1968, 90 Angus cows were allotted at random, within age groups, to three breeding groups. Two bulls each of the Angus, Charolais and Holstein breeds were randomly allotted by breeds to the cow groups, except that the cow group bred to Charolais bulls was subdivided, with a random half of the cows going to each bull. In December 1969 two different bulls of the same three breeds were again randomized to the same cow groups, with the restriction that no sire breed could be bred to the same cow group as the previous year. This time the Charolais bulls were not separated. The breeding season lasted for 75 days each year, from about December 15 to March 1.

Cows were wintered on corn, peanut and soybean stubble by gleaning the fields during the breeding season. Field gleanings were supplemented with hay and sorghum silage (1 lb. hay to 2 lb. silage) as needed to keep the cows in reasonable condition. When the field gleanings got short they were given 2 lb. of ground corn and cob meal (supplemented with 200 lb. of SBOM per ton) per head daily. They were turned on permanent pasture consisting mainly of fescue around April 1 of each year.

Calves were weaned on or about May 20 each year and the cows were left on the permanent fescue pasture until going back on field stubble in late October. Steer and heifer calves were separated at weaning. Heifer calves were placed on grass-legume pasture and fed 1 lb. of SBOM per head daily on pasture. Steer calves were divided, at random within breed groups, into two treatment groups. Group 1 was placed on permanent fescue pasture without supplement, whereas group 2 was put on a full feed of corn silage in drylot, supplemented with ground corn and SBOM at 1% of their body weight during the summer test period. The corn-oil meal supplement consisted of 3 parts corn to 1 part SBOM fed once daily. Silage was fed twice daily.

All calves were reweighed and scored for conformation and condition at approximately one year of age, late October or early November. Most of the females were kept for phase II of the experiment and the steers that were on pasture were placed in drylot with the other steers. All steers were then fed in drylot from early November until slaughtered.

Slaughter and Carcass Data Obtained

Generally, two or three steers each of Angus, Charolais x Angus and Holstein x Angus are slaughtered monthly, starting in May when they are about 18 months of age. The older and/or heavier steers are slaughtered first. This continues until all steers are slaughtered. The average age of all steers at slaughter is about 21 months.

The following carcass information is obtained and recorded at time of slaughter, along with the date: live animal, carcass and kidney fat weights; backfat thickness; ribeye area; marbling score; and tenderness measurement by use of the Armour Tenderometer. From these data carcass weight per day of age, ribeye area per hundredweight of carcass, carcass grade, yield grade and percent lean cuts are calculated.

Results of Two Calf Crops

Calving Percentage - During the two breeding seasons 199 cows were exposed and 156 calves were weaned for a calving percentage of 78.4. The calving percentages by sire groups were 75.0, 78.1 and 80.3 for Angus, Charolais and Holstein, respectively. These low percentages can be explained in part by two facts: Cows bred to Charolais bulls the first year were divided and 15 cows were with a sterile bull which was not discovered until near the end of the breeding season; also, 20% of the cows were heifers being bred for the first time. Calves born dead or died before weaning were 3 for Angus, 3 by Holstein and 2 by Charolais sires.

Birth Weights - Birth weights by breed and sex are shown in Table 1. Charolais x calves averaged 14.7 lb. heavier at birth than straight Angus calves. Holstein x calves were only 1 lb. lighter than the Charolais cross calves; however, there were no serious calving difficulties in any group. Female calves average 6 lb. lighter than male calves with the sex difference being greater for the crossbred calves than for the straightbred Angus calves.

Pre- and Post-weaning Performance - Both preweaning and postweaning performance is shown in Table 1 by sex within breed groups. Growth differences are illustrated by the adjusted 205 and 365 day weights. Performance was lower in 1971 than in 1970. This difference amounted to 73 lb. in 205 day weight but only 4 lb. in 365 day weight. There were also large breed differences. The Charolais x steer calves averaged 80 lb. heavier than straight Angus calves and 59 lb. heavier than the Holstein x calves at 205 days. Corresponding differences for the heifer calves were 64 and 41 lb. At 365 days the differences had increased to 118 lb. in favor of the Charolais x steers over straightbred Angus and 50 lb. over the Holstein x steers. Corresponding differences among the heifers were 109 and 59 lb.

Charolais x calves graded slightly higher than straight Angus calves, both at weaning and at a year of age. Both Charolais x and straightbred Angus calves graded approximately 2 grade points above the Holstein x calves. Angus calves were in better condition than the crossbred calves, with the Holstein x calves averaging approximately 1.5 grade points lower than the Angus yearlings.

Table 1. Comparison of Angus, Charolais, Charolais x Angus and Holstein x Angus Pre-and Postweaning Performance in the Southampton Correctional Farm Herd

Breed of		Sex of	Calf Performance				Yearling Performance							
			Birth	No.	205-d	Wean.	No.	Yearl.	Unadjusted			365-d	Yearling	
Sire	Dam	Calf	Wt.	Head	Wt.	Grade	Head	Age	Wt.	ADG	WDA	Wt.	Grade	Cond.
						1970 Calf Crop								
Ang	Ang	S	66.1	13	443	12.5	13	389	657	1.36	1.69	619	12.7	10.9
		H	60.1	11	446	11.8	11	393	545	0.87	1.39	505	11.5	10.7
Hol	Ang	S	82.7	14	467	9.6	14	374	684	1.47	1.82	665	10.0	8.9
		H	72.8	15	495	10.7	11	392	605	0.97	1.55	564	10.7	9.1
Char	Ang	S	83.6	8	563	13.0	8	393	837	1.69	2.13	778	13.3	10.0
		H	76.1	9	530	11.1	9	396	680	1.21	1.71	627	12.0	9.5
						1971 Calf Crop								
Ang	Ang	S	60.0	8	394	11.1	8	388	582	0.99	1.50	553	11.9	8.4
		H	57.4	14	389	11.1	14	384	583	1.09	1.52	563	12.4	8.8
Hol	Ang	S	69.8	9	411	10.0	9	386	669	1.45	1.73	642	8.7	7.1
		H	70.1	16	386	8.4	16	391	635	1.38	1.63	605	11.0	7.4
Char	Ang	S	76.7	22	433	12.3	22	384	648	1.23	1.81	630	11.8	7.7
		H	70.4	17	433	12.3	17	372	660	1.42	1.78	660	13.1	8.8
Char	Char*	B	92.0	6	562	12.0	6	355	797	1.58	2.25	815	13.0	8.7
		H	89.0	3	561	12.3	3	355	748	1.28	2.10	766	12.7	8.3
						1970-1971 Combined								
Ang	Ang	S	62.9	21	418	11.8	21	389	619	1.17	1.59	586	12.3	9.6
		H	58.6	25	417	11.4	25	388	564	0.98	1.45	534	11.9	9.7
Hol	Ang	S	77.6	23	439	9.8	23	380	676	1.46	1.77	653	9.3	8.0
		H	71.4	31	440	9.5	27	391	620	1.17	1.59	584	10.8	8.2
Char	Ang	S	78.5	30	498	12.6	30	388	742	1.46	1.99	704	12.5	8.8
		H	72.4	26	481	11.7	26	384	670	1.31	1.73	643	12.5	9.1
All Steers		S	73.8	74	457	11.5	74	366	686	1.38	1.81	655	11.4	8.8
All Heifers		H	67.8	82	446	10.8	78	388	619	1.15	1.59	588	11.7	9.0

* Not included in the combined groups.

Table 2. Carcass Data on 1970 Steers at Southampton

Breed	No. Head	Slaughter Age	Slaughter Wt.	Carcass Wt.	Carcass WDA	Carcass Gr.	Ribeye Area Act.	Ribeye Area Cwt.	Back Fat	Marb-ling	Tend. Score	Yield Grade	% lean cuts
Angus	11	648	1056	672	1.05	13.5	11.0	1.64	.69	7.8	13.6	3.9	48.2
Hol x Ang	12	644	1181	727	1.14	12.3	12.4	1.70	.50	6.1	12.6	3.1	49.8
Char x Ang	6	612	1266	794	1.30	12.0	13.9	1.75	.58	5.0	15.4	3.0	50.1

Steer calves were only 11 lb. heavier than heifer calves at 205 days but were 67 lb. heavier at 365 days. Other comparison may be made by using the values found in Table 1.

Carcass Comparison - Data is limited at this time since only one crop of steers has been slaughtered and some of them were slaughtered before we started collecting the data. Nevertheless, we are presenting the preliminary results. The data are presented in Table 2.

It should be pointed out that some of these steers should have been slaughtered at an earlier date before they became so fat. But, as explained earlier, they were killed as needed.

The Charolais x Angus steers were superior in carcass weight per day of age (WDA), ribeye area, yield grade and percent lean cuts. The Holstein x Angus steers were intermediate in nearly all traits measured - live and carcass weight, carcass WDA, ribeye area, marbling, tenderness and percent lean cuts. They had a slightly higher percentage of kidney fat but considerably less outside fat so that the yield grade was very similar to the Charolais cross steers. Straight Angus steers were superior in marbling and carcass grade only. They were much fatter, more wasty, with smaller ribeyes per hundredweight of carcass, and were lower in yield grade, percent lean cuts and carcass weight per day of age.

All groups had very acceptable carcasses from a quality standpoint. Of the Angus carcasses 7 graded choice and 2 graded prime; Holstein crosses were 11 choice and 1 good plus; Charolais crosses were 4 choice and 2 good.

COMPARISON OF SIRE BREEDS ON HEREFORD COWS AT THREE LOCATIONS

T. J. Marlowe and R. C. Carter

This research was initiated in 1968 as part of a cooperative crossbreeding project for beef production by the Animal Science Department of VPI & SU and five correctional farms of the Virginia Department of Welfare and Institutions. The objectives, cattle used and general mating schemes are described in the article entitled "Crossbreeding for Beef Production" presented elsewhere in this publication. This report will deal with the information obtained at Beaumont, Bland and Hanover. Data obtained in the Angus herd at Southampton is reported elsewhere in this publication. The research at State Farm was not initiated until the 1971 breeding season, consequently, data are not yet available for reporting.

The data obtained at each location will be handled separately. Beaumont data will cover two calf crops for both preweaning and postweaning performance. Bland data will include preweaning data for two calf crops and postweaning data for only one calf crop since many of the 1971 calves had not reached a year of age at the time this report was prepared. Hanover data will include only one calf crop since the research there was initiated with the 1970 breeding season.

Beaumont

Management of Cattle - Feeding and management practices at Beaumont have been suboptimal during the period of this study and this herd will be dispersed after weaning data has been obtained on the 1972 calf crop. Females for phase II produced in this herd will be transfered to State Farm and be made a part of phase II at that location.

Cows at Beaumont have wintered on low quality Johnson grass and fescue hay without supplementation. During the summer they have grazed mostly on unimproved river bottom pastures consisting largely of fescue and Johnson grass, with some upland pasture of local native grasses.

During the time of this experiment cows have been limited to a 75-day breeding season starting on or about April 1 so that the calves are dropped mainly in January and February. Calves were weaned during September and turned on a low quality pasture supplemented only with low quality hay. Consequently, these calves gained little or no weight during the winter period. As a result, the females were not large enough to breed until they were two or three years of age.

Even though feeding and management practices were suboptimul, we feel that breed comparisons under these conditions should be of interest.

Calving Percentage - Each year 75 cows were allotted within age groups into three breeding groups and two bulls each of the Charolais, Holstein and Shorthorn breeds were allotted at random to each of the cow groups. These 150 exposures produced a total of 99 calves weaned for a calving percentage of only 66.0%. Because the fences were so poor that bulls could pass from one pasture to another with little difficulty and because the herdsman was partial to Shorthorns and did not follow the breeding plan, we ended up with 30 Charolais x Hereford, 18 Holstein x Hereford and 41 Shorthorn x Hereford calves. There was no way to determine calving percentages by breed of sire.

Birth Weights - Birth weights by breed and sex are shown in table 1. There was very little difference in birth weight of the calves, even among the sexes. Male calves from the Charolais and Holstein sires were slightly heavier than male calves from the Shorthorn sires. This was not true, however, of the females. There was only a 2 lb. difference between the males and females among all crosses. These small differences can probably be accounted for, at least in part, by the fact that all calves were crossbred and the cows in this herd were always below average in flesh condition. In fact, most of the cows came through the winter in very thin flesh.

Pre- and Postweaning Performance - Both pre- and postweaning performance are shown in table 1 for each of the 1970 and 1971 calf crops and the two crops combined. The Holstein x Hereford calves were slightly superior in performance up to weaning with Charolais x Hereford calves intermediate. It is obvious from the 365-day weight that these cattle did not receive adequate ration since the steer calves gained only 21 lb. and the heifer calves only 13 lb. during a four month period. It is also obvious that the Holstein x calves require a higher level of nutrition than the straight beef breeds as they went from the heaviest weights at weaning to the lowest weights at 365 days. The condition scores, both at weaning and as yearlings, indicate that they were in much thinner flesh condition than the other calves.

Carcass Data - There was no opportunity to obtain carcass data from this herd.

Bland

Management of Cattle - This herd is located in the Alleghany mountains and pastures consist primarily of Bluegrass with some white clover. Cows are wintered on corn silage and hay. The hay is largely pasture clippings or orchard grass with some red clover. The feeding program, both during summer and winter, is adequate to keep the cows in average flesh and thrifty condition.

During the last three or four years, about half of this herd has been bred AI and the calving season has become extended from November through May. Bulls were pulled out a little earlier in 1971 in order to shorten the calving season. However, for the two calf crops reported here the age differences in the calves exceeded six months.

The older calves were weaned in September and the younger calves in November. Bull and heifer calves were fed separately. Each group was fed corn silage and hay, supplemented with 1.5 to 2 lb. of protein supplement per head daily. Around the first of march, 25 to 30 of the larger bulls were placed in a separate feeding area and, in addition to the silage and hay, were given daily about 1 lb. of supplement per hundred lb. of body weight. The supplement consisted of three parts ground corn to one part oil meal, and fed for about 90 days before the first ones were slaughtered.

Samples of 6 to 10 head representing each breed or breed cross were slaughtered monthly until all bulls had been slaughtered. As the older and/or larger bulls were taken out additional bulls were brought in to replace them. To date, only one calf crop has been slaughtered and the second crop is in the feeding pens at the time of the preparation of this report.

So far, nearly all of the crossbred heifers have been kept for phase II of the experiment, along with about 50% of the Hereford heifers. They are continued on silage and hay, supplemented with 1 to 1.5 lb. of protein per head daily, until they go on Bluegrass pasture in April. The final selection of heifers to be kept for breeding is made in April and the other heifers are put on a separate pasture and given additional feed during late summer and are slaughtered in the fall and winter.

AI Results - Prior to the initiation of the crossbreeding experiment, Mr. Roy Lee Saunders, Herdsman, had attended an artificial insemination school and was doing some AI in that herd. Table 2 shows the results of the AI by sires for the calf crop just prior to the initiation of our formal crossbreeding experiment. The Hereford bulls were performance tested bulls at Culpeper and semen was collected by a representative of the Virginia Animal Breeders Association, (ABA), processed and stored for our use. Charolais semen was also obtained from Virginia ABA. Mr. Saunders did all of the inseminating. It can be seen from this table that bulls varied greatly in their ability to settle cows, ranging from 14% to 67%. A higher percentage of cows were settled with the Charolais semen, probably because of the fact that these offspring were crossbred and also because half of the Hereford bulls were virgin bulls.

Table 3 shows the results of AI for the first year of these experiments. For some reason the results were much poorer than during the previous year. In addition to the crossbreeding effect, the Hereford semen was at a disadvantage because half of it was from virgin bulls and was used largely on heifers being bred for the first time. Again we see large sire differences in ability to settle cows. Of 117 cows bred only 33 calves were born, three of which were dead, for a combined calving percentage of only 28.2% born and 25.6% weaned. These were broken down as 27.8% Simmental, 20.5% Charolais, 33% Murray Grey. Since the 1970 breeding season all cows have been bred naturally other than those bred with Simmental semen.

Birth Weights - The birth weights by breed and sex are shown in table 4. As one studies these birth weights several things become apparent: 1) Angus calves are about 8 lb. lighter than Hereford calves; 2) Charolais and Simmental crossbred calves are about 9 lb. heavier than straightbred Hereford calves; 3) calves out of straightbred dams are about 7 lb. lighter than calves out of crossbred dams; 4) differences due to sex are very small,

Table 1

Comparison of Charolais, Holstein and Shorthorn Bulls on Hereford Cows
in the Beaumont School Herd

Breed of Sire	Breed of Dam	Sex of Calf	Calf Performance: Br. Wt.	Calf Performance: No. Head	Calf Performance: 205d Wt.	Weaning Gr.	Weaning Cond.	Yearling Performance: No. Head	Age	Unadjusted Wt.	Unadjusted ADG	WDA	365d Wt.	Yearling Gr.	Yearling Cond.
1970 Calf Crop															
Char	Her	S	76.5	10	479	12.8	9.1	10	369	510	0.07	1.38	502	12.5	8.1
		H	76.0	4	460	13.3	10.0	4	377	515	0.02	1.35	494	13.0	9.7
Hol	Her	S	76.6	7	461	11.0	8.0	7	357	498	0.11	1.37	497	10.1	7.2
		H	71.8	10	442	10.8	8.0	10	377	498	0.14	1.32	482	10.5	7.5
SH	Her	S	70.3	10	398	12.0	8.6	10	380	456	0.24	1.20	437	12.3	8.8
		H	68.7	13	404	11.5	8.5	13	367	425	0.20	1.16	425	11.6	7.5
1971 Calf Crop															
Char	Her	S	75.9	8	396	11.9	7.0	8	363	456	0.10	1.25	412	10.9	6.4
		H	67.2	8	336	11.5	6.9	8	376	402	0.06	1.07	347	11.3	5.6
Hol	Her	S	65.0	3	366	9.3	6.7	3	383	417	-.07	1.09	355	8.0	5.0
		H	71.2	8	379	8.6	6.3	8	377	409	-.34	1.08	325	8.7	4.9
SH	Her	S	72.1	10	376	11.5	7.7	10	363	473	0.45	1.28	435	11.5	6.9
		H	76.4	8	377	11.3	6.8	8	374	443	0.07	1.19	388	11.6	6.8
1970-1971 Combined															
Char	Her	S	76.2	18	442	12.4	8.2	18	366	487	0.03	1.32	462	11.6	7.2
		H	70.1	12	377	12.1	7.9	12	376	458	0.04	1.21	420	12.1	7.6
Hol	Her	S	73.1	10	413	10.1	7.3	10	370	457	0.02	1.23	426	9.0	6.1
		H	71.5	18	414	9.8	7.2	18	377	453	-.10	1.20	403	9.6	6.2
SH	Her	S	71.2	20	387	11.7	8.1	20	371	464	0.34	1.24	436	11.9	7.8
		H	71.6	21	390	11.4	7.6	21	370	434	0.14	1.18	406	11.6	7.1
All Steers			73.5	48	413	11.6	8.0	48	369	471	0.16	1.27	444	11.2	7.2
All Heifers			71.2	51	395	11.0	7.5	51	374	446	0.03	1.19	408	11.0	6.9

Table 2

A.I. Sire Breeding Summary
Bland Correctional Farm
1968-69

Herd	A.I. Sire	No. 1st Matings	Repeat Matings	Total Matings	No. calves born Alive	No. calves born Total	% calves 1st serv.	% all Matings
ABA	907	11	1	12	7	8	64	58
Char	4CH019	47	11	58	22	23	49	40
	All Charolais	58	12	70	29	31	53.4	44.3
2095	035	13	1	14	4	4	31	29
	0120	10	2	12	5	6	50	42
2111	P305	11	1	12	6	6	55	50
	P308	11	1	12	7	7	64	58
	P564	6	0	6	4	4	67	67
	P683	17	4	21	3	3	18	14
	All Herefords	68	9	77	29	30	44.1	39.0

110 cows attempted to breed by A.I. Only 59 cows settled. Another 44 conceived from natural service. 46.8% of cows bred by A.I. dropped a calf from first service. 40.1% calving based on all A.I. services. Overall calving percentage of 93.6.

Table 3

A.I. Sire Breeding Summary
Bland Correctional Farm
1969-70

Herd	A.I. Sire	No. 1^{st} Matings	Repeat Matings	Total Matings	No. calves born: Alive	No. calves born: Total	% calves 1^{st} serv.	% all Matings
ABA	Ch05	13	2	15	6	6	46	40
	Ch229	4	0	4	1	1	25	25
	4CH891	19	7	26	8	8	42	31
	4CH019	16	7	23	3	3	19	13
	M23159	2	0	2	0	0	0	0
	All Charolais	54	16	70	18	18	33.3	26.2
ABA	2E4	6	0	6	2	2	33	33
2006	R205	4	2	6	3	3	75	50
	R690	4	2	6	1	1	25	17
2095	007	8	2	10	2	2	25	20
	075	5	4	9	0	0	0	0
2124	135	7	4	11	3	3	43	27
	257	8	4	12	4	4	50	33
	All Herefords	42	18	60	15	15	35.7	25.0
ABA	Bismark	28	6	34	13	15	54	44
	Parisien	24	7	31	12	12	50	39
	Sultan	21	7	28	13	14	62	46
	All Simmental	73	20	93	38	41	56.2	44.1

156 cows attempted to breed A.I., only 74 settled, another 60 bred naturally. 47.4% of cows calved from first service. 33.2% calving based on all A.I. services. Overall calving percentage of 85.9.

Table 4

Pre-and Postweaning Performance by Breed and Sex Groups in the Bland Correctional Farm Herd

Breed of		Sex of	Calf Performance				Yearling Performance										
									Unadjusted			365d			550d		
Sire	Dam	Calf	Br. Wt.	No. Head	205d Wt.	Wean Grade	No. Head	Age	Wt.	ADG	WDA	Wt.	Grade	Cond.	Wt.	Grade[1]	Cond.
			1970-1971 Combined				1970 Calf Crop Only										
Ang	Ang	B	68.4	16	448	11.9	8	384	743	1.72	1.94	708	12.3	10.2	1030	9.8	
		H	64.9	12	398	11.1	5	381	590	1.15	1.56	627	11.0	8.9	730	11.0	10.2
Her	Her	B	76.3	68	417	11.5	39	411	604	1.18	1.64	606	11.9	7.4	937	9.4	
		H	72.6	59	402	11.2	39	367	550	1.08	1.49	590	11.2	7.6	725	10.9	9.2
Ang	Her	B	73.0	8	376	8.6											
		H	71.0	9	419	10.2											
Char	Her	B	83.5	39	481	12.3	12	367	769	1.73	2.09	752	12.5	7.9	1103	7.5	
		H	83.8	30	482	11.9	6	370	667	1.30	1.80	689	12.0	8.0	838	11.7	9.2
Sim	Her	B	86.6	26	503	13.0	17	354	769	1.67	2.11	763	12.6	8.0	1127	7.6	
		H	79.9	27	437	12.2	22	378	706	1.44	1.88	722	12.6	8.4	841	12.1	9.2
Ang	CxH	B	73.0	5	436	10.8											
		H	69.0	4	453	11.7											
Char	CxH	B	89.0	7	480	12.2											
		H	93.0	10	512	10.9											
Her	CxH	B	90.0	5	509	12.6											
		H	88.8	2	525	13.0											
Sim	CxH	B	84.0	4	489	13.0											
		H	82.0	2	446	11.0											

Notes:

1. The 550 day grades for bulls is the carcass grade.
2. The 1971 Yearling data were not available in time for inclusion in this report.

amounting to 3.3 lb. for calves out of Hereford dams in favor of bull calves and only 1.5 lb. out of Charolais x Hereford dams in favor of the female calves; and 5) bull calves outweighed heifer calves at birth by only 2.6 lb.

Pre- and Postweaning Performance - The preweaning performance for 1970 and 1971 are combined in table 4 and shown by breed and sex of calf. First cross calves averaged about 53 lb. heavier at 205 days than straightbred calves. Comparing Charolais x Hereford dams with straightbred Hereford dams, when all calves were crossbred, calves out of the crossbred dams averaged 20 lb. heavier. Crossbred calves also graded slightly higher than straightbred calves.

Postweaning performance was available at the time of this writing for the 1970 calf crop only. These data are also presented in table 4. The order of rank, based on 365-day weight, from high to low was Simmental x Hereford, Charolais x Hereford, Angus and Hereford. Again the crossbreds graded approximately 1 grade point higher at a year of age than did the straightbreds. Straight Angus calves were in the best condition, followed by the crossbreds. The 550-day weights followed the same patterns as the 365-day weights. Crossbred bulls were 150 lb. heavier than straight Hereford bulls at a year of age and 178 lb. heavier at 18 months. Crossbred heifers were about 115 lb. heavier than straightbred Hereford heifers both at 12 and 18 months of age.

Carcass Data - Carcass data are limited since only the bulls have been slaughtered from the 1970 calf crop. In this comparison we have included all of the Angus, Charolais x Hereford and Simmental x Hereford bulls but only 17 of the Hereford bulls which were killed at the same time as the other breeds. These data are shown in table 5. The crossbreeds were heavier, both alive and in the carcass, had a higher carcass weight per day of age and less backfact; however, they had lower grading carcasses, primarily because they had less marbling. There was no difference between the crossbreds and the straightbreds in ribeye area, tenderness score, yield grade or percent lean cuts.

Hanover

Management of Cattle - This herd of grade Hereford cattle did not come into the crossbreeding program officially until the 1971 breeding season. However, since these cows had already been gate cut and bred to Angus, Charolais and Hereford bulls we are reporting the performance of their 1971 calf crop. Beginning with the 1971 breeding season the cows were allotted at random, within age groups, into three breeding groups of equal size. Bulls of Brown Swiss, Charolais and Hereford breeds were then allotted at random to the cow groups. Bulls were turned with the cows on or about February 15 for a 75 day breeding season. Cows are grazed on permanent fescue pasture during the summer. They are fed small grain silage during the early part of the winter and corn silage and hay after calving. Young cattle are put on corn silage following weaning and supplemented with approximately 1% of the body weight with ground corn and oil meal.

Cows are pregnancy checked after the calves are weaned and those cows that are open are sent to slaughter.

Table 5. Carcass Data on 1970 Bulls Slaughtered at Bland

Breed	No. Head	Slaughter		Carcass			Ribeye Area		Back Fat	Marb-ling	Tend. Score	Yield Grade	%lean cuts
		Age	Wt.	Wt.	WDA	Gr.	Act.	Cut					
Angus	10	519	972	560	1.08	9.8	12.4	2.21	0.15	3.9	18.0	1.3	53.7
Hereford	17	529	931	510	0.96	8.8	11.8	2.31	0.13	3.1	18.1	1.2	54.0
C x H	13	508	1019	567	1.12	7.5	11.7	2.06	0.09	2.3	18.9	1.3	53.7
S x H	11	500	1024	566	1.14	7.8	12.6	2.23	0.08	2.7	16.1	1.1	54.3

Calving Percentage - For the 1971 calf crop, 87 cows were exposed and 72 calves weaned for a calving percentage of 82.8%. A breakdown by breed of sire gave 79.4, 87.1 and 81.8 for the Angus, Charolais and Hereford sires, respectively.

Pre- and Postweaning Performance - These data are given in table 6 for the 1971 calf crop. At 205 days of age the crossbred steer calves were approximately 40 lb. heavier than the straight Herefords and the crossbred heifer calves were 25 lb. heavier. The Charolais x Hereford calves were heaviest for both sexes; whereas, the Angus x Hereford calves were intermediate. This difference had increased to 75 lb. for steer calves and 90 lb. for heifer calves at a year of age, with the rank remaining the same. There was essentially no difference in grade either at weaning or at a year of age. However, the Angus x Hereford calves scored over 1 grade point higher in condition as yearlings. When all calves were compared on sex differences, the steer calves were approximately 30 lb. heavier at 205 days and about 40 lb. heavier at a year of age.

Table 6

Comparison of Angus, Charolais and Hereford Bulls on Hereford Cows in Correctional Field Unit 14 Herd at Hanover

Breed of			Calf Performance				Yearling Performance							
			No.	205-d	Wean.	Cond.	No.	Yearl.	Unadjusted			365-d	Yearling	
Sire	Dam	Sex	Head	Wt.	Grade	Score	Head	Age	Wt.	ADG	WDA	Wt.	Grade	Cond.
1971 Calf Crop														
Ang	Her	S	7	375	11.2	7.7	7	414	604	0.99	1.46	536	11.3	9.5
		H	20	351	11.2	7.8	20	408	542	0.84	1.33	484	10.9	9.0
Char	Her	S	15	419	11.3	7.2	15	404	630	0.85	1.56	562	12.5	8.1
		H	12	392	12.0	6.7	12	401	607	0.97	1.51	547	12.0	7.7
Her	Her	S	7	355	10.8	6.8	7	405	535	0.88	1.31	474	12.1	8.0
		H	11	346	11.0	6.8	11	403	495	0.48	1.22	425	11.8	7.7
All Steers		S	29	393	11.2	7.2	29	406	601	0.89	1.48	527	12.1	8.4
All Heifers		H	43	361	11.4	7.2	43	405	548	0.78	1.35	486	11.4	8.3

EVALUATION OF AN ABBREVIATED SYSTEM OF APPRAISING BEEF CATTLE

G. L. Minish and R. M. Winn

During the past 50 years, beef cattle selection has been done primarily by visual appraisal. Current research has indicated that present type and classification scores are poorly related to maximum production efficiency and carcass merit. Feed grades appear, in fact, to be emphasizing poor gaining, inefficient cattle that are early maturing and have an excess of fat at slaughter.

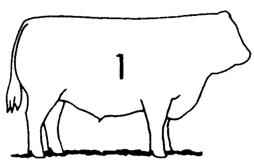
The authors of the following scoring system deemed it necessary to design and test a score for two traits that should more accurately identify and categorize economically efficient beef cattle.

Experimental Procedure

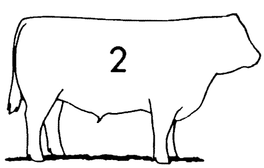
One hundred nineteen (119) yearling bulls on 140-day feed test at the Dublin and Culpeper B.C.I.A. stations and two hundred seventeen (217) Virginia 4-H steers were visually scored from 1 through 5 for frame and muscle respectively by three independent graders. The bulls were scored at the end of the feed test and the steers prior to slaughter.

The following score card defines the scoring system that was evaluated:

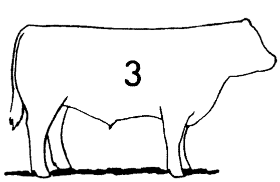
SIZE



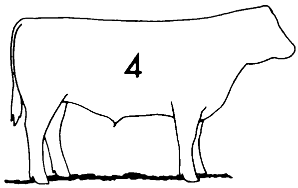
1. *Extremely small.* Short in every skeletal dimension. Approaching dwarfiness in type. Comparable to the "compact" and "compress" cattle of the 1940's and early 1950's. Extremely short-bodied and short-legged.



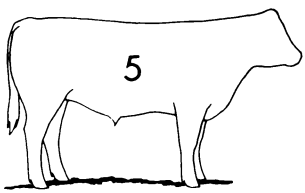
2. *Below the present-day average in size.* Quite short-legged and compact, but not as extreme as a No. 1.



3. *Present-day average.* This, of course, will change with time. This score represents where we are, not necessarily where we would like to be.

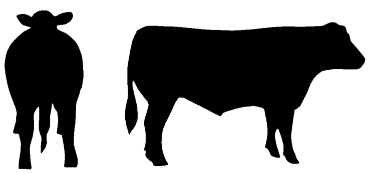


4. *Above the present-day average.* This score represents the kind of cattle that many breeders would like to be producing.

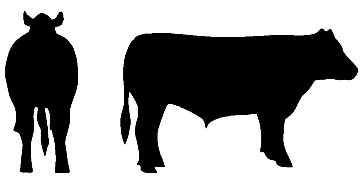


5. *Extremely large.* Long in every skeletal dimension. Very tall and long-bodied. In theory, bulls of this type mated to No. 3 cows should result in progeny that average No. 4.

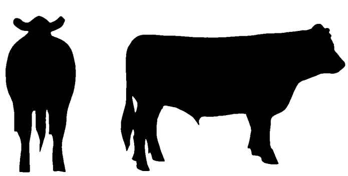
MUSCLING

A 

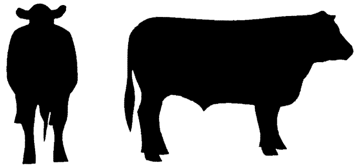
A. *Extremely heavy muscled.* Definite creases in the thigh. A well-defined groove down the top as a result of the loin eye muscle bulging up on each side of the backbone. Extremely prominent through the stifle and forearm.

B 

B. *Above the present-day average.* This score represents the degree of muscling that many breeders would consider near ideal. Very wide through the stifle and prominent in the forearm. Muscling over the hip is evident when the animal moves.

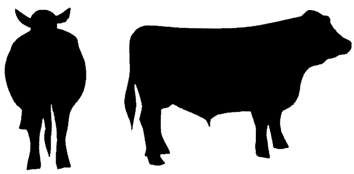
C 

C. *Present-day average in muscling.*



D

D. *Below the present-day average in muscling,* but not as deficient as E.



E

E. *Extremely light muscled.* Extremely deficient through the stifle. Very flat in the forearm.

Results

Detailed results can be seen in Tables 1, 2, 3, and 4.

As shown in Table 1, average daily gain, weight per day of age, and 365-day adjusted weights all favored bulls with larger frame scores. Sonaray fat measurements also indicated that larger framed bulls tended to carry less outside fat cover. Table 2 reports the results of evaluating performance and carcass data of slaughter steers scored for frame. Larger framed steers showed a highly favorable growth advantage. Carcass weight per day of age revealed a 41 percent spread in favor of larger framed steers, ranging from 1.05 pounds per day for the 1's to 1.54 pounds per day for the 5's. Pounds of edible beef produced per day of age and carcass value per day of age indicated a similar trend by increasing markedly for steers receiving higher frame scores. Carcass grade, fat thickness, percent lean cuts were not markedly different between frame scores.

Table 3 records the results of averaging bull performance according to muscle scores. Average daily gain, weight per day of age, 365-day adjusted weight and sonaray fat measurements all favored the bulls with higher muscle scores. Results of evaluating steers scored for muscle is reported in Table 4. The muscle scores very effectively grouped steers according to meatiness and muscling as rib eye area, fat thickness, and percent lean cuts all favored steers receiving higher muscling scores. In addition, carcass weight per day of age and retail carcass value per day of age improved with the higher scoring steers. Carcass grade, however, did not vary consistently between the different muscle scores.

Summary

Data from this preliminary trial indicate that the abbreviated system of scoring cattle for frame and muscle is very definitive in predicting growth rate and carcass merit. This study concluded the following:

1. Visual frame scores are effective in predicting bulls and steers with superior growth rate without reducing carcass grade.

2. Visual muscle scores are effective in identifying heavier muscled cattle with superior lean cut percentage.

TABLE 1. COMPARISON OF BULL FRAME SCORES TO FEED TEST PERFORMANCE

Frame Score	1	1+	2	2+	3	3+	4	4+	5
No. of observations (119 total)	-	-	3	18	40	46	12	-	-
Avg. daily gain, lb.	-	-	2.34	2.49	2.67	2.82	3.00	-	-
Wt./day of age, lb.	-	-	2.50	2.48	2.51	2.58	2.70	-	-
Fat thickness, inches[a]	-	-	0.49	0.42	0.41	0.42	0.37	-	-
365-day adj. wt., lb.[b]	-	-	910	919	930	959	1,000	-	-

[a]Sonaray fat measurement.
[b]Adj. 205-day weight + 160 x average daily gain on test.

TABLE 2. STEER FRAME SCORES AS RELATED TO CARCASS QUALITY AND ECONOMIC VALUES

Frame Score	1	1+	2	2+	3	3+	4	4+	5
No. of observations (217 total)	1	6	16	36	48	55	41	11	3
Live wt., lb.	750	742	815	855	889	978	1,004	1,091	1,250
Carcass grade[a]	13.00	11.80	11.50	12.00	11.60	11.60	11.50	11.50	12.00
Loin eye area, sq. in.	11.20	10.30	11.20	10.90	11.40	11.90	12.30	13.70	14.20
Fat thickness at 12th rib, in.	0.45	0.47	0.34	0.42	0.40	0.43	0.41	0.35	0.40
USDA yield grade[b]	2.60	2.70	2.20	2.60	2.50	2.60	2.50	2.20	2.50
Carcass wt./day of age, lb.	1.05	1.05	1.06	1.14	1.19	1.29	1.29	1.48	1.54
Lb. edible beef/day of age	0.74	0.71	0.70	0.69	0.71	0.75	0.79	0.83	0.79
Carcass value/day of age, $[c]	0.75	0.72	0.72	0.80	0.82	0.89	0.89	0.98	1.06

[a]Score range: 3-17 (9-11 good; 12-14 choice; 15-17 fancy, etc.).

[b]#1 = 54.6 percent lean cuts; #2 = 52.3 percent lean cuts; #3 = 50.0 percent lean cuts; #4 = 47.7 percent lean cuts; #5 = 45.4 percent lean cuts.

[c](Actual carcass value/days of age).

TABLE 3. COMPARISON OF BULL MUSCLE SCORES TO FEED TEST PERFORMANCE

Muscle Score	1	1+	2	2+	3	3+	4	4+	5
No. of observations (119 total)	-	-	1	9	54	43	12	-	-
Avg. daily gain, lb.	-	-	2.64	2.58	2.66	2.74	3.10	-	-
Wt./day of age, lb.	-	-	2.50	2.48	2.51	2.58	2.70	-	-
Fat thickness, in.[a]	-	-	0.48	0.49	0.41	0.41	0.33	-	-
Adj. 365-day wt., lb.[b]	-	-	936	918	930	956	1,000	-	-

[a]Sonaray fat measurement.
[b]Adj. 205-day weight + 160 x average daily gain on test.

TABLE 4. STEER MUSCLE SCORES AS RELATED TO CARCASS QUALITY AND ECONOMIC VALUES

Muscle Score	1	1+	2	2+	3	3+	4	4+	5
No. of observations (217 total)	0	1	5	38	85	67	16	4	1
Live wt., lb.	-	830	825	889	901	971	1,034	1,115	1,035
Carcass grade[a]	-	12.00	10.80	12.00	11.70	11.70	10.70	12.50	10.00
Loin eye area, sq. in.	-	10.70	10.30	10.90	11.40	12.20	13.50	14.50	12.10
Fat thickness at 12th rib, in.	-	0.50	0.26	0.43	0.41	0.41	0.37	0.40	0.20
USDA yield grade[b]	-	2.90	2.30	2.70	2.60	2.50	2.10	2.10	2.00
Carcass wt./day of age, lb.	-	1.10	1.06	1.14	1.19	1.29	1.33	1.58	1.35
Lb. edible beef/ day of age[c]	-	0.55	0.71	0.69	0.73	0.75	0.81	0.82	0.71
Carcass value/ day of age, $[d]	-	0.71	0.74	0.79	0.82	0.89	0.91	1.09	0.91

[a]Score range: 3-17 (9-11 good; 12-14 choice; 15-17 fancy, etc.).
[b]#1 = 54.6 percent lean cuts, #2 = 52.3 percent lean cuts; #3 = 50.0 percent lean cuts; #4 = 47.7 percent lean cuts.
[c]Percent of lean cuts/days of age.
[d](Actual carcass value/days of age).

A TWO YEAR FIELD TRIAL ON VIT-A-WAY PASTURE BALANCER

G. L. Minish

Procedure

Twenty-four purebred Hereford cows were officially divided into two treatment groups on November 11, 1968. The groups were divided as evenly as possible for age, weight, and type. Individual two-day weights were taken at the start of the trial. One group (Treatment Group) was assigned to be fed free-choice VIT-A-WAY Pasture Balancer while the second group (Control Group) was fed free-choice, a mineral mix containing two parts mineralized salt to one part dicalcium phosphorus. During spring, summer, and fall, each group was pastured on native grasses. During winter, both groups were given mixed grass hay as required. Pasture Balancer and the mineral mixture were available to the individual groups at all times.

On April 15, all cows and calves were removed from treatments and collectively pastured. During this time, the cows were pasture mated. Cows and calves were reallocated to their respective treatment and control pastures in August. The following data were collected:

Starting weight for the cows

Six month weight for the cows

Twelve month weight for the cows at the end of lactation

Birth weight of the calves

Weaning weight of the calves

Average daily gain for the calves

B.C.I.A. type and index scales for the calves

Daily Pasture Balancer consumption per head per cow for the twelve month period

Total hay consumption and mineral mixture consumption

Additional observations were made on breeding efficiency, calving percentages, disorders such as pink eye, retained placenta, grass tetany, and general health.

The trial was continued through 1969-1970 breeding season on the same animals. There were three additional cows added to the Treatment Group and four to the Control Group. This brought the cow numbers to fifteen per group, an extra animal being required in the Control Group due to the mortality.

The animals were similarly treated in the second year, excepting that both groups were pasture mated to the same purebred Hereford bull without removal from supplemental treatment. The bull was transferred daily between groups. The hay fed to the Treatment Group was reduced in January 1970.

During the second year, the Control Group was fed an equal parts mixture of trace mineralized salt, magnesium oxide, and dicalcium phosphate.

Results and Discussion

The performance data for the cows and calves for both years are given in Tables 1 and 2, and cow performance and feed intake is summarized for 1969 and 1970 in Table 3.

The cows fed supplementary Pasture Balancer demonstrated better weight maintenance throughout the two years of feeding. It was further noted that there was a greater consistency of weight maintenence due to individual performance during the first year, with the differential sustained during the second year. This latter observation was achieved with 240 lbs. less hay fed per cow to the Treatment (Pasture Balancer) Group.

The Treatment cows appeared to be in higher condition with more bloom than the Control cows. This latter difference was seen to best advantage in spring and early summer.

Two cows in the Control Group were treated for apparent symptoms of grass tetany during the first year. Two further cows in this group also required the assistance of a veterinarian to remove the afterbirth following calving. One cow in the Control Group was found dead in late summer prior to weaning and no cause of death could be determined.

During the first year, one cow in the Control Group failed to calve, and one calf born in the Treatment Group died three days after birth due to unknown causes. In the second year, two cows in the Control Group and one in the Treatment Group failed to calve. The relative calving percentage for both years were 96.3% for the Treatment Group and 88.9% for the Control Group (see Table 3). There was 3.7% cow mortality in the Control Group, with no losses in the Treatment Group. There appeared to be no difference in calving intervals.

The hay intake was equal for both groups in the first year; however, the Treatment Group was restricted in intake from late January 1970. For the entire second winter, there was 240 lbs. less hay fed per cow to the Treatment Group. The Pasture Balancer consumption averaged 6.84 ozs. per head per day for the first year and 8.27 ozs. per head per day for the second year. The mineral mixture was estimated at 0.8 to 2.40 ozs. per head per day for the Control Group in the first year and determined at 1.05 ozs. per head per day for the second year.

There appeared to be some seasonal per capita consumption of both supplemental products. These data do no consider calf consumption and are expressed per cow unit. The data are shown in Tables 1 and 2.

The calf performance is shown in Tables 1 and 2. The Control Group calves had slightly heavier average birth weight in both years. The 205-day adjusted weights were slightly higher in 1969 and 8.7 lbs. heavier in 1970 for the Treatment Group. There were no differences for B.C.I.A. feeder grade or index. Pounds of calf weaned per cow were not different in 1969; however, it was considerably higher for the Treatment Group in 1970 (36.3 lbs.).

Summary

Cows receiving VIT-A-WAY Pasture Balancer showed more bloom and were heavier and in higher condition throughout the study. Calving percentage favored the cows receiving Pasture Balancer and their calves' weight gains and 205-day adjusted weaning weights were slightly higher.

Results of this trial indicate that VIT-A-WAY Pasture Balancer does improve the weight, bloom, and condition of cows. In addition, cows on Pasture Balancer weaned more pounds of calf per cow on slightly less winter feed.

TABLE 1. Summary of Cow and Calf Performance 1968-1969

	Control Group	Treated Group	Treated Minus Control
No. cows	12	12	--
Initial cow wt.	1247	1261	+13
Six month cow wt.	1004	1085	+81
End of lactation cow wt.	1133[3]	1194	+61
No. calves born	11	12[1]	+1
Birth wt. (lbs.)	87.6	80.3	-7.3
205-day wt. (adj.) (lbs.)	444.5	445.8	+1.3
Lbs. of calf weaned per cow (lbs.)	407.4	408.6	+1.2
Feeder grade[2]	13	13	--
Avg. da. gain (adj.) (lbs.)	1.74	1.78	+0.04
No. cows at end	11[3]	12	+1
Winter feed:			
Hay (total lbs.)	47,750	47,750	
Hay per head per day (lbs.)	22.0	22.0	
Pasture Balancer per head per day (ozs.)		6.84	
Salt-mineral mix per head per day (ozs.) estimated	0.80-2.40		

[1] One calf in the Treated Group died shortly after birth with no apparent diagnosis.

[2] Feeder grades based on code of 12 - low choice, 13 - avg. choice, 14 - high choice, 15 - low fancy, etc.

[3] One cow died in the Control Group for unidentified reasons.

TABLE 2. Summary of Cow and Calf Performance 1969-1970

	Control Group	Treated Group	Treated Minus Control
No. cows	15	15	--
Initial cow wt.[1]	1133	1194	+61
Cow wt. (2/10/70)	1162	1235	+73
Cow wt. (7/1/70)	1090	1183	+93
End of lactation cow wt. (lbs.)	1111	1186	+75
No. calves[2]	13	14	+1
Wt. calves at birth (lbs.)	82.2	80.7	-1.5
Wt. calves (7/1/70) (lbs.)	264.2	281.8	+17.6
Wt. gain (7/1/70) (lbs.)	182.0	201.1	+19.1
205-day wt. (adj.) (lbs.)	421.9	430.6	+8.7
Lbs. of calf weaned per cow (lbs.)	365.6	401.9	+36.3
Feeder grade	11.9	12.4	+0.5
Avg. da. gain (7/1/70) (lbs.)	1.85	1.95	+0.10
Avg. da. gain 205-day (adj.) (lbs.)	1.66	1.71	+0.05
Winter feed:			
Hay (total lbs.)	54,500	50,900	
Hay per head per day (lbs.)	20.07	18.75	
Pasture Balancer per head per day (ozs.)		8.27	
Salt-mineral mix per head per day (ozs.)	1.05		

[1] End of lactation weight 1969 carry over animals only.

[2] Two cows in the Control Group and one in the Treatment Group did not have calves in 1970.

TABLE 3. Pasture Balancer Study (Summary)

1968-1970

	Control Group	Treated Group	Treated Minus Control
No. cow years	27	27	--
% calf crop	88.9	96.3	+7.4
% cow mortality	3.7	--	+3.7
% calf mortality	--	3.8	-3.8
Twelve month cow wt. loss (lbs.)	-3434	-1539	+1865
Twelve month cow wt. loss per live cow lbs.	-89	-57	+32
Lbs. of calf weaned per cow lbs.	384.2	404.9	+20.7
Total hay fed (lbs.)	102,250	98,650	-3600
Total Pasture Balancer (lbs.)	--	3990	+3990
Total mineral mixture (lbs.)	595.1	--	-595.1
Total calf wt. gain	8342.0	8919.1	+577.1
Loss of calves	--	1	-1

A COMPARISON OF CORN SILAGE AND ALFALFA HAY FOR WINTERING EWES

J. S. Copenhaver, R. C. Carter and W. B. Williams

Researchers have found that well-eared corn, harvested as high quality corn silage, yields more feed energy per acre of land than any other crop. Corn silage is in part responsible for the marked increase in numbers of cattle fed for slaughter in Virginia in recent years. This is due to its low cost per feed unit and because it can be harvested over a wide range of calender dates without much concern for weather and moisture conditions that are important in hay making, and because it lends itself well to automated feeding systems.

In recent years commercial sheep producers have shown much interest in corn silage as a portion of their ewe wintering rations. Most sheepmen have depended on alfalfa hay supplemented with a small amount of grain to winter their ewes. However, difficulties in growing it, due to alfalfa weevil and increasing harvesting and storing costs, have encouraged them to look at other sources of feed.

In 1971 a test was initiated to determine if a supplemented corn silage ration is comparable to a supplemented alfalfa hay ration for wintering ewes.

Forty-eight western ewes of Rambouillet and Suffolk x Rambouillet breeding were assigned to this test. On January 12, 1971, approximately four weeks prior to lambing, the ewes were weighed, divided into three similiar groups according to age, weight and kind of ewe, and the groups were randomly assigned to treatments. The test was terminated and all ewes and lambs turned to pasture on April 26. The treatments were as follows:

Treatment 1 (Control) This group of ewes was fed 4 pounds of second-cutting, alfalfa-orchardgrass hay and .75 pounds of ground ear corn per head, per day. After lambing they received 4 pounds of hay plus 2 pounds of ground ear corn daily.

Treatment 2 (Combination of hay and silage) These ewes were fed 2.5 pounds of mixed hay, 4 pounds of corn silage and .75 pounds of ground ear corn per ewe per day prior to lambing, and 2 pounds of hay, 6 pounds of corn silage and 1.5 pounds of ground ear corn after lambing.

Treatment 3 (Corn Silage) Prior to lambing this group received daily 6 pounds of corn silage, 1.25 pounds of ground ear corn and .5 pound of soybean oil meal (44%) per head. After lambing they were fed 10 pounds of corn silage, 1.5 pounds of ground ear corn and .25 pounds of soybean oil meal each per day. Rations are shown in table 1.

TABLE 1. RATIONS FED - POUNDS/DAY

	Gestation			Lactation		
	Hay	Hay & Silage	Silage	Hay	Hay & Silage	Silage
Alfalfa Hay (mixed)	4.00	2.50		4.00	2.00	
Corn Silage		4.00	6.00		6.00	10.00
Ground Ear Corn	.75	.75	1.25	2.00	1.50	1.50
Soybean Meal (44%)			.50			.25
Total	4.75	7.25	7.75	6.00	9.50	11.75
Cost/Day	7.5¢	6.9¢	7.9¢	10.0¢	8.4¢	8.25¢

Results:

There was very little difference in the lambing performance of ewes in all three treatments. All of the ewes in treatments 1 and 2 lambed while two ewes did not in treatment 3. The ewes in treatment 2 had more lambs than those in 1 and 3 but survival rate was best in treatment 1 and poorest in treatment 2. Three deaths in treatment 2 were due to lambing trouble and the other lamb died after being caught under a feed trough. The lamb lost in treatment 3 was due to an abortion. None of these death losses could be attributed to treatment. Results are shown in table 2.

TABLE 2. LAMBING PERFORMANCE OF EWES

Treatment	1 (Hay)	2 (Hay & Silage)	3 (Silage)
No. Ewes Bred	16	16	16
No. Lambing	16	16	14
Lambs Born	21	25	21
Lambs Raised	21	21	19

The weight gains before lambing were about the same for ewes in all three treatments, but there was a considerable difference in losses in weight at lambing and during lactation. The ewes in treatment 3 lost 7.5 pounds more than those in treatment 1 at lambing, but lost 9.9 pounds less than those in 1 during lactation.

The birth weights of the lambs were about the same for all three treatments, but the ewes in 2 and 3 had more twins than those in 1. The ewes in three produced 2 more pounds of lamb at birth than those in 1.

The lambs in treatment 1 gained faster than those in 2 and 3. This difference in gain was attributed to the milk production of the ewes since the lambs were not creep fed. Ewe and lamb performance is shown in table 3.

TABLE 3. EWE AND LAMB PERFORMANCE (POUNDS)

Treatment	1 (Hay)	2 (Hay & Silage)	3 (Silage)
Ewe:			
Wt. Gains, Gestation	22.2	22.2	25.8
Wt. Loss at Lambing	19.3	24.3	26.8
Wt. Loss, Lactation	18.3	19.1	8.4
Wool Wt.	7.95	7.39	7.75
Lambs:			
Birth wt.	10.8	10.6	10.3
lbs. lamb born/ewe	14.1	16.1	15.8
ADG to April 26	.533	.471	.423

The results of this test indicate that the corn silage ration (3) is just as good as the hay ration (1) for ewes during late pregnancy. The weight gains of the lambs indicate that ewes do not milk as well on the corn silage (3) ration as those fed the hay ration (1).

This report is based on one year's data on a limited number of ewes, so the results may change after additional testing, which is in progress.

CONCENTRATING SHEEP ON PASTURE

J. S. Copenhaver, R. C. Carter, F. S. McClaugherty and T. L. Bibb

Studies to determine the maximum number of sheep that can be carried per acre of improved native bluegrass pasture without adverse effects on performance, and the effect of close grazing on internal parasites and foot rot infection, have been underway for 4 years. The work in 1968 and 1969 was largely exploratory and was reported in the 1970-71 Livestock Research Report.

In 1970 an experiment comparing different methods of pasture management under close grazing with sheep and cattle was initiated at Blacksburg and partially replicated at Glade Spring.

In 1970 all pastures were stocked with ewes and lambs at the rate of 8 ewes and 12 lambs per acre with lambs receiving supplemental creep feed. The treatments were as follows:

1. Four 1 1/4 acre lots with 40 ewes and 55 lambs grazed in a 4-week rotation. In addition, 4 yearling heifers followed the sheep by 1 week in the rotation.

2. Two 2 1/2 acre lots grazed with 40 ewes and 57 lambs in a one week rotation.

3. One 2 1/2 acre lot with 20 ewes and 30 lambs set-stocked (grazed continually).

The treatments were the same in 1971 except that stocking rates of sheep were reduced to 6 ewes and 7.2 lambs per acre and yearling steers were used instead of yearling heifers.

The 1970 grazing season was dry during late May and early June; pastures became short and overstocked, so stocking rates were reduced in 1971 to prevent overgrazing. However, rainfall was normal in 1971 and the pastures could have been stocked at a higher rate.

In 1970 ewes and lambs were treated for worms and placed in the lots on 20 April. Lambs were weighed and drenched at 14 day intervals with alternate treatments of Thibenzole and Phenothiazine; ewes were weighed and drenched at 28 day intervals. Lambs were weighed and removed from the lots 15 June. Ewes were removed 12 August.

In 1971 ewes and lambs were treated for worms, weighed, and put on the lots 26 April. Lambs were weighed and drenched at 14 day intervals with alternate treatments of Thibenzole, Loxon, and Tramisol; ewes were weighed and drenched at 28 day intervals. Lambs were removed from the lots as they reached market weight, the first being marketed 9 July and at two week intervals to 18 August when all remaining lambs were weaned and removed from the lots.

Results for the two years are shown in table 1.

TABLE 1. COMPARISON OF SET-STOCKING WITH 1- AND 4-WEEK ROTATION (2 YRS. 1970-1971)

	Set-Stocking		1-Week Rotation		4-Week Rotation	
Acreage	1 Lot		2 Lots		4 Lots	
Per Lot	2 1/2 Acres		2 1/2 Acres		1 1/4 Acres	
Stocking Rate Per Acre:						
Year	1970	1971	1970	1971	1970	1971
Ewes	8	6	8	6	8	6
Lambs	12	7.2	12	7.2	12	7.2
Cattle	0	0	0	0	0.8	0.8
Gains:						
Ewes	-.23	-.043	-.29	+.018	-.45	-.033
Lambs	.50	.57	.38	.55	.38	.50
Cattle	--	--	--	--	.08	.314
Feed Per Lamb:						
Pounds	102	170	67	196	63	188

The lambs that were set-stocked in 1970 gained considerably faster than those grazed rotationally; however, they ate about 50% more creep feed. The lower feed consumption for the rotationally grazed lambs may have been due to inadequate feeder space.

The 1971 set-stocked lambs gained slightly faster on less creep feed than the rotationally grazed lambs. Ewes in all treatments came through the test in better condition than those in the 1970 test.

Fecal egg counts were made in 1970 and 1971. The egg counts of the ewes were high when they were put on pasture and decreased during the grazing season. The counts of the lambs were just the opposite, low at the beginning and increased during the grazing season, being highest when the lambs were weaned. The Thibenzole, Loxon and Tramisol used as a drench in 1971 was apparently more effective in controlling worms than the Thibenzole and Phenothiazine used in 1970. The 1970 lambs stopped growing and showed evidence of parasitism by 15 June while the 1971 lambs made very acceptable gains to 18 August and showed no visible evidence of parasitism. All 1970 lambs were weaned and removed from the test on 15 June while the 1971 lambs that had not reached market weight were weaned and removed 18 August.

Combined Sheep and Cattle--Set-Stocking

In 1970 at both Blacksburg and Glade Spring, ewes and lambs and yearling cattle were grazed together at rather high stocking rates. At each station two 3-acre lots were used. At Blacksburg, these lots were stocked with 2 yearling heifers, 12 ewes and 13 lambs per 3 acres with lambs in one lot receiving creep feed. At Glade Spring, the stocking rate was 3 cattle, 12 ewes and 15 lambs per 3 acre lot. Here also, lambs in one lot were provided creep feed.

This work was repeated in 1971 with slightly different stocking rates. At Blacksburg, the Lot 1 (creep fed lambs) was stocked with 2 cattle, 12 ewes and 18 lambs per 3 acres and Lot 2(no creep) was stocked with 2 cattle, 12 ewes and 17 lambs per 3 acres. The Glade Spring stocking rates were: Lot 1(lambs creep fed) 2 cattle, 12 ewes and 14 lambs per 3 acres and Lot 2 (no creep) 2 cattle, 12 ewes and 14 lambs per 3 acres. The results are shown in table 2.

TABLE 2. SET-STOCKING EWES AND LAMBS WITH CATTLE AT BLACKSBURG & GLADE SPRING 70-71

	With Creep				No Creep			
Station	Blacksburg		Glade Spring		Blacksburg		Glade Spring	
Year	1970	1971	1970	1971	1970	1971	1970	1971
Acres	3	3	3	3	3	3	3	3
No. Per Lot:								
Ewes	12	12	12	12	12	12	12	12
Lambs	13	18	15	14	13	17	15	14
Cattle	2	2	3	2	2	2	3	2
Gain:								
Ewes	.20	-.19	.43	.11	.26	-.17	.49	.06
Lambs	.69	.46	.57	.53	.69	.29	.48	.40
Cattle	.45	.53	1.05	1.66	.53	.46	.91	1.44
Feed:								
Lambs	20	47	99	96				

Very satisfactory gains were made by the lambs on both treatments and at both stations in 1970. The 1971 gains for both treatments at the Glade Spring station were about the same as they were in 1970, but the lambs on both treatments at Blacksburg were much lower in 1971. This may have been in part due to a difference in kind of sheep used. Purebred Hampshire ewes and lambs were used in 1970 while Purebred Dorsets were used in 1971.

The gains made by the cattle at Blacksburg were much lower in both years than those made by the Glade Spring cattle. The Blacksburg cattle were grain fed during the winter and were in better condition than the Glade Spring cattle (wintered on roughage)when they were placed on test.

Although the 1971 results were not as good as those in 1970, this system of producing lambs on pasture has merit. The pounds of lamb marketed by Virginia sheepmen could be tripled and perhaps quadrupled if sheep producers adopted this system. A disadvantage is the amount of fence needed to divide pastures into smaller tracts required by this system.

NON-PROTEIN NITROGEN SUPPLEMENTS FOR FINISHING STEERS FED CORN SILAGE AND GRAIN

W. H. McClure, M. B. Wise, J. P. Fontenot and R. C. Carter

Protein supplementation is an important consideration in the finishing of beef cattle. One of the most logical ways to lower protein cost is the utilization of non-protein nitrogen sources. Urea has been widely used in finishing rations and biuret has been tried in a number of instances. Feeding of non-protein nitrogen sources in a liquid form has received considerable attention during the past few years in an effort to reduce labor cost and to simplify the process of feeding. The work reported herein was designed to compare biuret in a dry form and urea in both a liquid and a dry form to cottonseed meal as sources of protein for steers being finished on a full-feed of corn silage with grain fed at a level of 1% of the body weight.

Procedure

Forty-four weanling steer calves averaging approximately 540 lbs. initially and consisting of 16 straight-bred calves of Angus, Shorthorn and Hereford breeding and 28 crossbred calves containing Angus, Hereford and Shorthorn breeding were randomly allotted on the basis of body weight within breeding groups to four treatments. One lot of five primarily straight-bred calves and another lot of six crossbred calves were assigned to each treatment. All calves were housed in partially covered concrete lots with automatic waterers. Each pen of calves was fed corn silage containing 46% dry matter and with a crude protein content of 4.0% and an estimated TDN of 31% on an "as fed" basis. A grain mixture containing equal parts of corn, barley and wheat was fed in the ground form to all calves at a level of 1% of the body weight. The grain contained 85% dry matter and an average of 10.75% crude protein.

The treatments consisted of various protein supplements as follows: cottonseed meal, a dry biuret supplement, a dry urea supplement and a liquid supplement based on urea. The cottonseed meal analyzed 91% dry matter and 45% crude protein. The dry biuret supplement shown in Table 1 analyzed 90% dry matter and 34% crude protein. The dry urea supplement (Table 1) analyzed 90% dry matter and 41% crude protein. The liquid supplement (Table 2) was compounded to contain 32% protein equivalent. The cottonseed meal and dry protein supplements were fed at a level of 2 lbs. per head daily spread over the top of the silage. The liquid urea supplement was offered free choice in a drum with a wheel installed to allow the cattle access to the supplement by licking and turning the wheel. The grain mixture was fed by top dressing over the corn silage. A mineral mixture containing one part bonemeal, one part limestone and one part plain salt was kept before the animals for free choice consumption. A separate box afforded plain salt on a free choice basis. All feeding was on a twice daily basis.

Cattle were weighed at 15 days, 28 days, and at 28 day intervals thereafter throughout the 168 day experimental period (November 18, 1970 to May 5, 1971.)

TABLE 1. COMPOSITION OF "DRY" SUPPLEMENTS

Ingredient	Biuret	Urea
	%	%
Ground shelled corn	39.95	41.0
Dry molasses	39.95	41.0
Defluorinated phosphate	5.0	5.0
Urea		9.26
Biuret	11.36	
Distillers solubles	2.50	2.50
Corn steepwater	1.25	1.25
Vitamins A & D	*	*
Trace minerals	0.12	0.12

*A - 10,000 I.U. per pound and D - 2,000 I.U. per pound of supplement.

TABLE 2. COMPOSITION OF LIQUID UREA SUPPLEMENT

Component	%
Molasses	68.57
Phosphoric acid	5.00
Sulfuric acid	1.00
Dry urea	10.78
Water	10.78
Trace minerals	0.12
Distillers solubles	2.5
Corn steepwater	1.25
Vitamins A & D	*

*10,000 I.U. Vitamin A and 2,500 I.U. Vitamin D per pound.

Results and Discussion

Performance, feed intake and feed per pound of body weight gain for the combined replications are shown by treatments in Table 3.

TABLE 3. PERFORMANCE AND FEED SUMMARY OF STEERS FED VARIOUS SUPPLEMENTS (168 days; 11 calves per treatment)

Lots	4 & 6	1 & 5	2 & 7	3 & 8
Protein Source	Cottonseed Meal	Dry Biuret	Dry Urea	Liquid Urea
Av. Init. Wt., lbs.	544	535	546	545
Av. Final Wt., lbs.	948	937	956	930
Av. Total Gain, lbs.	404	402	410	385
Av. Daily Gain	2.40	2.39	2.44	2.29
Fd. Int., lbs./Da.:				
Silage	31.40	31.34	31.46	31.25
Grain	7.11	6.99	7.09	6.93
Supplement	2.00	2.00	2.00	0.63
Fd./Gain:				
Silage	13.08	13.11	12.89	13.65
Grain	2.96	2.92	2.91	3.03
Supplement	.83	.84	.82	.28

Silage offered and consumed was the same for all treatments and averaged approximately 28 lbs. per head daily. Grain consumption was slightly higher on the cottonseed meal treatment than on the other three treatments and averaged 7.11 lbs. per head daily. Grain consumption was the lowest on the liquid urea supplement and averaged 6.93 lbs. per head daily. Average daily gains were similar for the cottonseed meal and dry biuret treatments and averaged about 2.4 lbs. per head daily. Daily gain on the dry urea treatment was slightly more (2.44) while gain on the liquid urea supplement was lower and averaged 2.29 lbs. per head daily. As can be noted in Table 3, consumption of the liquid supplement was considerably lower than the amount necessary to furnish protein at a level comparable to the dry supplements. An intake of approximately 2.5 lbs. per head daily was desired, however, the calves consumed only 0.63 lbs. per head daily during the 168 day period. This accounts, at least in part, for the lower gains exhibited by calves on this treatment.

Carcass characteristics of the steers fed the various protein supplements are shown in Table 4. Carcass weights were similar for steers receiving either cottonseed meal, dry biuret or dry urea but somewhat lower for those receiving the liquid urea supplement. A similar pattern was also displayed in dressing percent and carcass grade with the steers receiving the liquid urea supplement grading high good and steers fed the other three supplements grading low choice. The ribeye area of the steers fed the liquid supplement was about 0.5 square inch smaller than ribeyes of steers from the other three supplements. Carcass gain was also reduced by about 20 pounds on the liquid supplement treatment.

TABLE 4. CARCASS CHARACTERISTICS OF STEERS FED VARIOUS PROTEIN SUPPLEMENTS

Lots	4 & 6	1 & 5	2 & 7	3 & 8
Protein Source	Cottonseed Meal	Dry Biuret	Dry Urea	Liquid Urea
Slaughter grade [1/]	12.3	11.9	12.0	12.0
Carcass wt., lb.	562	559	565	543
Dressing %	59.3	59.7	59.1	58.4
Carcass grade [1/]	12.0	12.3	12.1	11.1
Back-fat th., in.	.69	.65	.67	.67
Ribeye area, sq. in.	10.2	10.1	10.1	9.5
Avg. carcass gain [2/]	263	265	265	243
Carcass gain compared to C.S.M. control, %	100	101	101	92

[1/]Based on 10=middle good, 11=high good, 12=low choice, etc.
[2/]Derived from final carcass wt. minus 55% of initial live wt.

Summary

Forty-four weanling calves were used in an experiment to compare cottonseed meal, a dry biuret supplement, a dry urea supplement and a liquid urea supplement when fed with high TDN corn silage and a grain mix consisting of equal parts of corn, barley and wheat at a level of 1% of the body weight. Body weight gains on the cottonseed meal and dry biuret supplement were about 2.4 lbs. per head daily. The dry urea supplement calves gained 2.44 lbs. per head daily and the liquid urea fed calves gained 2.29 lbs. per head daily. The lower gains on the liquid supplement were perhaps due to a low intake (0.63 lbs. per head daily) of this supplement. Carcass characteristics were similar for the three dry supplement treatments; however, the liquid supplement resulted in a reduced carcass weight, lower dressing percentage and smaller ribeye area.

ROTATION OF FEED ADDITIVE IN SWINE RATIONS

E. T. Kornegay, H. R. Thomas, and J. H. Carter

Numerous reports have shown that the greatest response to antibiotics and antibacterial agents occurs during the growing phase. Recent reports have shown that the response continues through the finishing phase and that the antibiotic should be continued until market weight or until the drug should be withdrawn prior to market. It has also been suggested that the rotation of antibiotics and antibacterial agents during the growing and finishing phases might be more effective than the continued use of a single antibiotic or antibiotic combination. The objective of this trial was to evaluate two antibiotics and copper in several rotational schemes for growing and finishing swine.

Experimental Procedure

One hundred ninety-two crossbred pigs averaging 49.6 lb. were used in a trial with two randomized blocks. Pigs were assigned to the various rations from outcome groups based on body weight, sex, and litters. Twelve treatment combinations shown in Table 1 were used. The basal ration consisted of corn and soybean meal fortified with minerals and vitamins. The protein levels, fed according to the following schedule, were varied by changing the portion of corn and soybean meal: 16% protein from 40 to 75 lb., 14% from 75 to 150 lb. and 12% from 150 lb. to market weight. The zinc level was equalized in all rations by adding zinc sulfate to rations A, B, and D. Ration A contained no additive and served as the control. Copper was added at a level of 200 ppm in ration B. Ration C contained 40 gm/ton of bacitracin added as zinc bacitracin in phase I with the level lowered to 20 gm/ton in phase II, and 10 gm/ton in phase III. Tylosin was added to ration D at a level of 40 gm/ton in phase I, 20 gm/ton in phase II, and 10 gm/ton in phase III.

The pigs were self-fed and housed in a totally enclosed building in pens with partially slotted floors. Body weight and feed intake were measured every two weeks. Data were statistically analyzed using the analysis of variance technique with various treatment comparisons being tested.

Results and Discussion

In phase I, the average daily gain of pigs fed the ration D containing Tylosin was greater than for pigs fed rations C containing zinc bacitracin (Table 2). Pigs fed ration B containing copper and the basal, ration A, had intermediate gains. Feed intake and feed/gain were not different between various combinations. In phase II, average daily gain tended to be greatest for pigs fed ration D than for pigs fed the other rations. Feed intake and feed/gain were not different between various combinations. In phase III there was little difference in gain between pigs fed the various rations, although pigs fed the basal ration tended to have larger average daily gains which would suggest compensatory growth.

For the overall trial, average daily gain, feed intake and feed/gain were similar for all treatment combinations with no major trends evident. Carcass data shown in Table 3 were not significant in differences between the various treatment combinations.

In conclusion, there appeared to be no over-all benefit in average daily gain, feed intake, or feed/gain when the various feed additives were added in the various rotational schemes. The initial improvement in gain obtained when Tylosin was added appeared to be lost, or the pigs which did not receive it had compensated growth, during the latter phases. These conclusions are not in agreement with a number of other reports in the literature.

TABLE 1. EXPERIMENTAL TREATMENTS IN FEED ADDITIVE ROTATION STUDY

Treatment Combination & Rations	Phases		
	I (40-75 lb.)	II (75-150 lb.)	III (150 lb.-Market)
1	A-16	A-14	A-12
2	B-16	B-14	B-12
3	B-16	B-14	A-12
4	B-16	D-14	C-12
5	C-16	C-14	C-12
6	C-16	C-14	A-12
7	D-16	D-14	D-12
8	D-16	D-14	A-12
9	D-16	B-14	C-12
10	D-16	C-14	A-12
11	D-16	B-14	A-12
12	D-16	D-14	C-12

A = basal with no additive
B = plus 220 ppm Cu for all phases
C = plus zinc bacitracin - 40, 20 and 10 gm/ton, respectively for phases I-III.
D = plus Tylosin - 40, 20 and 10 gm/ton respectively, for phases I-III.

TABLE 2. FEEDLOT PERFORMANCE OF PIGS FED VARIOUS FEED ADDITIVES IN ROTATION

	Feed Additive Combinations											
Phases	1	2	3	4	5	6	7	8	9	10	11	12
I (40-75 lb.)	A	B	B	B	C	C	D	D	D	D	D	D
II (75-150 lb.)	A	B	B	D	C	C	D	D	B	C	B	D
III (150lb.-Market)	A	B	A	C	C	A	D	A	C	A	A	C
No. of pigs	16	16	16	16	16	16	16	16	16	16	16	16
Avg. initial wt., lb.	50.6	49.5	49.1	48.6	49.1	49.4	50.3	49.4	48.8	49.9	49.8	50.5
Avg. final wt., lb.	206.6	205.0	198.8	209.3	206.5	202.1	208.9	212.9	207.6	206.2	208.8	209.8
Days to market	98.9	101.6	95.9	102.1	102.1	98.9	101.1	98.4	102.5	102.2	99.4	98.9
Avg. Daily gain, lb.[a]												
Phase I	1.63	1.69	1.72	1.57	1.66	1.60	1.75	1.79	1.72	1.66	1.78	1.80
Phase II	1.52	1.53	1.52	1.57	1.64	1.53	1.58	1.66	1.59	1.63	1.64	1.70
Phase III	1.63	1.50	1.35	1.62	1.43	1.55	1.51	1.62	1.44	1.38	1.47	1.45
Overall	1.58	1.54	1.50	1.58	1.55	1.55	1.58	1.67	1.55	1.54	1.60	1.62
Avg. daily feed intake, lb.												
Phase I	3.69	3.82	3.78	3.60	3.76	3.72	3.77	3.85	3.82	3.62	4.00	3.92
Phase II	4.78	4.77	4.64	5.15	5.10	4.51	5.00	5.10	4.73	5.03	5.22	5.32
Phase III	5.66	5.47	5.65	6.05	5.63	5.77	5.66	5.89	5.49	4.97	5.60	5.71
Overall	4.91	4.87	4.88	5.22	5.04	4.78	5.02	5.17	4.86	4.74	5.14	5.17
Feed per lb. of gain, lb.												
Phase I	2.27	2.27	2.31	2.30	2.28	2.33	2.15	2.15	2.22	2.21	2.25	2.18
Phase II	3.14	3.13	3.05	3.28	3.11	2.94	3.16	3.07	2.99	2.71	3.19	3.07
Phase III	3.50	3.72	4.12	3.78	3.98	3.84	3.78	3.65	3.82	3.61	3.82	3.97
Overall	3.12	3.19	3.27	3.31	3.27	3.10	3.19	3.11	3.13	3.08	3.22	3.21

[a] Treatment comparisons - Duncan's multiple test

Phase I 5&6 1 2-4 7-12 ($P<0.05$)

II 1 3 2 6 4 7 9 10 5 11 8 12 ($P<0.01$)

III 3 10 5 9 12 11 2 7 6 4 8 1 ($P<0.01$)

Over-all 3 10 2 5 6 9 1 4 7 11 12 8 ($P<0.05$)

TABLE 3. CARCASS CHARACTERISTICS OF PIGS FED VARIOUS FEED ADDITIVES IN ROTATION

	Feed Additive Combinations											
Phases	1	2	3	4	5	6	7	8	9	10	11	12
I (40-75 lb.)	A	B	B	B	C	C	D	D	D	D	D	D
II (75-150 lb.)	A	B	B	D	C	C	D	D	B	C	B	D
III (150lb.-Mkt)	A	B	A	C	C	A	D	A	C	A	A	C
No. of pigs	8	8	7	9	8	8	7	10	8	7	9	8
Length, in.	30.29	30.49	30.23	30.80	30.98	30.20	30.11	30.59	30.44	30.87	30.90	30.41
Backfat, in.	1.36	1.29	1.31	1.38	1.40	1.37	1.42	1.35	1.32	1.31	1.30	1.34
Carcass wt., lb.	166.9	166.6	164.1	167.2	172.4	167.5	166.4	163.3	162.5	167.9	168.4	165.4
Dressing percent[a]	75.3	76.5	77.0	75.9	75.6	74.9	75.5	74.5	74.4	75.9	74.9	75.0
Loin eye area, in.^{2}	4.74	4.80	4.97	4.50	4.81	4.47	4.33	4.60	5.02	5.23	5.41	4.74
Marbling[b]	7.3	10.6	6.0	7.9	8.1	6.5	6.6	8.8	8.1	5.9	8.4	7.3
Quality score[c]	6.6	7.8	7.0	7.9	7.6	6.7	7.0	7.7	7.0	6.9	7.6	8.0

[a] Based on hot carcass weight

[b] Scored from 1 through 12 with 1= devoid and 12= extra abundant

[c] Considered color, firmness, and waterness; scored 1 through 15 with $1=1^-$ and $15=5^+$

EVALUATION OF HYDROLYZED HOG HAIR MEAL AS A PROTEIN SOURCE FOR SWINE

E. T. Kornegay and H. R. Thomas

Disposal of by-products such as hair resulting from the slaughter of hogs poses a problem of economic importance if outlets for these by-products are not available to the pack-processor. Unprocessed keratinous proteins such as hog hair and feathers are of little or no nutritional value due to a lack of digestibility. However, if these are properly processed, they are potentially sources of protein as shown by work with chicks and poults.

This series of trials was conducted to evaluate hydrolyzed hog hair meal as a protein source for swine.

Experimental Procedure

Crossbred pigs used in all trials were housed in partially slotted floored pens within an enclosed building. Feed and water were allowed *ad libidum*. The data was statistically analyzed using the variance technique and Duncan's multiple range test.

In trial 1, 60 pigs averaging 20 lb. were fed diets containing 18% crude protein and formulated to contain, 0, 2, 4, 6 and 8% HHH meal by varying the corn and soybean meal in a 28-day test (table 1). From the linear relationship of performance (gain and gain/feed) and calculated digestible protein values for each diet in trial 1, it was considered that digestible protein rather than crude protein would be a more accurate basis for formulating the diets to be used in subsequent trials. The digestible protein values used for corn, soybean meal and HHH meal were 80, 91 and 70%, respectively.

In trial 2, 72 pigs averaging 25 lb. were used in a 35-day test to evaluate diets containing 0, 2 and 4% HHH meal. Diets were formulated on a digestible protein basis. Digestible protein levels were lowered as the pigs grew according to the following schedule: Phase 0 (20-45 lb.) - 16%; Phase I (45-75 lb.) - 14%; Phase II (75-150 lb.) - 12%; Phase III (150 lb - Market) - 11%, Calcium, phosphorus and vitamin levels were also lowered with each stepdown of protein after Phase I.

In trial 3, 33 pigs averaging 19 lb. were used in a 42-day test. Diets (table 1) were formulated on a digestible protein basis to contain 0, 2 and 3% HHH meal.

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[1] This work was supported in part by a grant from ITT Gwaltney, Inc., Smithfield, Va. who are producers of the hydrolyzed hog hair meal used.

[2] Appreciation is expressed to John Blaha and Charlie Babb for caring for animals; to Peter Gati for laboratory analyses; to Dr. C. Y. Kramer for statistical analyses; and to J. H. Carter, Jr. for taking carcass measurements.

In trial 4, 120 crossbred pigs were used to evaluate the following diets: 1) positive control, 2) negative control, 3) 2% HHH meal, 4) 4% HHH meal - isonitrogenous with diet 1, and 5) 6% HHH meal. The negative control diet was formulated to supply the amount of digestible protein supplied by corn and soybean meal in diet 4. Digestible protein levels were lowered as the pigs grew according to the schedule described above. At an average of 220 lb., the male pigs were slaughtered and carcass measurements were taken.

Results and Conclusions

By feeding diets containing 0 to 8% added HHH meal, it was found that 2-3% HHH meal could be substituted for soybean meal without depressing gain and gain/feed, if the diets were formulated on a digestible protein basis (table 2). Feed intake was not depressed until the diets contained more than 6% HHH meal. With the exception of loin eye area, carcass characteristics obtained in trial 4 were not affected by the substitution of HHH meal in the diet on a digestible protein basis (table 3). Pigs fed the higher protein level diets had larger loin eye areas than pigs fed the lower protein level diet. This finding is in agreement with previous reports from Virginia Tech. The failure to get a response to higher levels of HHH meal suggests that amino acid deficiencies or imbalances were occuring, or that the amino acids were not as available in HHH meal as in soybean meal and corn. In general these results are in agreement with work reported using hydrolyzed hog hair meal in chick and poult diets.

Calculations of the amino acid content of the diets suggest that lysine and methionine are the two limiting amino acids in hydrolyzed hog hair meal when fed to pigs. This agrees with results reported for the chick and poult. Further research needs to be conducted to determine the digestible protein, nitrogen utilization, digestible energy and metabolizable energy for hydrolyzed hog hair. Also, the optimum size of pig and level of hydrolyzed hog hair to use needs to be determined in feeding trials.

TABLE 1. PERCENTAGE COMPOSITION OF DIETS. TRIALS 1 THROUGH 4

	Diets						
	Trial 1[a]	Trials 2 and 3[b,c]	Trial 4[c]				
Item	1	1	1	2	3	4	5
Corn	69.8	73.4	79.1	86.5	84.1	81.6	79.1
Soybean meal	27.1	23.5	17.9	10.5	10.9	11.4	11.8
HHH meal[d]	--	--	--	--	2.0	4.0	6.0
Defluorinated phosphate	1.1	1.1	1.0	1.0	1.1	1.2	1.3
Limestone	1.0	1.0	1.0	1.0	0.9	0.8	0.8
Trace mineral salt[e]	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Vitamin premix[f]	0.4	0.4	0.4	0.4	0.4	0.4	0.4
Antibiotic[g]	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Crude protein	18.0	18.6	16.4	13.5	15.3	17.2	19.1
Digestible protein[h]	15.7	16.0	14.0	11.3	12.6	14.0	15.3

[a]Corn and soybean meal were varied to maintain constant crude protein levels as 2, 4, 6 and 8% HHH meal was added to the basal diet.

[b]Corn and soybean meal were varied to maintain constant digestible protein levels as 2 and 4 (trial 2) and 2 and 3% (trial 3) HHH meal was added to the basal diet.

[c]Digestible protein levels were lowered or raised by varying corn and soybean meal according to the following schedule: Phase 0 - 16%, 20 to 45 lb.; Phase I - 14%, 45 to 75 lb.; Phase II - 12%, 75 to 150 lb.; Phase III - 11%, 150 lb. to market. Calcium, phosphorus and vitamin premix levels were also lowered with each stepdown of protein after Phase I.

[d]Supplied by ITT Gwaltney, Inc., Smithfield, Va.

[e]Contained (%): 0.01 Co, 0.08 Cu, 0.4 Fe, 0.01 I, 0.8 Mn, 1.0 Zn and 95.9 NaCl.

[f]Supplied (per lb. of premix): 0.6 g riboflavin, 3.1 g pantothenic acid, 3.1 g niacin, 4.8 mg vitamin B_{12}, 100 g choline chloride, 600,000 IU vitamin A, 100,000 IU vitamin D and 1,000 IU vitamin E.

[g]Contained 50 g Neomycin sulfate and 50 g oxytetracycline per lb. of premix.

[h]Assumed 80, 91 and 70% digestible protein for corn, soybean meal and HHH meal, respectively.

TABLE 2

AVERAGE DAILY GAIN, FEED INTAKE AND GAIN/FEED OF GROWING PIGS FED DIETS CONTAINING HYDROLYZED HOG HAIR MEAL. TRIALS 1 THROUGH 4.

	Criteria				
Ration No.	HHH meal	Dig. Protein sequence	Avg. Daily gain	Avg. Feed intake	Gain/Feed
	%	%	lb.	lb.	
			Trial 1[a]		
1	0	15.7	1.07[b]	2.03	0.53[b]
2	2	15.3	0.95	2.01	0.48
3	4	14.9	0.92	2.04	0.45
4	6	14.5	0.83	1.98	0.42
5	8	14.0	0.67	1.75	0.38
			Trial 2[a]		
1	0	16-14	1.06[c]	2.39	0.45[f]
2	2	16-14	1.10[c]	2.48	0.44
3	4	16-14	0.99[d]	2.36	0.42
			Trial 3[a]		
1	0	16-14	1.19[g]	2.79	0.43
2	2	16-14	1.06	2.49	0.43
3	3	16-14	1.13	2.63	0.43
			Trial 4[a]		
1	0	14-12-11	1.62[c]	5.32[e]	0.30[c]
2	0	11.3-9.4-8.3	1.02[e]	4.41[d]	0.23[e]
3	2	12.6-10.7-9.7	1.31[d]	5.09[cd]	0.26[d]
4	4	14-12-11	1.51[c]	5.36[c]	0.28[cd]
5	6	15.3-13.3-12.3	1.50[c]	5.49[c]	0.28[cd]

[a]Pigs per mean were 12, 24, 11 and 24; length of trial was 28, 35, 42 and 126.5 (avg.) days; and the average initial wts. (lb.) were 20, 25, 19, and 45 respectively, for trials 1 through 4.

[b]Significant ($P<.01$) linear effect of diets.

[cde]Means with different superscript letters are significantly different ($P<.01$)

[f]Significant ($P<.05$) linear effect of diets

[g]Significant ($P<.05$) quadratic effect of diets.

TABLE 3

CARCASS CHARACTERISTICS OF PIGS FED VARYING AMOUNTS OF HYDROLYZED HOG HAIR MEAL

TRIAL 4

	Rations[a]				
	1	2	3	4	5
HHH meal, %	0	0[b]	2	4	6
Number of pigs	11	10	10	11	11
Avg. days to market	112.4^{c}	153.6^{e}	131.3^{d}	119.9^{c}	117.5^{c}
Avg. final wt., lb.	225.4^{c}	198.7^{e}	215.5^{d}	223.0^{cd}	219.2^{cd}
Avg. hot carcass wt., lb.	175.4^{d}	161.5^{c}	161.7^{cd}	172.9^{d}	170.6^{d}
Avg. length, in.	30.2		29.8	30.1	30.2
Avg. backfat thickness, in.	1.46		1.54	1.56	1.46
Avg. loin eye area, in.	5.03^{d}		3.94^{c}	4.53^{d}	4.68^{d}
Avg. loin eye marbling[f]	8.4		10.4	9.8	8.9
Avg. quality score[g]	7.6		7.2	7.4	7.2
Avg. dressing percent[h]	75.7	75.6	75.4	75.9	76.5

[a] Digestible protein level (%) was: 14, 11.3, 12.6, 14 and 15.3 respectively for rations 1 through 5 for phase I; 12, 9.4, 10.7, 12 and 13.3 for phase II; and 11, 8.3, 9.7, 11 and 12.3 for phase III.

[b] Carcasses were cut by mistake before carcass measurements were taken.

[cde] Means with different superscript letters differ significantly ($P<.01$).

[f] Scored from 1 through 12 with 1 = devoid and 12 = extra abundant.

[g] Considered color, firmness and wateriness; scored 1 through 15 with $1 = 1^{-}$ and $15 = 5^{+}$.

[h] Based on hot carcass weight.

WHAT DIETARY PROTEIN LEVEL FOR WELL-MUSCLED HOGS

E. T. Kornegay, H. R. Thomas and J. H. Carter

Changes are continually being made in the swine industry. The development of a meat type hog which produces a leaner carcass is one of these changes. Other changes include new production techniques, new varieties of grain and high protein feeds and new types of housing. The proper protein level sequences to feed the modern meat type hog is still of major interest.

A second study was conducted to evaluate, using well-muscled crossbred pigs, the effect of various protein level sequences upon feedlot performance and carcass characteristics.

Experimental Procedure

One hundred-ninety-two crossbred pigs were used in the second trial, with only minor changes in the experimental procedure. Protein level sequences were the same as reported in last year's research report. The composition of diets is shown in table 1.

Results and Summary

The combined feedlot and carcass data for trials 1 and 2 are shown in tables 2 and 3. Average daily gain and feed intake for the entire test was greater and feed/gain was less for pigs fed sequences 1 through 6 than for pigs fed sequences 7 and 8. Pigs fed sequences 1, 2 and 3 had faster gains and lower feed/gain ratios than pigs fed sequences 4, 5 and 6. A comparison of the amino acid requirement with the amino acid content of the diets reveals lysine as the amino acid to be most limiting in the lower protein level diets. The analyzed lysine level as a percent of the diet was 0.66, 0.56 and 0.47%, respectively, for the 16, 14 and 12% protein diets.

Backfat thickness, quality score, and dressing percent were not different between pigs fed the various protein level sequences. The pigs fed the lower protein sequence had carcasses which were longer than those of pigs fed the higher protein sequence which may be explained by a difference in age of the pigs. Pigs fed the lower protein levels were from 4 to 20 days older. Loin eye areas were larger for pigs fed sequences 1 through 6 as compared to pigs fed 7 and 8. Pigs fed sequences 1 through 3 produced larger loin eye areas than pigs fed sequences 4 through 6. Loin eye areas were larger for pigs fed sequences 1 and 2 as compared to pigs fed sequence 3. Loin eye marbling was less for pigs fed the higher protein level sequences (1 through 6) as compared to pigs fed lower sequences (7 and 8)

Gilts grew at a slower rate (1.48 _vs_ 1.64 lb.), but produced carcasses which had larger loin eye areas (5.32 _vs_ 5.07 sq. in.). Theoretically, gilts which produce a leaner carcass would require a higher dietary protein level; however, a plot of the average daily gain by sex for the various protein level sequences failed to show any greater response of gilts as compared to barrows to the higher protein level sequences.

Variable and fixed cost were calculated for the various protein level sequences. The data can be supplied upon request. Fixed costs per pig were greater for the lower protein level sequences because it took longer for these pigs to reach market weight. When all costs were considered, variable and fixed, the intermediate to high protein sequences produced hogs at the least cost. The above calculations did not take into consideration improvements in the leaness of the pigs fed the high protein level sequences or that pigs fed the higher protein level sequences should have a higher sales value per lb. Examples of theoretical feed costs/gain with varying prices for corn and soybean meal are shown in table 4. In all cases feed costs/gain are less for pigs fed the intermediate protein level sequences. If corn prices are low as compared to soybean meal prices, then feed costs/gain are in favor of the lower protein sequences. On the other hand, if corn prices are high in relation to soybean meal prices, then feed costs/gain are in favor of the higher protein sequences.

When taking into consideration the faster and more efficient body weight gains, greater muscling and not greatly different feed costs, it is recommended that the higher protein level sequences be fed in most situations. Certainly when a producer is striving to produce the leanest possible carcass in the shortest possible time, the higher protein level sequences should be fed. There appears to be no advantage for feeding the lower protein level sequences (14-12-12 and 12-12-12) as the feed costs/gain were greater than for the intermediate sequences and the amount of muscling was less. A general recommendation would be to feed a 16% protein ration from 40 to 100 lb. and a 14% protein ration from 100 lb. to market weight. It should be pointed out that these results were obtained with corn-soybean meal rations which provide good protein quality. The use of other ingredients of poorer protein quality would probably require higher protein levels to obtain equal response.

TABLE 1. PERCENTAGE COMPOSITION OF DIETS

	Diets, % protein[a]		
Ingredients	16	14	12
Corn	77.65	83.60	88.85
Soybean meal[b]	19.20	14.10	9.05
Defluorinated phosphate	2.20	1.50	0.75
Limestone	----	----	0.70
Trace mineral salt[c]	0.50	0.50	0.50
Vitamin premix[d]	0.35	0.25	0.10
Antibiotic	0.10	0.05	0.05

[a]In trial 2, mineral, vitamin and antibiotic levels were the same for all protein levels during each phase. For example, during phase I, the 16, 14 and 12% protein diets had the same level of defluorinated phosphate, vitamin premix and antibiotic.

[b]Dehulled solvent extracted.

[c]Contained (%): 0.01 Co, 0.08 Cu, 0.4 Fe, 0.01 I, 0.8 Mn, 1.0 Zn and 95.9 NaCl.

[d]Supplied (per lb. of premix): 0.6 g riboflavin, 3.1 g pantothenic acid, 3.1 g niacin, 4.8 mg vitamin B_{12}, 100 g choline chloride, 600,000 IU vitamin A, 100,000 IU vitamin D and 1,000 IU vitamin E.

[e]Contained 50 g each of neomycin sulfate and terramycin per lb. In trial 2, the antibiotic was discontinued through phase III.

TABLE 2. FEEDLOT PERFORMANCE OF PIGS FED VARYING PROTEIN LEVEL SEQUENCES TO MARKET WEIGHT

	Protein level sequences[a]							
Phase and Criteria	1	2	3	4	5	6	7	8
I, 40 to 75 lb.	16	16	16	16	14	14	14	12
II, 75 to 150 lb.	16	16	14	14	14	14	12	12
III, 150 lb. to market	16	14	14	12	14	12	12	12
No. of pigs	40	40	40	40	40	40	40	40
Avg. initial wt., lb.	38.08	37.78	37.72	38.02	38.16	37.66	37.72	37.60
Avg. final wt., lb.	221.34	221.44	220.42	219.80	222.70	221.02	219.06	219.16
Avg. daily gain, lb.								
Phase I	1.50	1.45	1.54	1.49	1.37	1.36	1.36	1.07
Phase II	1.74	1.75	1.71	1.67	1.64	1.63	1.47	1.43
Phase III	1.64	1.61	1.67	1.55	1.67	1.65	1.58	1.61
Overall	1.63	1.62	1.65	1.59	1.58	1.57	1.47	1.40
Avg. daily feed intake, lb.								
Phase I	3.30	3.23	3.29	3.30	3.30	3.25	3.20	3.05
Phase II	4.99	4.98	5.08	4.95	4.83	4.65	4.77	4.64
Phase III	5.56	5.55	5.49	5.42	5.58	5.64	5.33	5.30
Overall	4.78	4.77	4.78	4.74	4.73	4.69	4.63	4.44
Feed per lb. gain, lb.								
Phase I	2.20	2.22	2.14	2.23	2.40	2.38	2.35	2.81
Phase II	2.87	2.84	2.95	2.97	2.94	2.86	3.26	3.23
Phase III	3.46	3.51	3.37	3.50	3.43	3.49	3.58	3.61
Overall	2.94	2.96	2.93	3.00	3.02	3.01	3.20	3.28

[a] Significant treatment comparisons - $(P<.05)^{*}$; $(P<.01)^{**}$

<u>Avg. daily gain</u>

Phase I: $T_{5,6,7}$ <u>vs</u> T_8^{**}
T_{1-4} <u>vs</u> T_{5-8}^{**}
II: $T_{5,6}$ <u>vs</u> $T_{7,8}^{**}$
T_{1-4} <u>vs</u> T_{5-8}^{**}
III: T_4 <u>vs</u> $T_{5,6}^{*}$
Overall: T_{1-3} <u>vs</u> T_{4-6}^{*}
T_{1-6} <u>vs</u> T_{7-8}^{*}

<u>Avg. daily feed intake</u>

Phase II: T_{1-4} <u>vs</u> T_{5-8}^{**}
Overall: T_{1-6} <u>vs</u> $T_{7,8}^{**}$

<u>Feed/gain</u>

Phase I: $T_{5,6,7}$ <u>vs</u> T_8^{**}
T_{1-4} <u>vs</u> T_{5-8}^{**}
II: $T_{1,2}$ <u>vs</u> $T_{3,4}^{**}$
$T_{5,6}$ <u>vs</u> $T_{7,8}^{**}$
T_{1-4} <u>vs</u> T_{5-8}^{**}
Overall: T_{1-3} <u>vs</u> T_{4-6}^{**}
T_{1-6} <u>vs</u> $T_{7,8}^{**}$

TABLE 3. AVERAGE DAYS TO MARKET, AVERAGE FINAL WEIGHT AND CARCASS MEASUREMENTS FROM PIGS FED VARYING PROTEIN LEVEL SEQUENCES TO MARKET WEIGHT

	Protein level sequence							
Phase and Criteria	1	2	3	4	5	6	7	8
I, 40 to 75 lb.	16	16	16	16	14	14	14	12
II, 75 to 150 lb.	16	16	14	14	14	14	12	12
III, 150 to market	16	14	14	12	14	12	12	12
No. of pigs	40	40	40	40	40	40	40	40
Avg. days to market	113.28	113.98	111.18	117.30	117.76	117.82	125.46	134.58
Avg. final wt., lb.	221.4	221.5	219.2	219.8	222.7	220.8	219.1	219.5
Avg. length, in.	30.5	30.7	30.5	30.8	30.6	30.8	30.9	30.7
Avg. backfat thickness, in.	1.32	1.34	1.34	1.34	1.34	1.37	1.38	1.36
Avg. loin eye area, sq. in.	5.40	5.55	5.14	5.07	5.21	5.22	5.04	4.86
Avg. loin eye marbling[a]	5.87	6.30	5.91	5.94	6.04	7.17	7.83	7.91
Avg. quality score[b]	7.18	7.39	7.05	6.99	6.95	7.50	7.08	7.19
Avg. dressing percent	74.57	73.29	74.37	74.36	75.29	74.66	74.51	74.70

[a] Scored from 1 through 12 with 1 = devoid and 12 = extra abundant.

[b] Based on color, firmness and wateriness with 1 = 1^- and 15 = 5^+

[c] Based on hot carcass weight

[d] Significant treatment comparisons - ($P<.05$)*; ($P<.01$)**

<u>Avg. days to market</u>

T_7 <u>vs</u> T_8 **

T_{1-3} <u>vs</u> T_{4-6} *

T_{1-6} <u>vs</u> $T_{7,8}$ **

<u>Avg. length</u>

$T_{1,2}$ <u>vs</u> T_{4-6} *

T_{1-6} <u>vs</u> $T_{7,8}$ *

<u>Avg. loin eye area</u>

$T_{1,2}$ <u>vs</u> T_3 **

T_{1-3} <u>vs</u> T_{4-6} *

T_{1-6} <u>vs</u> $T_{7,8}$ *

<u>Avg. loin eye marbling</u>

T_5 <u>vs</u> T_6

T_{1-6} <u>vs</u> $T_{7,8}$

TABLE 4. FEED COST PER POUND OF GAIN WHEN CORN AND SOYBEAN MEAL PRICES ARE VARIED[a]

Phase & cost		Protein level sequence 1	2	3	4	5	6	7	8
I, 40 to 75 lb.		16	16	16	16	14	14	14	12
II, 75 to 150 lb.		16	16	14	14	14	14	12	12
III, 150 lb. to Mkt.		16	14	14	12	14	12	12	12
Corn $/bu	Soybean meal $/ton								
1.00	85	7.8	7.6	7.4	7.5	7.6	7.4	7.7	7.9
	105	8.4	8.1	7.9	7.8	8.0	7.7	8.0	8.2
	125	8.9	8.6	8.3	8.2	8.4	8.1	8.3	8.5
1.35	85	9.2	9.2	9.0	9.1	9.1	9.0	9.4	9.7
	105	9.8	9.7	9.4	9.5	9.6	9.3	9.8	10.0
	125	10.4	10.1	9.8	9.8	10.0	9.7	10.1	10.3
1.70	85	10.7	10.7	10.5	10.7	10.7	10.6	11.2	11.5
	105	11.3	11.1	10.9	11.1	11.2	11.0	11.5	11.8
	125	11.8	11.6	11.4	11.4	11.6	11.3	11.8	12.1

[a]Based on feed/gain data in table 2.

FEEDLOT PERFORMANCE AND CARCASS CHARACTERISTICS OF PIGS FED HIGH LYSINE CORN-, NORMAL CORN- AND NORMAL CORN PLUS LYSINE-SOYBEAN MEAL DIETS.

H. R. Thomas and E. T. Kornegay[1]

Previous studies have shown that feedlot performance was greater for pigs fed high lysine-peanut meal diets unsupplemented with synthetic lysine as compared with unsupplemented normal corn-peanut meal diets, although the performance was suboptimum with both diets. Performance was greatly improved when synthetic lysine was added to either high lysine corn- or normal corn-peanut meal diets. It was found that weight gain and feed efficiency were positively related to the dietary lysine level of the diets irrespective of the kind of corn up to the level of about 0.85% total lysine. From these studies it was concluded that when diets for growing pigs are formulated to contain about 16% protein using high lysine corn and peanut meal, the lysine content of the high lysine corn, although higher than that of normal corn, is not adequate to overcome the lysine deficiency of peanut meal as the sole protein source.

The objective of the present study was to compare three protein level sequences of high lysine corn- and normal corn-soybean meal diets and two normal corn plus synthetic lysine-soybean meal sequences.

Experimental Procedure

The high lysine corn for this trial was produced with seed obtained from a field selection of high quality grain from the initial planting of high lysine corn used in previous years. The high lysine corn was raised in an isolated field in southeast Virginia.

One hundred-forty-four crossbred pigs averaging 30.5 lb. were used in three randomized blocks based on weight. Eight diets shown in table 1 were used during each of the three phases. Pigs were housed in partially slotted floored pens and were allowed feed and water *ad libitum*.

Results and Summary

A summary of the feedlot data and mean squares are shown in tables 1 and 2, respectively. In general, feedlot performance was greater for pigs fed the higher protein level diet and pigs fed normal corn diets. There was a slight response to the addition of synthetic lysine to both the low and high protein level sequences. The response to lysine was less than has been obtained in previous studies. The high lysine corn was of poorer physical quality than the normal corn which might explain why normal corn diets at equal protein levels produced greater gains and feed efficiency.

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[1]Appreciation is expressed to Drs. C. Y. Kramer and Ken Webb, Peter Gati and Charlie Babb for their help.

Carcass characteristics were generally not greatly different between pigs fed the various diets. The loin eye areas were larger for pigs fed the highest high lysine protein level sequence as compared to two lower high lysine protein level sequences. When all pigs fed high lysine corn diets were compared to those fed normal corn diets, the loin eye areas were larger for pigs fed the high lysine corn diets. Pigs fed diets 4 and 5 had less marbling than pigs fed diets 6 and 7. The effect of less marbling at higher protein levels has been observed previously.

In summary, high lysine corn fed to pigs produces less gain and greater feed/gain than pigs fed normal corn diets. There appeared to be a slight advantage for high lysine corn diets when carcass characteristics were considered. Lysine supplementation of the normal corn-soybean meal diets produced only a slight improvement in feedlot performance which was less than has been obtained previously. As observed in other studies, feedlot performance was improved at the higher protein level sequences as compared to the lowest protein level sequence. Amino acid analysis of the rations are being completed and may help explain why high lysine corn failed to produce as well as or better than normal corn.

TABLE 1. AVERAGE DAILY GAIN, FEED INTAKE AND FEED/GAIN OF PIGS FED HIGH LYSINE CORN- AND NORMAL CORN-SOYBEAN MEAL RATIONS WITH AND WITHOUT LYSINE SUPPLEMENTATION

	Diets[1]							
	1	2	3	4	5	6	7	8
Corn, source	HL	HL	HL	N	N	N	N	N
Lysine added	0	0	0	0	+	0	+	+
Protein and lysine[2]								
Phase I, 40 to 75 lb.	16(.96)	14(.83)	12(.69)	16(.85)	16(.97)	14(.71)	14(.82)	12(.68)
Phase II, 75 to 150 lb.	14(.83)	12(.69)	10(.56)	14(.71)	14(.82)	12(.56)	12(.68)	10(.56)
Phase III, 150 lb. to Mkt.	12(.64)	10(.56)	10(.56)	12(.56)	12(.68)	10(.42)	10(.56)	10(.56)
No. of pigs	18	18	18	18	18	18	18	18
Avg. initial wt., lb.	30.7	30.9	30.1	30.6	30.6	30.7	30.3	30.1
Avg. final wt., lb.	217.7	211.1	206.4	219.4	216.1	211.1	216.2	209.1
Avg. daily gain, lb.								
Phase I	1.31	1.30	1.12	1.51	1.49	1.38	1.45	1.21
Phase II	1.68	1.74	1.58	1.77	1.91	1.86	1.89	1.62
Phase III	1.45	1.27	1.37	1.54	1.53	1.31	1.40	1.39
Overall	1.51	1.43	1.36	1.62	1.66	1.50	1.56	1.40
Avg. daily feed intake, lb.								
Phase I	3.20	3.12	2.84	3.24	3.06	3.23	3.05	2.98
Phase II	4.90	4.85	5.08	5.21	5.53	5.38	5.32	4.81
Phase III	5.33	5.10	5.37	5.75	5.60	5.19	5.26	5.13
Overall	4.56	4.48	4.46	4.83	4.83	4.67	4.67	4.39
Feed/gain								
Phase I	2.33	2.40	2.54	2.15	2.06	2.34	2.11	2.48
Phase II	2.92	2.80	3.23	2.96	2.90	2.90	2.81	2.91
Phase III	3.68	4.04	3.95	3.75	3.61	3.96	3.75	3.70
Overall	3.02	3.12	3.28	2.98	2.93	3.10	2.98	3.12
Days to market	124.3	125.8	130.1	115.4	112.2	120.1	118.9	127.6

[1] Rations were formulated using either high lysine corn (9.8% crude protein and 0.54% lysine) or normal corn (8.0% crude protein and 0.27% lysine), soybean meal (49.0% crude protein and 3.2% lysine), defluorinated phosphate, limestone, swine trace mineral salt, VPI vitamin premix, tylosin plus sulfa and lyamine (50% lysine).

[2] Calculated levels

TABLE 2. MEAN SQUARES FOR AVERAGE DAILY GAIN, FEED INTAKE AND FEED/GAIN

Source of Variation	df	Criteria: Avg daily gain	Avg daily feed intake	Feed/gain
Phase I				
$T_{4,5}$ vs $T_{6,7}$	1	.0225	.0003	.0456
$T_{4,6}$ vs $T_{5,7}$	1	.0016	.0936	.0736
$T_{1,2,3}$ vs $T_{4,5,6,7,8}$	1	.1512**	.0191	.2146**
$T_{4,5,6,7}$ vs T_8	1	.1460**	.0627	.2381**
T_6 vs T_8	1	.0444*	.0888	.0294
T_7 vs T_8	1	.0840**	.0074	.2017**
$T_{6,7}$ vs T_8	1	.0827**	.0491	.1284*
Error	14	.0084	.0315	.0177
Phase II				
$T_{4,5}$ vs $T_{6,7}$	1	.0033	.0016	.0154
$T_{4,6}$ vs $T_{5,7}$	1	.0225*	.0481	.0154
$T_{1,2,3}$ vs $T_{4,5,6,7,8}$	1	.1166**	.5321*	.0314
$T_{4,5,6,7}$ vs T_8	1	.1363**	.7216*	.0157
T_6 vs T_8	1	.0864**	.4874*	.0081
T_7 vs T_8	1	.1094**	.3800	.0384
$T_{6,7}$ vs T_8	1	.1301**	.5760*	.0212
Error	14	.0035	.0877	.0200
Phase III				
$T_{4,5}$ vs $T_{6,7}$	1	.0972*	.6120	.0901
$T_{4,6}$ vs $T_{5,7}$	1	.0056	.0044	.0936
$T_{1,2,3}$ vs $T_{4,5,6,7,8}$	1	.0301	.0789	.1054*
$T_{4,5,6,7}$ vs T_8	1	.0077	.2419	.0101
T_6 vs T_8	1	.0096	.0043	.0988
T_7 vs T_8	1	.0003	.0254	.1400*
$T_{6,7}$ vs T_8	1	.0022	.0168	.0460
Error	14	.0111	.0894	.0229
Overall				
$T_{4,5}$ vs $T_{6,7}$	1	.0350*	.0752	.0234*
$T_{4,6}$ vs $T_{5,7}$	1	.0070	.0001	.0234*
$T_{1,2,3}$ vs $T_{4,5,6,7,8}$	1	.0728**	.1836*	.0777**
$T_{4,5,6,7}$ vs T_8	1	.0799**	.3096**	.0390*
T_6 vs T_8	1	.0150	.1176	.0008
T_7 vs T_8	1	.0384	.1176	.0308*
$T_{6,7}$ vs T_8	1	.0338	.1568*	.0139
Error	14	.0047	.0281	.0049

* ($P<.05$)
**($P<.01$)

TABLE 3. CARCASS MEASUREMENTS FROM PIGS FED HIGH LYSINE CORN- AND NORMAL CORN -SOYBEAN MEAL RATIONS WITH AND WITHOUT LYSINE SUPPLEMENTATION

	Diets							
	1	2	3	4	5	6	7	8
Corn, source	HL	HL	HL	N	N	N	N	N
Lysine added	0	0	0	0	+	0	+	+
Protein and lysine[a]								
Phase I	16(.96)	14(.83)	12(.69)	16(.85)	16(.97)	14(.71)	14(.82)	12(.68)
Phase II	14(.83)	12(.69)	10(.56)	14(.71)	14(.82)	12(.56)	12(.68)	10(.56)
Phase III	12(.64)	10(.56)	10(.56)	12(.56)	12(.68)	10(.42)	10(.56)	10(.56)
No. of pigs	12	12	15	8	14	12	14	11
Final wt., lb.	217.6	208.8	204.7	221.1	217.6	208.5	214.4	202.8
Carcass wt., lb.	162.2	156.6	151.3	162.2	162.6	155.1	157.9	150.8
Length, in.	30.7	30.2	30.1	30.2	30.5	30.2	30.7	30.3
Backfat, in.	1.24	1.33	1.42	1.41	1.32	1.40	1.36	1.35
LEA, in.^{2}	5.69	4.93	4.13	4.74	4.84	4.56	4.52	4.39
Dressing percent	74.9	75.9	74.5	74.6	74.9	74.8	74.2	74.9
Marbling	7.0	7.8	8.8	6.9	6.4	9.4	7.6	9.1
Quality	8.1	7.4	7.2	7.3	7.7	7.3	7.6	7.0

[a]Calculated levels

[b]Significant treatment comparison

Loin eye area	Marbling	Dressing percent
T_1 vs $T_{4,5}^{**}$	$T_{4,5}$ vs $T_{6,7}^{*}$	T_4 vs T_5^{*}
T_{1-3} vs T_{4-8}^{*}		T_2 vs $T_{6,7}$

NITROGEN DIGESTIBILITY AND UTILIZATION OF PIGS FED LYSINE CORN- AND NORMAL CORN-SOYBEAN MEAL DIETS

E. T. Kornegay and H. R. Thomas

Studies conducted by animal scientists at the University of Kentucky have shown that Obaque-2 corn is more digestible and has a higher biological value than normal corn. The present digestion-metabolism study was conducted as a part of previously reported feeding trials to determine the digestibility and nitrogen utilization of high lysine corn versus normal corn at two protein levels.

Experimental Procedure

Thirty six crossbred pigs taken from pens fed diets 1, 2, 4 and 8 during phase II of the feeding trial were placed in metabolism stalls. Pigs were continued on their respective diet and were given a nine day preliminary period to adjust. This was followed by a five day collection period during which urine and feces were collected. Pigs were fed approximately what they would clean up within an hour during the preliminary period. After one hour, feed that had not been consumed was removed from the feed trough and water was placed in the feed trough until the next feeding. Intake was reduced about 10% during the collection period. Pigs were fed twice each day equal portions. Pigs were weighed at the beginning and the end of each trial. Blood samples were also taken at the completion of the trial.

Results and Summary

The digestibility, nitrogen balance and performance data is shown in table 1. The daily nitrogen intake was greater for pigs fed diets 1 and 4 than diets 2 and 8 because of the designed difference of the diets. There were also differences in nitrogen intake due to corn sources. Pigs consumed slightly more of the high lysine corn-soybean meal diet than the normal corn-soybean meal diet. Nitrogen (or protein) digested was significantly less for pigs fed the lower protein diets.. This may just be due to the differences in protein levels of the two diets fed and the difference would be due to the effect of protein level. There was a significantly lower nitrogen digestibility for pigs fed the normal corn diet as compared to the high lysine corn diets. This effect might be related to the slightly lower daily nitrogen intake for pigs fed the normal corn diets. Pigs fed the high lysine corn diets retained more of the digested nitrogen as compared to pigs fed the normal corn. Pigs fed the lower protein diets retained less nitrogen as compared to pigs fed the higher protein diets. When nitrogen retained was related to intake or digested nitrogen there was no significant difference due to either source of corn or protein level. Performance was essentially the same for all pigs with the exception of a reduction in intake for pigs fed the normal corn versus high lysine corn during the collection period. There was also a slight increase in the intake for pigs fed the lower protein level as compared to the high protein level during the collection period.

In summary the differences in nitrogen digestibility between high lysine corn and normal corn and between low versus high protein levels may be due only to differences in daily nitrogen intake for the various groups of pigs. Nitrogen retained did appear to be higher for pigs fed the high lysine corn diets as compared to pigs fed the normal corn diets. There was little difference in performance which is somewhat contradictory to results from the feeding trial where pigs fed the normal corn had slightly greater daily gains and were slightly more efficient as compared to pigs fed the high lysine corn diets. However, performance data from digestion trials have to be interpreted with caution as the animals are under some stress.

TABLE 1. SUMMARY OF NITROGEN DIGESTIBILITY AND BALANCE DATA AND PERFORMANCE DATA

	Rations[1]				Statistical Analysis		
	1	2	4	8	Corn Source	Pro. Level	Inter-Action
Corn Source	High lysine corn		Normal corn				
Protein and lysine %	14(.83)	10(.56)	14(.71)	10(.56)			
No. of pigs	9	9	9	9			
Initial wt., lb.	136.6	103.2	135.1	121.9	*2	*2	-
Beginning (coll) wt., lb.	143.55	114.22	144.66	128.66	-	**2	-
Final (coll) wt., lb.	150.66	119.88	149.66	133.11	-	**2	-
Daily N intake, gm	41.88	31.12	39.66	29.22	**2	**2	-
Daily fecal N, gm	5.69	4.91	6.13	5.86	*2	-	-
Daily urine N, gm	12.59	8.59	12.31	7.93			
N-digested, gm	36.19	26.21	33.53	23.36	**2	**2	-
N-digested, %	86.43	84.25	84.64	79.82	**2	**2	-
N-retained, gm	23.60	17.62	21.22	15.42	**2	**2	-
N-retained/BW, gm	0.17	0.16	0.15	0.12	*2	-	-
N-retained/intake, %	56.35	56.63	53.90	52.80	-	-	-
N-retained/digested, %	65.19	67.26	63.22	65.94	-	-	-
Preliminary AGD, lb.	0.96	1.18	1.03	0.83	-	-	**2
Preliminary ADFI, lb.	3.32	3.48	3.32	3.39	-	-	-
Preliminary F/G	3.69	3.20	3.26	4.48	-	-	-
Collection ADG, lb.	1.02	1.13	1.00	0.89	-	-	-
Collection ADFI, lb.	4.01	4.16	3.86	3.97	**2	*2	-
Collection F/G	4.13	3.98	3.72	4.92	-	-	-

[1]Same diets and pigs as in previous study.
[2](P<.05)*, (P<.01)**

INTERACTION OF DIETARY COPPER AND IRON AS MEASURED BY BLOOD PARAMETERS AND FEEDLOT PERFORMANCE OF SWINE

J. D. Hedges and E. T. Kornegay

Copper when added to swine diets at levels of 150 to 250 ppm has been shown to stimulate growth and improve feed efficiency similar to that reported for low level antibiotics. Hemoglobin levels have been reported to be depressed when the high level of copper is fed. Due to the known antagonism of copper and iron, it has been suggested that dietary iron levels should be increased when high levels of copper are fed. It has also been suggested that in the presence of high levels of iron which may be found in many of our natural diets, that the copper requirement of the pig is greater than 6 ppm.

The objectives of the present study were: 1) to ascertain if a high level of iron will overcome the anemic effects of high copper levels and 2) to determine if higher than NRC recommended levels of copper are needed when diets contain high levels of iron.

Experimental Procedure

Seventy two crossbred pigs averaging 17.8 lb. were used in two six week trials to determine the effect of the following diets upon feedlot performance and blood constituents: 1) basal - 7 Cu, 92 Fe; 2) 21 Cu, 92 Fe; 3) 259 Cu, 92 Fe; 4) 7 Cu, 263 Fe; 5) 21 Cu, 265 Fe; 6) 255 Cu, 264 Fe (total Cu and Fe in ppm by analysis). All diets contained 102 ppm Zn. Feed intake was equalized within blocks. The basal diet was an 18% protein diet composed of dairy nutrient blend, soybean meal, and corn, fortified with purified minerals and vitamins (table 1). Dairy nutrient blend was used because of its low copper content (3 ppm) and high quality protein. Reagent grade sodium chloride, dibasic calcium phosphate and calcium carbonate were used to maintain a low level of iron in the basal diet. The pigs were kept in stainless steel cages to eliminate the possibility of mineral contamination. Pigs were given water _ad libitum_ and were fed three times daily. Blood samples were taken initially and at two week intervals. All minerals were determined using a Perkin Elmer 403 Atomic Absorption Spectrometer. The analysis of variance was used for statistical analysis of the data.

Results and Summary

Differences in growth were not significant although the higher level of copper resulted in a trend towards heavier weights regardless of the dietary iron level. This slight increase in weight would be due to increased feed efficiency since feed intake between treatments was equalized (table 2). Added iron increased hematocrit and hemoglobin values ($P<.01$). Copper at the highest level tended to decrease hematocrit and hemoglobin levels although differences were not significant. Serum iron values were increased by the addition of dietary iron and decreased when copper was added. At two weeks, copper levels were increased when diets contained either 21 or 257 ppm copper but were not different at six weeks. Serum ceruloplasmin values which may give an indication of the copper status of the animal were depressed when the diet contained the highest dietary copper level.

In summary, these results suggest, although not conclusively, that supplemental iron may be necessary when high levels of copper are added to obtain growth stimulation.

TABLE 1

COMPOSITION OF BASAL DIET[1]

Item	Percent
Dairy nutrient blend (20% CP)	10.0
Soybean meal (45% CP)	22.0
Ground yellow corn (8.7% CP)	65.1
NaCl	0.5
Vitamin premix[2]	0.5
Dibasic calcium phosphate	0.9
Limestone	1.0

[1]Calculated to contain 18% crude protein.
Dairy nutrient blend was analyzed to contain 4 ppm Cu and 40 ppm Fe; soybean meal contained 18 ppm Cu and 154 ppm Fe; corn contained 4 ppm Cu and 34 ppm Fe.
The basal diet had 30 ppm Fe and 59 ppm Zn added.

[2]Vitamin premix supplied (per kilogram of diet); vitamin A, 1100 I.U.; vitamin D, 220 I.U.; pantothenic acid, 8.8 mg; niacin, 11.0 mg; riboflavin, 2.2 mg; choline chloride, 660 mg; vitamin B_{12}, 44 mcg.

TABLE 2. WEIGHT GAIN, HEMATOCRIT, HEMOGLOBIN, SERUM IRON AND COPPER, AND CERULOPLASMIN OF PIGS FED DIETS CONTAINING THREE LEVELS OF COPPER AND TWO LEVELS OF IRON

	Cu, ppm			
Fe, ppm	7	21	257	Mean
	Weight - 6th week			
92	27.69	27.72	29.39	28.26
264	27.11	27.31	28.28	27.56
Mean	27.40	27.52	28.84	
	Hematocrit (%) - 6th week			
92	40.66	39.14	38.12	39.31[a]
264	41.18	43.55	40.88	41.87
Mean	40.92	41.34	39.50	
	Hemoglobin (g/100 ml) - 6th week			
92	13.74	13.46	12.72	13.31[a]
264	14.08	14.54	13.89	14.17
Mean	13.91	14.00	13.31	
	Serum Iron (ppm) - 6th week			
92	1.93	1.66	1.96	1.85[b]
264	2.45	1.86	1.98	2.10
Mean[c]	2.19	1.76	1.97	
	Serum Copper (ppm) - 6th week			
92	1.33	1.32	1.39	1.35
264	1.30	1.31	1.50	1.37
Mean	1.32	1.31	1.45	
	Ceruloplasmin (I.U.) - 6th week			
92	53.35	58.80	48.18	53.44
264	49.40	52.16	48.00	49.85
Mean[c]	51.38	55.48	48.09	

[a]Significant ($P<.01$) Fe effect

[b]Significant ($P<.05$) Fe effect

[c]Significant ($P<.05$) Cu effect