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1981 ANIMAL SCIENCE RESEARCH PROGRESS REPORT

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DEPARTMENT OF ANIMAL SCIENCE

FOREWORD

Please accept with our compliments the 1981 Animal Science Research Progress Report. These summaries will provide a partial overview of our departmental research program. Continuing projects are not included every year. Therefore, a complete overview would require two or three years to accomplish. It is fully intended that much of this information will eventually appear in more detailed publications, experiment station bulletins or journal articles, but if you have more immediate need for additional information, feel free to contact the authors.

The research program of the Animal Science Department is directed toward providing meaningful information that is relevant to the animal agriculture industry of the State of Tennessee. Much of this research data would also be applicable to the southeast and/or national in scope. These efforts are made possible by the support of legislature and the livestock industry and its associated agribusinesses. We definitly appreciate that support.

The department has experienced some unusual losses in the last year. Drs. Merriman and Tugwell retired within the last year and Drs. Chamberlain and Murphree are contemplating retirement during 1982. In addition, Dr. Johnson, the former Head of the Animal Science Department, accepted the challenge of guiding the Oklahoma Agriculture Experiment Station on the first of September, 1981. In addition, valued members of the department (appointments in the College of Veterinary Medicine), Drs. Bratton, Kincaid and Schaub, accepted appointments at other institutions. (Bratton at Texas A&M, Kincaid at Purdue, and Schaub with UpJohn). Obviously, the replenishment of our ranks is a priority item and essential to the growth of the program. A complete faculty listing appears in the back of this publication.

During the year 1981, the new research facility at the Plateau Experiment Station to study the management of feeder pigs was completed and is now being utilized. The revision of the rotary parlor to a double herring bone was completed at the WTES unit. Unfortunately, we still have not been able to obtain the badly needed poultry unit or complete remodeling swine and beef facilities at Blount Farm or the dairy unit at Cherokee Farm or to complete the repairs to the roof of Brehm Animal Science building.

In spite of these problems, we are planning on another productive and rewarding year in our research and teaching programs.

Don O. Richardson
Professor and Acting Head

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FATTENING PATTERNS IN YEARLING STEERS SERIALLY SLAUGHTERED AFTER SPRING-SUMMER GRAZING

B. B. Green, W. R. Backus and M. J. Riemann

Beef cattle are traditionally fattened on grain prior to slaughter to enhance the eating quality of the steaks and roasts from the carcass. However, in recent years there has been a growing demand for ground beef and a somewhat diminished demand for roasts from the less tender portions of the carcass. This study was conducted to describe the fattening patterns, in those cuts which most logically should be made into ground beef, from steers which had been grown on Spring-Summer pasture and then slaughtered after varying lengths of feedlot finishing.

Ninety yearling Angus steers were allotted to 6 slaughter groups of 15 each. One group was slaughtered at the end of the grazing season and one group after 28, 56, 84, 112 and 140 days, respectively, of full feed in the feedlot. The cuts were removed from the carcass, the bone and connective tissue was removed and all the soft tissue (muscle and fat) was ground. Representative samples of each were analyzed chemically for fat content as was a representative sample of all the ground cuts mixed together. Those cuts fabricated as ground beef were the chuck, brisket, foreshank, plate, rib ends, flank, loin flap and hind shank. The fat content of these cuts both with and without the contribution of the chuck was calculated.

1. Percent fat in all cuts increased from 12.01% to 32.65% during the 140 day feeding period.

2. The fat level of regular ground beef (27%) was attained in those cuts selected for grinding between 84 and 112 days on full feed.

3. At 140 days on full-feed the Angus steers in this study did not get overly finished having an average yield grade of 2.69 and had marbling to qualify them for the average choice grade and an average carcass weight of 632 lb.

Table 1. Means of percent total fat of cuts selected for ground beef and carcass measurements by days on feed

Days on feed	Percent total fat	Percent total fat w/o chuck	Final fat thickness (mm)	Yield grade	Marbling[a]	Carcass wt. (lb)
0	12.01	14.46	2.34	1.61	2.65	355
28	18.31	20.03	4.49	1.84	3.67	435
56	22.08	24.22	7.70	1.91	4.93	465
84	25.08	28.72	10.87	2.55	5.79	540
112	28.91	31.35	14.05	2.81	6.24	588
140	32.96	35.05	12.07	2.69	6.59	632

[a]1 = Devoid, 5 = Small, 10 = Abundant, etc.

PALATABILITY CHANGES IN CARCASSES FROM YEARLING STEERS SERIALLY SLAUGHTERED AFTER SPRING-SUMMER GRAZING

K. L. Dunn, M. J. Riemann and W. R. Backus

There is much emphasis in the beef industry at present to reduce the length of time beef cattle are fed grain in the feedlot prior to slaughter. Proponents of shortening the length of feedlot finishing cite a significant decrease in the fatness of beef with little if any decrease in the eating quality of the edible portion as reasons for doing so. This study was conducted to study the effects of varying lengths of feedlot finishing following Spring-Summer grazing on the palatability characteristics of beef.

Ninety yearling Angus steers were allotted to 6 slaughter groups of 15 each. One group was slaughtered at the end of the grazing season and one group after 28, 56, 84, 112 and 140 days, respectively, of full feed in the feedlot. After slaughter and cooler aging, loin steaks were fabricated for analysis by a trained sensory panel and a quantitative descriptive analysis panel.

1. Steaks from steers slaughtered after the grazing season with no feedlot finishing were ranked lowest in tenderness, juiciness, flavor and overall desirability by the trained sensory panel.

2. Flavor was the characteristic which was improved to the greatest degree during feedlot finishing.

3. The undesirable flavor of the cattle slaughtered with no feedlot finishing was described by the quantitative descriptive analysis panel as a "milky-oily" flavor. The greatest decrease in this undesirable flavor component was during the first 84 days on feed with a slight degree of decrease thereafter.

Table 1. Quantitative descriptive analysis means[1] of loin steaks from steers varying in time on feed

Quantitative descriptor	Days on Feed					
	0	28	56	84	112	140
Milky-oily aroma	68.1	66.8	61.2	58.5	55.7	50.8
Beef fat aroma	55.9	53.4	61.1	66.0	67.7	71.9
Milky-oily flavor	80.6	81.2	63.9	56.5	54.2	51.4
Beef fat flavor	56.8	59.5	69.9	83.1	86.1	87.8
Liver flavor	26.6	26.2	28.8	31.6	27.8	30.5
Sour flavor	33.8	40.2	39.8	40.7	41.6	39.0
Raw flavor	27.3	29.9	27.1	31.3	32.8	32.6

[1]Measured on a 1-150 mm scale, 1 = slightly intense, 150 = extremely intense

SUBSTITUTION OF WHOLE WHEAT FOR WHOLE CORN IN FINISHING RATIONS FOR YEARLING CATTLE

W. R. Backus, D. Wright, J. T. Fain, J. M. Anderson and N. W. Robinson

The primary use of wheat is as a component of the human diet. However, during times when wheat is in over-supply or when it is contaminated with other seeds (garlic, etc.) its price is competitive with other grains for livestock feed. It is recommended that wheat be processed prior to its inclusion in a beef finishing ration. However, suitable processing facilities are not readily available to many Tennessee farmers. Whole shelled corn rations have been found to be quite suitable for finishing yearling cattle. The objective of this research was to examine the alternative of substituting varying percentages of whole unprocessed wheat for whole shelled corn in a finishing ration for yearling cattle.

Trials were conducted at three branch stations. Whole wheat was substituted for whole corn at the rate of 20, 40 and 60 percent of the total grain ration. All rations were supplemented with Tend-R-Leen, a commercial 36% protein supplement.

1. No problems were encountered in ration acceptability or digestive disturbances by the inclusion of whole wheat in the ration.

2. Feed efficiency tended to decrease as the percentage of whole wheat in the ration was increased.

3. Average daily gain and most carcass characteristics showed a lack of linear response as the level of whole wheat increased in the ration.

4. From these data it appears that up to 40% whole wheat can be included in a mixture with whole shelled corn in a finishing ration for yearling cattle with no decrease in the acceptability of the carcasses and average daily gain with some decrease in feed efficiency.

Table 1. Least square means of performance variables

Treatment	Means		
	Final wt. (lb)	ADG (lb)	Feed efficiency
100% Whole corn	1034^{a}	3.24^{a}	6.65^{a}
80% Corn + 20% wheat	$1019^{a,b}$	$3.06^{b,c}$	$6.96^{a,b}$
60% Corn + 40% wheat	$1027^{a,b}$	$3.15^{a,b}$	$7.85^{b,c}$
40% Corn + 60% wheat	1008^{b}	2.98^{c}	7.92^{c}

^{a,b,c}Means in column with differing superscripts are significantly different ($P<.05$).

Table 2. Least squares means of carcass variables

Treatment	Means						
	Carcass fat(mm)	PKF%	Marbling[d]	Quality grade[e]	Yield grade	Carcass wt.(lb)	REA(in^2)
100% Whole corn	14.1^{b}	2.81^{a}	52^{a}	12.1^{a}	3.3^{a}	613^{a}	10.9^{a}
80% Corn + 20% wheat	13.1^{a}	2.72^{a}	51^{a}	12.0^{a}	$3.2^{a,b}$	$606^{a,b}$	10.9^{a}
60% Corn + 40% wheat	13.2^{a}	2.65^{a}	50^{a}	11.8^{a}	$3.1^{b,c}$	$608^{a,b}$	11.0^{a}
40% Corn + 60% wheat	11.9^{a}	2.50^{b}	50^{a}	11.8^{a}	2.9^{c}	593^{b}	10.9^{a}

^{a,b,c}Means in a column with differing superscripts are significantly different ($P<.05$).

[d]Marbling: 47 = small minus; 53 = small plus.

[e]Quality grade: 11:00 = high good; 12:00 = low choice.

BERMUDAGRASS AND FESCUE PASTURES WITH CLOVER FOR BACKGROUNDING BEEF STEERS

J. B. McLaren, H. A. Fribourg, R. J. Carlisle and J. M. Bryan

A backgrounding pasture experiment was conducted at Ames Plantation to measure animal gains and beef production. The seven pasture combinations were (1) "Midland" bermudagrass + ladino clover (MID + C), (2) Midland + 200 lb N/A (MID + N); (3) 1 A Midland plus 2 A of tall fescue + N (MID use F), (4) Midland overseeded with fescue + N (MID + F), (5) Common bermudagrass + 200 lb N/A (Common + N); (6) Fescue + clover (F + C), and (7) Orchardgrass + clover (O + C). The pastures were replicated twice and grazed using a modified put-and-take system which minimized the frequency of stocking rate changes within a pasture. Individual weight of tester animals were taken at about 21-day intervals during the grazing season. Beef production for each period was calculated by multipling the total number of animal grazing days per weighing period by the ADG of the tester steers.

1. Steers gained an average of 1.24 lb/day over the three year 138-day average grazing season. MID + C steers gained slightly more (1.27 lb/day) and O + C steers gained considerably more (1.82 lb/day). The other five treatments resulted in lower gains of 1.05 to 1.15 lb/steer/day. The smallest gains (1.05 lb/steer/day) were those of steers grazing the MID + F pastures, which had the largest number of grazing days (482) per acre.

2. The effects of the different pastures on animal gains were reflected in cumulative steer gains over the season (figure 1). During early spring, ADG of steers grazing fescue were rapid regardless of whether fescue occurred in mixtures with Midland or with clover. Steers grazing MID + C gained 15% faster than those grazing MID + N. Thus compensating for the lower stocking rate associated with MID + C pastures (304 vs 356 animal grazing days/A). The high quality and palatability of + C pastures was expressed as larger ADG (1.81 lb/steer) by the small number of steers grazing these pastures.

3. The high beef production on MID + F pastures (lb beef/A) was achieved due to the substantially higher stocking rate and longer grazing season associated with that treatment than those associated with other pasture combinations. Beef production from F + C was less than from MID + C. The greater productivity of MID + F than common + N was reflected by 25% greater beef production.

4. The semi-dormancy of fescue in summer limits its value for backgrounding operations. If F or F + C pastures are used, the backgrounded animals should be sold or moved to other pastures in early July. MID + C pastures resulted in 25% more beef/A than F + C pastures over the March to September grazing season. Producers who desire to background steers for this entire period might find that two pastures, one of fescue with clover and one of Midland with clover, might be of greater value than relying on one kind of pasture.

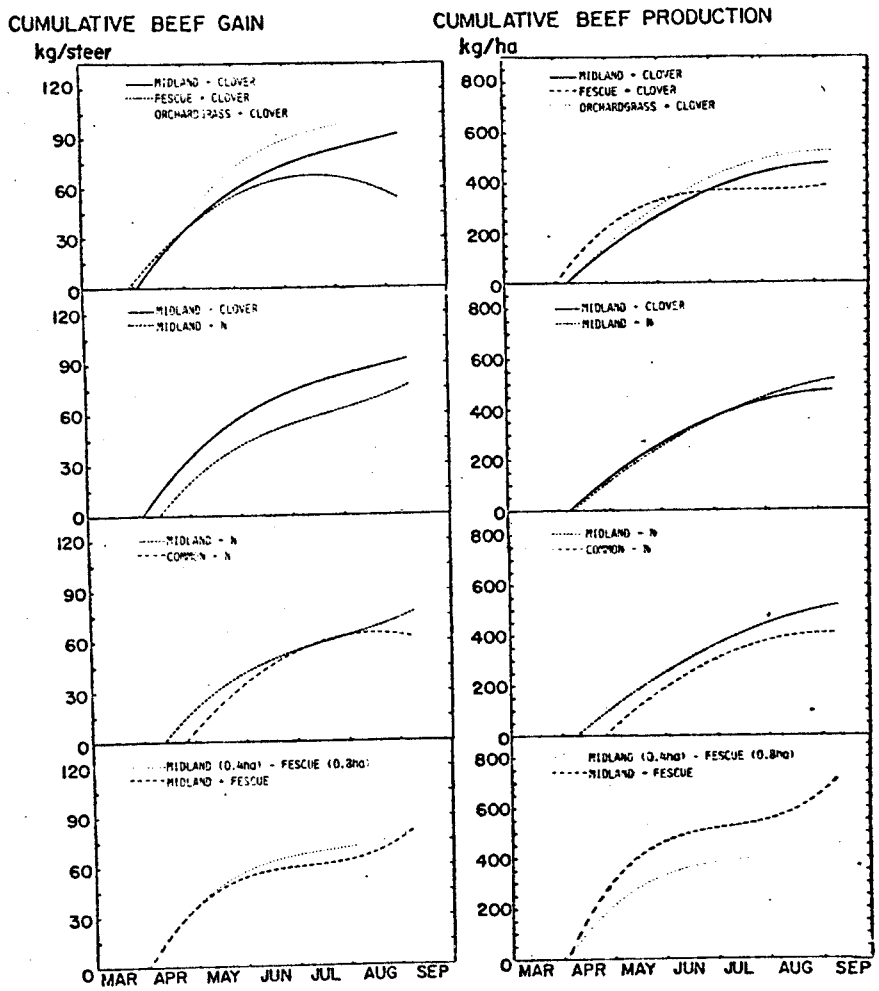


Figure 1. Cumulative beef gain and production (least squares 3-year means) for seven pasture combinations during the 1975-1977 grazing seasons.

CALF SIZE AND SHAPE AND RUMINAL CHARACTERISTICS

J. B. McLaren, P. J. Hamlett, W. S. Damron and L. M. Safley

During the fall feeder calf marketing seasons of 1977 and 1978, a total of 54 Hereford or Angus steer calves per year, weighing 125 to 250 kg, were purchased from two Tennessee feeder calf producers. Prior to weaning and marketing, each calf was weighed, body measurements (length, width, height, depth) were taken, fat cover at the 12th rib was ultrasonically estimated, and rumen fluid samples were collected. Coefficients of correlation between the individual body measurements and individual rumen characteristics were calculated on a within farm-year basis. In order to further evaluate the relationship of body measurements and rumen characteristics, a preliminary statistical model containing year, farm, a term for the value of each measurement (weight, length, height, depth, width and backfat thickness), the values squared, and the values cubed were fitted for each rumen characteristic. In the final analysis, all terms which were not significant were deleted and an interaction term between significants covariates was added. Results of the analysis are presented in figure 1.

1. Rumen liquid volume was correlated with calf weight ($P<.001$), width ($P<.05$), height ($P<.01$), and depth ($P<.01$). Propionic acid was the only VFA significantly correlated with individual body measurements. It was associated only with weight ($P<.05$), depth ($P<.01$), and fat thickness ($P<.05$).

2. In calves with smaller fat thickness, acetate increased as weight increased. Similar but less pronounced trends were observed in calves with 3 to 4.5 mm of fat. In calves with more than 4.5 mm of fat the acetate concentration was higher in the heavier (>300 lb) and lighter (<240 kg) calves than in calves with weight between 250 and 300 kg.

3. Inverse trends were observed in butyrate, with respect to the effect of body weight and fat thickness. Weight was the only body measurement that explained a large ($P<.001$) portion of the variation in propionate.

4. Trends observed with respect to the association of the higher VFA concentrations with calf weight and fat thickness were similar, but less pronounced than those observed for acetate. These trends were in light weight calves, but not observed in heavy (<280 kg) calves. Concentrations of total VFA in the rumen was associated with weight and backfat. The total VFA concentration increase was more rapid in fat calves than in less fat calves. The highest total VFA concentrations were observed in heavy calves with intermediate BF.

5. Depth and height were the only measurement variables associated with rumen protozoal concentrations. Concentration of the protozoal subclass, Spirotricha, decreased as depth increased in calves with lower wither heights, but increased in taller calves. Total rumen protozoal populations decreased as depth increased.

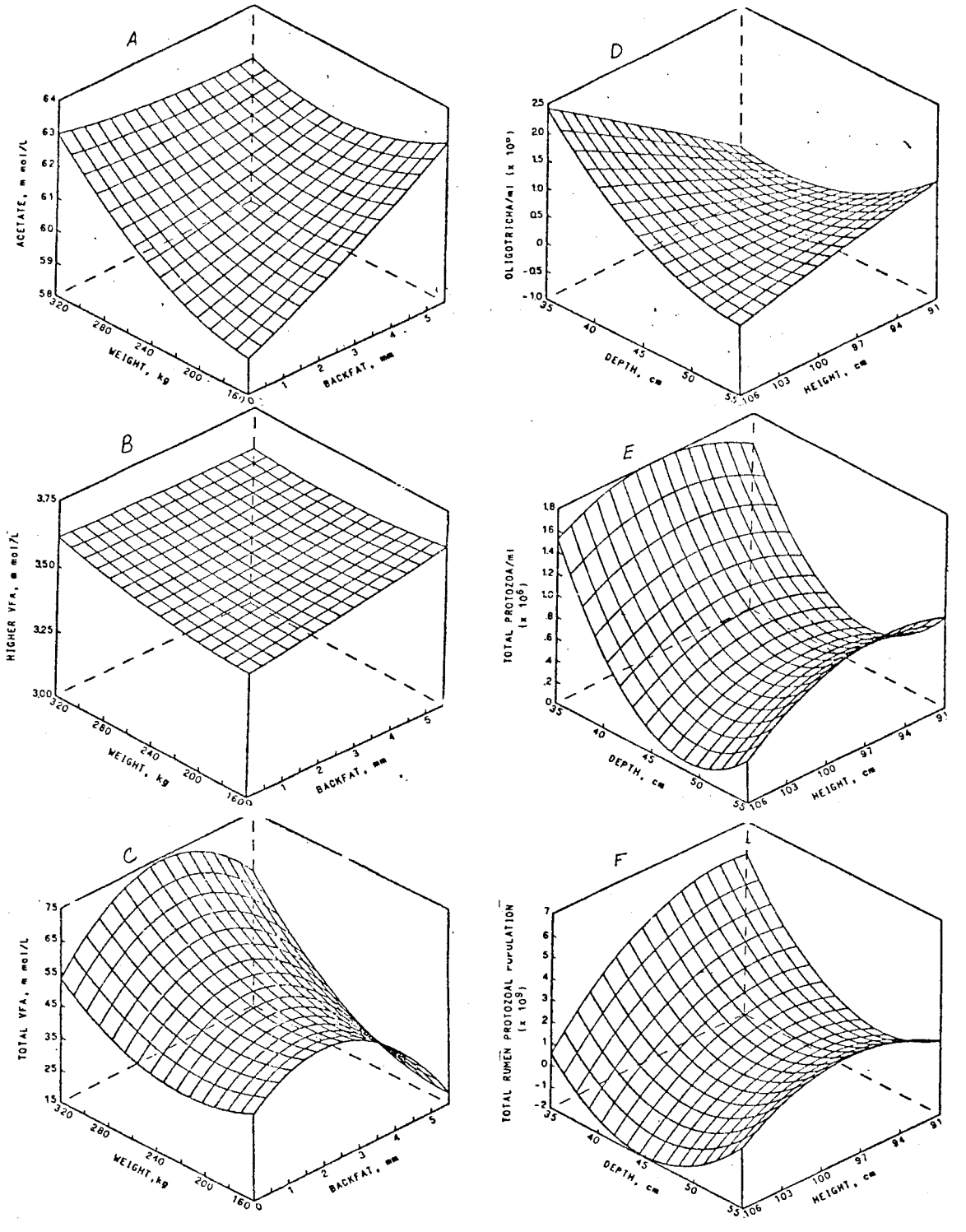


Figure 1. Relationship of individual body measurements to rumen parameters

THE RELATIONSHIP BETWEEN BODY SIZE OR SHAPE OF BEEF STEERS AND THEIR INTAKE AND DIGESTIBILITY OF NUTRIENTS

V. L. Fulgoni, III, K. M. Barth, S. Gelaye and W. T. Butts, Jr.

Body size and shape of cattle varies widely. It is feasible that beef cattle of different shapes and sizes could have different rumen volumes and rates of passage of ingesta. Thus, external differences may be indicative of internal differences. Digestibility of feedstuffs is dependent on rumen environment, therefore, differences in body size and shape may affect nutrient digestibility. Fibrous nutrients would be affected most by rumen environment since they must remain in the rumen a longer period of time to achieve maximum digestion. If this hypothesis holds true, then selection based on size and shape as related to higher nutrient digestibility could lead to more digestively efficient animals.

Seventy beef steers, over a period of three years, were utilized in this experiment. Weight, height, length, depth and width of each steer was measured at weaning. About six months after weaning, a digestion trial was conducted using acid-insoluble ash as an internal indicator. The animals were fed corn silage and a limited amount of concentrate. After a seven-day intake adjustment period, feed and fecal samples were collected for six days. Samples were analyzed for acid-insoluble ash and various nutrients, and nutrient digestibility calculated.

Canonical correlation, a multivariate statistical procedure, was utilized to determine the relationship among body size and shape at weaning to nutrient digestibility after removing the effects of year on each variable. This technique created a linear vector for both body measures and, intake and nutrient digestibility. Then the maximum correlation between these vectors was calculated. When significance was found, correlation of the original variables to their respective vector permitted an interpretation of which body measures was associated with which nutrient digestibility. The means of the observed values, after adjustment for year, are presented in table 1, while the canonical correlation and the correlation of the variables with their respective vectors are presented in table 2.

1. The first canonical correlation (u_1 with v_1) indicates that heavier, wider, longer, taller and deeper steers at weaning consumed more dry matter. Overall, this indicates that the larger animal has a greater intake.

2. The second canonical correlation (u_2 with v_2) indicates that taller, wider and less deep steers at weaning have higher digestibility of cell contents and crude protein, while having lower digestibility of cell-wall constituents and hemi-cellulose.

Table 1. Means and standard deviations of variables used in canonical correlation[a]

Variable	Mean[b]	Standard deviation
Weaning weight, kg	194.7	26.3
Weaning height, cm	89.6	4.5
Weaning depth, cm	41.5	5.4
Weaning length, cm	101.9	5.9
Weaning width, cm	31.9	3.3
Dry matter intake, kg/day	5.7	0.6
Apparent digestion coefficients, %		
Dry matter	57.6	5.8
Cell contents	61.9	7.2
Crude protein	51.5	7.2
Cell wall constituents	51.6	7.3
Acid-detergent fiber	45.9	7.5
Hemi-cellulose	58.0	8.9
Cellulose	57.2	6.2

[a]Observed values adjusted for year effects.
[b]Number of steers = 70

Table 2. Correlations of canonical variables with observed values[a]

Measure	u_1	u_2
Weaning weight	.97	.17
Weaning height	.61	.70
Weaning depth	.43	-.90
Weaning length	.67	-.26
Weaning width	.68	.46
	v_1	v_2
Dry matter intake	.72	.37
Apparent digestion coefficients		
Dry matter	-.08	.17
Cell contents	-.19	.50
Crude protein	-.01	.41
Cell wall constituents	.09	-.41
Acid-detergent fiber	.14	-.17
Hemi-cellulose	.03	-.53
Cellulose	.17	-.13
Canonical correlation	.64[b]	.92[b]

[a]Observed values adjusted for year effects.
[b]Correlations between u_1 and v_1 and between u_2 and v_2 are significant ($P<.001$).

FECAL INDICES: RELATIONSHIP BETWEEN FECAL COMPONENTS AND GREEN FORAGE DIGESTIBILITY AND INTAKE

G. R. Wehner, J. W. Holloway and W. T. Butts, Jr.

A limitation of nutritional research with grazing ruminants, especially under extensive pasture conditions, is that no reliable and simple technique for measuring intake and digestibility of forage ingested by undistrubed animals is available. Previous research indicated a relationship between fecal N and DM digestibility; however, this relationship changes with forage type and the various stages of maturity within a forage specie. This changing relationship necessitates the development of many individual regressions for each forage specie and stage of maturity. Much of the current research concerning this problem has been directed towards forage characteristics and their relationship to green pasture intake and digestibility. An inherent shortcoming of this approach is inability to account for selective grazing. The purpose of this research was to relate an array of fecal components to green forage intake and digestibility in order to develop broad application fecal indices for grazing beef cows. Thirty-eight *in vivo* digestion determinations with 3 year old, spring-calving cows were made on fresh red clover, orchardgrass-white clover, fescue and fescue-legume forages at various stages of maturity to obtain an array of intakes and digestibilities. Composite fecal samples were analyzed for various fecal components (table 1). Variables related ($P<.05$) to DM intake (DMI, kg/day), DM digestibility (DMD, %), fecal DM output (FDMO, kg/day) and digestible DM intake (DDMI, kg/day) are presented in table 2. All variables were regressed on these variables by use of a stepwise regression analysis, maximizing R^2 values (table 3).

1. Trial, animal and seasonal effects were accounted for by the indices.

2. Previous work showed fecal N and DMD were correlated, but the relationship changed with forage type and maturity. Use of additional fecal components overcame this.

3. DDMI was predicted with a high R^2 (0.75) than DMD, FDMO or DMI (0.67, 0.71 and 0.71, respectively).

4. Addition of animal weight to models slightly increased R^2 (0.09 for DMI; 0.04 for DDMI).

5. The equation, DDMI = 4.904 + 0.014 (wt) + 0.52 (N) + 0.279 (SOLN) + 0.145 (Ca) - 11.569 (MF/mm) + 4.963 (MF .5 mm) (R^2 = 0.79 and RSD = 0.70 kg/day) appears adequate for prediction of forage intake and digestibility by grazing beef cows.

Table 1. Fecal components analysis

Dry matter (DM)	Density
N	IVDMD
Ether extract (EE)	IVOMD
Crude fiber (CF)	Soluble N (SOLN)
Ash	CF-N
Cell wall constituents (CWC)	Acid detergent fiber (ADF)
	Acid detergent lignin (ADL)
Acid insoluble ash (AIA)	ADF-N
	ADL-N
Na	Acid soluble ash (ASA)
Zn	NFE
Mg	Cellulose (CELLU)
Ca	Cellu-N
K	Hemicellulose (HEMI)
Fe	Hemi-N
Mn	Modulus of fineness (MF) at:
P	-1.0 mm
Ca	-0.5 mm
	-0.25mm

Table 2. Independent variables related to Y variables ($P<.05$)

Y variables	Related independent variables
DMI (kg/day)	N, CF-N, HEMI, NFE, IVDMD, Ca, Cu
DMD (%)	N, SOLN, ADF, CWC, CELLU, NFE, EE, density, IVDMD, IVOMD, Ca, P, Cu, MF.5mm, MF.25mm
DDMI (kg/day)	N, HEMI, NFE, density, IVDMD, Ca, Cu
FDMO (kg/day)	ADF, ADL, EE, P, MF/ .0mm

Table 3. Example of stepwise regression for Y=DDMI (kg/day) without animal weight in model

# Variables	Model	R^2	RSD
1	3.14 + 0.14 (Ca)	.53	.96
2	2.43 + 0.31 (SOLN) + 0.13 (Ca)	.60	.89
3	1.11 + 0.37 (SOLN) + 0.16 (Ca) + 0.83 (Na)	.66	.84
4	0.07 + 0.36 (SOLN) + 0.21 (Ca) - 7.70 (Zn) + 0.91 (Na) - 9.88 (MF/mm) + 3.98 (MF.5mm)	.75	.75

DOSAGE RATE OF LASALOCID FOR YEARLING HEIFERS GRAZING FESCUE PASTURES

W. L. Backus, J. W. Holloway and W. T. Butts, Jr.

Lasalocid-sodium® is an ionophore which is similar to the widely used monensin-sodium®. Lasalocid has a similar effect on VFA concentrations in the rumen in that it inhibits acetate and butyrate producing bacteria and increases propionate producing bacteria. Lasalocid is also similar to monensin when used for feedlot cattle in that it reduces feed intake with either no change or an increase in growth rate. Use of monensin for pastured cattle has shown erratic results due to its low palatability which results in erratic consumption and a low rate of effectiveness. Lasalocid is more palatable than rumensin and is more likely to be effective in a grazing situation. The purpose of this experiment was to study the effective dosage rate of lasalocid for grazing cattle.

Seventy-two yearling black-baldy heifers were allotted to twenty-four 3 acre fescue pastures. All heifers were fed two pounds of a pelleted carrier feed containing varying concentrations of lasalocid, either 0, 50, 100, 200 or 300 mg of lasalocid per heifer per day. The heifers were weighed at 28 day intervals during the course of the trial (April 16 - July 9, 1981).

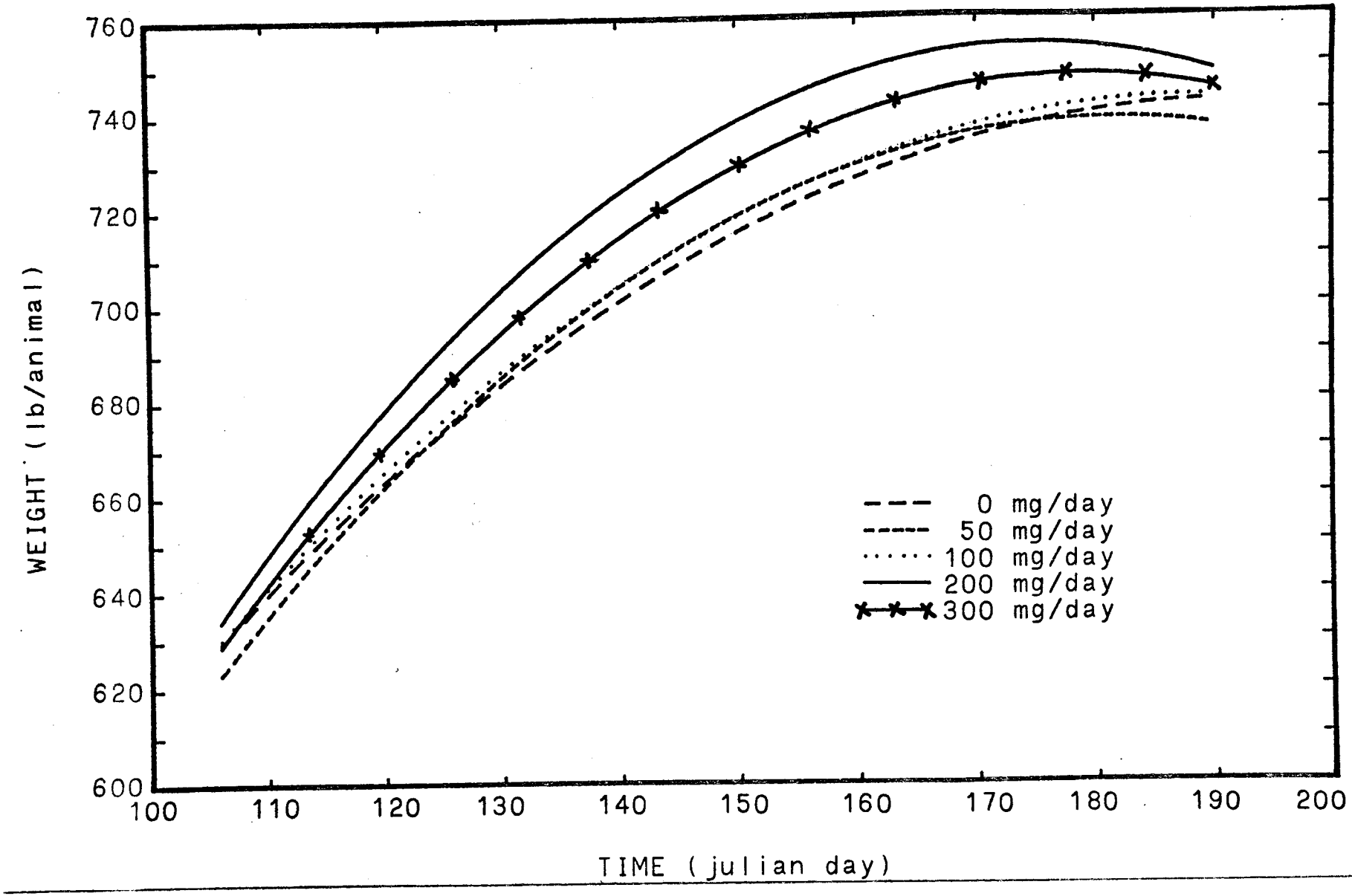
1. Heifers receiving 200-300 mg lasalocid/day gained ($P<.10$) faster during the first part of the trial than did those receiving less lasalocid.

2. During the later part of the trial, as the fescue became dormant, heifers grew at a very slow rate and the heifers receiving the larger amounts of lasalocid grew more slowly than those heifers consuming less lasalocid during this period (Figure 1).

3. There was a tendency for the heifers receiving 200-300 mg lasalocid/day to gain more rapidly than those receiving 0-100 mg/day with maximum performance being in those fed about 200 mg/day.

4. The optimum dosage rate of monensin is 200 mg/day; therefore, the optimum dosage rates of monensin and lasalocid under pasture situations appear to be quite comparable.

FIGURE 1. WEIGHT GAIN OF HEIFERS RECEIVING VARIOUS LEVELS OF LASALOCID



UTILIZATION OF FORAGE AND MILK BY ANGUS CALVES GRAZING FESCUE OR FESCUE-LEGUME PASTURES

E. Mahoney, J. W. Holloway and W. T. Butts, Jr.

Efficiency of conversion of milk and forage to calf gain is of importance to the cow-calf beef producer. Improved efficiency would result in more economical cow-calf production. A better understanding of the utilization of forage and milk for growth should aid in the development of more efficient beef production systems. Over a four year period, milk and forage intake and preweaning growth were estimated for a total of 153 Angus calves. These calves were born January-March and allotted to two, twenty-acre pastures (10 cow-calf pairs/acre) consisting of either fescue or fescue-legume (70% tall fescue and 30% red and white clover, Korean and Kobe lespedeza). Milk and forage intake were determined by the weigh-suckle-weigh technique and the internal (acid-detergent lignin)-external (Cr_2O_3) indicator technique, respectively. Calf growth patterns were determined by weighing calves at monthly intervals from the time of birth to weaning (October 15). Regression procedures were employed to determine influence of forage and milk DE intakes on weight and daily change in weight for each trial and pasture type.

1. Calves grazing fescue-legume pastures grew .18 kg/day more rapidly, however, but were less efficient in growth than calves grazing fescue.

2. Calves consuming fescue-legume pastures had higher intakes ($P<.001$) of milk DE and forage DE than those grazing fescue.

3. Generally, as lactation progressed, milk DE intake gradually decreased and forage DE intake gradually increased. However, milk DE composed a higher percentage of total DE intake for calves grazing fescue pasture than for those grazing fescue-legume pasture, especially during later lactation.

4. Calves grazing fescue legume, or forage of high energy density (3.4 Mcal DE/kg DM) while consuming small amounts of milk DE, compensated for low milk intakes by increasing forage DE intake. However, calves grazing fescue, or forage of low energy density (2.2 Mcal DE/kg DM) consumed approximately the same amount of forage DE regardless of level of milk DE intake (Figure 1).

5. Calves grazing fescue relied more on milk for growth, whereas calves grazing fescue-legume relied on forage for growth particularly during the middle and last parts of lactation.

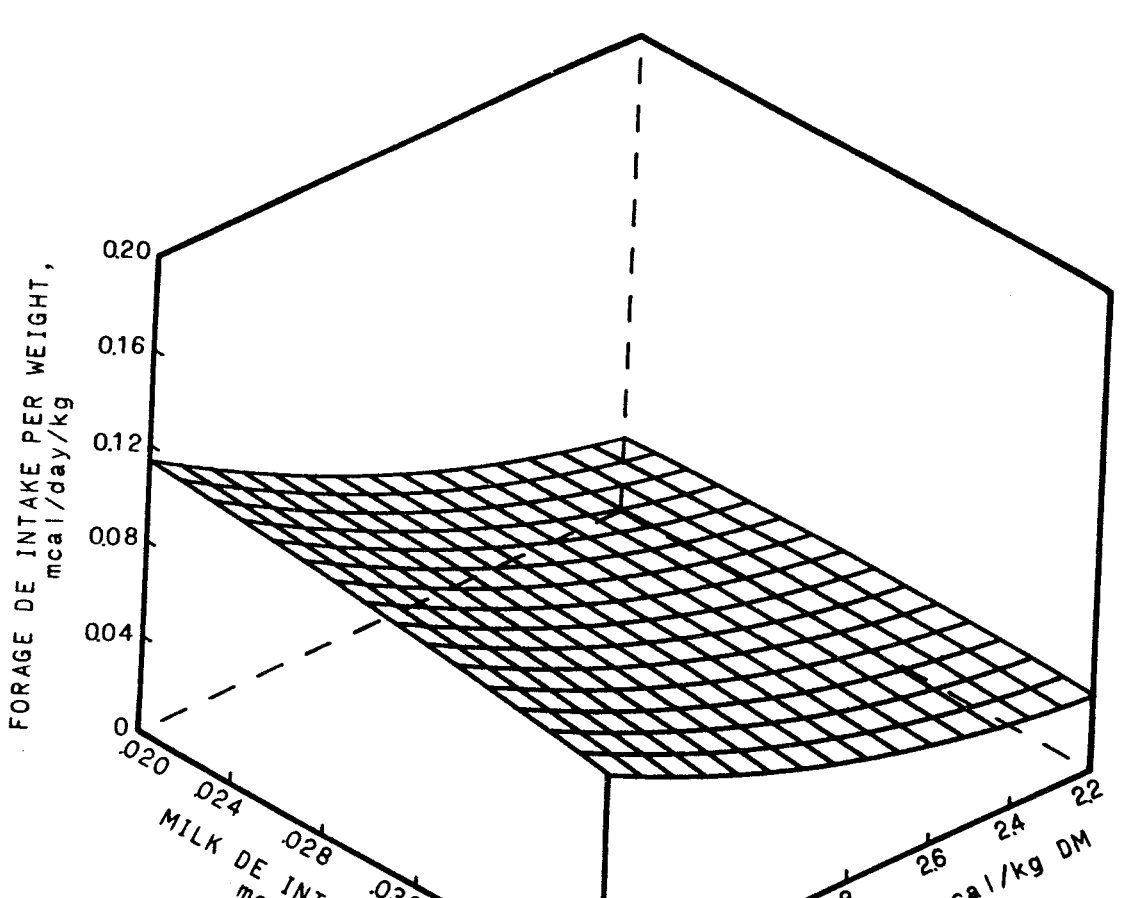


Figure 1. Relationship of forage DE intake, milk DE intake and forage quality.

PATTERN OF MILK INTAKE AS RELATED TO WEANING TRAITS OF ANGUS CALVES GRAZING FESCUE-LEGUME OR FESCUE PASTURES

E. E. Beaver, J. W. Holloway, T. L. Worley and
W. T. Butts, Jr.

Amount of milk consumed by beef calves is considered an important determinant of growth. However, the importance of milk to calf growth is thought to change as lactation progresses and the calf gets older. Most researchers report a decreasing correlation between milk consumption and rate of growth as lactation progresses, while some researchers have reported an increasing correlation. The purpose of this study was to estimate relationships between patterns of milk intake (amount and distribution) and weaning traits of calves grazing fescue-legume or fescue pastures. One hundred and ninety-seven lactations of mature Angus cows, ages from 5 to 12 years, grazing either fescue-legume pastures consisted of about 60-70% Kentucky-31 tall fescue, 30-40% legume, consisting of red clover, Korean, and Kobe lespedeza and white clover, while the fescue pastures were almost homogeneous stands of tall fescue. Twenty-four hour milk consumption was estimated by the weigh-suckle-weigh technique seven times a year per calf at monthly intervals. Calf weights were taken at these monthly intervals and withers height and fatness were measured at the time of weaning.

1. Milk intake curves of calves grazing fescue-legume pastures generally had similar levels at peak intake, but were more persistent than those of calves grazing fescue pastures, reflecting a difference in the quality of forage ingested by their dams during summer.

2. Calves consuming larger amounts of milk as an average through lactation were heavier, taller and fatter at weaning, and the relationship of milk intake and weaning traits was more pronounced for calves grazing fescue than for those grazing fescue-legume pastures.

3. Calves that consumed larger amounts of milk generally had more even distributions of milk intake than calves consuming similar amounts of an average of lactation. The most desirable pattern of milk intake for calf growth in each type of pasture was described by a high peak and low persistency (Figure 1).

4. Calves consuming milk in a distribution depicted by high peaks and low persistencies evidently grew more rapidly early and were physiologically more mature at any age and therefore more capable of forage consumption. This resulted in increased weaning weight.

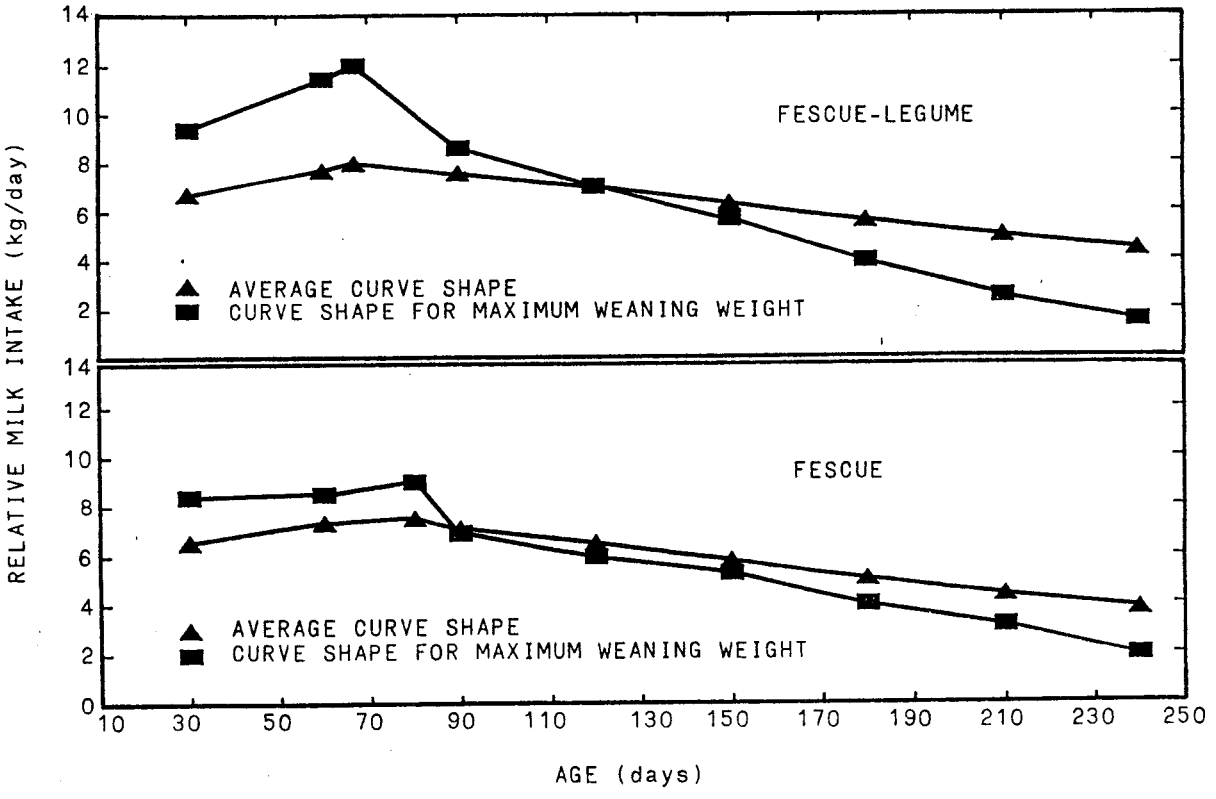


Figure 1. Relationship between lactation curve shape and weaning weight.

PHENOTYPE BY NUTRITIONAL ENVIRONMENTAL INTERACTIONS IN FORAGE INTAKE AND EFFICIENCY OF ANGUS COWS GRAZING FESCUE-LEGUME OR FESCUE PASTURES

G. R. Wehner, J. W. Holloway and W. T. Butts, Jr.

Data from drylot experiments have implicated mature cow size and milk yield as criteria related to biological efficiency. However, due to counter-balancing factors, only small variation among cows in net efficiency of weaned calf production resulted. Genotype x environment interactions involving forage intake and milk yield on pasture have not been reported. The purpose of this research was to evaluate a variety of phenotypes within the Angus breed (varying in mature size and lactation potential) grazing either fescue-legume or fescue pasture as to forage intake, milk yield, calf growth and efficiency of milk yield and calf growth over a five year period. Forage intake, milk production, calf growth and efficiency of milk production and calf growth were estimated for 198 lactations of 91 mature Angus cows. Cows calved January -March and calves were weaned in October of each of the five years of the experiment. Forage intake of the cows was continuously estimated for 152 days starting April 29, whereas 3 estimates of forage consumption by calves were obtained at 114, 147 and 197 days of age. Forage digestibility was estimated by the lignin ratio technique. Twenty-four hour milk productions were measured at monthly intervals beginning in April through weaning. Calves were weighed at birth and at monthly intervals to weaning. Cow weight and ultrasonic fatness was measured monthly during lactation.

1. Cows grazing fescue-legume consumed 1.4 kg/day more ($P<.01$) digestible DM, that was 4.6% more digestible ($P<.01$) than cows grazing fescue.

2. Cows grazing fescue-legume pasture produced 0.4 kg/day more ($P<.01$) milk and weaned 23.8 kg more ($P<.01$) calf; however, they were, in general, less efficient than those grazing fescue.

3. Cows grazing fescue-legume required 2.5 kg more ($P<.01$) digestible DM consumed by cow and calf/kg weaned calf than cattle allowed fescue.

4. Cows producing large amounts of milk consumed more digestible DM, weaned heavier calves, were more efficient producers of milk and weaned more kg of calf than cows producing smaller amounts of milk regardless of pasture type with the influence being more dramatic for cows on fescue than those on fescue-legume.

5. Factor analysis of data revealed two factors accounting for 70% of the correlation structure and can be defined in terms of cow type. Factor 1, explaining 49% of the correlation structure, may be considered largely as structural dimension of the cows, whereas factor 2, explaining an additional 21%, may be considered as weight and fatness independent of structural dimension (Figures 1 through 4). Factor 1 did not influence the relationship between digestible dry matter intake by the cow and calf/calf gain and milk production (Figure 2).

Figure 1. Relationships of DDMI by cow and calf per calf gain, milk production and factor 1 of cattle grazing fescue.

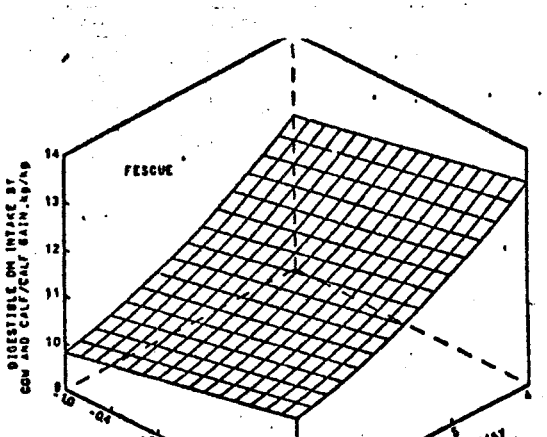


Figure 2. Relationship of DDMI be cow and calf per calf gain and milk production of cattle grazing fescue-legume.

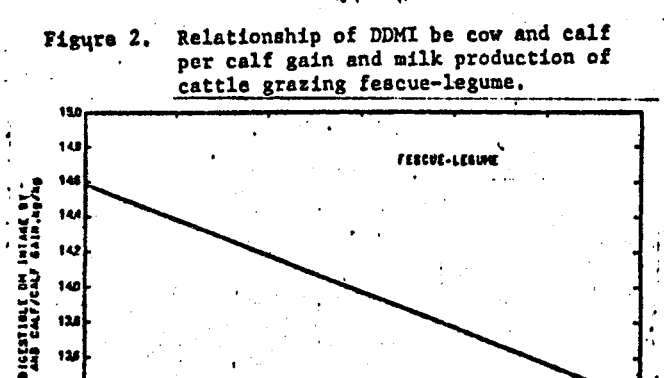


Figure 3. Relationship of DDMI by cow and calf per calf gain, milk production and factor 2 of cattle grazing fescue.

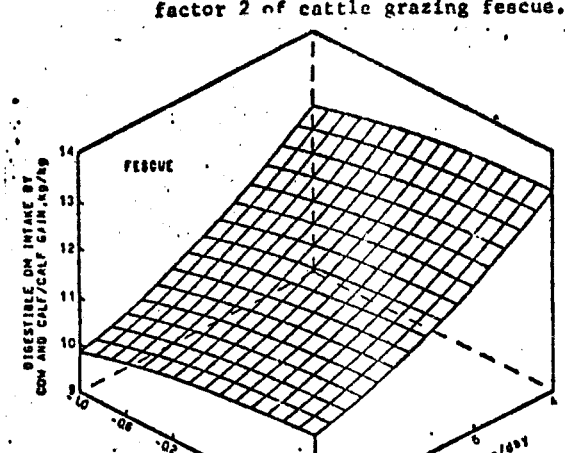
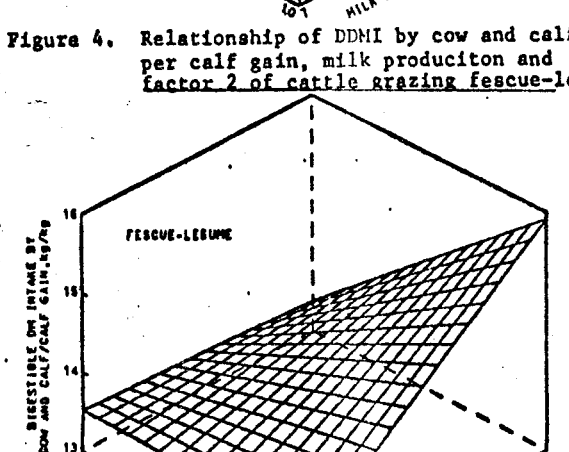


Figure 4. Relationship of DDMI by cow and calf per calf gain, milk produciton and factor 2 of cattle grazing fescue-legume



A STUDY OF TEN YEARS' DATA ON BLOOD TYPES IN AN ANGUS HERD
I. TRENDS IN FREQUENCIES

N. E. Sanders and R. R. Shrode

Blood types of all animals in the University of Tennessee Plateau Experiment Station Angus herd during the years 1970-1979 were studied to determine if there were any identifiable trends in the frequencies of red-cell antigens and transferrins within system. Of specific interest were changes in frequencies from calf crop to calf crop and differences between observed and expected heterozygosis.

1. Significant ($P<.01$ or $P<.05$) differences between calf crops with respect to several frequencies were observed within all but one of the eleven systems for which types were recorded.

2. Flucuation of frequencies from calf crop to calf crop was greatest (percentagewise) for the antigens and transferrins with the smallest frequencies.

3. In systems with some frequencies greater than .2, antigens and transferrins showing the greatest fluctuation from calf crop to calf crop were generally those found (in another study) to have the strongest association with average daily gain from birth to a year of age, the trait subjected to selection in this herd.

4. In the F and R systems, in which heterozygotes can be identified, observed heterozygosis was greater than expected heterozygosis in all calf crops except that born in 1977. However, this difference was found to be significant ($P<.01$ or $P<.05$) only in the R system in calf crops born in the years 1975 through 1979.

A STUDY OF TEN YEARS' DATA ON BLOOD TYPES IN AN ANGUS HERD
II. ASSOCIATIONS OF BLOOD TYPES WITH OTHER TRAITS

N. E. Sanders, R. R. Shrode and M. C. Bell

Results of attempts to demonstrate associations of blood types with other traits in cattle and other species have been inconsistent and, in some cases, contradictory between studies. The present study yielded evidence of some association between blood type and incidence of positive reactors to the brucellosis test, weaning weight, post-weaning weight, pre-weaning average daily gain, post-weaning average daily gain, certain body measurements and level of red-blood-cell potassium. Also, in some systems, differences were detected between homozygotes and heterozygotes with respect to some of the quantitative variables. These results, too voluminous for presentation numerically in their entirety here, are exemplified in table 1.

1. Types within the B, C and S red-cell antigen and the blood serum transferrin system differed ($P<.12$ to $P<.16$) with respect to frequency of positive reactors to the brucellosis test.

2. Types within the S red-cell antigen and the blood serum transferrin systems differed ($P<.01$ and $P<.05$) with respect to pre-weaning average daily gain.

3. Types within the S red-cell antigen and the blood serum transferrin systems differed ($P<.01$ and $P<.05$) with respect to pre-weaning average daily gain.

4. Types within the S red-cell antigen and the blood serum transferrin systems differed ($P<.05$) with respect to average daily gain to a year of age.

5. Types within the Z red-cell antigen and the blood serum transferrin systems differed ($P<.05$) with respect to weaning weight.

6. Types within the S red-cell antigen system differed with respect to yearling weight ($P<.01$) and ratio of body volume to height at hips at weaning ($P<.05$).

7. Types within the F-V red-cell antigen system differed with respect to heart girth ($P<.01$) and ratio of body volume to height at hips at weaning ($P<.05$).

8. Types within the J red-cell antigen system differed ($P<.05$) with respect to body length at weaning.

9. Within the S red-cell antigen system, heterozygotes had greater values than did homozygotes for pre-weaning average daily gain ($P<.01$), weaning weight ($P<.01$), yearling weight ($P<.01$), heart girth at weaning ($P<.01$), body length at weaning ($P<.05$) and height at hips at weaning ($P<.01$), and these genotype groups differed ($P<.01$) similarly within the Z red-cell antigen system also.

10. Types within the B and C red-cell antigen systems differed ($P<.01$) with respect to level of red-blood-cell potassium.

Table 1. Least-squares means of average daily gains and weights in kg by blood type within the S and Z blood group systems and transferrins

Blood group system	Blood type	Daily gain			Weight	
		Adjusted[a] weaning	Post weaning	Lifetime	Adjusted weaning	Yearling
		+	*	**	+	**
S	S0/S0	.88	.55	.70	200.8	280.0
	S1/S0	.90	.58	.73	200.9	290.0
	S1/S4	.84	.33	.63	193.4	297.9
	S4/S0	.95	.62	.74	210.0	294.4
	S4/S6	.92	.55	.72	209.8	287.8
	S6/S0	.94	.59	.75	212.2	298.5
	S12/S0	.95	.61	.75	199.2	293.2
	S12/S4	.93	.40	.66	210.5	267.2
	S12/S6	.96	.85	.86	208.9	341.8
		+			*	
Z	Z0/Z0	.89	.54	.72	203.3	285.4
	Z1/Z0	.91	.52	.72	208.0	285.1
	Z1/Z1	.93	.52	.74	206.2	290.0
		*		+	*	+
Trans-ferrins	Tf1/Tf1	.89	.53	.71	201.3	281.9
	Tf1/Tf2	.91	.53	.72	206.2	286.3
	Tf1/Tf3	.91	.52	.71	204.6	283.3
	Tf2/Tf2	.90	.54	.73	204.1	289.0
	Tf2/Tf3	.88	.52	.71	199.4	282.1
	Tf3/Tf3	.91	.57	.75	209.0	295.5

+ .05<P<.20, * .01<P<.05, ** P<.01

[a]Adjustments were made to remove variation due to differences in sex of calf and age of calf's dam.

VITAMINS A, D AND E INJECTION EFFECTS ON PREGNANT BEEF COW PLASMA Ca, Mg, AND K AND ON CALF VIABILITY

M. C. Bell, R. Q. Synder, J. E. Martin, D. D. Howard, L. K. West, G. Lambert and T. Johnson

Vitamin injections are being used routinely in may beef cattle herds. Reasons given include calf viability, more live calves born, need for extra vitamin A due to possible nitrate interference, to help prevent "pinkeye", and to prevent vitamin A deficiency. Most vitamin A injection solutions also include vitamin D and vitamin E is included as a preservative. The purpose of this research was to determine the effects of vitamins A, D and E injections on cows and their calves.

Blood samples were taken from 358 pregnant beef cows at three different experiment stations to determine the effect of vitamins A, D and E injections on plasma minerals and on calf viability. Injections were made between December 11 and December 18. Half of the cows were injected with a solution containing 4.5 million I.U. of vitamin A, 675,000 I.U. of D_3 and 450 I.U. of E, while an equal number of cows were injected with the same volume of physiological saline. Calves born to the injected cows were scored on viability ranging from 0 being a healthy calf and 5 being a dead calf. Forage samples taken when blood samples were obtained at the three stations were analyzed for beta carotene. Plasma samples were also analyzed for Ca, Mg, K and vitamin A.

1. Vitamin injections had no effect on plasma minerals. Research in other states using higher levels of vitamin D had found depressed plasma Mg levels.

2. In contrast to the previous year which showed no difference in number of dead calves, there were 8 dead calves in the control group and only 3 in the vitamin injected group.

3. This year there were about equal numbers of weak calves in each group while there were more weak calves in the vitamin injected group the previous year.

4. Beta carotene of forages fed these cows during December and January averaged .518 mg per kg which is less than that fed the previous year.

Table 1. Effects of vitamins A, D, and E injections on plasma minerals in beef cows in winter of 1980-1981. (mg/100 ml)

Injection	Days after injections		
	0	1	28
	---------- Calcium ----------		
Saline	10.82	10.48	10.07
Vitamins	10.77	10.47	10.00
	---------- Magnesium ----------		
Saline	2.20	2.21	2.30
Vitamins	2.17	2.19	2.29
	---------- Potassium ----------		
Saline	17.59	17.30	17.78
Vitamins	17.47	17.20	17.76

Table 2. Effects of cow injections on calves at birth - 1981

Calf score	Vitamin	Saline	Total
0 = healthy	139	117	256
1 = minor problem	5	2	7
2 = weak	10	10	20
3 = weak & minor problem	2	1	3
4 = weak & mechanical assistance	4	6	10
5 = dead	3	8	11
TOTAL	163	144	307

EFFECTS OF EXCESS K FERTILIZATION OF FESCUE PASTURES ON METABOLISM OF Mg, Ca AND K IN LACTATING BEEF COWS

D. L. Hodge, M. C. Bell and G. Lambert

Grass tetany is associated with many factors including excess fertilization of forages. It is more of a problem in Tennessee in older lactating cows with calves less than eight weeks of age than with other beef cattle. Grass tetany outbreaks are more prevalent on permanent pastures which are rapidly growing. The purpose of this research was to determine the effects of high K fertilization of fescue pasture on plasma Mg, Ca and K and on the metabolism of Mg, Ca and K in lactating beef cows.

For this study, 24 Angus cows averaging 466 kg and averaging 10 years of age were placed on two 4 hectare rapidly growing tall fescue pastures in February and March, 1981. Both pastures had been fertilized with 112 kg N and 169 kg P/hectare in Fall, 1980. One of the pastures was also fertilized with 224 kg K per hectare. Six cows in early lactation were placed on each pasture in late February for 14 days. A replication of this procedure was made in March using the other six cows on each treatment. Acid detergent lignin, chromic oxide, and creatine were used as indicators for the 7-day balance trial after a 7-day preliminary for each replication.

1. Cows on the control pasture consumed more forage and Mg than those on the K added pasture.

2. Cows consuming the K-added pasture had reduced urinary Mg excretion, indicating reduced Mg absorption.

3. Excretion of Mg and Ca in milk remained the same regardless of treatment and plasma Mg.

4. More cows on the K-added pasture had hypomagnesemia than those on the control pasture but none developed tetany.

5. Older cows had lower plasma Mg.

6. In spite of the individaul variation among cows, these data show that excess K fertilization reduced Mg utilization and could increase incidence of grass tetany in a tetany prone year.

Table 1. Means of daily Mg balance in grams, (± SEM)

Item	Treatment	
	Control pasture	K-fertilized pasture
Intake[a]	10.39 ± .56	9.21 ± .33
Excretion		
Fecal	6.37 ± .44	7.11 ± .34
Urinary[b]	1.68 ± .27	1.10 ± .19
Milk	.24 ± .01	.24 ± .02
Balance	2.10 ± .53	.76 ± .57

[a]Means within this row are different (P<.10); [b](P<.05).

Table 2. Effect of K fertilization on cow plasma Mg (mg/dl)

Pasture treatment	Day					
	0	3	5[a]	8[a]	10	12
Control	2.15	1.91	2.12	2.26	2.20	2.24
(± SEM)	.05	.07	.08	.08	.06	.07
+K	2.24	1.89	1.80	2.06	2.06	2.18
(± SEM)	.05	.06	.08	.08	.06	.07

[a]Means within this column are different (P<.05).

Table 3. Effect of age of cow on plasma Mg (mg/dl)

Age[a]	Day					
	0	3	5	8	10	12
1	2.46[b]	2.15[b]	2.19[b]	2.17[b]	2.28[b]	2.29[b]
2	2.19[c]	1.81[c]	1.87[c]	2.00[b]	2.08[bc]	2.21[b]
3	1.86[d]	1.74[c]	1.87[c]	2.04[b]	2.00[c]	2.08[b]

[a]Group 1, 5-9 yr; Group 2, 10-12 yr; Group 3, 13-15 yr.
[b,c,d]Means with different superscripts within columns are different (P<.05).

THE EFFECTS OF DEPLETION AND REPLETION OF MG ON BLOOD AND CSF MINERAL LEVELS IN YOUNG CALVES

C. K. Reynolds, M. C. Bell, M. H. Sims and G. H. Lambert

Rectal infusions of $MgCl_2.6H_2O$ solution have been shown to elevate plasma Mg levels in ruminants and have been suggested as an emergency treatment for grass tetany. Development of hypomagnesemic tetany has been shown to be accompanied by a drop in the level of Mg in the cerebrospinal fluid (CSF). Depletion and repletion of CSF Mg has been investigated in several species. It has not been established, however, how lowered CSF Mg is involved in development of hypomagnesemic tetany or by what physiological route(s) repletion of CSF Mg occurs. The objective of this study was to determine the effects of rectal infusions of $MgCl_2.6H_2O$ solution on plasma, CSF and RBC mineral levels in hypomagnesemic and normal calves.

After the diets had been fed long enough to deplete CSF Mg in calves on Mg deficient diets, two trials were run involving 8 Holstein bull calves each which were fed 1 of 4 different semipurified diets. The diets were: Mg deficient basal diet (1), basal diet plus 2.0% K (2), basal diet plus 0.1% Mg (3), and basal diet plus 0.1% Mg and 2.0% K (4). After the calves were fed the diets long enough to deplete CSF Mg in the calves on the Mg deficient diets, rectal infusions of 50 ml of a 30% $MgCl_2.6H_2O$ solution were given to each calf while under general anesthesia. Subsequent samples of blood and CSF were taken for a 3-hour period and the plasma, CSF and RBC were analyzed for Mg, Ca and K content.

1. Dietary K appeared to have no effect on blood or CSF Mg level.

2. The rectal infusions of $MgCl_2.6H_2O$ elevated ($P<.001$) plasma Mg levels within 5 minutes when given to calves on each diet.

3. Calves on the Mg deficient diets which had subnormal levels of CSF Mg had significant increases in CSF Mg level within 30 minutes after administration of the $MgCl_2.6H_2O$ solution.

4. The infusions appeared to have no effect on plasma Ca and K, CSF Ca and K, RBC minerals or packed cell volume.

5. One calf fed diet 1 had episodes of tetany which were treated successfully with $MgCl_2.6H_2O$ solution infusions. CSF samples taken during these episodes had Mg levels as low as 1.09 mg/dl.

Table 1. Mean blood plasma, CSF and RBC Mg levels in calves following a rectal infusion of a 30% $MgCl_2.6H_2O$ solution

Minutes after infusion	1 Low Mg, normal K	2 Low Mg, high K	3 Normal Mg, normal K	4 Normal Mg, high K
	Plasma Mg (mg/dl)			
0	0.51	0.57	2.09	1.94
5	1.30	1.41	2.80	3.40
15	1.87	1.95	3.31	4.17
30	2.02	2.11	3.36	4.33
60	2.10	2.22	3.49	4.30
120	2.00	2.45	3.41	3.89
180	1.98	2.37	3.19	3.73
	CSF Mg (mg/dl)			
0	1.66	1.79	2.12	2.14
5	1.67	1.87	2.10	2.15
15	1.78	1.87	2.24	2.17
30	1.94	2.02	2.24	2.21
60	2.02	2.08	2.17	2.19
120	2.18	2.28	2.15	2.22
180	2.16	2.26	2.15	2.26
	RBC Mg (mg/dl)			
0	1.18	1.30	1.72	1.61
5	1.47	1.48	1.95	1.67
15	1.33	1.55	1.85	1.71
30	1.36	1.34	1.93	1.72
60	1.36	1.52	1.88	1.80
120	1.34	1.59	1.82	1.76
180	1.39	1.60	1.82	1.71

THE EFFECT OF EXCESS K ON MINERAL METABOLISM IN HYPOMAGNESEMIC AND NORMAL CALVES

C. K. Reynolds, M. C. Bell and G. H. Lambert

Numerous factors have been shown to affect the metabolism of Mg and play a role in the etiology of grass tetany in ruminants. For more than 30 years it has been known that high dietary intake of K can increase the incidence of grass tetany and researchers have shown that excess dietary K can reduce the absorption of Mg from the digestive tract. It has also been shown that high levels of K can affect the level of circulating Mg through various mineral and hormonal interactions. Varying effects of K on Mg excretion have been reported from balance studies using cattle and sheep but very few studies have involved calves. In this study, effects of Mg deficiency and excess dietary K on mineral metabolism in young male Holstein calves were investigated.

A total of 16 calves were fed one of 4 semipurified diets in 2 trials involving 8 calves each. The diets were: Mg deficient basal diet (1), basal diet plus 2.0% K (2), basal diet plus 0.1% Mg (3), and basal diet plus 0.1% Mg and 2.0% K. Calves were maintained in metabolism stalls and fitted with harness and bags for separate collection of feces and urine. After a 5-day preliminary period, feed, feces and urine were weighed and sampled for a 5-day balance trial. Only samples from 9 calves were used for statistical analysis because of problems with diarrhea and anorexia.

1. For calves fed the Mg supplemented diets, the intake, fecal excretion and balance of Mg were greater ($P<.05$) than calves fed Mg deficient diets.

2. Urinary excretion of Mg was less for calves fed excess dietary K, however, differences were not significant statistically.

3. Supplemental K appeared to have no effect on Mg excretion or balance. Differences between means were much greater when the two Mg supplemented diets were compared than when the two Mg deficient diets were compared.

4. There were no differences in intake, excretion or balance of Ca.

5. The intake and urinary excretion of K was greater ($P<.05$) for calves consuming the diets supplemented with K. The balance of K was greater ($P<.05$) for calves consuming the diet supplemented with Mg and K.

Table 1. Least square means of daily Mg balance in grams

Item	Diet			
	1	2	3	4
No. of animals	2	3	2	2
Intake	.197[a]	.196[a]	1.694[b]	1.813[b]
Urinary excretion	.009	.008	.155	.075
Fecal excretion	.358[a]	.366[a]	1.048[b]	1.143[b]
Balance	-.170[a]	-.178[a]	.492[b]	.595[b]

[a,b]Least square means within a row superscripted with different letters are different ($P<.05$).

EFFECT OF DIFFERENT LEVELS OF SUPPLEMENTAL DIETARY IODIDE UPON TOTAL IODINE CONTENT OF ORGANS AND MEAT OF DAIRY COWS

E. W. Swanson, J. K. Miller and C. S. Patton

Dietary iodide frequently has exceeded nutrient requirements of lactating cows (.5 ppm) because iodides have been added from many sources, e.g. purchased dairy concentrate, trace mineral mixes, salt, and vitamin-mineral mixes. In some instances there has been an effort to maintain EDDI at 50 mg per cow daily (40 mg iodide) to aid in control of certain diseases (foot rot, lumpy jaw). This addition of EDDI would be 2 to 3 ppm in dry feed, or 4 to 5 times dietary requirement. The effect of 1, 2, and 4 ppm supplemental levels of iodide upon iodine concentration in meat was determined with 42 Holstein cows.

The cows were fed a diet of approximately 50:50 concentrate:roughage, consisting of a farm-mixed concentrate and corn silage at 2:3, fed to full appetite plus 5 to 10 lb of alfalfa-grass mixed hay. The feeding phases were divided into four consecutive 5 wk periods of basal, KI treatment, basal, and EDDI treatment. Diets of six groups of seven cows each were supplemented with 0, 1 ppm I, 1 ppm I + I teat dip, 2 ppm I, 4 ppm I and 4 ppm I + I teat dip during the treatment periods. Cows were slaughtered about 24 hr after the last dosing with EDDI. Carcasses and organs were examined for signs of pathology, and samples of about 200 g were taken from three muscle areas, adipose tissue, heart, liver, and kidneys. These tissues, plus the thyroid glands, were analyzed for total iodine. Analyses were corrected to full recovery on basis of determined partial recovery of radioactive thyroxine added to meat samples. Results of the analyses are presented in table 1.

A summary of observations is as follows:

1. No signs of iodism were seen in the treated cows at any time during the experiment. No significant pathological changes were noted that could possibly be associated with level of iodide feeding.

2. Iodine concentration in organs and muscle followed the trend of iodine in blood plasma, but was consistently lower except for that in kidneys. Iodine concentration in muscles was generally lower than that in heart, liver, and kidneys, but was higher than iodine in adipose tissue.

3. Effect of treatment on concentration of iodine in thyroid glands and on thyroid gland weight was not significant.

4. Teat-dipping with iodine did not cause a significant increase in iodine of tissues and organs.

5. This experiment indicated that 1 or 2 ppm iodide supplement to diets nutritionally adequate in iodide had a very small effect on iodine in tissues, but supplementing with 4 ppm iodide produced a significant increase in iodine concentration of most organs and tissues (table 1).

Table 1. Iodine concentration in organs and tissues of cows fed different quantities of ethylenediamine dihydriodide (EDDI) for five weeks before slaughter

Item	Treatments, (ppm suppl. I, teatdip)					
	0	1	1+ teatdip	2	4	4+ teatdip
Iodine intake (mg/d)	12.2	27.2	25.7	38.2	71.2	70.4
Body wt kg	680	736	697	680	704	693
Organ wts						
Liver, kg	9.91[a]	11.30[b]	10.97[b]	10.61[b]	10.81[b]	9.89[a]
Kidneys, kg	1.73[a]	1.94[a]	1.83[a]	1.84[a]	1.74[a]	1.75[a]
Heart, kg	3.23[a]	3.24[a]	3.17[a]	2.86[a]	3.11[a]	2.86[a]
Thyroid, g	34.6 [a]	40.6 [a]	35.0 [a]	33.8 [a]	41.0 [a]	42.0 [a]
I concentration						
Blood plasma (ug/L)	112[a]	158[b]	146[b]	170[c]	290[d]	273[d]
Liver (ug/kg)	106[a]	101[a]	114[a]	106[a]	157[b]	164[b]
Heart (ug/kg)	89[a]	94[a]	115[a]	103[a]	150[b]	132[b]
Kidneys (ug/kg)	118[a]	177[b]	154[b]	191[b]	245[c]	240[c]
Biceps M (ug/kg)	86[a]	92[a]	101[a]	108[a]	136[b]	99[a]
Triceps M (ug/kg)	84[a]	94[a]	80[a]	90[a]	108[b]	115[b]
Gluteal M (ug/kg)	88[a]	80[a]	91[a]	77[a]	108[a]	92[a]
Adipose T (ug/kg)	14[a]	15[a]	9[a]	11[a]	17[a]	13[a]
Thyroid (ug/g)	1672[a]	1653[a]	1693[a]	1915[a]	1936[a]	1802[a]

[abcd]Means in a row (across treatments) which have different superscripts are significantly different ($P<.05$).

EFFECT OF SUPPLEMENTING DIETS FOR DAIRY COWS AT 1, 2, AND 4 PPM IODIDE FROM KI OR EDDI UPON TOTAL IODINE CONCENTRATIONS IN BLOOD PLASMA AND MILK

E. W. Swanson, J. K. Miller and J. Bacon

In high producing dairy cows, the mammary gland is a major avenue of excretion of excess iodide. This system results in high concentrations of total iodine in milk when cows are fed more iodide than the nutritional requirement (.5 ppm DM). An experiment was conducted to determine the relationship of different levels of dietary iodide to total iodine concentrations in blood and milk. All dietary components and drinking water were analyzed for total iodine, and individual feed intakes were measured to determine the actual daily iodide intake. Six groups of seven cows each were used. Feeding periods of 5 wk were consecutively - (1) all basal diet, (2) supplemented with KI, (3) all basal diet, (4) supplemented with EDDI. In the treatment periods (2 & 4), six groups received: (1) only basal diet, (2) 1 ppm I added, (3) 1 ppm I added plus I teat-dipping, (4) 2 ppm I added, (5) 4 ppm I added, and (6) 4 ppm I added, plus teat-dipping. Concentration of total iodine in plasma and milk was determined twice weekly.

Results are shown in figure 1 (plasma) and figure 2 (milk). Concentrations of total iodine plotted in figures 1 and 2 are based on logarithmic means of iodine values adjusted within cows on the basis of iodine concentrations in the first basal period. These data give comparisons among 0, 1, 2 and 4 ppm supplement, between KI and EDDI supplements, and between teat-dipped and non-dipped cows (treatments 2 and 5 vs 3 and 6).

1. The treatment level effects were significant; 1 ppm I supplement resulted in higher milk and plasma iodine than that from the basal diet, and in turn 2 ppm I supplement, and 4 ppm I supplement each gave significant increases in milk and plasma I.

2. The general relationships of milk and plasma total iodine to daily iodide intakes were:

   $$\text{Milk I } (\mu g/L) = 128 + 9.5 \times \text{I intake } (R^2 = .46)$$

   $$\text{Plasma I } (\mu g/L) = 77 + 2.9 \times \text{I intake } (R^2 = .72)$$

3. When cow and treatment effects were removed the relationship of milk iodine to plasma iodine was:

   $$\text{Milk I } (\mu g/L) = .379 \times \text{plasma I}^{1.344} \quad (R^2 = .85)$$

4. Comparing plasma and milk total iodine for periods 2 and 4 within the treated groups showed that differences in plasma I due to supplement I source were not significant. However, milk total iodine was significantly higher from EDDI than from KI.

5. The effect of I teatdipping on plasma iodine was not significant, and its effect on milk iodine was not consistent, therefore, also non-significant.

6. The percentage of iodide consumed which was recovered from milk for 0, 1, 2, and 4 ppm I supplementation averaged 35, 36, 25, and 20. The trend to lower percentage recoveries in milk with higher iodide intakes was significant.

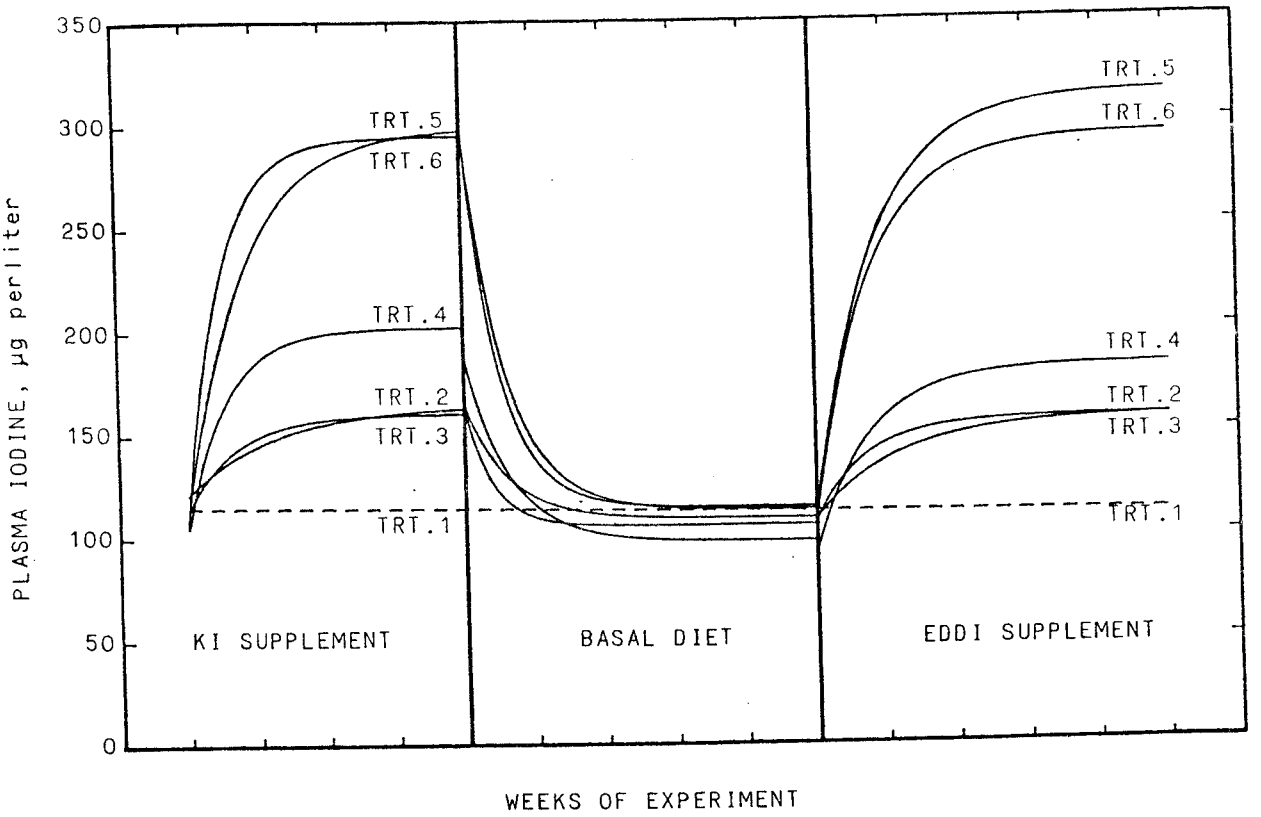


FIG. 1. PLASMA IODINE CHANGES FROM SIX TREATMENTS IN LAST THREE PERIODS OF EXPERIMENT.

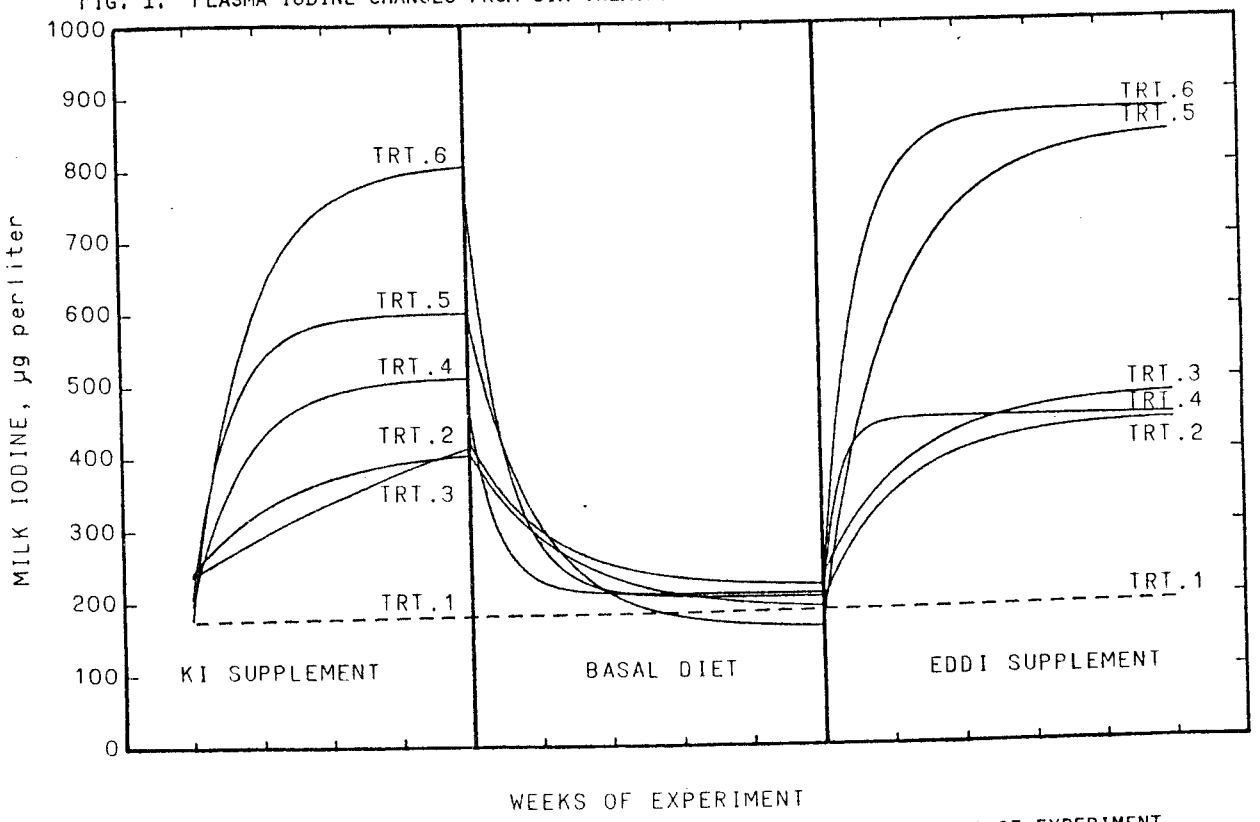


FIG. 2. MILK IODINE CHANGES FROM SIX TREATMENTS IN LAST THREE PERIODS OF EXPERIMENT.

THE USE OF SODIUM BICARBONATE IN COMPLETE RATIONS FOR LACTATING COWS

B. C. Bogart, M. J. Montgomery and C. R. Holmes

Efforts to maximize the expression of a cow's genetic potential have led to alterations in the principles of dairy cattle feeding. Many dairymen have experienced a positive production response with increased level of concentrate feeding and decreased level of roughage feeding. However, several metabolic problems have been caused in dairy herds fed ensiled forages combined with high levels of concentrate.

Two continuous 16 week feeding trials were conducted to evaluate intake and milk production response of early post partum Holstein cows fed corn silage and pelleted dairy concentrate with or without sodium bicarbonate. Sixty-two Holstein cows from the University of Tennessee-Knoxville herd were randomly assigned to respective treatments according to age classification three days post partum. Treatment 1 consisted of a complete ration containing corn silage and pelleted concentrate (16% CP) mixed at an as fed ratio of 3:1. Treatment II consisted of the same 3:1 mixture of corn silage and pelleted dairy concentrate with feed grade sodium bicarbonate added at an as fed rate of 0.5 percent of total mixture. Each cow also received 5 pounds of alfalfa-grass hay and, during each milking, three pounds of pelleted dairy concentrate. Complete mixed rations were formulated to contain approximately 13.7% crude protein (CP) and 70% total digestible nutrients (TDN) on a dry matter basis. The feeding trials were for 112 days.

1. There were no significant treatment differences between production parameters due to treatment.

2. Although means were not significantly different, cows consuming the sodium bicarbonate treated ration had a higher milkfat percentage (3.42 vs 3.30; table 1).

3. Although means were not significantly different, cows consuming the sodium bicarbonate treated ration had a higher total and ration dry matter intake, indicating palatability was not a problem (2.09 vs 2.19, 2.44 vs 2.55; table 1).

4. Data from these experiments indicate that incorporation of 0.5% sodium bicarbonate to complete rations was neither beneficial nor harmful.

Table 1. Means and standard error of production parameters

Parameter	Treatment[a] I $\bar{X}$	I S.E.[b]	II $\bar{X}$	II S.E.
Milk yield (lb/day)				
Initial lactation[c]	58.03	2.21	55.74	1.66
Subsequent lactations[d]	68.13	3.41	66.81	2.19
All lactations	62.76	2.15	60.91	1.68
Milkfat (%)				
Initial lactation	3.23	.06	3.30	.5
Subsequent lactations	3.38	.07	3.55	.01
All lactations	3.30	.05	3.42	.06
4% Fat corrected milk (lb/day)				
Initial lactation	51.35	2.03	49.86	1.33
Subsequent lactations	61.83	3.17	62.29	2.11
All lactations	56.26	2.03	55.66	1.66
Ration dry matter intake (% of body weight)				
Initial lactation	2.17	.07	2.27	.08
Subsequent lactations	2.00	.09	2.09	.1
All lactations	2.09	.06	2.19	.06
Total dry matter intake[e] (% of body weight)				
Initial lactation	2.54	.07	2.67	.08
Subsequent lactations	2.33	.09	2.41	.1
All lactations	2.44	.06	2.55	.07

[a]Treatment I = complete ration of 3 part corn silage and 1 part commercial dairy pellet (16%) on an as fed basis.
Treatment II = complete ration of 3 part corn silage and 1 part commercial dairy pellet (16%) with 0.5% sodium bicarbonate on an as fed basis.
[b]Standard error.
[c]Initial lactation = first lactation cows.
[d]Subsequent lactation = second and subsequent lactation cows.
[e]Total dry matter intake = complete ration + hay dry matter intake.

COMPARISON OF PELLETED COTTONSEED HULLS AS A REPLACEMENT FOR ALFALFA HAY AS A FIBER SOURCE IN COMPLETE MIXED RATIONS FOR LACTATING DAIRY COWS

C. M. Irwin, M. J. Montgomery and C. R. Holmes

Cottonseed hulls (CSH) have been successfully utilized as alternative sources of fiber for promoting growth in weanling calves and replacement heifers and in the maintenance of milk production and milk fat % in lactating dairy cows. CSH have been shown to be comparable or superior in production tests against other forages or sources of fiber. However, the bulk of CSH limits economical transportation. Pelleted cottonseed hulls (PCSH) have a density of 33-36 lbs/ft^3 for bulk CSH. Pelleting facilitates handling and lower transportation costs, but the effects of the pelleting process on the physical and chemical makeup of PCSH have yet to be defined.

Direct comparison trials of PCSH versus alfalfa hay as a replacement fiber source in complete mixed rations were begun in 1979 and continued through 1981. Fifty-one Holstein cows with a projected milk production level of 17,500 lbs or higher were randomly assigned to one of two complete mixed ration dietary treatments at calving: (1) a mixture of corn silage, 16% crude protein grain mixture, soybean meal (44% CP) and a mineral mix, blended to contain 16% crude protein (DM basis), 16% crude fiber (DM basis), offered ad lib., plus 10 lbs of alfalfa hay per head per day; (2) a mixture consisting of corn silage, 16% crude protein grain mixture, soybean meal (44% CP), PCSH (15% of the ration as fed) and a mineral mix, blended to contain 16% crude protein (DM basis), 20% crude fiber (DM basis), offered ad lib. All cows were on trial for the first eighteen weeks of lactation. The least squares means for production response data for the combined lactation years (1979-80, 1980-81) are presented in table 1.

1. Cows fed ration treatment II consumed less total dry matter per day than cows fed ration treatment I. This approached significance ($P<.10$) for the overall period. Cows fed ration treatment II consumed significantly ($P<.05$) less total dry matter during period IV.

2. Cows fed ration treatment II maintained a higher level of milk production and persistency of lactation than did cows fed ration treatment I. These differences were significant ($P<.05$) only during period IV and for the overall mean.

3. Similar results are shown for 4% fat-corrected milk, since there were no significant differences in butterfat percent.

4. Cow fed PCSH may produce milk more efficiently and at increased levels during early lactation, demonstrating the efficacy of PCSH as a replacement fiber source for alfalfa hay in complete mixed rations.

Table 1. Response data of Holstein cows fed alfalfa hay (I) vs pelleted cottonseed hulls (II).

Lactation period (weeks)	Treatment[b]	Milk production (lb/day)	Fat test (%)	Fat corrected milk (lb/day)	Dry matter consumption (lb/day)	Dry matter intake (% bodyweight)
I	I	73.67	3.24	64.80	37.57	2.83
(3-6)	II	74.53	3.27	66.40	37.48	2.84
II	I	72.09	3.09	62.47	43.05	3.20
(7-10)	II	75.34	3.15	65.55	43.14	3.23
III	I	68.37	3.16	60.03	44.66	3.26
(11-14)	II	72.59	3.07	62.55	43.48	3.20
IV	I	62.57	3.20	55.29	44.39	3.21
(15-18)	II	67.83[a]	3.19	60.01[a]	42.15[a]	3.09[a]
Overall	I	69.29	3.17	60.72	42.36	3.12
Mean	II	72.74[a]	3.17	63.76[a]	41.59	3.09

[a]Least squares means are significantly different ($P<.05$).
[b]Treatment I-cows receiving alfalfa hay (10 lbs ad lib.).
Treatment II-cows receiving pelleted cottonseed hulls (15% of ration as fed).

COMPARISON OF SOYBEAN-GRAIN SORGHUM SILAGE WITH CORN SILAGE FOR LACTATING COWS

H. D. Baxter, M. J. Montgomery and J. R. Owen

The objectives of this experiment were: (A) to determine the effect of the stage of maturity of soybean-grain sorghum mixture on the chemical composition of the silage, and (B) to compare the feeding value of soybean-grain sorghum silage and corn silage for lactating dairy cows.

Lee 74 soybeans and Dekalb C42A grain sorghum were drilled separately at the rate of 2 bu and 15 lbs per acre, respectively. Pioneer 3147 corn was planted at the rate of 20 lbs per acre. Soybeans and grain sorghum silage were scheduled to be harvested in the early bloom stage and early pod stage of the soybean. Rains prevented the harvesting of the pod stage the first year. Ten lactating Jersey cows in early lactation were used for each treatment both years. Grain mixes fed with the silages contained 16% crude protein for the soybean-grain sorghum and 20% crude protein for the cows fed corn silage. Table 1 summarizes the data obtained in the feeding trial.

1. Problems developed with weed control in the soybean-grain sorghum. Difficulty was encountered in finding herbicides suitable for use with both soybeans and grain sorghum.

2. Corn silage yielded an average of 16.2 tons of 30% dry matter (DM) silage, and the soybean-grain sorghum yielded only 11.5 tons of 30% DM silage.

3. Corn silage contained 30% acid detergent fiber (ADF) and soybean-grain sorghum silage contained 42% ADF on a dry matter basis. Higher ADF values would indicate lower energy content. Protein content averaged 13.2% and 8.8% for soybean-sorghum and corn silage, respectively.

4. Cows fed corn silage consumed more dry matter than cows fed early stage soybean-sorghum silage. There was no difference in dry matter intake of corn silage and pod stage soybean-sorghum (table 1).

5. Milk production was significantly higher for cows fed corn silage. Cost per ton of silage and income over feed cost favored corn silage.

6. Data would suggest that if soybean-sorghum silage is used for lactating cows, additional grain feeding needs to be increased in order to compare favorably with corn silage.

Table 1. Summary of data in trials with corn and soybean-sorghum silage

Item	Corn silage 1979	Corn silage 1980	Flower* soybeans-sorghum 1979	Flower* soybeans-sorghum 1980	Pod* soybean-sorghum 1979	Pod* soybean-sorghum 1980
DM consumption (% B.W.)	3.16[a]	3.25[a]	2.88	2.91[b]		3.16[a]
Actual milk (lbs/day)	36.80[a]	37.25[a]	33.79[b]	33.31[b]		33.18[b]
FCM (lbs/day)	41.10[a]	40.12[a]	37.01[b]	35.85[b]		36.71[b]
Milk fat (%)	4.81[a]	4.49[a]	4.61[a]	4.55[a]		4.71[a]
Milk protein (%)	3.61[a]	4.00[a]	3.39[b]	3.82[a]		3.80[a]
Body weight change (lbs/day)	+ .80[a]	+ .37[a]	+ .29[b]	+ .08[b]		+ .18[ab]
Total cost per ton silage ($)	12.39	13.75	15.00	15.60		14.94
Daily value of milk ($)	5.20	5.49	4.67	4.95		5.02
Cost of silage consumed ($)	.37	.37	.34	.37		.37
Cost of grain ($)[f]	.83	1.10	.73	0.98		0.98
Income over feed cost ($)	4.00	4.02	3.60	3.60		3.67

[a]Means on the same line with different superscripts are significantly different (P<.05) within years.
*Stage of maturity of soybeans.
[f]Differences in cost of grain consumed reflect the difference between the cost of 16% and 20% crude protein grain mixtures: Mixture 1 cost $153.20 per ton in 1979 and $188.80 in 1980, and mixture 2 cost $175.00 per ton in 1979 and $207.20 in 1980.

COMPARISON OF ALFALFA HAY AND ALFALFA LOW MOISTURE SILAGE IN HIGH ENERGY COMPLETE RATIONS

M. J. Montgomery and B. J. Bearden

The importance of maintaining adequate fiber level in complete rations has been recognized in order to maintain normal milkfat percentages in the milk. The use of long hay in the feeding program is one of the best methods to maintain normal fat test. However, in group feeding situations where hay is offered ad lib., some cows may not consume enough hay; therefore, some variation in fat test between individual cows does exist. Hay chopped and added to a complete ration would eliminate the selectivity and possibly help alleviate variation in fat percentage. Another alternative is to use low moisture silage (LMS) as the source of fiber in a complete ration.

Data were collected for two years at the Middle Tennesse Experiment Station with Holstein cows fed one of the three following rations. 1) corn silage-grain complete feed with 10 lbs of hay per cow per day group fed ad lib., 2) complete ration of corn silage-grain and chopped alfalfa hay group fed ad lib. and, 3) complete ration of corn silage, grain and alfalfa LMS group fed ad lib. Twelve to fifteen cows were used per treatment each year. All rations were formulated to contain 14-15% crude protein in the total ration dry matter. Energy levels were adjusted by the level of grain in the complete ration. The feeding trials were 112 days each year.

1. There was a trend toward higher production on the two total mixed rations suggesting a more uniform intake of total nutrients.

2. There was less between-animal variation in milkfat on the complete rations where hay or LMS intake was assured.

3. There were no major difference in total milk solids between cows on the three treatments.

4. Dry matter intake was excellent on all ration combinations.

5. Complete ration feeding programs offer an excellent means of providing a ration that is balanced for both protein and energy for high levels of milk production.

Table 1. Data summary for complete ration studies

	Corn silage: grain + hay	Total mixed ration: Corn silage, hay & grain	Total mixed ration: Corn silage, low moisture silage & grain
Milk (lb/day)			
Year 1	66.74[a]	64.77[a]	68.35[a]
Year 2	58.10[a]	62.63[a]	64.15[a]
Milkfat (%)			
Year 1	3.70[a]	4.02[a]	3.97[a]
Year 2	3.73[a]	3.74[a]	3.40[b]
4% Fat-corrected milk (lb/day)			
Year 1	63.28[a]	65.19[a]	67.83[a]
Year 2	55.57[a]	59.04[a]	58.65[a]
Total solids (%)			
Year 1	12.04[a]	12.39[a]	12.25[a]
Year 2	12.45[a]	12.53[a]	11.91[a]
Body Wt. change (lbs/day)			
Year 1	+1.09[a]	+ .88[a]	+1.13[a]
Year 2	+ .94[a]	+ .45[a]	+ .93[a]
Dry matter intake (% of B.W.)			
Year 1	3.98	3.49	4.09
Year 2	N.A.	N.A.	N.A.

[a]Means on the same line with different superscripts are significantly different ($P<.05$) within years.
N.A. = not available.

COMPARISON OF A CONVENTIONAL FEEDING PROGRAM WITH A TWO-STAGE COMPLETE RATION PROGRAM UTILIZING COTTONSEED HULLS AS THE FIBER SOURCE FOR REPLACEMENT HEIFERS

S. N. Migioia, M. J. Montgomery and C. R. Holmes

Many dairymen in an attempt to reduce feeding costs have modified their feeding program by using less expensive sources of feeds, such as by-products from industry. A by-product that has been shown to be satisfactory as a hay substitute is cottonseed hulls (CSH). The use of CSH in complete rations for replacement dairy heifers is not only cost efficient but has also yielded acceptable growth rates with no adverse effect on rumen development. A refinement in the feeding of complete rations is to provide the optimum amount of fiber and protein in the diet to promote adequate growth rates with minimal wastage of feed. Therefore, the objective of this experiment was to determine the feasibility of a two-stage complete ration feeding program which used CSH as the fiber source for growing replacement heifers and that of a conventional feeding program using hay and grain.

Thirty-six Holstein replacement heifers at one week of age were divided into two treatment groups in a 30-week continuous type feeding trial. Treatment I consisted of a two stage complete ration (ration Ia and Ib). Ration Ia contained 20% CSH, 60% corn and 20% soybean meal and was fed ad libitum up to approximately 300 pounds body weight. Ration Ib consisted of 43% CSH, 43% corn and 14% soybean meal and was fed ad libitum to calves which achieved a body weight of 300 pounds and continued up to 30 weeks of age. Treatment II consisted of long alfalfa hay fed ad libitum plus an 18% crude protein grain concentrate fed separately ad libitum.

1. Dry matter consumption was less ($P<.05$) for calves fed treatment II than for calves fed treatment I (table 1).

2. Differences in growth parameters of calves due to treatment effect, as measured by body length and wither height, were non-significant ($P<.05$). Body weight differences due to treatment approached significance ($P<.10$). Treatment I heifers had greater heart girth measurement ($P<.05$).

3. Heifers fed ration Ia had higher propionate and lower acetate ($P>.05$) concentration in rumen fluid than those fed ration II. No significant differences ($P<.05$) were found between volatile fattly acids of rumen fluid of calves consuming ration Ib and II.

4. Data from this experiment suggest that the application of a two-stage complete ration utilizing cottonseed hulls as the fiber source is a viable alternative to a conventional feeding program using hay and grain concentrate.

Table 1. Response data for calf experiment

	Treatment I		Treatment II	
	Ia	Ib	Hay	18% CP concentrate
Crude protein (%) DMB	16.8	13.4	16.7	18.9
Acid detergent fiber (%)DMB	18.2	34.2	40.6	12.1
Acetate (molar %)*	52.5[a]	66.2[b]	63.1[b]	
Propionate (molar %)*	31.0[a]	21.0[b]	21.5[b]	
Mean body weight (30 weeks of age) (lbs)	481[a]		446[b]	
Mean crude protein intake (lbs/day) 30 weeks of age	2.2		2.3	
Dry matter intake (lbs/day)[c]	8.4[a]		6.9[a]	
Body length (in)[c]	34.7[a]		34.5[a]	
Wither height (in)[c]	38.0[a]		37.8[a]	
Heart girth (in)[c]	44.0[a]		42.5[b]	

*Based on analysis of rumen fluid.
[a]Values with same letter are not significantly different (P>.05).
[c]All values are means for the 30 week experimental period.

EFFECT OF MOISTURE CONTENT OF ALFALFA-ORCHARDGRASS HAY ON CHEMICAL COMPOSITION, DIGESTIBILITY, AND PROTEIN UTILIZATION

A. A. Tineo, H. D. Baxter, J. R. Owen,
M. J. Montgomery and B. L. Bledsoe

In recent years, there has been a large increase in the number of large package forage harvesting systems. Researchers indicate that large hay packages reduce harvesting, handling and storage costs, as well as labor requirements. They also have greater density when compared with a conventional bale system. However, nutritive values of large round bales are affected when harvested at high moisture contents and stored outside, exposed to severe weather conditions.

A digestibility trial was conducted using mature wethers to determine the digestibility of alfalfa-orchardgrass hay from the inside core vs. outside shell of large round bales harvested at 24 (wet) and 17% (medium) moisture content. Conventional square bales baled at the same moisture contents were compared with the large round bales' inner and outer sections.

1. The temperature of the large round bales stored wet exceeded 90 C thus causing a caramelization of the inside core of hay.

2. The inside core of large bales baled wet contained a higher content of acid detergent fiber and acid detergent fiber nitrogen than similar bales stored at medium moisture (table 1).

3. Dry matter digestibility (DMD) was significantly lower for both sections of the large bales compared to conventional baling. The inside core of the bales was significantly lower in DMD than the exterior shell.

4. Protein digestibility with the bales stored wet was severely depressed due to the high percentage of protein binding. Only 1/3 of the protein was digested from the inside core of the wet bales.

5. All measures of protein utilization were significantly depressed for the bales stored wet.

6. If the large bale system is used, care should be taken to insure that the moisture content is less than 18% at baling to minimize problems with protein binding.

Table 1. Effect of moisture content on composition and digestibility of alfalfa-orchardgrass hay

Chemical composition	Wet (75.9% DM)			Medium (84.2% DM)		
	Inside core	Outside shell	Conv.	Inside core	Outside shell	Conv.
Chemical composition						
Crude protein	18.93	19.11	16.44	16.09	17.70	18.37
ADF	47.93	41.16	37.41	38.89	37.98	37.10
Lignin	20.01	10.34	6.90	7.54	7.31	6.79
ADF-N	45.86	24.03	27.32	13.60	13.17	9.66
Digestibility						
Dry matter	48.12^{e}	56.78^{d}	63.78^{ab}	60.64^{c}	62.36^{b}	64.08^{a}
Protein	33.23^{e}	55.30^{d}	71.00^{b}	65.96^{c}	72.52^{b}	74.78^{a}
ADF	39.29^{c}	51.64^{b}	54.70^{a}	55.39^{a}	54.69^{a}	55.19^{a}
Protein utilization						
Net protein utilization	48.80^{d}	66.47^{c}	80.41^{ab}	77.94^{b}	80.69^{a}	81.75^{a}
Net protein value	9.23^{e}	12.70^{d}	13.21^{c}	12.54^{d}	14.28^{b}	15.01^{a}
Intake nitrogen retained	27.72^{e}	45.11^{d}	55.22^{b}	52.07^{c}	59.03^{a}	58.58^{a}

^{a,b,c,d,e}Means in a row with different superscripts differ ($P<.05$).

EFFECT OF METHOD OF STORAGE ON CHEMICAL COMPOSITION AND FEEDING VALUE OF ALFALFA-ORCHARDGRASS HAY

M. J. Montgomery, H. D. Baxter and B. J. Bledsoe

Use of the large round baler in hay harvesting has increased markedly in the last 5 years due to the labor saved in baling and storage. Many dairymen have been reluctant to use this system of storage for alfalfa hay due to the high storage losses if stored outside. Inside storage will provide shelter from the rain, however, facilities must be constructed to handle the large bales. Previous data have shown that outside storage on tires will aid in preventing bottom spoilage and thus decrease total losses considerably. The objective of this experiment was to compare conventional baling with hay harvested with the large round baler stored inside or outside on tires with and without a black plastic cover.

Third cutting alfalfa-orchardgrass hay was cut and baled with either a conventional rectangular baler or large round baler. Conventional bales were stored inside. Large round bales were stored inside or outside on tires with and without a black plastic cover over the top one half of the bale. Storage losses were determined and chemical composition changes were measured after approximately 5 months storage. Lactating Jersey cows were fed the hays as the only source of forage in a feeding trial comparing conventional, inside and outside stored large bales.

1. Only small differences in composition were seen with the hays at baling.

2. It should be noted that there was an increase in ADF-N from baling to feeding indicating a moderate amount of heating and thus binding of the nitrogen in an undegradable form.

3. The ADF-N content in the outside 8" shell of uncovered bales was over 20% of total N in ADF. Bales stored inside or covered had only 12% ADF-N.

4. High fiber content of the feed refused indicates that the animals were selecting the high energy parts of the hay.

5. Cows fed conventional baled hay produced significantly more milk than cows fed large round bales. Level of milk production is difficult to interpret due to lack of pressure the herdsman puts on the cows to consume the large bales.

Table 1. Chemical composition of large round bales of hay at baling and feeding

	CP %	ADF %	Lignin %	ADF-N % of total-N
At baling				
Outside				
Covered-tires	17.21	31.13	5.73	8.37
Uncovered-tires	17.49	31.25	6.20	7.84
Inside	16.99	31.26	5.87	7.81
At feeding				
Outside				
Covered-tires: Fed	18.03	37.23	7.38	12.39
Refused	14.45	47.27	10.12	16.28
Uncovered-tires: Shell	19.56	47.14	12.35	20.87
Core	18.70	38.54	8.34	14.14
Refused	19.38	48.33	13.67	18.41
Inside Fed	16.72	39.52	7.77	12.03
Refused	13.95	48.44	10.37	15.56

Table 2. Performance summary for feeding trial

	Storage method		
	Conventional bales	Large round bales	
		Inside	Outside
Actual milk (lbs)	44.59[a]	42.64[b]	41.76[ab]
Milkfat (%)	4.63[a]	4.87[a]	4.64[a]
FCM (lbs)	48.58[a]	47.82[a]	45.73[a]
Milk protein (%)	3.50[a]	3.64[b]	3.60[ab]
Body wt. change (lbs/day)	+ .61[a]	+ .38[a]	+ .06[b]

[a]Means on the same line with different superscripts are significantly different ($P<.05$).

SOYBEAN HAY STORED IN LARGE ROUND BALES

H. D. Baxter, B. J. Bledsoe, M. J. Montgomery
and J. R. Owen

Occasionally soybeans will be planted as an emergency hay crop when perennial forages are not available. Soybeans planted for grain usually have a stiff stem to prevent lodging prior to harvesting the beans. When soybeans of this type are used for hay, problems may develop with large coarse stems that will be refused by high producing dairy cows. Storing in large round bales increases the problem if fed in manger feeders. The purpose of this study was to gain experience with storing soybean hay in large bales while at the same time obtaining data on the effect of covers and type of elevation off of ground on storage losses and chemical composition.

FFR-666 soybeans were planted with a grain drill at the rate of 2 bushels per acre. They were cut for hay at 36-40 inches in height with a mower-conditioner. Two days were required for drying. There was no rain damage on any of the hay prior to baling. Large bales were stored outside on old automobile tires or on concrete blocks to assist in reducing moisture uptake from the soil. One half of the outside bales were covered with a black plastic cover over the top half of the bale. Bales stored inside were stacked end to end on a concrete floor only one bale high. All bales were stored for 3.5 months prior to sampling and feeding.

1. Weights and bale densities were similar at baling (table 1).

2. Dry matter (DM) content of the outside 8" shell of the bales without covers was low due to the rain absorption by the bales. Also, DM of the inside core of these bales was less than covered bales.

3. Bales stored outside on tires with a cover compare favorably with inside storage on dry matter losses.

4. The highest losses occurred with the uncovered bales (12-17% loss).

5. Bales stored outside without covers had higher fiber content suggesting some fermentation or leaching of soluble DM during storage.

6. The increased content of ADF-N from baling to feeding suggest that some heating took place in the bales that bound the nitrogen to the fiber. The high level (22.6%) in the outside shell of uncovered bales indicates extensive heating in this portion of the bale.

7. Feeding of the soybean hay resulted in a large quantity of harsh stiff stems that were refused by lactating cows. Due to difficulties encountered in achieving high intake the feeding trial was discontinued after 6 days.

Table 1. Physical characteristics of large round bales of soybean hay

	Inside	Covered		Uncovered	
		Blocks	Tires	Blocks	Tires
Baling					
Bale wt. (lbs)	1043	998	1074	1011	1011
Wet density (lbs/cu.ft)	8.00	7.56	7.94	7.81	7.08
DM density (lbs/cu.ft)	6.70	6.63	6.69	6.67	5.97
Feeding					
Bale wt. (lbs)	966	971	1063	1226	1120
% DM-outside shell	85.2	79.9	80.5	35.2	35.1
% DM-inside core	87.2	86.7	86.6	77.3	81.3
Wet density (lbs/cu.ft)	7.73	7.12	7.65	10.29	9.04
DM density (lbs/cu.ft)	6.67	5.99	6.44	5.98	5.68
% DM loss in storage	3.75	5.79	2.53	12.42	17.45

Table 2. Chemical composition of soybean hays

% of dry matter	Inside	Outside	
		Covered	Uncovered
Crude protein			
at baling	15.3	15.2	15.5
at feeding - inside core	15.1	15.0	15.1
- outside shell	14.6	15.4	15.3
ADF-N (% of total N)			
at baling	12.8	10.7	10.7
at feeding - inside core	12.0	10.0	14.7
- outside shell	13.2	10.8	22.6
Acid detergent fiber (ADF)			
at baling	43.7	45.2	40.8
at feeding - inside core	43.5	44.9	45.3
- outside shell	44.5	44.1	50.9
Lignin			
at baling	8.3	8.8	7.8
at feeding - inside core	8.8	8.8	8.9
- outside shell	8.7	8.1	13.2

A COMPARISON OF THREE FARROW-FINISH PORK PRODUCTION SYSTEMS AT AMES PLANTATION*

E. R. Lidvall, M. C. Dixon, R. L. Wyatt, R. A. Reynolds and J. M. Anderson

A study has been under way for five years at Ames Plantation comparing three systems of farrow-to-finish pork production. System I is a pasture system. Fifteen acres of orchard grass-ladino clover pasture are utilized for spring farrowing and finishing of the pigs during the summer. An additional eighteen acres is seeded to winter pasture for the production of fall farrowed pigs. Individual housing is utilized, pigs are farrowed in April and October, pigs are weaned at 8 weeks of age and one sow herd is maintained producing about 24 litters at each farrowing. System II is a modest investment system involving the use of a pen-type central farrowing house and finishing on pasture. Two sow herds are maintained; one herd farrowing in January and July and the other in April and October. Pigs are weaned at 8 weeks of age and are moved to three-acre lots for growing and finishing. Sufficient sows and/or gilts are maintained to insure about 24 litters at each farrowing. System III involves the use of a central environment control crate-type farrowing house, a pig nursery, and two partial slatted modified open front finishing barns. The farrowing house has a capacity of 24 farrowing crates, pigs are weaned at 4-5 weeks of age, sows are immediately rebred, pigs are moved to the total slatted environment control nursery for approximately five weeks, and are then moved to one of the two finishing barns. Sufficient sows and/or gilts are maintained in four sow herds to insure 24 litters at each farrowing (9 farrowings per year). In all systems, the sows are bred and gestated on pasture. The breeding program involves 3 and 4-way crosses utilizing Duroc, Hampshire, Landrace and Yorkshire boars. The rations are mixed in a portable type mixer using grain, soybean meal and a vitamin-mineral pre-mix. A 5-year summary of the sow, litter and pig performance is presented in table 1.

1. Pigs farrowed per litter, pig birth weight, pigs weaned per litter, percent weaned of those born alive and days to a 230 lb market weight are similar for each system.

2. Conception rate continues to be slightly lower in System III, probably because of earlier weaning.

3. The pounds of feed required to produce a lb of live pork from the farm continues to favor System III because of greater production per sow/year and a more favorable feed efficiency during the growing and finishing phases of production.

*The University of Tennessee is the beneficiary of a perpetual trust under the terms of the will of the late Julia C. Ames.

Table 1. Five year average of sow, litter and pig performance of three swine production systems at Ames Plantation, years 1976-80

	System		
	I	II[1]	III
Sow herds maintained	1	2	3.4[2]
Number sows/system	29.7	62.8	106.7
Number litters produced/yr	48	108	189
Conception rate, %	80.2	80.6	77.2
Litters produced/sow/yr	1.60	1.72	1.77
Pigs produced/sow/yr	12.1	13.0	13.2
Pigs farrowed/litter	10.3	10.5	10.2
Pigs farrowed alive/litter	10.1	10.0	9.8
Pigs weaned/litter	7.5	7.5	7.5
% pigs weaned of born alive	74	75	76
Pig birth wt., lbs	3.3	3.1	3.2
Pig wean wt., lbs	36.1	33.6	18.3
Final nursery wt., lbs	---	---	52.4
Average daily gain, nursery, lb	---	---	0.72
Market wt., lbs	232	227	218
Days to 230 lb mk. wt.	205	208	208
Lbs of feed required to produce a pound of live pork[5]	4.21	4.22	3.91

[1]Some adjustment made in production figures for unusual "predator losses" during some finishing periods in 1979 and 1980.
[2]Three sows herds maintained during years 1976-78; 4 herds 1979-80.
[3]Pigs weaned at about 56 days of age.
[4]Pigs weaned at about 28-35 days of age.
[5]Includes breeding herd feed, creep feed, grower and finisher feed.

MANAGEMENT OF PURCHASED FEEDER PIGS

F. B. Masincupp, J. P. Hitchcock, R. L. Freeland

Finishing swine for the slaughter market has been a profitable operation for many Tennessee and American farmers. However, the co-mingled, purchased feeder pigs present many and varied problems due to disease and stress brought on by co-mingling. Scientific information on this type of operation is practically non-existent. The objective of the first experiments within this project is to determine the effects of various rations and kinds and levels of antibiotics and anthelmintics on the health of purchased feeder pigs.

Experiment I was conducted February through May, 1981 utilizing 95 pigs on a 16 percent crude protein ration composed of corn, 44 percent soybean meal and vitamin mineral premix. Four antibiotic-anthelmintic combinations were used with the basic ration. A description of the four treatments are in table 1 and the results are presented in table 2.

Experiment II was conducted June through December, 1981 utilizing 240 pigs and a 2 x 2 x 2 factorial design. The two basic 16 percent rations were either corn-soybean meal-premix (A) or corn-soybean meal-alfalfa meal-premix (B). The antibiotics were either ASP-250 in the feed for 21 days and Neomycin in water for 7 days (C) or Furox 50 in the feed and Sulvitalife in the water (D). The anthelmintics were either Atgard (E) or Tramisol (F) in the feed each for 3 days. A description of the results are presented in table 3.

1. Statistical analysis has not been completed, but there are no apparent differences due to treatment in experiment I.

2. In experiment II, pigs receiving alfalfa meal had slower gains (1.14 vs 1.20) and were less efficient feed converters (2.70 vs 2.48) after 21 days.

3. Pigs receiving Tramisol gained slightly faster (1.19 vs 1.14) and tended to be more efficient (2.54 vs 2.64) after 21 days. The same was true at market weight (1.69 vs 1.64 ADG and 3.07 vs 3.18 FE).

Table 1. Description of antibiotic-anthelmintic combination in experiment I

Treatment	Antibiotic (feed)	Antibiotic (water)	Anthelmintic
1	ASP-250 : 21 days	Neomycin : 7 days	Atgard-3 days
2	ASP-250 : 21 days	Neomycin : 7 days	Tramisol-3 days
3	Furox 50 : 21 days	Sulvitalife : 7 days	Atgard-3 days
4	Furox 50 : 21 days	Sulvitalife : 7 days	Tramisol-3 days

Table 2. Experiment I performance means for all pigs by treatment

Treatment	No. of pigs	Start wt. (lbs)	21 day ADG	21 day FE	Final wt. (lbs)	Final ADG	Final FE
1	24	54	1.13	3.06	220	1.58	3.41
2	24	54	1.10	2.93	227	1.65	3.24
3	24	55	1.13	2.93	224	1.68	2.31
4	23	54	1.09	2.91	224	1.62	3.39

Table 3. Experiment II performance means for all pigs by treatment[a]

Componement	Treatment	Start wt.	21 day ADG	21 day FE	Final wt.	Final ADG	Final FE
1	ACE	43	1.20	2.45	224	1.62	3.13
2	ACF	41	1.15	2.43	227	1.65	3.07
3	ADE	42	1.17	2.49	228	1.62	3.16
4	ADF	43	1.26	2.53	231	1.73	2.98
5	BCE	43	1.12	2.79	232	1.71	3.15
6	BCF	43	1.14	2.62	231	1.68	3.13
7	BDE	43	1.08	2.83	229	1.60	3.29
8	BDF	42	1.20	2.57	229	1.71	3.11

[a]Means of 30 pigs per treatment

DETERMINATION OF CYTOSOLIC ANDROGEN RECEPTORS IN THE HYPOTHALAMUS OF THE BOAR

C. J. Jennings, H. G. Kattesh and T. T. Chen

Target cells of many tissues accumulate and retain steroid hormones by means of intracellular binding proteins. These receptor proteins carry the steroid hormone into the cell nucleus and there initiate changes in RNA synthesis, leading to altered production of specific proteins and ultimately producing a physiological response. One of the important features of steroid receptors in brain tissue is their discrete localization within certain brain regions which, in several instances, have been shown to respond to implanted steroid hormones and to regulate sexual behavior and gonadotropin release. While attempts have been made to characterize protein receptors in the hypothalamic region of the brain in gilts, no research has been reported investigating hypothalamic receptor binding in the boar. This study was an attempt to determine the presence and concentration of cytosolic androgen receptors in the anterior, medial and posterior portions of the hypothalamus of the boar.

Twenty-one crossbred boars of Landrace X Duroc and Landrace X Duroc X Yorkshire breeding, all farrowed in the fall of the year, were used in this study. At approximately six weeks of age, boars were randomly allotted in equal numbers to seven concrete floored pens located in an open fronted building. Beginning at approximately five months of age and continuing at weekly intervals thereafter, boars were individually permitted a 15-minute exposure to ovarioectomized-estrogenized gilts exhibiting standing estrus. Libido response, which included mounting, penile extension and ejaculation was recorded. At nine months of age, all boars were slaughtered by exsanguination and the brain immediately removed for subsequent excision of the hypothalamus. The hypothalamus was then sectioned into anterior, medial and posterior sections. Each section was homogenized and the resulting supernatant fraction was used to evaluate testosterone (T) and 5α-dihydrotestosterone (DHT) receptor binding as well as protein content.

1. Using a charcoal adsorption assay, androgen receptors were found distributed throughout the hypothalamus.

2. Although section of the hypothalamus had no significant ($P>.10$) effect on the amount of T or DHT binding, T appeared to accumulate more in the medial hypothalamus with more DHT binding in the posterior hypothalamus (table 1).

3. The protein concentration in the medial hypothalamus was greater ($P<.10$) than that in the posterior hypothalamus (table 1).

4. The protein receptor appeared to exhibit greater ($P<.10$) specificity for DHT than for T, especially in the medial ($r=.43$) and posterior $r=.46$) sections of the hypothalamus.

5. These findings suggest that a cytoplasmic receptor for androgens exists in the hypothalamus of the boar at nine months of age and, that the metabolic conversion of T to DHT may be an essential step toward controlling the release and secretion of gonadotropins.

Table 1. Least squares means ($\bar{X}$ + SEM) of testosterone and dihydrotestosterone specific binding and protein content as determined in three regions of the hypothalamus of the boar

	Testosterone (fm/mg of protein)	Dihydrotestosterone (fm/mg of protein)	Protein (ug/mg)
Section of the hypothalamus:			
Anterior	.030 ± .018	.042 ± .032	20.89 ± 1.26[ab]
Medial	.052 ± .018	.050 ± .032	24.33 ± 1.26[a]
Posterior	.021 ± .018	.101 ± .032	20.44 ± 1.26[b]

[a,b]Means with different superscript in the same column are significantly different (P<.10)

PERIPHERAL PLASMA GLUCOCORTICOID LEVELS IN GILTS FOLLOWING ADMINISTRATION OF A LONG ACTING ADRENOCORTICOTROPHIN PREPARATION

H. G. Kattesh, J. D. Arnold, M. C. Henson and C. J. Jennings

Results of a previous study conducted in our laboratory suggests that daily intramuscular injections of a long acting adrenocorticotrophin preparation (Corticotropin Zinc, Organon Pharmaceuticals, West Orange, N.J.), regardless of dosage or period administered during the first three weeks of gestation in gilts, has no significant effect on embryonic survival or on development of the porcine fetuses as measured on day 37 of pregnancy. In order to confirm the efficacy of the adrenocorticotrophin in eliciting an adrenal glucocorticoid response, the following experiment was performed.

Three eight month old crossbred gilts demonstrating normal estrous activity were housed together and checked twice daily (morning and evening) for estrus with the aid of a boar. On day 4 or 5 of the estrous cycle each gilt was surgically fitted with an indwelling jugular cannula and maintained throughout the treatment period in individual crates. Gilts were randomly assigned to receive either 0, 40 or 80 I.U. of Corticotropin Zinc, administered daily by intramuscular injection over a two day period beginning on day 10 of the estrous cycle. Blood samples (10 ml) were taken from each gilt via the cannula immediately prior to and at .5, 1.0, 1.5, 2.0, 3.0, 4.0, 5.0, 6.0, 7.0 and 8.0 hours following treatment administration. Each blood sample was collected in a 20cc syringe containing 2-3 drops of a 13.9% EDTA solution, centrifuged at 2000 x g for 10 minutes, plasma recovered and stored at -20°C until analyzed for glucocorticoid concentration by means of a competitive protein binding assay.

1. The nonpregnant gilt injected intramuscularly with 40 units of corticotropinzinc hydroxide did not appear to differ from the control gilt in measured plasma glucocorticoid response (Figure 1).

2. Administration of 80 units of the long acting ACTH preparation resulted in a two fold increase in plasma glucocorticoid levels which peaked at approximately four hours post-injection on day 1 and six hours post-injection on day 2 (Figure 1).

3. These results indicate that administration of a long acting adrenocorticotrophin preparation (Corticotropin-Zinc) at a dosage of 80 units will elicit a significant adrenal glucocorticoid response as determined in a 150 kg gilt.

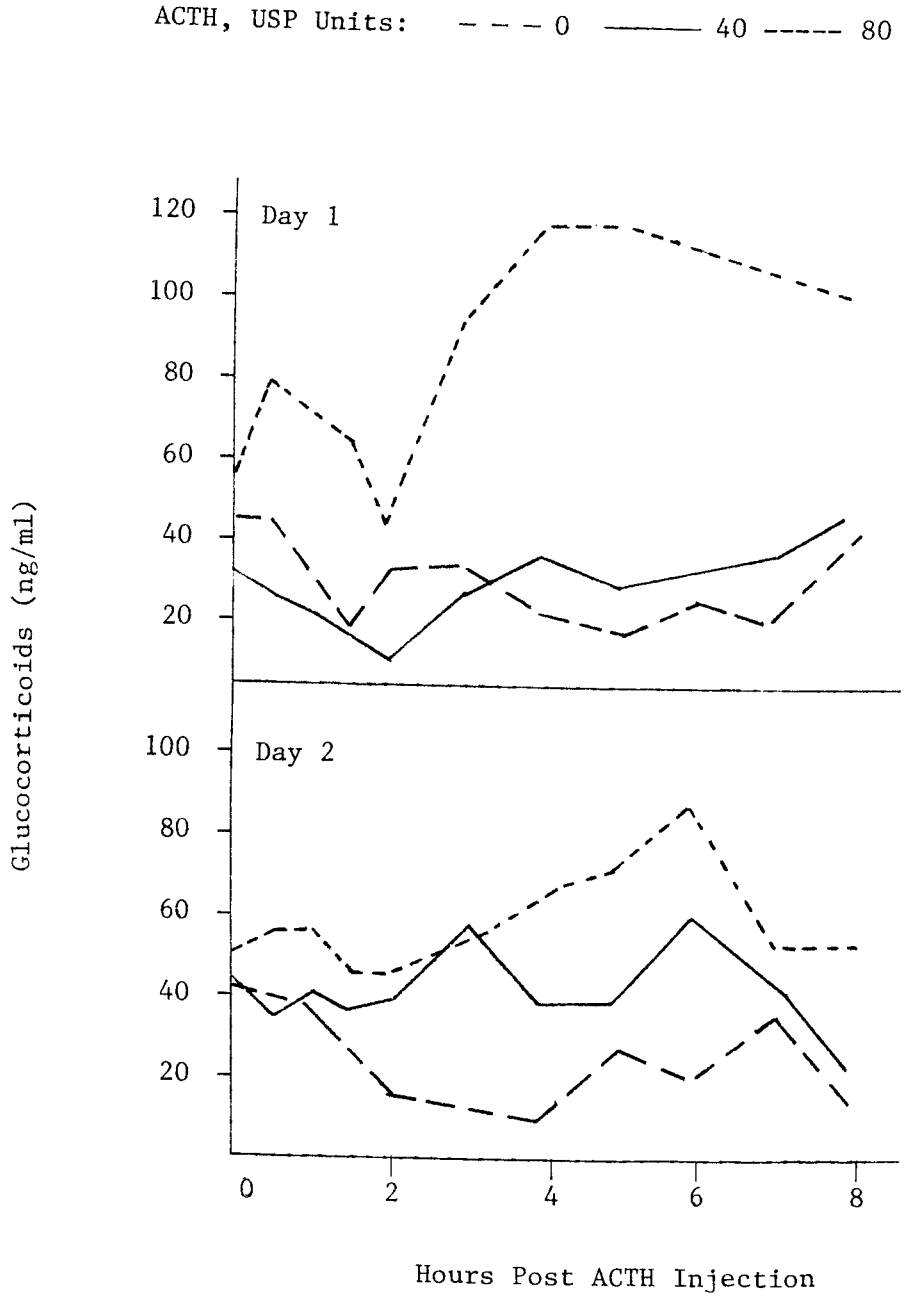


FIGURE 1. PLASMA GLUCOCORTICOID LEVELS AFTER INJECTING NONPREGNANT GILTS WITH CORTICOTROPHIN AT LEVELS OF 0, 40 or 80 USP UNITS.

INFLUENCE OF DIETARY SELENIUM LEVELS ON GROWTH AND REPRODUCTIVE DEVELOPMENT OF BOARS

M. C. Henson, H. G. Kattesh, J. P. Hitchcock and S. A. Kincaid

Research has revealed a number of vital functions performed by selenium as a dietary constituent. A most important role is as a component in certain enzymatic reactions serving to prevent oxidative damage to cell membranes and other oxidant sensitive sites of cell structure. Recent research involving small laboratory animals and, to a lesser extent bulls, implicates selenium as an important factor in the genesis of normal spermatozoa and the maintenance of their structural integrity. Therefore, the objective of this study was to investigate the effects of level of dietary selenium on growth and reproductive development of young boars.

Thirty-three crossbred boars (47-58 days of age) maintained similarly on concrete were randomly allotted to receive a corn-soybean meal ration containing selenium at the basal level of approximately 50 (t_1) ppb or supplemented with 100 (t_2) or 250 (t_3) ppb selenium (from sodium selenite). All boars were fed their respective diets ad libitum until six months of age and then hand-fed 2.2 kg/boar/day for the remainder of the study. Body weights, testicular widths and blood samples were taken on each boar at biweekly intervals until six months of age and at monthly intervals thereafter. Libido was routinely scored (1 = no interest; 5 = intromission with ejaculation) upon exposure to ovarioectomized - estrogenized gilts, beginning at approximately five months of age. Seven animals from each group, all of which exhibited typical male sexual aggressiveness, were slaughtered by means of exsanguination at nine months of age.

1. Regression of body weight and libido, measured in all 33 boars, and plasma testosterone levels for the 21 boars slaughtered were different ($P<.01$) over time, among the three treatment groups (Figure 1 a,b,c). Values for each parameter were found to be greater for boars in t_1 than for those in t_2, which were greater than those in t_3.

2. A similar but less pronounced relationship to treatment ($P<.05$) was found for testicular width as regressed over time (Figure 1d).

3. No treatment differences were observed in either weights or spermatozoan concentrations in the testes, capita-corporea or caudae epidymides, or in testicular length, weight or circumference.

4. Caudal epididymal spermatozoa, examined using bright field and phase contrast microscopy, revealed no evidence of structural changes due to treatment.

5. Epididymal epithelial heights measured in the capita tended ($P<.10$) to be greater in t_1 than t_3.

6. Testicular width as measured on the live animal was unrelated to total testicular spermatozoan concentration.

7. These results suggest that dietary selenium, fed at the supplemented levels of 150 and 300 ppb, may act to significantly retard the development of certain reproductive processes in young boars as analyzed over time.

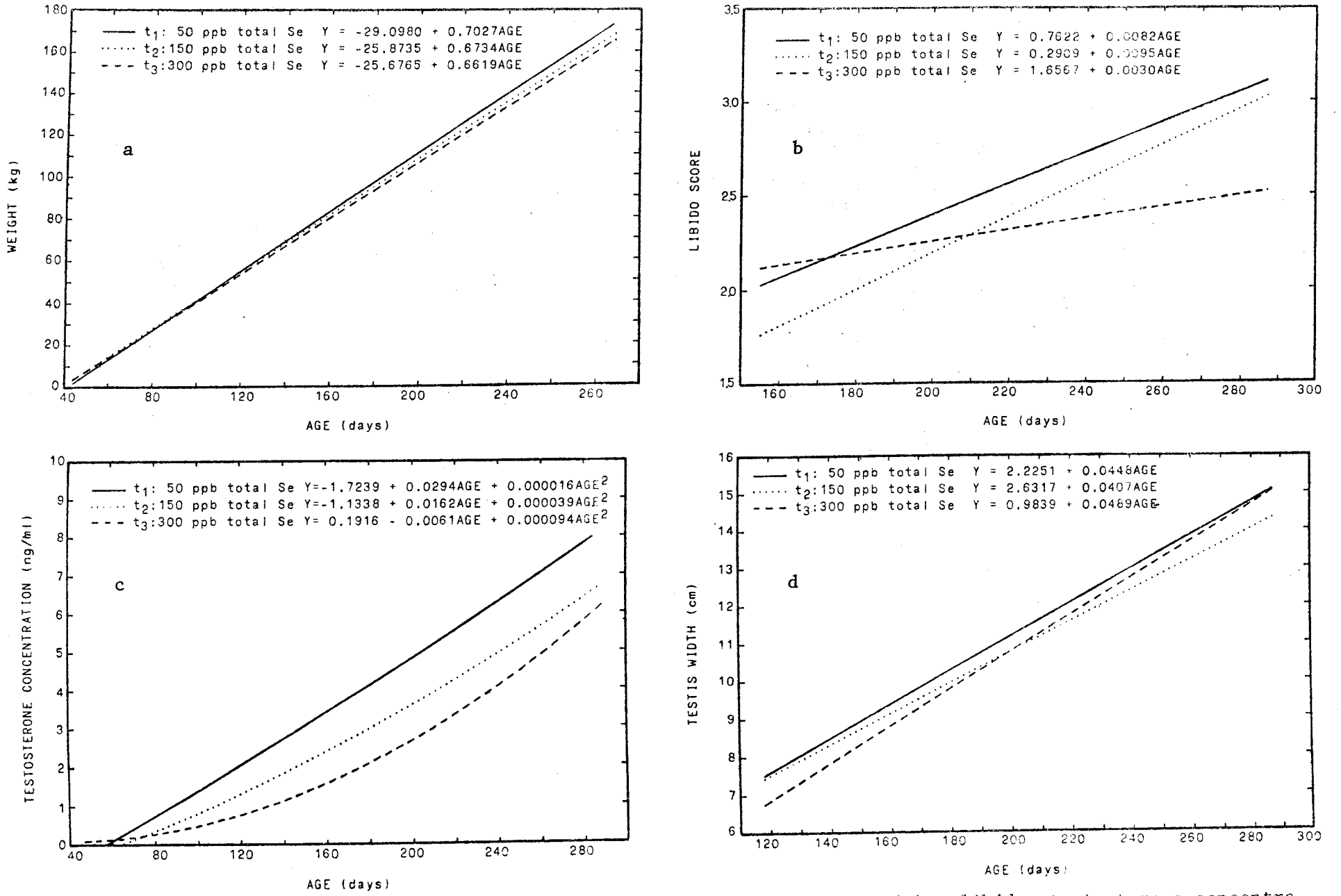


Figure 1 a,b,c,d. Relationship between the linear regressions of body weight, libido, testosterone concentration and testis width of boars receiving three levels of dietary selenium (Se) over age (days). Treatments 1, 2 and 3 received 50, 150 and 300 ppb selenium, respectively.

EFFECT OF FORM OF ORAL IRON ON UTILIZATION OF IRON BY NURSING PIGS

G. S. Allen and J. P. Hitchcock

In the confinement rearing of swine, the need for supplemental iron by the nursing pig for the prevention of iron deficiency anemia remains as one of the major problems faced by the producer. The most common means of supplying supplemental iron to the nursing pig is an intramuscular injection of iron dextran within the first three days of life which has proven to be very effective. However, previous research has also indicated that iron dextran can be given orally within the first 12 hours of the pigs life and be utilized as effectively as iron dextran administered intramuscularly for the prevention of anemia. Research with other species of animals has shown favorable results with several other different iron compounds for the prevention of anemia. Therefore, the objective of this experiment was to compare the effects of different orally administered iron compounds to iron dextran administered intramuscularly for the prevention of iron deficiency anemia in the piglet when the iron sources were given within the first 24 hours of life.

One hundred and fifty-six pigs from twenty litters were utilized in this experiment. The pigs were randomly allotted within litter to one of four treatments. The 4 treatments were: (1) iron dextran given by intramuscular injection to provide 100 mg iron, (2) iron dextran given orally to provide 100 mg iron, (3) ferrous gluconate given orally to provide 100 mg iron and (4) ferrous - L-aspartate given orally to provide 100 mg iron.

1. Performance of pigs during the 4-week trial and hematological parameters are presented in table 1. Pigs which received ferrous gluconate as the source of oral iron had significantly lower ($P<.01$) weights than did pigs receiving either intramuscularly injected or oral iron dextran, but had weights similar to pigs receiving ferrous - L-aspartate.

2. Pigs receiving ferrous gluconate and ferrous - L-aspartate had significantly lower ($P<.01$) hematological parameters at 4 weeks of age than did pigs receiving iron dextran intramuscularly.

3. There were no significant differences in hematological values of pigs receiving oral ferrous gluconate or ferrous - L-aspartate and those pigs receiving oral iron dextran.

4. The results of this experiment indicate that ferrous gluconate and ferrous - L-aspartate as oral sources of iron for the nursing pig were utilized as effectively as oral iron dextran to support hematological profiles and prevent iron deficiency anemia in the nursing pig.

Table 1. Effect of source of iron on weight, hematocrit and hemoglobin

	Iron source			
	Iron dextran, injectable	Iron dextran, oral	Ferrous gluconate, oral	Ferrous-L aspartate, oral
Weight, kg				
Initial	1.58	1.65	1.65	1.58
Week 1	2.47[c]	2.56[c]	2.17[d]	2.31[c]
Week 4	6.36[a]	6.50[a]	5.36[b]	5.82[a,b]
Hematocrit, %				
Initial	34.5	33.9	33.5	34.1
Week 1	34.4	33.9	33.2	32.9
Week 4	35.6[a]	32.1[b]	31.4[b]	31.9[b]
Hemoglobin, g/dl				
Initial	10.60	10.32	10.36	10.41
Week 1	10.70	10.10	10.44	10.11
Week 4	12.09[a]	10.38[b]	10.13[b]	10.14[b]

[a,b]Means in the same row with different superscripts are significantly different ($P<.01$).

[c,d]Means in the same row with different superscripts are significantly different ($P<.05$).

UTILIZATION OF FERRIC NITRILOTRIACETATE AND FERRIC OLEATE AS ORAL FORMS OF IRON BY NURSING PIGS

J. P. Hitchcock and G. S. Allen

In the confinement rearing of swine, the need for supplemental iron by the nursing pig for the prevention of iron deficiency anemia remains as one of the major problems faced by the producer. The most common means of supplying supplemental iron to the nursing pig is an intramuscular injection of iron dextran within the first three days of life which has proven to be very effective. However, previous research has indicated that iron dextran can be given orally within the first 12 hours of the pig's life and be utilized as effectively as iron dextran administered intramuscularly for the prevention of anemia. Previous research has indicated that oleic acid was the fatty acid most readily metabolized for energy by the nursing pig. Studies with laboratory animals have demonstrated that ferric nitrilotriacetate did increase iron levels in the offspring of dams which were administered this form of iron in the drinking water. Therefore, the objective of this experiment was to compare the effects of orally administered ferric nitrilotriacetate and ferric oleate to iron dextran administered intramuscularly or orally for the prevention of iron deficiency anemia in the pig when the iron sources were given within the first 24 hours of life.

One hundred and forty-six pigs from twenty litters were utilized in this experiment. The pigs were randomly allotted within litter to one of four treatments. The 4 treatments were: (1) iron dextran given by intramuscular injection to provide 100 mg iron, (2) iron dextran given orally to provide 100 mg iron, (3) ferric nitrilotriacetate given orally to provide 100 mg iron, and (4) ferric oleate given orally to provide 100 mg iron.

1. Performance of pigs during the 4-week trial and hematological parameters are presented in table 1. Pigs receiving ferric nitrilotriacetate as the source of oral iron had significantly lower ($P<.05$) weights than did pigs receiving either intramuscularly injected iron dextran, oral iron dextran or oral ferric oleate at 4 weeks of age.

2. Pigs receiving ferric nitrilotriacetate and ferric oleate had significantly lower ($P<.01$) hematological parameters at 4 weeks of age than did pigs receiving intramuscularly injected iron dextran.

3. There were no significant differences in hemoglobin values of pigs receiving oral ferric nitrilotriacetate on ferric oleate and those pigs receiving oral iron dextran.

4. The result of this experiment indicates that ferric nitrilotriacetate and ferric oleate as oral sources of iron for the nursing pig were utilized as effectively as oral iron dextran to support hematological profiles and prevent iron deficiency anemia in the nursing pig.

Table 1. Effect of ferric nitrilotriacetate and ferric oleate on performance and hematology of nursing pigs

	Iron source			
	Iron dextran, injectable	Iron dextran, oral	Ferric nitrilotri-acetate, oral	Ferric oleate, oral
Weight, kg				
Initial	1.53	1.56	1.59	1.86
Week 1	2.42[a]	2.50[a]	2.01[b]	2.45[a]
Week 4	6.34[a]	6.21[a]	5.30[b]	6.66[a]
Hematocrit, %				
Initial	32.0	32.9	32.1	33.8
Week 1	33.7[a]	33.9[a]	31.7[b]	33.8[a]
Week 4	35.6[c]	31.7[d]	30.4[d]	31.4[d]
Hemoglobin, g/dl				
Initial	10.05	10.28	9.94	10.40
Week 1	11.10[a]	11.09[a]	10.44[b]	11.50[a]
Week 4	12.57[c]	11.16[d]	10.53[d]	10.41[d]

[a,b]Means in the same row with different superscripts are significantly different ($P<.05$).

[c,d]Means in the same row with different superscripts are significantly different ($P<.01$).

EFFECT OF CARBOHYDRATE SOURCE IN CREEP FEED DIETS ON UTILIZATION OF IRON BY NURSING PIGS

J. P. Hitchcock, G. S. Allen, C. K. Bensinger and D. F. Ellis

There are a number of factors which are known to influence the utilization of administered iron including the route of administration, the form of iron and level of dietary copper, ascorbic acid and vitamin E. Less well-known is the influence of environment, form of diet and type of dietary protein, carbohydrate and fat on oral iron utilization by the baby pig. Work with laboratory animals has demonstrated that the absorption of radio-iron was greatest with diets containing lactose, less with diets containing sucrose and least with diets containing starch. Therefore, the objective of this experiment was to determine the effect of carbohydrate source in creep feed diets on utilization of iron by nursing pigs.

One hundred and eighty pigs from twenty litters were utilized in this experiment. One half of the pigs from each litter received an intramuscular injection of 100 mg of iron from iron dextran at 3 days of age and litters were randomly assigned to 4 dietary creep feed treatments at 10 days of age. The 4 creep feed treatments consisted of a basal, 18% crude protein, fortified corn-soybean meal ration; 18% starch-soybean meal ration; 18% dextrose soybean meal ration or an 18% lactose-soybean meal ration.

1. Performance of pigs during the 5-week trial and hematological parameters are presented in Table 1. Source of carbohydrate had no effect on pig weight gains and performance during the 5-week experiment.

2. Source of carbohydrate in the creep feed diet did significantly affect hematology and utilization of iron by nursing pigs. Pigs receiving dextrose and lactose had greater hematological profiles than did pigs receiving the control diet or a diet where corn starch was the major carbohydrate in the diet.

3. Pigs receiving dextrose and lactose as the major source of carbohydrate consumed less creep feed per pig weaned than did pigs receiving the control or the starch-soybean meal diet.

4. These data agree with previously cited research indicating increased efficiency and utilization of iron from diets containing lactose or dextrose.

Table 1. Effect of carbohydrate source on performance and utilization of iron by nursing pigs

	CHO - Source			
	Control	Starch	Dextrose	Lactose
Weight, kg				
Week 1	1.81	1.54	2.00	1.95
Week 2	3.90	3.54	3.81	3.67
Week 3	6.53	5.44	5.85	5.62
Week 4	8.21	6.98	7.44	7.26
Week 5	9.89	8.57	8.53	8.71
Hematocrit, %				
Week 3	30.6[a]	31.1[a]	33.6[b]	33.7[b]
Week 4	32.6[a]	32.1[a]	35.1[b]	34.7[b]
Week 5	33.3	32.2	34.2	34.1
Hemoglobin, g/dl				
Week 3	8.69	8.15	8.73	9.40
Week 4	8.94[a]	9.27[a]	10.42[b]	10.08[b]
Week 5	9.89	9.65	10.33	10.11
Creep per pig weaned, kg				
Week 5	2.50[c]	2.30[c]	1.63[d]	1.60[d]

[a,b]Means in the same row with different superscripts are significantly different ($P<.01$).

[c,d]Means in the same row with different superscripts are significantly different ($P<.05$).

EFFECT OF EXCESS DIETARY METHIONINE CONSUMPTION ON PERFORMANCE, HEMATOLOGY AND PLASMA FREE AMINO ACID CONCENTRATIONS IN YOUNG SWINE

J. M. Merrick, J. P. Hitchcock, K. R. Robbins,
T. M. Shipley and J. M. Moore

Methionine has been shown to be the most toxic indispensable amino acid when consumed at levels exceeding its physiological requirement. Studies utilizing rats and chicks have shown that growth, feed consumption and gain:feed were impaired and that tissue damage occurred when high levels of methionine (2 x the N.R.C. requirement) were consumed. In both rat and chick studies, methionine has been shown to affect amino acid concentrations in the blood as well. Considering that previous research has dealt mainly with members of the avian and rodent families and that limited research was available on the effects of excess dietary methionine on the performance of swine, this study was undertaken to investigate the effects of excess dietary methionine supplementation in weanling pigs.

This experiment utilized 16 weanling pigs which were 6 to 7 weeks of age to evaluate the effects of excess dietary methionine. Pigs were allotted by weight within litter replicate. Diets containing the 1979 N.R.C. requirement of methionine and cystine or with methionine at 2.5, 4.0 or 5.5 x N.R.C. requirements were utilized in this experiment. Pigs were individually housed in expanded metal pens. Animals were pair-fed a constant amount of their diet based on the consumption of their litter mate on the highest methionine diet twice daily. Pigs were hand-watered after each feeding and water was also added to the diets to form a more palatable gruel feed.

1. Performance, hematology and plasma free amino acid concentrations of pigs utilized in this experiment are presented in table 1. Data from this experiment indicated that gain and gain:feed were increased by the addition of 2.5 times the basal level of methionine but that a precipitous decrease resulted from higher levels of added methionine during the first week. Gain and gain:feed during week 2 and 3 exhibited similar responses to week 1 but were smaller in magnitude indicating that an adaptation to higher levels of methionine had occurred.

2. Hemoglobin values were not affected by methionine additions to the diets of weanling pigs.

3. Plasma methionine and threonine were increased while plasma glycine was depressed throughout the experiment in pigs fed 4 or 5.5 x the methionine requirement.

4. Weanling pigs appear to adapt to high methionine consumption as evidenced by resumption of gain and gain:feed while consuming elevated levels of methionine. The decrease in plasma free methionine concentration over a short period of time while dietary methionine supplementation remained high indicated an adaptive mechanism was functioning.

Table 1. Effect of supplemental dietary methionine on performance, hematology and plasma free amino acid concentration in young swine[a]

Item	Methionine level (x N.R.C)[b]			
	1	2.5	4.0	5.5
Gain (grams)[c,d]				
Week 1	3527	3765	3098	2177
Week 2	3720	4525	3958	3663
Week 3	3379	3788	3844	3425
Gain:feed[c]				
Week 1	.58	.65	.55	.40
Week 2	.56	.68	.61	.57
Week 3	.48	.55	.56	.50
Hemoglobin (grams/dl)				
Week 1	12.51	12.43	12.51	13.44
Week 2	13.02	12.35	12.90	13.01
Week 3	13.83	13.37	13.63	13.53
Plasma methionine (nmoles/ml)[c,e]				
Week 1	107	325	1214	1631
Week 2	28	76	1161	1458
Week 3	35	55	717	1967
Plasma threonine (nmoles/ml)[c]				
Week 1	302	280	645	806
Week 2	236	154	574	785
Week 3	221	175	565	849
Plasma glycine (nmoles/ml)[c]				
Week 1	1185	1064	690	979
Week 2	1340	969	938	887
Week 3	1187	951	907	866

[a]Animals were pair-fed. Mean of four samples per methionine level

[b]Methionine levels 1, 2.5, 4.0 and 5.5 correspond to total sulfur amino acid concentrations of .55, 1.37, 2.20 and 3.02%, respectively.

[c]Methionine effect significant ($P<.01$).

[d]Period effect significant ($P<.01$).

[e]Period effect significant ($P<.05$).

EFFECT OF EXCESS DIETARY METHIONINE CONSUMPTION ON PERFORMANCE, HEMATOLOGY AND PLASMA FREE AMINO ACID CONCENTRATIONS IN YOUNG POULTRY

J. M. Merrick, J. P. Hitchcock, K. R. Robbins,
J. M. Moore and T. M. Shipley

Methionine has been shown to be the most toxic indispensable amino acid when consumed at levels exceeding its physiological requirement. Previous studies utilizing young chicks had indicated that growth, feed consumption and feed efficiency were impaired when high levels of methionine were consumed. In previous studies, plasma threonine, serine and glycine levels were depressed while plasma methionine increased with dietary methionine supplementation. Therefore, the objective of this experiment was to determine the response of chicks of different ages to excess dietary methionine consumption.

This experiment utilized 108 Hubbard X Hubbard chicks, 54 per age group, to evaluate the effects of incremental additions of DL-Methionine to the diets of 8-day-posthatched and 5-week-posthatched chicks. Diets containing the 1977 N.R.C. requirement of methionine with treatment diets having 3.0 or 5.0 x N.R.C. levels were used for each age group. Chicks were housed in wire-bottom chick batteries in continuous light. Feed and water were supplied ad libitum.

1. Performance, hematology and plasma free amino acid concentrations of chicks utilized in this experiment are presented in table 1. Excess methionine consumption depressed gain, feed intake and gain:feed in both young (8-day-posthatched) and older (5-week-posthatched) birds.

2. Hemoglobin values were reduced in young chicks fed increasing amounts of methionine but hemoglobin values were unaffected in older chicks consuming high levels of dietary methionine. Plasma glucose was increased in young chicks consuming the highest amount of methionine but older chick's plasma glucose was not significantly affected.

3. Plasma methionine was elevated in young and old chicks consuming supplemental methionine. Plasma threonine was depressed in young chicks fed 3 x the N.R.C. requirement. Plasma glycine was increased in young chicks fed 5 x the N.R.C. level but was decreased in older chicks consuming methionine at 3 or 5 x the requirement.

4. It appears from comparative observations of older and younger birds that excess dietary methionine causes depressed gain, feed intake and gain:feed equally in both age groups, but older chicks are less sensitive to metabolic abnormalities associated with excess methionine consumption.

Table 1. Effect of supplemental dietary methionine on performance, hematology and plasma free amino acid concentration in young poultry[a]

Item	Methionine level (X N.R.C.)[b] 1.0	3.0	5.0
Gain (grams)[c]			
Age 1	188.1	130.8	40.2
Age 2	192.0	136.5	52.2
Gain:Feed[c,d]			
Age 1	.69	.62	.44
Age 2	.30	.26	.13
Hemoglobin (grams/dl)[d]			
Age 1	9.47	6.80	6.95
Age 2	8.65	10.15	8.65
Plasma glucose (mg/dl)[e]			
Age 1	165.13	185.64	197.26
Age 2	167.19	171.97	175.73
Plasma methionine (nmoles/ml)[c,d]			
Age 1	53	968	1560
Age 2	45	89	565
Plasma threonine (nmoles/ml)[c,d]			
Age 1	1191	996	987
Age 2	846	381	741
Plasma glycine (nmoles/ml)[c,d]			
Age 1	701	644	819
Age 2	578	324	403

[a]Mean of triplicate pooled groups of six male chicks. Age 1 = 8-day-posthatched chicks; age 2 = 5-week-posthatched chicks.

[b]Methionine levels 1, 3 and 5 correspond to total sulfur amino acid amounts of .93, 2.79 and 4.65%, respectively, for age group 1 chicks and to .72, 2.16 and 3.60%, respectively, for age group 2 chicks.

[c]Methionine effect significant ($P<.01$).

[d]Age effect significant ($P<.01$).

[e]Methionine effect significant ($P<.05$).

EFFECTS OF DIETARY LEVEL AND RATIO OF ARGININE AND LYSINE ON PERFORMANCE OF YOUNG CHICKS

N. S. Mitchell, K. R. Robbins and J. P. Hitchcock

Lysine and arginine are two indispensable amino acids required in high concentrations in diets for poultry. Lysine is the first or second limiting amino acid in many feedstuffs. Although arginine is seldom limiting in practical diets, a marked antagonism exists between arginine and lysine. Namely, excess dietary lysine can increase the rate of catabolism of arginine thus reducing available arginine to levels below that required for body metabolism. And, excess arginine is a competative inhibitor of lysine absorption in the small intestine. Hence, it appears that excess arginine impairs lysine utilization. As a consequence, several investigators have recommended that reported requirements for either lysine or arginine should be qualified by the ratio of the two amino acids. A preliminary study designed to assess the effects of dietary arginine:lysine ratio on the requirement for each was undertaken.

A lysine-and arginine-deficient purified crystalline amino acid diet was used (table 1). From this, 18 experimental diets were prepared (table 2). In diets 1-6, arginine and lysine were increased simultaneously from deficient to adequate levels, thus maintaining equal arginine:lysine ratios. In each of these diets lysine was first limiting. In diets 7-12, dietary arginine was increased in the presence of adequate lysine, thus yielding diets with increasing arginine:lysine ratios. And, in diets 13-18, lysine was increased in the presence of adequate arginine, thus yielding diets with decreasing arginine:lysine ratios.

1. Inspection of gain and gain/feed ratio data in table 2 indicates that regardless of dietary arginine:lysine ratio, bird growth is maximized at approximately .78% arginine and .78% lysine.

2. Plasma lysine of chicks fed diets 1-6 and 13-18 remained low until a level of .78% lysine was achieved at which point a marked increase in plasma lysine occurred. Plasma arginine likewise remained low in chicks fed diets 7-12 until a level of .93% arginine was achieved at which point plasma arginine increased markedly. This supports an estimated requirement of approximately .78% for each amino acid.

3. Plasma lysine of chicks fed diets 7-12 decreased linearly as the level of dietary arginine increased. However, plasma arginine was unaffected in chicks fed diets containing graded levels of lysine (diets 13-18).

Table 1. Composition of purified basal diet

Basal diet	%	Amino acids	%
Cornstarch	60.79	L-Arginine HCl	.40
Corn oil	10.00	L-lysine HCl	.35
Salt premix	5.37	L-histidine HCl H_2O	.45
Cellulose	3.00	L-tyrosine	.45
$NaHCO_3$	1.50	L-tryptophan	.15
Choline chloride	.20	L-phenylalanine	.50
Vitamin premix	.20	DL-methionine	.35
Ethoxyquin	+	L-cystine	.35
Amino acids	18.94	L-threonine	.65
	100.00	L-leucine	1.00
		L-isoleucine	.60
		L-valine	.69
		glycine	.60
		L-proline	.40
		L-glutamic acid	12.00
			18.94

Table 2. Performance and plasma amino acid concentrations of chicks fed graded levels of arginine and lysine in varied ratios

Diet description						Plasma amino acid concentration[b]	
Diet no.	Arginine %	Lysine %	Arginine: lysine	Gain (g)[a]	Gain: feed (g/kg)[a]	Arginine (nmoles/ml)	Lysine
1	.33	.28	1.18	30	400	64	17
2	.48	.41	1.17	51	481	65	17
3	.63	.53	1.19	63	463	111	55
4	.78	.66	1.18	92	568	119	36
5	.93	.78	1.19	99	553	225	83
6	1.1	.91	1.21	96	519	172	214
7	.33	.91	.36	23	261	55	995
8	.48	.91	.53	56	459	56	811
9	.63	.91	.69	77	527	40	605
10	.78	.91	.86	103	578	50	463
11	.93	.91	1.02	107	598	186	320
12	1.1	.91	1.21	98	598	226	275
13	1.1	.28	3.93	21	273	247	43
14	1.1	.41	2.68	43	417	328	33
15	1.1	.53	2.07	58	484	257	52
16	1.1	.66	1.67	86	565	278	52
17	1.1	.78	1.41	97	539	282	586
18	1.1	.91	1.21	101	646	218	586
		Pooled SEM (36 df)		4.8	.031	28	55

[a]Data are means of triplicate groups of six chicks each fed the experimental diets from day 18 through 24 posthatching.
[b]Blood was collected from each chick on day 24 and polled within replicate groups thus yielding one sample per replicate group (i.e., three samples per treatment).

EFFECT OF DIETARY POTASSIUM LEVEL AND ARGININE:LYSINE RATIO ON THE CHICK'S LYSINE REQUIREMENT

N. S. Mitchell and K. R. Robbins

In the preceding two reports we discussed the effect of dietary potassium and arginine:lysine ratio on lysine utilization. This study was conducted to further quantify the effect of both on the chick's lysine requirement.

The corn-based semi-purified diet described in table 1 of the preceding report was also used in this experiment except that supplemental arginine and lysine were omitted. In diets 1-5 lysine was incrementally increased from .45% to 1.05% while arginine was kept constant at 1.7% (table 1). Hence, as dietary lysine was increased the arginine:lysine ratio decreased. In diets 6-10 the same lysine levels were used, but arginine was increased proportionately so that the arginine:lysine ratio was held constant at 1.1. Each experimental diet was fed either with or without .5% supplemental potassium as potassium citrate. The chick's lysine requirement was estimated from the gain data using a non-linear least squares point estimation technique.

1. Without supplemental dietary potassium the chick's lysine requirement (table 2) was not significantly affected by the dietary arginine:lysine ratio, i.e. .876% vs .894%.

2. Gain and gain/feed ratio of chicks fed potassium-supplemented, lysine-deficient diets was slightly improved with the addition of potassium. However, these differences were not statistically significant.

3. The chick's lysine requirement was reduced by an average of 11% with the addition of supplemental potassium.

4. It appears as though supplemental potassium does slightly increase efficiency of lysine utilization when chicks are fed low-lysine diets which contain only a slight excess of potassium.

Table 1. Effect of dietary potassium and arginine:lysine ratio on chick performance[a]

Diet description			gain, g		Gain/feed (g/kg)	
Diet No.	Arginine %	Lysine %	- Potassium	+ Potassium	- Potassium	+ Potassium
1	1.7	.45	63	68	420	425
2	1.7	.60	96	95	533	540
3	1.7	.75	115	124	578	579
4	1.7	.90	125	122	622	552
5	1.7	1.05	121	112	587	562
6	.50	.45	73	79	456	470
7	.65	.60	96	98	425	478
8	.80	.75	119	122	553	592
9	.95	.90	121	120	571	561
10	1.10	1.05	121	118	579	536
		Pooled SEM (36 df)	5		24	

[a]Data are means of triplicate groups of six chicks each, fed the experimental diets from day 8 to day 14 posthatching.

Table 2. Estimated lysine requirements

Conditions	Estimated requirement, % ± SE
Constant arginine concentration	
-potassium	.876 ± .075
+potassium	.757 ± .059
Constant arginine:lysine ratio	
-potassium	.894 ± .086
+potassium	.818 ± .074

EFFECT OF SUPPLEMENTAL DIETARY POTASSIUM AND SODIUM ON PERFORMANCE OF CHICKS FED A LYSINE-DEFICIENT DIET

N. S. Mitchell, K. R. Robbins and J. P. Hitchcock

Lysine is the first limiting amino acid in many low-protein swine diets, and often the second-limiting amino acid in low-protein poultry diets. This, of course, can be remedied by supplementing the diet with crystaline L-lysine·HCl. However, at times this is cost prohibitive. An alternative method reported to improve growth of swine and poultry fed low-lysine diets is supplementation with dietary monovalent cations (potassium and sodium). The efficacy of this method is still questionable. The study reported herein was designed to determine if and to what degree potassium and sodium improves growth of young (1 week old) chicks fed a lysine-deficient diet.

The basal diet listed in table 1 was formulated to contain 90% of the chick's estimated lysine requirement. By analysis, the diet contained .28% potassium and .36% sodium which, based on National Research Council estimates, exceeds the chick's sodium requirement. From the basal diet, eight experimental diets were formulated (table 2). In one diet crystalline L-lysine·HCl was added. In the remaining diets .5% potassium or sodium in either the acetate, citrate, or bicarbonate form was added.

1. Supplementing the basal diet with lysine or any of the three forms of potassium or sodium significantly ($P<.05$) improved chick gain and gain:feed (table 2).

2. The addition of dietary lysine significantly increased plasma lysine ($P<.01$) and decreased plasma arginine concentrations. The fact that plasma lysine was increased, indicated that the chick's lysine requirement was exceeded. The decrease in plasma arginine was probably due to the well defined antagonism which exists between lysine and arginine.

3. Although not statistically significant, potassium or sodium supplementation of the basal diet consistently resulted in decreased plasma lysine concentration. This effect plus the improved growth suggests that supplementation of low-lysine diets with sodium or potassium may improve growth by hastening the transport of plasma lysine to muscle tissue.

Table 1. Composition of semi-purified basal diet

Ingredient	%	Amino Acid	%
Cornstarch	to 100.00	L-arginine·HCl	.92
Dextrose	5.00	L-histidine·HCl·H_2O	.43
Rice hulls	4.00	L-isoleucine	.55
Ground yellow corn	67.00	L-leucine	.61
Amino acids	12.67	L-lysine·HCl	.61
Dicalcium phosphate	2.60	DL-methionine	.37
Limestone	.50	L-cystine	.33
Salt	.50	L-phenylalanine	.40
Vitamin premix	.20	L-tyrosine	.32
Choline chloride	.20	L-threonine	.49
		L-tryptophan	.17
		L-valine	.47
		glycine	.50
		L-glutamic acid	6.50
			12.67

Table 2. Effect of supplemental potassium or sodium on performance of chicks fed a lysine-deficient diet[a]

Experimental diet	gain	gain/feed	Plasma amino acids	
			Lysine	Arginine
	(g)	(g/kg)	(nmoles/ml)	
Basal diet (lysine deficient)	68	476	148	280
Basal + .188% L-lysine·HCl	87	558	395	92
Basal + 1.25% potassium acetate	97	567	87	271
Basal + 1.31% potassium citrate	91	532	79	303
Basal + 1.28% potassium bicarbonate	89	549	84	337
Basal + 1.78% sodium acetate	89	589	72	286
Basal + 2.13% sodium citrate·$2H_2O$	98	620	55	279
Basal + 1.83% sodium bicarbonate	94	614	72	338
Pooled SEM (16 df)	6	22	39	44

[a]Data represent means of triplicate groups of six chicks each, fed the experimental diets from day 8 to day 14 posthatching.

EFFECTS OF ALKALINE TREATMENT ON SOY PROTEIN QUALITY

K. R. Robbins and J. E. Ballew

Alkaline treatment of protein concentrates is becoming increasingly popular in the food industry. Such treatment increases the degree of amino acid crosslinking thereby altering the physical nature of proteins. Treated proteins can, for example, be spun into protein fibers and used as so-called meat analogues. The crosslinking reaction involves OH^- catalyzed beta-elimination of either the hydroxyl group of serine or the sulfhydryl group of cysteine thus, forming (in both cases) dehydroalanine. The doubly bonded methylene group of dehydroalanine then readily binds the free epsilon-amino group of lysine forming the crosslinked amino acid, lysinoalanine. The lysine bound in lysinoalanine is rendered totally unavailable. However, this per se does not affect the quality of soy protein since it contains an excess of lysine. Instead, protein quality may be lowered by 1) decreased nitrogen digestibility, and 2) loss of bioavailable cysteine. Loss of cysteine is of primary importance in soy protein because the sulfur amino acids (cysteine and methionine) are first limiting. Results reported herein are from preliminary experiments designed to assess the effects of severe alkaline treatment on protein quality.

A 3% solution of isolated soy protein (85% CP) was treated at 60°C, pH 12.5 for two hours. The treated protein was precipitated at pH 4.5 with 6N HCl, concentrated by cetrifugation, and freeze dried. Serine, lysine, lysinoalanine and histidine concentrations were determined analytically. Estimates of bioavailable sulfur amino acids and histidine were determined using a chick bioassay. In both experiments (tables 2 and 3) a standard growth response curve was constructed by feeding a crystalline amino acid diet which contained graded levels of the amino acid under study. Using the standard curve and the gain and feed intake of chicks fed the protein-supplemented diets, bioavailability estimates were made.

1. A substantial quantity (1.9%) of lysinoalanine was formed during the two hour alkaline treatment (table 1). Further, it appears that serine was the major source of dehydroalanine, since the molar loss of serine was approximately equal to the molar increase in lysinoalanine.

2. Alkaline treatment reduced sulfur amino acid bioavailability by 71%. However, this was apparently due entirely to decreased digestibility, since histine bioavailability was reduced by 80% even though its concentration in the protein was unaffected by alkaline treatment.

3. It is concluded that the reduction in soy protein quality following alkaline treatment is due primarily to decreased digestibility rather than cysteine destruction.

Table 1. Effect of alkaline treatment on amino acid composition[a]

Amino acid	Amino acid concentration (g/16g N)	
	Untreated protein	Treated protein
Serine	6.4	4.5
Lysine	7.3	5.6
Lysinoalanine	-	1.9
Histidine	3.2	3.1

[a]Due to analytical problems, cysteine and methionine concentrations were not determined.

Table 2. Effect of alkaline treatment on sulfur amino acid bioavailability[a]

Diet description[b]	Gain[c](g)	Feed consumed (g)
1. Basal (SAA deficient)	31	110
2. Basal + .05% SAA	46	138
3. Basal + .10% SAA	72	160
4. Basal + .15% SAA	86	180
5. Basal + 5.77% untreated soy protein	66	133
6. Basal + 5.77% treated soy protein	40	119

[a]Data are means of triplicate groups of five chicks each, fed the experimental diets from day 8 to day 15 posthatching.
[b]SAA = sulfur amino acids (50:50 w:w mixture of DL-methionine and L-cysteine).
[c]Regression of gain on mg SAA consumed (diets 1-4) yielded the equation: gain = 30.97 + .2433 SAA, R^2 =.91. Based on gain and feed consumption of chicks fed diets 5-6, it was calculated that the untreated and treated soy protein contained 1.88% and .54% bioavailable sulfur amino acids, respectively.

Table 3. Effects of alkaline treatment on histidine bioavailability[a]

Diet description[b]	Gain[c](g)	Feed consumed (g)
1. Basal (HIS deficient)	45	117
2. Basal + .05% HIS	77	148
3. Basal + .10% HIS	110	190
4. Basal + .15% HIS	147	240
5. Basal + 2.0% untreated soy protein	72	145
6. Basal + 2.0% treated soy protein	51	125

[a]Data are means of triplicate groups of five chicks each, fed the experimental diets from day 8 to day 15 posthatching.
[b]HIS = L-histidine HCl H_2O.
[c]Regression of gain on mg HIS consumed (diets 1-4) yielded the equation: gain = 46.34 + .559 HIS - .0007 HIS^2, R^2=.99. Based on gain and feed consumption by chicks fed diets 5-6, it was calculated that the untreated and treated soy protein contained 1.68% and .34% bioavailable histidine, respectively.

MAGNESIUM, CALCIUM AND POTASSIUM CONCENTRATIONS IN TISSUES OF MAGNESIUM DEFICIENT AND NORMAL SHEEP

J. K. Miller, M. D. Schneider, N. Ramsey and P. K. White

Comparisons of normal and magnesium (Mg) deficient rats or guinea pigs have usually shown reduced Mg, elevated calcium (Ca) and normal or reduced potassium (K) concentrations in tissues from Mg-deficient animals. In a German study of cows which died in hypomagnesemic tetany or were slaughtered because of complications resulting from Mg deficiency, low contents of both Mg and Ca were found in heart muscle, liver, spleen and skeletal muscle. In the present report, Mg, Ca and K contents of internal organs, bone and skeletal muscle of sheep fed semipurified diets deficient or adequate in Mg and adequate or excessive in K are presented.

Thirty-six weaned lambs were divided randomly into a 2 x 2 factorial arrangement of four groups of nine animals each and fed diets with .01% (groups 1 and 3) or .2% (groups 2 and 4) Mg and .8% (groups 1 and 2) or 4% (groups 3 and 4) K. Although the lambs were used for other measurements, tissues from six in group 1, seven in group 2, seven in group 3 and nine in group 4 were available for Mg, Ca and K analysis.

1. All lambs in groups 1 and 3 became hypomagnesemic (plasma Mg below 1 mg/dl) within 3 weeks. Six lambs fed Mg-deficient diets died in hypomagnesemic tetany; three in group 1 died after 3, 12 and 12 months and three in group 3 died after 2, 2 and 3 months.

2. No notable treatment differences in tissue Mg content were found except for lower Mg concentrations in rib from Mg-deficient animals (table 1). Mg content of tissues from lambs which died in tetany was not measurably lower than that of hypomagnesemic lambs which survived or that of normomagnesemic lambs.

3. Except for a few samples from heart, lung and kidney from one or two animals receiving Mg-deficient diets (footnote, table 1), tissue Ca content did not differ between treatments in most cases. In these exceptional cases, Ca concentrations were 2-7 times higher in kidney, 3 times higher in heart and 3 times higher in lung than corresponding measurements in animals fed adequate Mg-normal K diets. Mg content in lung tissue from one lamb fed the normal Mg-excessive K diet was eight times higher than in lung tissue from group 2 lambs. Treatment differences in tissue K content were not found.

4. Apparently, the soft tissue calcification usually found in Mg-deficient laboratory animals does not always occur in ruminants, even in those which died in hypomagnesemic tetany.

Table 1. Tissue cation concentrations in tissues of magnesium deficient and normal sheep

Element and tissue	Group			
	Normal K		High K	
	-Mg	+Mg	-Mg	+Mg
	(ug/g dry wt)			
Magnesium				
Heart apex	752	787	635	718
Intraventricular septum	846	835	819	844
Left ventricle	860	859	815	820
Right ventricle	756	754	735	712
Lung	482	544	436	543
Kidney	824	843	728	962
Spleen	699	650	682	715
Rib	1,311	3,516	2,118	3,140
Gastrocnemius muscle	772	854	850	904
Calcium				
Heart apex	165	138	168	113
Intraventricular septum	514[a]	119	110	97
Left ventricle	152	96	364[b]	76
Right ventricle	195	120	149	98
Lung	984[a]	323	327	1,086[d]
Kidney	2,037[a]	1,227	1,485[c]	1,151
Spleen	163	98	92	109
Rib	168,138	153,756	158,439	138,294
Gastrocnemius muscle	118	389	377	76
Potassium				
Heart apex	8,327	7,122	8,890	4,955
Intraventricular septum	8,732	8,875	10,196	7,222
Left ventricle	9,638	8,723	9,414	7,820
Right ventricle	7,693	6,527	7,453	6,451
Lung	7,105	6,989	3,708[e]	7,756
Kidney	8,266	6,796	8,533	7,712
Spleen	10,833	10,254	10,942	12,389
Rib	874	778	754	860
Gastrocnemius muscle	8,134	8,424	10,186	9,092

[a]Includes a lamb which died in tetany and analyzed: intraventricular septum, 2044; lung, 3190; and kidney, 7652 ug/g dry wt. Kidney from another group 1 lamb which survived until slaughter analyzed 2494 ug/g dry matter.
[b,c]Includes left ventricle analyzing 1546 ug/g and kidney analyzing 3456 ug/g dry matter from lambs which survived until slaughter.
[d]Includes lung tissue which analyzed 2840 ug/g dry matter from one lamb.
[e]Only one sample analyzed.

USE OF ACID-INSOLUBLE ASH AS AN INTERNAL DIGESTIBILITY INDICATOR FOR ATYPICAL SHEEP RATIONS

K. M. Barth, V. L. Fulgoni, III, S. Gelaye, K. T. Leahy and M. L. Langley

For animal performance, the nutritive value of a ration is most commonly described by its digestibility. Digestibility is usually determined by the total-collection method which makes it necessary for animals to be either confined to a collection crate or fitted with a harness and fecal collection bag. Total amount of feed eaten and fecal material voided has to be measured, which makes this method time consuming and expensive.

An alternative method of measuring digestibility which eliminates having to measure amount of feed and fecal material is the use of indicators. They are substances that are not absorbed or altered in the GI tract. There are external and internal indicators; external indicator must be added to the feed while internal indicators are natural components of the feed.

Five total-collection digestion trials with sheep had previously been conducted in which agricultural waste or byproducts made up a major portion of the rations. The feed, refusal and fecal samples from these trials were analyzed for insolubility in 2 N HCl (acid-insoluble ash). Dry matter digestibility by this method was calculated and compared to dry matter digestibility obtained by the total-collection method. A digestion trial with fescue hays was included to see if we can repeat the favorable results obtained by other workers with natural rations. A comparison of dry matter digestibility values obtained by the two methods is presented in table 1.

1. Digestibility of the fescue control hays obtained by the two methods was very similar, differed only 1.3 percentage points and confirmed the effectiveness of the acid-insoluble ash indicator method with natural rations.

2. With rations containing either corn stover, cattle manure or vegetable wastes, percent digestibility differed from -33.3 to 17.7. Digestibility with some rations, like the high-fiber manure rations, differed only a few percentage points. However, results from the acid-insoluble ash method with atypical rations are totally unacceptable.

3. One problem with this indicator method appears to be the difficulty of obtaining a representative feed sample. In a digestion trial with silages made from caged excreta (poultry excreta) and corn stover, three different "representative" feed samples were obtained, individual acid-insoluble ash determinations made and dry matter digestibility based on sample 1, mean of samples 1 and 2, and mean of samples 1, 2 and 3 calculated (table 2). Results based on more than one feed sample came closer to results from the total-collection trial, indicating that part of the problem of using acid-insoluble ash with waste rations is the difficulty of obtaining a representative feed sample.

Table 1. Dry matter digestibility as determined by acid-insoluble ash and total collection for individual rations

Trial	Ration	No. sheep	DM digestibility, % Total collection	DM digestibility, % AIA indicator	Deviation[a]
Fescue hay					
	Early maturity	3	67.1 ± 0.7[b]	68.4 ± 1.0[b]	1.3 ± 0.3[b]
	Medium maturity	3	65.4 ± 0.4	66.7 ± 0.6	1.3 ± 0.6
	Late maturity	3	55.5 ± 2.1	56.8 ± 1.3	1.3 ± 0.8
Stover					
	Corn stover	3	48.6 ± 1.6	63.6 ± 3.0	15.0 ± 4.0
	NH_4 corn stover	3	49.6 ± 3.1	63.5 ± 3.1	13.8 ± 3.2
	Stalklage	3	37.0 ± 1.9	45.9 ± 0.7	8.9 ± 2.5
High-fiber cattle manure					
	80% manure	3	35.0 ± 1.7	32.2 ± 1.3	-2.8 ± 1.1
	60% manure	3	44.1 ± 0.6	46.6 ± 2.1	2.5 ± 1.6
	40% manure	3	47.9 ± 1.6	50.5 ± 3.3	2.6 ± 4.8
Low-fiber cattle manure					
	80% manure	3	47.2 ± 0.9	59.3 ± 3.9	12.1 ± 3.9
	60% manure	3	52.2 ± 1.3	59.3 ± 2.3	7.1 ± 1.0
	40% manure	3	53.3 ± 2.2	60.1 ± 1.2	6.8 ± 1.2
Vegetable waste silages					
	Potato-bean	3	83.7 ± 0.5	50.4 ± 3.0	-33.3 ± 3.2
	Cabbage	2	76.6 ± 1.4	95.5 ± 1.9	17.7 ± 3.4
	Cabbage and hay	3	77.3 ± 0.3	80.7 ± 3.3	3.5 ± 3.4

[a]Deviation - total collection DMD - acid-insoluble ash DMD.
[b]Standard error of a mean.

Table 2. Feed sub-sample effects on comparison of dry matter digestibility as determined by total collection and acid-insoluble ash

Trial	Ration	No. sheep	DM digestibility, % Total collection	DM digestibility, % AIA indicator Feed sub-sample no. 1	1&2	1,2&3
Poultry excreta-corn stover silage						
	18% poultry excreta	4	47.2[a]	40.8[b]	50.1[a]	47.6[a]
	22% poultry excreta	4	36.9[a]	48.5[b]	39.7[a]	40.0[a]
	30% poultry excreta	4	46.4[a]	51.7[b]	46.6[a]	48.5[a]

[a,b]Means on the same line with different superscripts are significantly different ($P<.01$).

EFFECTS OF CAGED LAYER EXCRETA-CORN STOVER SILAGE AND TALL-FESCUE-RED CLOVER HAY ON RUMEN ENVIRONMENT

V. L. Fulgoni, III and K. M. Barth

Recently there has been an interest in feeding caged layer excreta (CLE) to cattle primarily as a protein substitute. However, harmful bacteria present in CLE must be eliminated before feeding. An inexpensive way to achieve this is to ensile the CLE with a fermentable substance. Corn stover is in relative abundance and has received attention as a cheap source of nutrients that will otherwise go to waste. In those studies the resultant total digestible nutrients, as determined by feeding mature sheep, were only about 45%. This would indicate CLE-stover silage would only be adequate for maintenance.

Sometimes it is desirable to feed animals close to the maintenance level and thereafter higher energy diets are supplied such as a higher quality hay or even concentrates. This experiment was conducted to determine the rumen environment during CLE-stover silage feeding and to determine any possible adverse carry-over effects on rumen environment after the silage was replaced with a medium quality hay.

Three rumen fistulated sheep were used on this experiment to facilitate rumen fluid sampling. Initially, the sheep were fed tall fescue-red clover hay for three days and then their diet was abruptly switched to the CLE-stover silage. Silage feeding continued for 16 days. After this period, the hay was reintroduced to the sheep and fed for a period of 9 days. Rumen samples were taken every two days of the experiment and analyzed for pH, volatile fatty acids (VFA) and protozoa species. Regression equations were calculated and values were predicted from these equations for various days of interest. The predicted pH and VFA's are presented in table 1 while predicted protozoa concentrations are presented in table 2.

1. Total VFA decreased and pH increased after feeding CLE-stover silage. Molar percent acetate decreased while molar percent propionate increased.

2. When hay was re-fed, total VFA increased dramatically, indicating no adverse carry-over effects of feeding CLE-stover silage on the microflora of the rumen.

3. Total protozoa (10^4/ml) and concentrations of individual species decreased while feeding CLE-stover silage.

4. When hay was re-fed, total protozoa and the individual species increased, indicating that rumen microfauna was not affected adversely by any carry-over effect of CLE-stover silage feeding.

5. Overall, feeding CLE-stover silage did result in lower VFA and protozoa concentrations than in the hay diet, but no adverse carry-over effects on rumen microflora or microfauna were noted. The response of higher levels of rumen VFA and protozoa while feeding hay was probably indicative of it being a better quality feedstuff (TDN, 67%).

Table 1. Ruminal pH and volatile fatty acid levels during dietary changes

Day of trial	pH	Total VFA (mM/l)	VFA, molar percent			
			Acetate	Propionate	Butyrate	Other acids[a]
	---------- Hay, days 0-2 ----------					
1	6.38	95.2	72.1	19.2	6.2	2.6
	---------- Excreta silage, days 2-18 ----------					
5	6.53	101.3	69.8	21.1	6.1	3.0
10	6.63	89.2	67.7	22.6	6.5	3.4
15	6.74	77.1	64.9	24.6	7.0	3.5
	---------- Hay, days 18-26 ----------					
20	6.55	90.9	66.9	21.0	7.8	4.4
25	6.41	120.6	64.3	21.1	8.5	4.6

[a]Includes isobutyrate, isovalerate and valerate

Table 2. Ruminal protozoa concentrations during dietary changes

Day of trial	Protozoa, x 10^4/ml				
	Total	Entodinia	Diplodinia	Dasytricha	Isotricha
	---------- Hay, days 0-2 ----------				
1	15.86	12.11	.41	.27	.13
	---------- Excreta silage, days 2-18 ----------				
5	11.56	10.07	.57	.15	.24
10	9.21	8.46	.51	.07	.12
15	6.86	6.86	.45	-.01	.03
	---------- Hay, days 18-26 ----------				
20	12.18	11.13	.81	.09	.05
25	10.12	18.24	1.46	.23	.20

DIGESTIBILITIES OF WET DISTILLERS GRAINS ENSILED WITH MATURE FESCUE HAY

D. M. Britton and R. N. Heitmann

Research with distillers feeds is increasing due to national interest in alcohol fuels. The residue from alcohol production by grain fermentation is referred to as wet distillers grains and can be used for animal feeds. However, one of the problems encountered with wet distillers grains is that it spoils quickly upon storage and consequently must be fed almost immediately. The objectives of this research were to determine: 1) whether wet distillers grains could be stored successfully in the ensiled form and, 2) the digestibilities of the ensiled wet distillers grains.

Digestion trials were conducted on 18 mature crossbred wethers weighing 87 $\pm$ 10 kg to compare three silages made from wet distillers grains and mature, chopped fescue hay. The ratio of wet distillers grains to fescue hay was 75:25 in silage 1, 70:30 in silage 2, and 65:35 in silage 3. The wethers were randomly assigned into three groups of six and each silage was fed to one of the three groups.

1. Silage 1 had heavy weepage, molded quickly, and there was a moderate loss of feed without capping. No problems were encountered with silage 2 and 3.

2. The digestibilities of dry matter, crude protein, ether extract, crude fiber, and percent total digestible nutrients were all higher ($P<.05$) on silages 1 and 2 than on silage 3. However, silage 1 only had significantly higher digestible crude fiber than silage 2.

3. Considering the problems with wastage on silage 1 and the low digestibilities and total digestible nutrients on silage 3, it would appear that the 70:30 wet distillers grains:fescue hay silage would be the most desirable.

Table 1. Proximate analysis of WDG[a]:fescue silages

	75:25	70:30	65:35
Dry matter, (%)	28.1	32.1	35.2
	--------- % of Dry matter ---------		
Crude protein	11.6	12.5	11.9
Crude fiber	34.0	31.5	35.0
Ether extract	7.1	6.8	4.2
Ash	6.5	6.8	5.1
NFE	33.9	34.9	34.6
ADF	49.7	47.8	48.8

[a]Wet distillers grains

Table 2. Apparent digestibilities of WDG[a]:fescue silages, (%)

	75:25	70:30	65:35
Dry matter	60.2 ± 1.7[b]	60.7 ± 2.3	45.9 ± 7.5*
Crude Protein	62.1 ± 3.4	68.7 ± 6.1	54.0 ± 8.1*
Crude fiber	62.8 ± 2.5	55.8 ± 4.9	48.1 ± 7.3*
Ether extract	84.4 ± 3.5	88.6 ± 0.4	71.4 ± 9.4*
NFE	52.4 ± 4.8	57.6 ± 4.2	39.7 ± 8.4*
ADF	61.7 ± 1.3	58.1 ± 3.2	42.6 ± 10.6*
TDN	60.8 ± 2.1	59.4 ± 2.1	43.7 ± 6.2*

[a]Wet distillers grains

[b]Mean ± standard deviation

*Significantly different from the 75:25 or 70:30 silages, $P<.05$

EFFECTS OF WET DISTILLERS GRAINS:FESCUE SILAGE ON RUMEN pH AND PROTOZOA NUMBERS

D. M. Britton and R. N. Heitmann

Wet distillers grains as a group are low in both pH and soluble carbohydrates. Rumen protozoa, which make up only 0.002% of the total rumen microbial population but 47% of the total rumen microbial volume (Warner, 1962), are very susceptible to rumen pH and their numbers decline quickly as the rumen pH falls below 6.0. In addition, holotricha especially are soluble carbohydrate utilizers. Unlike holotricha, entodiniomorpha have a limited ability to use monosaccharides. The objectives of this research was to determine the effects of wet distillers grains:fescue silage on rumen pH and protozoa population.

Eight mature crossbred wethers were randomly divided into two groups and were fed mature fescue hay ad lib for five days. Rumen fluid was sampled daily via stomach tubing and analyzed for pH, total protozoa count, and protozoa identification. Following the five day fescue period, each group was randomly assigned to either a 70:30 (Group 1) or a 65:35 (Group 2) wet distillers grains:fescue hay ration. The animals were adapted over a five day period and changes in rumen fluid pH and protozoa were measured on a daily basis. After adaptation to the silage, rumen parameters continued to be monitored daily for an additional five days.

1. Although there were differences in rumen pH between groups, this difference was due solely to the initial assignment of animals and does not indicate a difference between the 70:30 and 65:35 wet distillers grains:fescue silages.

2. No pH changes were observed within groups as the animals progressed from mature, chopped fescue hay to the silage feeding regimes.

3. Total protozoa numbers decreased with silage feeding specifically due to the disappearance of the holotrich, isotricha and dasytricha. There were no changes in entodiniomorpha populations during the experiment.

4. The disappearance of the holotricha during silage feeding was not due to any change in ruminal pH, but rather may have been due to the lack of soluble carbohydrates.

Table 1. Rumen pH on mature, chopped fescue hay and WDG[a]:fescue silage

	Fescue	Silage adaptation	Silage
Group 1 (70:30)	6.48 ± 0.12[b]	6.48 ± 0.09	6.41 ± 0.12
Group 2 (65:35)	6.63 ± 0.10	6.63 ± 0.11	6.51 ± 0.09

[a]Wet distillers grains
[b]Means ± SEM

Table 2. Protozoa concentrations (10^3/ml) on mature, chopped fescue hay and WDG[a]:fescue silage

	Diet	Isotricha	Dasytricha	Diplodinia	Entodinia	Total
Group 1 (70:30)	Fescue	5.1 ± 0.8[b]	26 ± 3.9	2.7 ± 0.1	36 ± 8	70 ± 10
	Adaptation	0	0.8 ± 0.5	0.6 ± 0.4	52 ± 11	53 ± 12
	Silage	0	0	0.4 ± 0.2	50 ± 7.3	50 ± 7.3
Group 2 (65:35)	Fescue	6.7 ± 1.6	29 ± 9.8	4.2 ± 1.9	59 ± 16	96 ± 23
	Adaptation	0.3 ± 0.2	0.2 ± 0.2	1.3 ± 0.7	51 ± 9.8	52 ± 9.8
	Silage	0.5 ± 0.5	0	0.2 ± 0.2	62 ± 12	62 ± 12

[a]Wet distillers grains
[b]Mean ± SEM

EFFECTS OF BETAHYDROXYBUTYRATE ON PLASMA FREE FATTY ACIDS IN MATURE WETHERS

R. N. Heitmann and D. R. Metzler

It has been suggested that ketone bodies decrease elevated plasma free fatty acid concentrations in the rat (Bjorntorp, 1966) and dog (Bjorntorp and Schersten, 1967). Free fatty acids are direct precursors for hepatic ketone body production. The ability of ketone bodies to inhibit their own production by a negative feedback mechanism may play an important role in controlling the ketotic state so often associated with twin pregnancy in sheep and lactation in dairy cows. The objectives of this research were to determine 1) the optimum dose of β-hydroxybutyrate required to depress plasma free fatty acids, 2) whether ketone bodies decrease basal as well as elevated plasma free fatty acids, and 3) the length of time following a ketone body challenge required for maximum free fatty acid depression.

During the months of April, May, and June, 1980, twelve pulse dose trials were conducted on 5 mature wethers. The animals were equipped with chronic, indwelling jugular catheters through which β-hydroxybutyrate could be given and blood samples withdrawn. The sheep were either fed or fasted 1, 3, or 5 days and were then challenged with doses of 4, 12 or 20g of β-hydroxybutyrate. Prepulse blood samples were taken followed by blood samples taken at 15, 30, 45, and 60 minutes after the ketone body challenge. Blood was analyzed for free fatty acids.

1. Although plasma free fatty acids were depressed at all levels of β-hydroxybutyrate pulsed, a significantly more dramatic depression was observed with the 12 and 20g doses than the 4g dose. However, there was no difference in efficacy between the 12 and 20g dose of β-hydroxybutyrate. In addition, one sheep on the 20g level died in anaphylactic shock immediately following the eleventh trial.

2. As expected, fasting increased plasma free fatty acids. Basal concentrations of plasma free fatty acids were depressed following ketone body challenge. However, the most dramatic results were observed at maximum free fatty acid elevation during the fifth day of fasting.

3. Although plasma free fatty acid concentrations began to decline within 15 minutes following the ketone body challenge, significant depression was not observed prior to the 30-minute blood sample. For the most part, blood sampled at 60 minutes was not significantly lower in free faty acids than that of 30 minutes. Generally, plasma free fatty acid concentrations on the 4g β-hydroxybutrate dose reached maximum depression at 30 minutes and then began to return to basal levels. On the high doses, plasma free fatty acid concentrations tended to reach a minimum at 30 minutes and remain there throughout the 60-minute sampling period.

4. There is no indication as to whether plasma free fatty acids were lowered due to an increased insulin response or due to a direct effect of ketone bodies on adipose tissue inhibiting lipolysis. Future work will be done to answer this question. In addition, in future work 12g of β-hydroxydutyrate will be pulse dosed followed by infusion rates of 12g/hr and the first blood samples will not be taken until 30 minutes following the pulse dose.

Table 1. Plasma free fatty acid concentrations (MM/L) in fed and fasted mature wethers following ketone body challenge

Dose (g)	Sampling time (min.)	Days fasted 0	1	3	5
4	0	496 ± 179*	773 ± 87	979 ± 75	1553 ± 140
	15	409 ± 101	542 ± 86	840 ± 78	1187 ± 92
	30	393 ± 114	460 ± 93	966 ± 119	978 ± 40
	45	381 ± 88	601 ± 113	852 ± 73	1051 ± 131
	60	518 ± 131	550 ± 63	753 ± 44	1008 ± 162
12	0	555 ± 43	775 ± 134	1061 ± 92	1378 ± 114
	15	380 ± 33	663 ± 118	802 ± 31	927 ± 59
	30	360 ± 39	452 ± 66	603 ± 62	789 ± 40
	45	334 ± 33	448 ± 78	542 ± 82	658 ± 47
	60	391 ± 82	460 ± 109	558 ± 78	679 ± 77
20	0	419 ± 83	734 ± 85	993 ± 151	1234 ± 111
	15	438 ± 44	595 ± 21	930 ± 177	1024 ± 43
	30	359 ± 29	412 ± 21	616 ± 92	701 ± 52
	45	353 ± 37	457 ± 55	597 ± 27	583 ± 51
	60	344 ± 32	526 ± 85	623 ± 77	539 ± 42

*Means ± SEM

USE OF "EXOTIC BREEDS" OF SHEEP TO INCREASE LAMB PRODUCTION IN TENNESSEE

E. R. Lidvall and F. B. Masincupp

The number of lambs born and reared per ewe per year is most important to Tennessee sheep producer profits. There are a number of breeds known for high lambing rates which have been imported into the United States and Canada in recent years. Three of these breeds were selected for their apparant desirable reproductive capabilities (multiple lambing rate and/or "out-of-season" breeding). Two rams of each breed were crossed on the parent ewe flock (Knoxville Station) of predominately Hampshire breeding during 1976 and 1977 to produce F_1 crosses. The breeds utilized were:

Finnish Landrace: The Finnsheep breed was developed in Finland and has been bred for scores of generations with no intermixture of other blood. They are rather average in size, flat muscled, free of wool on the face and legs, and low yielding in regards to wool production. They are very prolific, averaging about 1.8 lambs for a yearling ewe and 2.65 lambs for an adult ewe.

Clun Forest: The Clun Forest is a European breed which has found favor in England and Wales. Only a few have been imported to the United States. They are a relatively large breed, have a typical mutton or meat conformation, are adequate in wool production and quality, and maintain a lambing rate well above 150%.

Barbados Blackbelly: The Blackbelly or "Barbs" were first recorded as imports from the West Indies to Texas in 1904. They tend to be dark in color, small in size and produce hair instead of wool. Their social structure and behavior varies considerably from the more conventional breeds. California observations report a lambing rate close to 3 lambs per ewe per year. They grow rather slowly and reach puberty at an early age.

All F_1 ewes have been bred to Suffolk rams. Lambs have been weaned at about 50 days of age and reared to a market weight of about 100 lbs. on slatted floors. Ewes have an opportunity to lamb three times in two years — January, September and May (8-month intervals). The ewes were first lambed at 16 months of age. A summary of the ewe and lamb performance data to date is presented in table 1.

1. The Finn and Barbadoe ewes have proven to be highly prolific mothers averaging almost a 200% lamb crop reared to weaning; both far superior to the Clun Forest ewes.

2. The Finn ewes tend to "triplet" more often; however, both the Finn and Barbadoe ewes lamb a high percentage of strong twin lambs.

3. The Barbadoe ewes excel in the livability of their lambs, most likely because of greater heterosis in the cross.

4. Growth rate has been superior in the lambs from Clun ewes; however, a much higher percentage of these lambs are singles giving them an advantage in a slightly higher weaning weight as well as subsequent growth rate.

5. All crosses continue to produce relatively lean, meaty carcasses of a desirable quality.

Table 1. Use of "exotic breeds" of sheep to increase lamb production in Tennessee. Ewe and lamb performance data[1]

	Finnish Landrace	Clun Forest	Barbadoe Blackbelly
Ewes beginning project ('77-78)	14	19	18
Ewes lost to date	4	2	4
Ewes per flock, 4-30-81	10	17	15
Av. no. ewes/flock to date	11	18	16
Av. ewe wt. 1-4-81, lbs	147	159	136
Av. fleece wt. (3-yr av.,) lbs	4.48	4.58	3.45
Ewe lambings/yr	14.0	19.4	23.4
% ewe lambings/yr	127	108	146
Lambs born to date[2]	87	87	114
Lambs born/flock/yr	24.9	24.9	32.6
% lamb crop born/flock/yr	226	138	204
Lambs weaned to date	78	80	111
Lambs weaned/flock/yr	22.3	22.9	31.7
% lamb crop weaned/flock/yr	203	127	198
Lambs raised to date	75	76	108
Lambs raised/flock/yr	21.4	21.7	30.9
% lamb crop raised/flock/yr	195	121	193
Av. lamb birth wt., lbs	8.6	9.9	9.5
Av. lamb wean (48 da.) wt., lbs	41.9	43.3	43.6
ADG, birth-weaning, lb	.681	.728	.680
Lbs. lamb weaned/ewe in flock	84.9	55.1	86.4
Market wt. (180 da.), lbs	97	100	95
ADG, wean-mk. lb[3]	.420	.427	.387
Carcass traits[4]:			
No. of lambs	21	17	44
Fat thickness, inch[5]	.19	.22	.19
Leg score[6]	13.2	13.2	12.5

[1]These data not corrected for age of ewe and type of birth or rearing.
[2]All lambs are sired by Suffolk rams.
[3]Reared on slatted floors in confinement.
[4]Subjective estimates - live lambs; committee of three.
[5]13th rib estimate of fat thickness. Under .25 considered desirable.
[6]Leg score is a measure of muscling. Scores of 15, 14 and 13 represent "prime" conformation; 12, 11 and 10 represent "choice" conformation; etc. Score of 11 is considered average.

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TENNESSEE ANIMAL SCIENCE RESEARCH FACILITIES

1. Tobacco Experiment Station - Greeneville - P. Hunter, Supt.
   Beef cattle - Approximately 150 brood cows in genetic and nutrition studies. Feeding facilities for steer and heifer silage feeding trials.

2. Knoxville Experiment Station - Knoxville and Alcoa - J. R. Hodges, III, Supt.
   Beef cattle - Three farms with a total of 525 brood cows used in genetic and nutritional studies. Feeding facilities for approximately 400 steers in feeding trials using silage and grain.
   Swine - Fifty sow operation for sow feeding and baby pig research. Duroc, Landrace, Yorkshire and Hampshire crosses.
   Sheep - Breeding flock of 45 ewes used in crossbreeding research to increase lamb production - limited amount of confinement feeding work.
   Dairy cattle - Mixed herd of 125 Holsteins and 25 Jerseys used in nutrition, physiology and management research with dry lot confinement.
   Poultry - Broiler and layer facilities for nutrition and physiology research. New facilities are being planned to improve and expand research capabilities.

3. Plateau Experiment Station - Crossville - R. D. Freeland, Supt.
   Beef cattle - 225 brood cows used in pasture management nutrition and genetic studies. Feeding facilities for 200 steers in nutrition experiments.
   Swine - Feeding facility for conducting research with 240 feeder pigs.

4. Dairy Experiment Station - Lewisburg - J. R. Owen, Supt.
   Jersey herd of 170 cows used in genetic, nutrition and waste management research.

5. Middle Tennessee Experiment Station - Spring Hill - J. W. High, Jr., Supt.
   Beef cattle - 100 brood cows used in pasture management studies.
   Facilities for feeding 135 steers in nutritional studies.
   Swine - Swine testing station.
   Dairy cattle - Herd of 110 Holstein cows used in genetic and nutritional studies.

6. Highland Rim Experiment Station - Springfield - L. M. Safley, Supt.
   Beef cattle - herd of 200 brood cows used in pasture management studies.
   Feeding facility for 150 steers in shipping fever research.

7. Ames Plantation - Grand Junction - J. M. Anderson, Supt.
   Beef cattle - 350 brood cows and 120 feeder animals used in pasture management research.
   Swine - Sow herds that produce approximately 2500 finished hogs annually in housing, breeding and nutritional research.

8. West Tennessee Experiment Station - Jackson - J. F. Brown, Supt.
   Dairy cattle - Jersey (100) and Holstein (40) used in nutrition and physiology research.
   Swine - Swine testing station.

9. Martin Experiment Station - Martin - H. A. Henderson, Supt.
   Beef cattle - 60 brood cows and 100 feeder steers used mainly in nutrition research.
   Dairy cattle - 35 Jerseys and 65 Holstein used mainly for nutrition research.
   Swine - 25 Yorkshire sows used in teaching and nutrition research.

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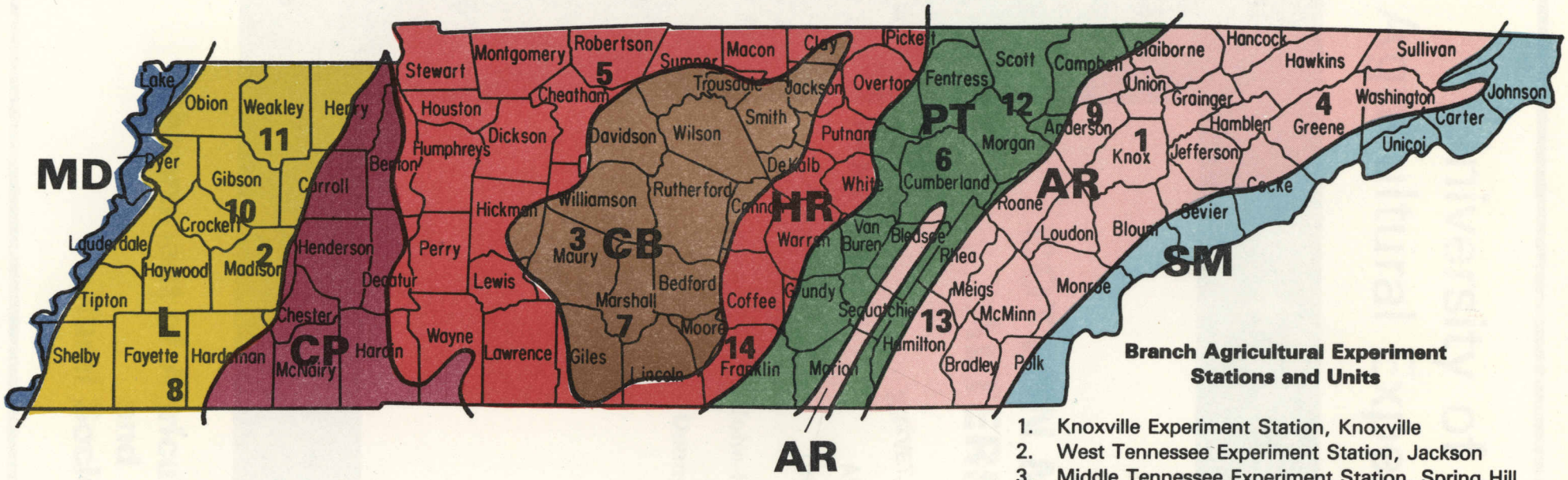
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Tennessee Branch Agricultural Experiment Stations and Units
Tennessee Land Resource Areas



Land Resource Areas

MD	Mississippi Delta
L	Loess
CP	Coastal Plain
HR	Highland Rim
CB	Central Basin
PT	Cumberland Plateau and Mountains
AR	Appalachian Ridges and Valleys
SM	Smoky Mountains

Branch Agricultural Experiment Stations and Units

1. Knoxville Experiment Station, Knoxville
2. West Tennessee Experiment Station, Jackson
3. Middle Tennessee Experiment Station, Spring Hill
4. Tobacco Experiment Station, Greeneville
5. Highland Rim Experiment Station, Springfield
6. Plateau Experiment Station, Crossville
7. Dairy Experiment Station, Lewisburg
8. Ames Plantation Experiment Station, Grand Junction
9. Forestry Experiment Station, Oak Ridge
10. Milan Experiment Station, Milan
11. Martin Experiment Station, Martin
12. Cumberland Forest Unit, Scott and Morgan Counties
13. Friendship Forest Unit, Hamilton County
14. Highland Rim Forest Unit, Tullahoma