University of Tennessee Agricultural Experiment Station

E11-1615-00-001-83

1982 Animal Science Research Progress Report

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RR. No. 83-08

April, 1983

Animal Science Faculty

Dept. of Animal Science

FOREWORD

Please accept with our compliments the 1982 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.

Several events occurred during 1982 and at the start of 1983 that have affected the developing program of the Animal Science Department. A serious loss occurred when Dr. E. W. Swanson, a very productive scientist, died very suddenly of a heart attack on February 12, 1983. Dr. Swanson had earned a national and international reputation for his research activities in dairy nutrition, rearing of replacement heifers, milk secretion and artificial insemination. In addition, Drs. Chamberlain and Murphree retired during 1982, although we have continued to impose on Dr. Murphree. He taught during fall quarter of 1982 and will teach again in the spring quarter of 1983. We appreciate the loyality and continued support of our emeritous faculty.

The department was very pleased to have successfully recruited several new faculty members. Dr. Craig Cullen and Dr. Terry Schultz joined the department as histologists and will teach in the College of Veterinary Medicine program. Dr. Benny Bell joined the department as a dairy cattle geneticist and will coach the dairy cattle judging team. Two reproductive physiologists have been successfully recruited and will join the department this summer. Several vacancies remain and faculty recruitment remains a departmental priority.

The department is pleased that Brehm Animal Science building received a much needed reroofing. Other items such as the badly needed poultry unit and modification of other animal facilities remain on our priority lists.

I particularly would like to acknowledge the assistance of the faculty of the Animal Science Department in the transitional year from Dr. Johnson's leadership through my learning the 'ropes' as a novice department head. This transition seems to have been accomplished with few ripples and splashes because the faculty and staff were most cordial, cooperative and helpful. My special thanks to all of them.

Don O. Richardson
Professor and Head

TABLE OF CONTENTS

BEEF CATTLE

PAGE

Evidence for sex linkage in the heredity of quantitative traits of beef cattle..... 2

Effects of dietary K and fescue pasture fertilization on Mg, Ca and K metabolism in lactating beef cows..... 4

Vitamins A, D and E injection effects on pregnant beef cow plasma Ca, Mg, and K on calf viability..... 6

Effect on fetal sex on nutrient intake and digestibility by beef cows..... 8

Changes in rumen fluid characteristics and weight of southeastern feeder calves during market-transit stress..... 10

Influence of cow frame size and fatness on seasonal patterns of forage intake, performance and efficiency of Angus cow-calf pairs grazing fescue-legume or fescue pastures..... 12

Patterns of forage intake, milk yield, calf growth and efficiency of Angus cow-calf pairs grazing fescue-legume or fescue pastures..... 14

Phenotype x nutritional environment interactions in economic efficiency of Angus cows grazing fescue-legume or fescue pastures..... 16

Biology of the uterus. The uterotonic effect of prostaglandin $F_{2\alpha}$ and oxytocin on the postpartum cow..... 18

Reproductive biology of the bull. Effect of exogenous oxytocin on the output of sperm and on the uterotonic effect of electrojaculate..... 20

Reproductive biology of the bull. Clearance of exogenous L-thyroxine and exogenous in the ejaculate..... 22

Reproductive biology of the bull. Passage of exogenous cortisol and progesterone into the ejaculate collected by artifical vagina and electroejaculation..... 24

Predicting natural breeding performance via examinations of prospective herd sires..... 26

DAIRY CATTLE

Round bale silage..... 28

Effect of K on plasma mineral, glucose and insulin response to glucose injections in hypomagnesemic and normal calves..... 30

PAGE

Dietary Mg and K effects on plasma minerals and glucose in calves..... 32

Hypomagnesemia in young calves and repletion of magnesium effects on plasma and CSF mineral levels..... 34

SWINE

A comparison of three farrow-finish pork production systems at Ames plantation..... 36

Management of purchased feeder pigs..... 38

An attempt to control the sex-ratio of offspring in swine by maternal active immunization to the histocompatibility-Y (H-Y) antigen..... 40

POULTRY

Effect of supplemental methionine on performance of 1 to 3-week old broilers fed corn-soybean meal diets at two energy levels..... 42

Effect of supplemental methionine on performance of 3 to 5-week old broilers fed corn-soybean meal diets at two energy levels..... 44

Effect of supplemental choline on the response to supplemental methionine in 1 to 2-week old broilers fed corn-soybean meal diets..... 46

Biology of the ovary. Effect of exogenous luteinizing hormone releasing hormone (LHRH) on the reproductive function of laying hens and cockerels..... 48

The effects of photoperiod on plasma corticosterone levels and their relationship to glaucoma in the fowl..... 50

Ochratoxicosis in laying hens..... 52

SHEEP

Magnesium, calcium and potassium balances in lambs fed low or adequate magnesium and adequate or excessive potassium..... 54

Effects of ketone bodies on alimentary and hepatic ketogenesis in fed sheep..... 56

Effects of betahydroxybutyrate on plasma insulin in mature wethers..... 58

Effects of whole stillage:fescue silage on rumen volatile fatty acids..... 60

MISCELLANEOUS

PAGE

Steroidal hormone functions. Retention of calcium in the intestinal wall of the rabbit..... 62

Biology of the ovary. Effect of bull semen on ovulation in the rabbit..... 64

Biology of the uterus. Homotransplant of the intestine to the uterus..... 66

Steroidal hormone functions. Evaluation of hyperadrenocorticism in the dog by the combined dexamethasone suppression/ACTH stimulation testing..... 68

ACKNOWLEDGMENTS..... 70

ANIMAL SCIENCE RESEARCH FACILITIES..... 71

ANIMAL SCIENCE DEPARTMENT RESEARCH FACULTY AND STAFF..... 72

PUBLICATION LIST FOR ANIMAL SCIENCE..... 75

ABSTRACTS OF PAPERS PRESENTED..... 78

EVIDENCE FOR SEX LINKAGE IN THE HEREDITY OF QUANTITATIVE TRAITS OF BEEF CATTLE

A. D. S. Kharoofa and R. R. Shrode

Wright's coefficient of relationship is calculated as though all heredity were autosomal. If sex-linked heredity could be taken into account in the calculation of coefficients of relationship, coefficients of relationship between mammalian sire and daughter and between mammalian dam and son would be larger than coefficients of relationship between parent and offspring of the same sex. Accordingly, it would be expected that phenotypic correlations between parent and offspring of opposite sex would be larger than those between parent and offspring of the same sex if segregation of sex-linked genes contributes importantly to the phenotypic variation in the trait in question. The relative influences of sex linkage and maternal effects on birth weight and weaning and post-weaning (to a year of age) weight, gain, average daily gain, heart girth, body length, hip width, hip height, fat thickness, type score, condition score and frame score of 1903 Angus calves and 1126 Polled Hereford calves were assessed by means of appropriate comparisons of sire-son, sire-daughter, dam-son and dam-daughter correlations calculated after least-squares adjustment of the variables to remove variation due to differences in age of individual and age of individual's dam. The table on the following page shows some examples of comparisons that were made to produce the conclusions listed below.

1. Sex-linkage appeared to be important in weaning weight, weaning gain, weaning average daily gain, post-weaning weight, lifetime average daily gain, post-weaning heart girth and post-weaning hip width in the Angus data.

2. None of the traits seemed to be affected importantly by sex linkage in the Polled Hereford data.

3. Maternal effects (cytoplasmically transmitted or from maternal environment) appeared to be important in post-weaning body length in the Angus data and in weaning fat thickness, post-weaning weight, lifetime average daily gain, post-weaning type score and post-weaning condition score in the Polled Hereford data.

4. Maternal effects and/or sex linkage (maternal effects confounded with sex linkage) apeared to be important in weaning weight, weaning gain, weaning average daily gain, weaning heart girth, weaning body length, post-weaning weight and lifetime average daily gain in the Angus data and in birth weight, weaning hip width, weaning fat thickness and post-weaning type score in the Polled Hereford data.

5. Apparent differences between the breeds is probably due, in a subtle, complex way, to the known difference in rate of maturing between the breeds.

Table 1. Examples of coefficients of Angus parent-offspring correlation and various differences among them

Trait	Sire		Dam		Measure of sex-linkage and/or maternal effect = dam-son minus sire-son	Measure of maternal effect = dam-son minus sire-daughter	Measure of sex-linkage effect = sire-daughter minus sire-son
	Son	Daughter	Son	Daughter			
Weaning weight	-0.101	0.039	0.138	0.232	0.239**	0.099	0.140*
Post-weaning weight	-0.037	0.186	0.209	0.290	0.246**	0.023	0.223**
Weaning gain	-0.125	0.011	0.105	0.188	0.230**	0.094	0.136*
Weaning avg. daily gain	-0.119	0.014	0.097	0.186	0.216**	0.083	0.133*
Lifetime avg. daily gain	-0.048	0.172	0.174	0.283	0.222**	0.002	0.220**

*P<.05.
**P<.01.

EFFECTS OF DIETARY K AND FESCUE PASTURE FERTILIZATION ON Mg, Ca AND K METABOLISM IN LACTATING BEEF COWS

S. R. Banet, M. C. Bell and T. O. Johnson

Lactating cows grazing early spring pasture are often noted to have depressed plasma Mg levels. This depression in plasma Mg often leads to a series of convulsions or tetany. The incidence of tetany has been noted to be increased by heavy pasture fertilization. The purpose of this study was to compare the effects of potassium fertilization of fescue pastures and oral administration of potassium chloride on plasma Ca, Mg and K in lactating beef cows.

Two groups of twelve Angus cows, ranging in age from 5-16 years, were allotted to 1 of 4 treatment groups by age, weight, plasma Mg and age of calf. This study consisted of trials conducted in February and March of 1982. Twelve cows were used in each trial with each trial consisting of a 1-week preliminary period and a 1-week collection period. Six cows were placed on each treatment pasture. The control pasture was fertilized at a rate of 112 kg of N/ha, 169 kg of P/ha with no K fertilization. The high K pasture was fertilized at the same rate as the control pasture except 224 kg of K was also applied. Three cows from each treatment pasture were also bolused with 140 gms of KCl twice daily. Chromic oxide, creatinine and acid detergent lignin were used to determine intake, urine volume and fecal output. Fecal, urine and milk samples were collected twice daily.

Results:

1. KCl bolus treatment had no effect on plasma K and Mg.

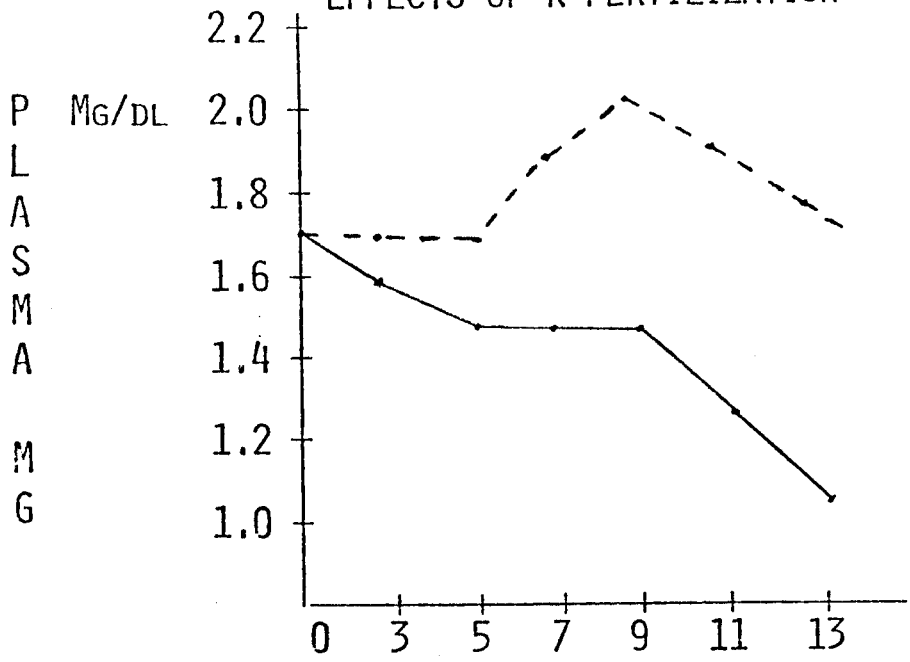
2. KCl bolus treatment depressed plasma Ca, but results were inconsistent ($P<.05$).

3. Potassium fertilization treatment had no effect on plasma Ca or plasma K.

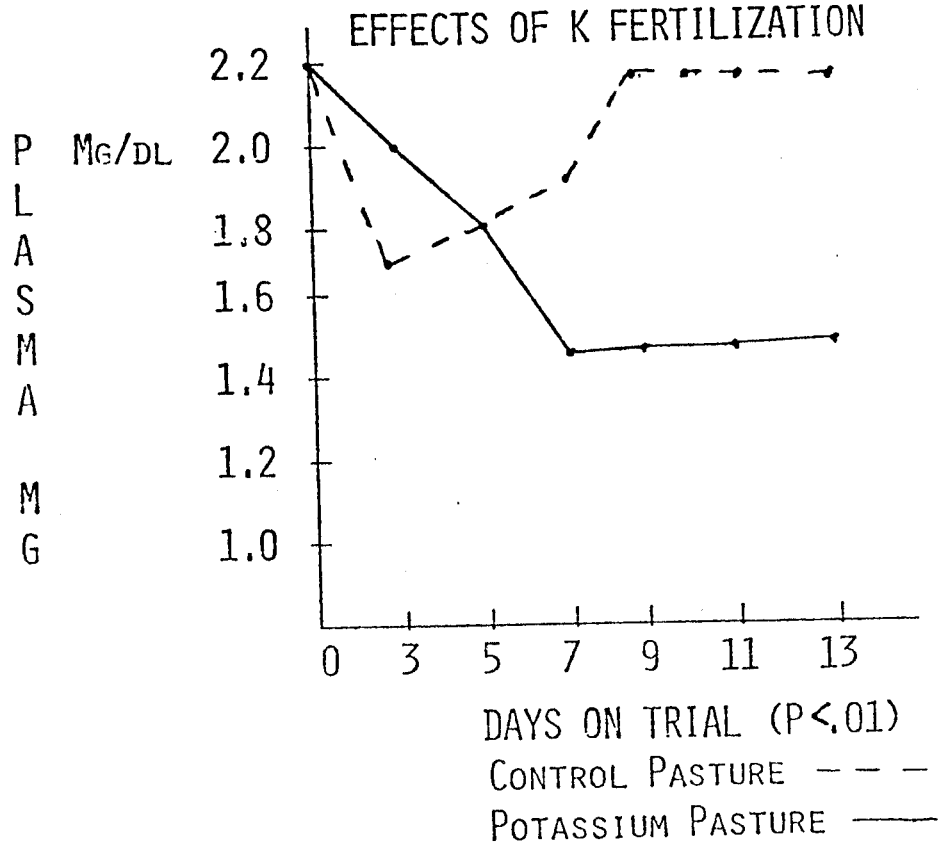
4. Potassium fertilization treatment depressed plasma Mg ($P<.01$) in both trials.

5. Of the 10 cows which became hypomagnesemic, nine were on the K fertilized pasture.

TRIAL I
EFFECTS OF K FERTILIZATION



TRIAL II
EFFECTS OF K FERTILIZATION



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,
P. P. Hunter and T. Johnson

Vitamin injections are being used routinely in many 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 361 pregnant beef cows at three different experiment stations to determine the effect of vitamins A, D and E injections on plasma, vitamin A, carotene, minerals, and on calf viability. Injections were made between December 7 and December 15, 1981. One hundred eighty-five 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 176 of the cows were injected with the same volume of physiological saline. Calves born to 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, vitamin A and carotene.

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. Plasma samples taken 24 hrs after vitamin injections contained higher ($P<.01$) levels of vitamin A than controls (Table 1). Plasma vitamin A and carotene samples 28 days later were not different between the treatment groups but were considerably lower than preliminary samples (41 mg vitamin A/100 ml reduced to 30; 75 mg carotene/100 ml reduced to 39).

3. Small but inconsistent differences were found in calf viability.

Table 1. Effects of vitamin injections on plasma vitamin A in μg/100 ml

Injection	Days after injection 0	1	28
		Greeneville	
Saline	44.9	49.2	33.3
Vitamin A	46.8	63.1	34.0
		Crossville	
Saline	43.5	42.4	32.8
Vitamin A	47.8	57.5	32.9
		Alcoa	
Saline	36.1	31.0	33.5
Vitamin A	31.3	52.0	41.9

Table 2. Effects of cow injections on calves at birth — 1982

Calf score	Vitamin	Saline	Total
0 = healthy	159	153	312
1 = minor problem	5	4	9
2 = weak	7	5	12
3 = weak & minor	4	2	6
4 = weak & mechanical assistance	5	7	12
5 = dead calf	5	5	10
	185	176	361

EFFECT OF FETAL SEX ON NUTRIENT INTAKE AND DIGESTIBILITY BY BEEF COWS

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

The fetal-placental unit is a very active organ, producing many compounds involved in the maintenance of pregnancy. Researchers have reported an effect of fetal sire upon milk production by lactating dairy cows. These researchers suggested that these differences were due to differential hormone production by the fetal-placental unit. If this effect is hormonal, it would be of interest to determine if sex of fetus also effects production. The objective of the present research was to examine the effect of sex of fetus on nutrient intake and nutrient digestibility by mature beef cows.

Digestion trials were conducted over a two-year period with thirty-eight mature Angus and Hereford cows, with calf, utilizing acid-insoluble ash (AIA) as an internal indicator. Each cow was individually fed grass silage. After an intake adjustment period, feed, refusal and fecal samples were collected for six days. Samples were analyzed for dry matter (DM), crude protein (CP), acid-detergent fiber (ADF), acid-insoluble lignin (AIL), neutral-detergent fiber (NDF) and AIA. Cellulose (CELL), hemicellulose (HMCL) and neutral-detergent solubles (NDS) were calculated. Nutrient digestibility and digestible nutrient intake were also calculated.

1. Nutrient intake was not affected ($P>.05$) by breed of cow or sex of fetus.

2. The only digestibility affected by cow breed was that of hemicellulose (Table 1). Angus cows digested significantly more hemicellulose than did Hereford cows (80.9 vs 75.6%).

3. The sex of fetus the cow was carrying significantly affected digestibility. Cows harboring female fetuses digested more DM, NDS, ADF, CELL and NDF than cows harboring male fetuses (Table 1). The largest differences in digestibility were found with fibrous nutrients. These data indicate an effect of sex of fetus on digestibility which further suggests a possible relationship of fetal hormones in production.

4. Cow breed did not affect digestible nutrient intake (Table 2). Sex of fetus significantly affected digestible fiber intake (ADF, CELL and NDF). Again, cows with female fetuses had significantly ($P<.05$) higher digestible intakes. The effect of increased digestible fiber intake was due to the increased fiber digestibility presented above.

Table 1. Effects of cow breed and sex of fetus on nutrient digestibility by beef cows

Variable	Digestibility, %						
	DM	CP	NDS	ADF	CELL	NDF	HMCL
Breed							
Angus	64.9[a]	61.8	64.7	60.4	70.1	64.8	80.9[b]
Hereford	63.9	60.6	63.7	60.1	69.8	64.0	75.6[c]
Sex of fetus							
Female	66.5[b]	62.8	65.7[d]	63.3[b]	72.4[b]	66.9[b]	78.9
Male	62.3[c]	59.5	62.7[e]	57.2[c]	67.4[c]	61.9[c]	77.6

[a]Least square means generated from the model Y = year + cow breed + dry matter intake + gestation + sex of fetus.
[b,c]Least square means within an effect with different superscript are significantly different (P<.05).
[d,e]Least square means within an effect with different superscripts are significantly different (P<.10).

Table 2. Effects of cow breed and sex of fetus on digestible nutrient intake by beef cows

Variable	Digestible intake, kg/day						
	DM	CP	NDS	ADF	CELL	NDF	HMCL
Breed							
Angus	5.8[a]	.75	2.0	2.7	2.5	3.8	1.1
Hereford	6.1	.79	2.1	2.9	2.7	4.0	1.1
Sex of fetus							
Female	6.2	.79	2.1	2.9[b]	2.7[d]	4.1[d]	1.1
Male	5.7	.75	2.0	2.7[c]	2.5[e]	3.7[e]	1.1

[a]Least square means generated from the model Y = year + cow breed + gestation + sex of fetus.
[b,c]Least square means within an effect with different superscript are significantly different (P<.05).
[d,e]Least square means within an effect with different superscripts are significantly different (P<.10).

CHANGES IN RUMEN FLUID CHARACTERISTICS AND WEIGHT OF SOUTHEASTERN FEEDER CALVES DURING MARKET-TRANSIT STRESS

P. J. Hamlett, J. B. McLaren, W. S. Damron and N. A. Cole

One-hundred eighty-four weanling steer calves were subjected to the stresses associated with industry procedures for marketing and transporting southeastern feeder calves from the farms where they were raised to commercial backgrounding and/or finishing facilities. These stresses (market-transit) included a 24-h starvation period at a commercial auction barn, a 72-h period at an orderbuyer barn facility where the calves were fed grass hay and provided water free-choice, and a transit phase of 20 to 30 h when the calves were transported by truck from the orderbuyer barn to a feedlot. The calves were weighed immediately after arrival at the auction barn, at the end of the auction barn phase (arrival at orderbuyer barn), prior to loading onto the trucks (departure from orderbuyer barn), and immediately after unloading at the feedlot or wheat pasture (arrival at the feedlot). At these sampling times, rumen fluid samples were collected by stomach tube. The pH of the rumen fluid was determined immediately and gas producing potential of the fluid was determined by in vitro methods. Rumen liquid volume was estimated by a polyethylene glycol technique. The effect of elapsed time in days was included as a covariate in the statistical model, and the effect on each parameter was partitioned into linear, quadratic, and cubic components. Analysis of variance was performed to evaluate the effects of the independent variables (year, shipment, farm of origin, and elapsed time in the market-transit sequence) on the dependent variables (rumen parameters). Coefficients or regression of individual rumen parameters on elapsed time were used to express sequential changes in the various parameters during market-transit.

1. During the 5-day market-transit period the calves sustained an overall mean weight loss of 30 kg. Body weight decreased during the auction barn phase, increased slightly during the orderbuyer barn phase, and decreased during transit (figure 1). Total market-transit weight loss was 13% of the arrival auction barn weight.

2. Rumen liquid volume, gas-producing potential, rumen total volatile fatty acid concentration (TVFA), and rumen protozoal concentration decreased significantly (25.6%, 71%, 25%, and 50%, respectively) during the auction barn phase. During the auction barn starvation period, rumen pH increased followed by a decrease during the orderbuyer barn phase.

3. Weight and all rumen parameters increased during the orderbuyer barn phase. Total market-transit decreases in gas-producing potential, TVFA, and total protozoa concentration were 19.4%, 57.5%, and 78.5%, respectively.

4. The gas-producing potential, rumen volume, and TVFA were more severely affected by the intermittent starvation-feeding and stress periods than were other parameters. The recovery from the depressed values sustained at the auction barn was more rapid in all other parameters than it was in rumen protozoal concentrations (figure 1).

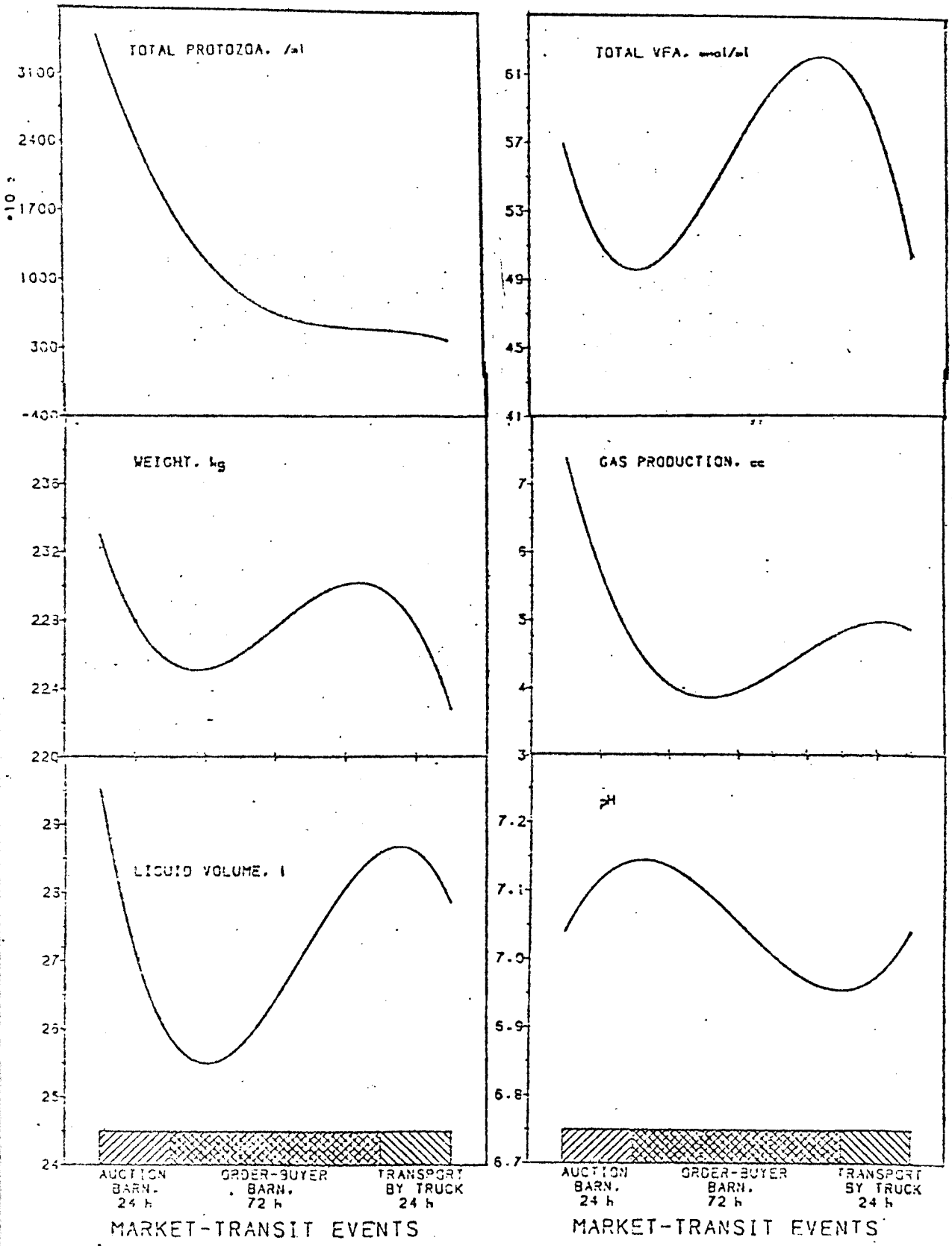


Figure 1. Effect of Market-Transit stresses on body weight and ruminal parameters (total protozoa, liquid volume, total VFA, gas-producing potential and pH).

INFLUENCE OF COW FRAME SIZE AND FATNESS ON SEASONAL PATTERNS OF FORAGE INTAKE, PERFORMANCE AND EFFICIENCY OF ANGUS COW-CALF PAIRS GRAZING FESCUE-LEGUME OR FESCUE PASTURES

J. W. Holloway and W. T. Butts, JR.

Certain characteristics of cattle have long been thought to be related to their ability to function economically. Among these, frame size has recently received increased attention. Relationship of frame size to functionality of grazing animals has not been widely studied although some studies indicate little animal variation in net efficiency and some indicate that genotype x environmental interactions may be important. Adaptability to an environment in a grazing context is a function of the animal's ability to consume forage and "funnel" nutrients toward useful products. Ability of grazing animals of a particular type to perform these functions possibly varies with pasture type and season. The purpose of this experiment was to relate cow frame size to seasonal patterns of forage intake, milk yield, calf growth and efficiency of cow-calf pairs grazing fescue-legume or fescue pastures.

Patterns of forage quality, intake, performance and efficiency were measured over 5 yrs for 197 mature Angus cows. Cows calved January through March and grazed either fescue-legume (70% fescue, 30% red and ladino clover and lespedeza) or fescue. Forage quality and intake was measured by an internal (H_2SO_4 acid detergent lignin), external (Cr_2O_3) dilution technique for cows (continuous estimate from April 30 to September 29) and for calves (3 trials on May 30, June 29 and Aug 29). Cows and calves were weighed and milk production measured (weigh-suckle-weigh technique) monthly. Cow type at initiation of the study was characterized by a factor analysis that yielded two orthogonal factors identified as frame size and fatness characteristics. Frame size then related to patterns of energy intake, expenditure and efficiency.

1. Large framed cows grazing fescue-legume consumed more ($P<.01$) digestible energy (DE) during the first part of grazing season (April 29-Aug 29) gave more ($P<.01$) milk throughout and had faster ($P<.01$) growing calves than small framed cows.

2. The opposite tendency was noted for cows grazing fescue although the variation was less.

3. Efficiency of conversion of DE (above maintenance costs) to milk was negatively related to frame size for both pasture types but was much more pronounced for cows grazing fescue.

Figure 1. Pattern of forage DE intake of cows varying in frame size (* = large, x = medium, + = small) grazing fescue-legume (——) and fescue (-----) pastures.

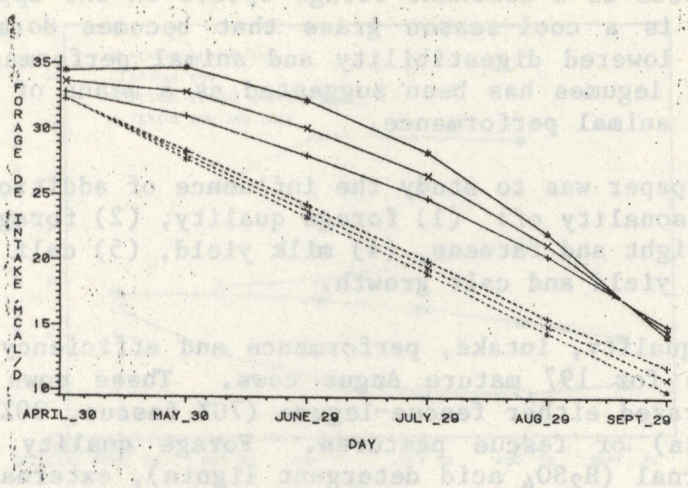
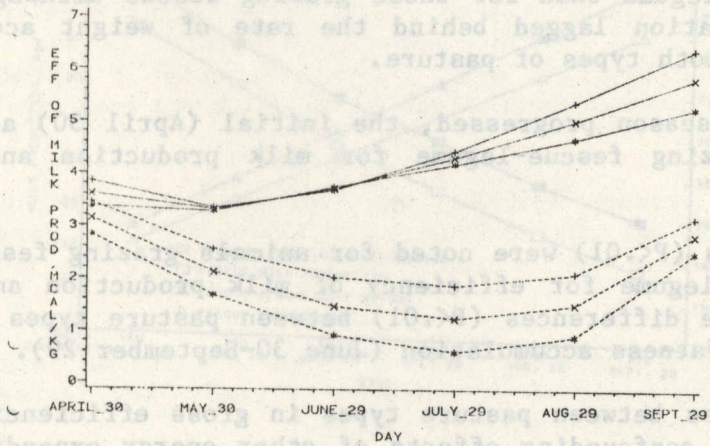


Figure 2. Pattern of efficiency of milk production for cows varying in frame size (* = large, x = medium, + = small) grazing fescue-legume (——) and fescue (-----) pastures.



PATTERNS OF FORAGE INTAKE, MILK YIELD, CALF GROWTH AND EFFICIENCY OF ANGUS COW-CALF PAIRS GRAZING FESCUE-LEGUME OR FESCUE PASTURES

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

Kentucky-31 tall fescue is a dominant forage specie in the upper southeastern United States. It is a cool-season grass that becomes dormant during the summer resulting in lowered digestibility and animal performance during that season. Addition of legumes has been suggested as a means of partially alleviating this reduced animal performance.

The purpose of this paper was to study the influence of addition of legumes to fescue swards on seasonality of: (1) forage quality, (2) forage intake by cow and calf, (3) cow weight and fatness, (4) milk yield, (5) calf growth, and (6) efficiencies of milk yield and calf growth.

Patterns of forage quality, intake, performance and efficiency variables were measured over 5 yrs for 197 mature Angus cows. These cows calved January through March and grazed either fescue-legume (70% fescue, 30% red and ladino clover and lespedeza) or fescue pastures. Forage quality and intake was measured by an internal (H_2SO_4 acid detergent lignin), external (Cr_2O_3) dilution technique for cows (continuous estimate from April 30 to September 29) and for calves (3 trials on May 30, June 29 and Aug 29). Cows and calves were weighed and milk production measured (weigh-suckle-weigh technique) monthly during this time.

1. DE concentration of fescue-legume was always greater ($P<.05$) than that for fescue and decreased as the season progressed at a less rapid rate.

2. Cows grazing fescue-legume maintained greater ($P<.05$) forage DE intakes than those grazing fescue mainly because the rate of decline as the season progressed was not nearly as great.

3. Rate of weight and fatness accumulation was much greater ($P<.05$) for cows grazing fescue-legume than for those grazing fescue although the rate of fatness accumulation lagged behind the rate of weight accumulation for cattle grazing both types of pasture.

4. As the grazing season progressed, the initial (April 30) advantages held by animals grazing fescue-legume for milk production and calf weight became greater.

5. Large advantages ($P<.01$) were noted for animals grazing fescue over those grazing fescue-legume for efficiency of milk production and calf growth only after large differences ($P<.01$) between pasture types were noted in cow weight and fatness accumulation (June 30-September 29).

6. These differences between pasture types in gross efficiencies were probably results of confounding effects of other energy expenditures and not due to differences in net efficiency.

Figure 1. Pattern of forage DE intake of cattle grazing fescue-legume and fescue pastures.

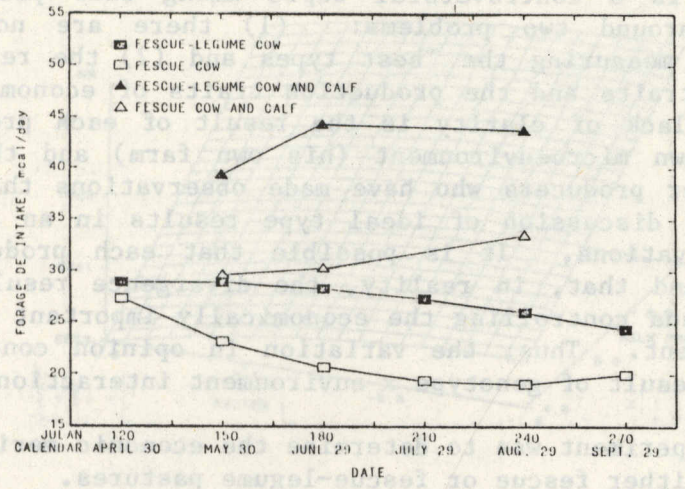
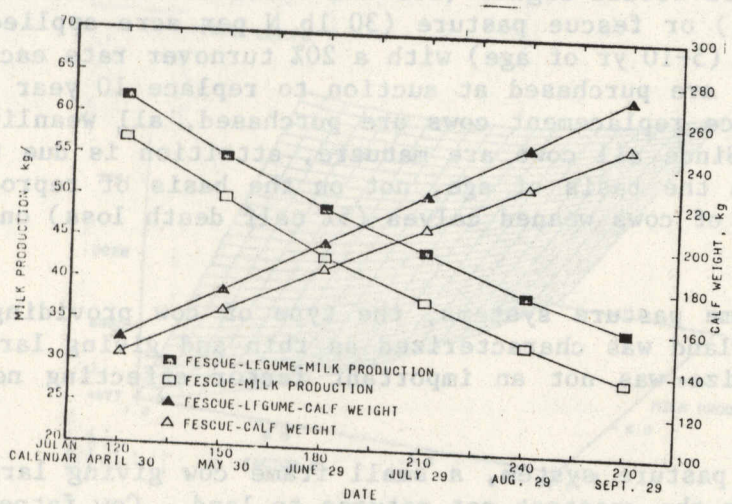


Figure 2. Pattern of milk production and calf growth of cattle grazing fescue-legume and fescue pastures.



PHENOTYPE X NURITIONAL ENVIRONMENT INTERACTIONS IN ECONOMIC EFFICIENCY OF ANGUS COWS GRAZING FESCUE-LEGUME OR FESCUE PASTAURES

J. W. Holloway, W. T. Butts, Jr. and D. L. McLemore

Ideal beef cow type is a controversial topic among beef producers. The controversy centers around two problems: (1) there are no universally accepted criteria for measuring the "best types and (2) the relationship of visually perceptible traits and the production traits of economic importance is not clear. This lack of clarity is the result of each producer making observations in his own microenvironment (his own farm) and then comparing observations with other producers who have made observations that are divergent. Therefore, any discussion of ideal type results in an argument over these divergent observations. It is possible that each producer's observations are correct and that, in reality, the divergence results from different natural phenomena controlling the economically important relationships in each microenvironment. Thus, the variation in opinion concerning ideal type is possibly the result of genotype x environment interactions.

The purpose of this experiment was to determine the economic merit of an array of cow types allowed either fescue or fescue-legume pastures.

Data were collected on 160 Angus cow-calf pairs varying widely in frame size, fatness and milk production, grazing fescue-legume or fescue pastures over a 4-yr period. These data included forage production and intake, cow and calf weight, height and fatness at weaning, and milk production. From these variables, frame size, cow fatness, land requirements and costs and revenue were calculated with the purpose of relating cow phenotype to economic efficiency for the two pasture types. The production unit studied was a 100-acre unit stocked with 50 averaged type Angus cows (2 acres/cow). The two pasture systems compared were fescue-legume (red and white clover and lespedeza renovated every 4 years) or fescue pasture (30 lb N per acre applied each year). All cows are mature (5-10 yr of age) with a 20% turnover rate each year. Five year old stock cows are purchased at auction to replace 10 year old cows sold for slaughter. Since replacement cows are purchased, all weanling calves are sold at auction. Since all cows are matuare, attrition is due to a 2% death loss and culling on the basis of age, not on the basis of reproductive rate. Ninety-five percent of cows weaned calves (5% calf death loss) on both pasture types.

1. For fescue-legume pasture systems, the type of cow providing the largest net returns to land was characterized as thin and giving large amounts of milk. Frame size was not an important factor affecting net returns of this system.

2. For the fescue pasture system, a small frame cow giving large amounts of milk resulted in the greatest net returns to land. Cow fatness was not an important variable for this pasture system.

Figure 1. Influence of cow frame size (Factor 1) and milk production on net returns (NR) to land and management for cattle grazing fescue.

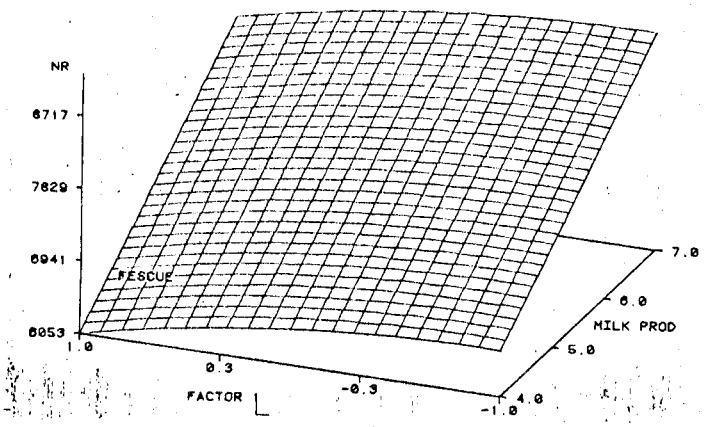
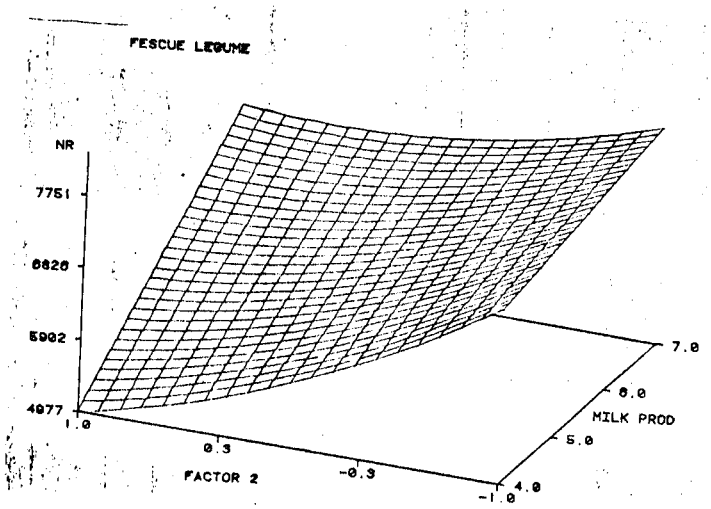


Figure 2. Influence of cow fatness and milk production on net returns (NR) to land and management for cattle grazing fescue-legume.



BIOLOGY OF THE UTERUS. THE UTEROTONIC EFFECT OF PROSTAGLANDIN $F_{2\alpha}$ AND OXYTOCIN ON THE POSTPARTUM COW

H. Eiler, F. M. Hopkins, C. S. Armstrong and W. A. Lyke

The present experiment was conducted to determine the effect of $PGF_{2\alpha}$ treatment and oxytocin treatment on the bovine uterus 48-72 hours postpartum, as part of a group of experiments conducted to test the validity of prostaglandin treatment in cows suffering from retained fetal membranes (RFM).

Uterine motility was measured in six mixed beef breed cows 48-72 hours postpartum by using the intrauterine balloon technique. Baseline uterine motility was measured for 30 minutes after a stabilization period. Then prostaglandin ($PGF_{2\alpha}$, 25 mg IM) was injected and motility recorded for 2 to 4 hours. The next day, the experiment was repeated. This time oxytocin treatment was administered first and then (two to four hours later) $PGF_{2\alpha}$. The Tension-Time Index was calculated.

1. Unexpectedly, when $PGF_{2\alpha}$ was injected IM (day 1), it did not affect ($P > 0.05$) uterine motility. However, oxytocin elevated the uterine motility about an average of 225% baseline at 20 minutes post injection (Table 1).

2. When oxytocin was given before $PGF_{2\alpha}$ treatment (day 2), the average increment of uterine motility was 875% baseline at 20 minutes post oxytocin injection (Table 2).

3. The injection of $PGF_{2\alpha}$ did not affect uterine motility significantly, whether given before or after oxytocin treatment. When $PGF_{2\alpha}$ (10 mg) was given intravenously at the end of the experiment, a small (100% above baseline) and short lasting (about 10 minute) uterotonic effect was found.

4. Regression analysis showed a linear decrease of the uterotonic effect of oxytocin between the 10-minute and 2-hour period. When oxytocin was injected first, the correlation coeffecient for the time-response relationship was -0.98. When oxytocin was injected after prostaglandins, the correlation coefficient was -0.84.

5. This result is not conclusive of ineffectiveness of $PGF_{2\alpha}$ treatment. However, it favors the use of oxytocin in the treatment of RFM in the cow.

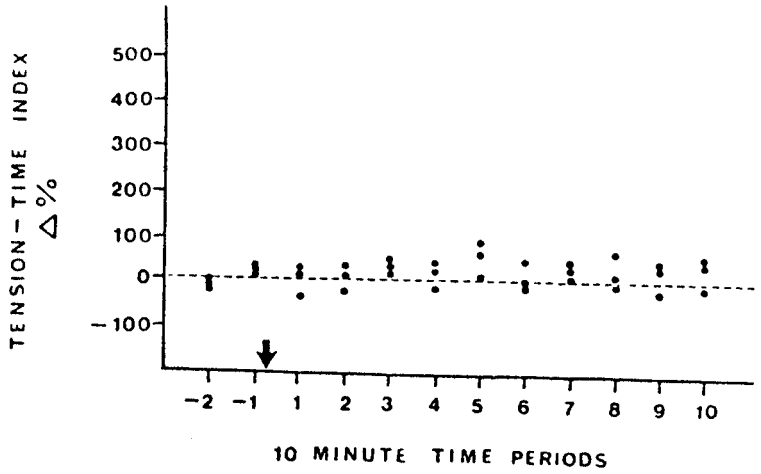


Figure 1. Effect of PGF (25 mg im) treatment on uterine motility in 72 hours post partum cows. Notice the lack of uterotonic effect. Arrow indicates PGF injection.

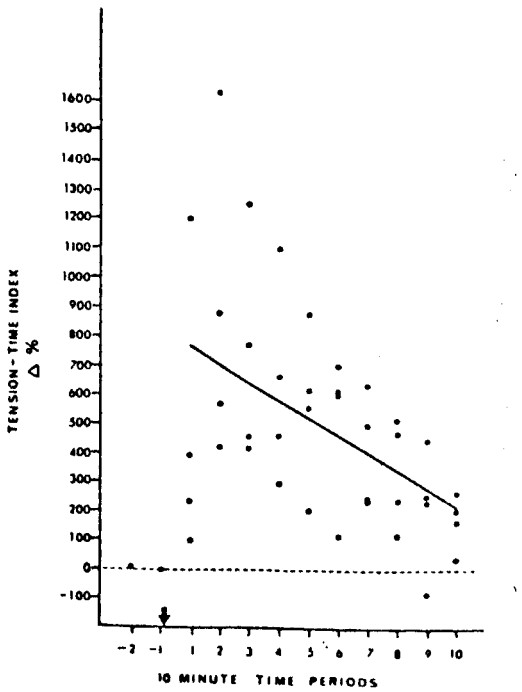


Figure 2. Effect of oxytocin (200 IU im) treatment on uterine motility in 72 hours post partum cows. Notice a significantincrease in motility. Arrow indicates oxytocin injection.

REPRODUCTIVE BIOLOGY OF THE BULL. EFFECT OF EXOGENOUS OXYTOCIN ON THE OUTPUT OF SPERM AND ON THE UTEROTONIC EFFECT OF ELECTROEJACULATE

C. S. Armstrong and H. Eiler

Exogenous oxytocin when given prior to mating has been found to increase sperm output in several species of animals. However, the effect of oxytocin given to bulls prior to electroejaculation, has not been reported. Also, it has been documented that small molecules of different chemical nature pass from the blood into the ejaculate. The objectives of this study were to investigate if oxytocin, given prior to electroejaculation would increase sperm output, and to find if oxytocin is transferred into the electroejaculate by measuring the uterotonic effect of semen from bulls injected with oxytocin. In experiment I, five 16-month-old Angus bulls were injected (IM) with 0, 2, 20, or 200 IU of synthetic oxytocin and electroejaculated at 15 and 75 minutes post injection. Collections were kept on ice and sperm were counted in the laboratory using a hemocytometer. Results were expressed as total output of sperm. In experiment II, four bulls were injected with 400 IU oxytocin (IV) and 200 IU oxytocin (IM). Semen was collected by electroejaculation at 0, 5, 15, 30, and 60 minutes post injection. Blood was taken from an indwelling jugular catheter at 0, 15, and 60 minutes. Heparin was added to blood. The uterotonic effect of semen and plasma samples was tested by using the rat uterus preparation bioassay. Thioglycolate was used to break the disulfide bonds in the oxytocin molecule to test if oxytocin was responsible for the uterotonic effect of the blood and semen samples.

1. The results of experiment I showed that oxytocin, given prior to electroejaculation increased the total sperm output of the group up to 415 percent as compared to the non-injected bulls. However, the mean difference between groups was not statistically significant, possibly due to individual variation (Table 1).

2. Experiment II indicated that the uterotonic effect of the ejaculate was not affected by the injection of oxytocin prior to electroejaculation. Therefore, if there is release of oxytocin in the male during mating, it is doubtful oxytocin is passed into the ejaculate in significant concentrations (Table 2).

Table 1. Effect of different doses of oxytocin on sperm output per group during the first[a] and second collection period

Dose of oxytocin (IU)	First collection: overall total output of sperm (in millions)	Δ%[b]	Second collection: Overall total outputof sperm (in millions)	Δ%[b]
0	1042	0	1028	0
2	2073	99	707	-31
20	5385	417	1849	80
200	3040	192	2743	167
TOTAL	11540		6327	

[a]The first collection was taken 15 minutes and the second collection 75 minutes post oxytocin injection (IM).
[b]Δ% is the percent change as compared to the control group (zero oxytocin).

Table 2. Uterotonic effect of semen and plasma from control and oxytocin treated bulls when 2 times threshold and 4 times threshold volumes were added into the rat uterus preparation

Percent change[a] on tension - time index (area under tracing)

Sample	Dose: 2 times threshold volume — Minutes after oxytocin injection				Dose: 4 times threshold volume — Minutes after oxytocin injection			
	5	15	30	60	5	15	30	60
Semen	-42[b]	+47[b]	+61[b]	+58[b]	+66[b]	+153[b]	-22[b]	+5[b]
Plasma	NM	87[b]	NM	116[b]	NM	23[b]	NM	16[b]

[a]Percentage change is the increase(+) or decrease(-) as related to the controls.
[b]No significant difference (P>0.05) as compared to controls.
NM: Not measured.

REPRODUCTIVE BIOLOGY OF THE BULL. CLEARANCE OF EXOGENOUS L-THYROXINE AND EXOGENOUS IN THE EJACULATE

H. Eiler, C. S. Armstrong and W. A. Lyke

The existence of the blood-testis barrier and blood-epididymal barrier led to the assumption that the environment of the sperm is relatively constant. A series of experiments have been conducted in this laboratory to investigate what type of substances, that may potentially affect fertility, can pass into the ejaculate, and hence into the cow's reproductive tract. In this experiment, thyroxine (T4), a bioactive (hormone) iodine containing amino acid that is normally converted in the body into triiothyronine (T3), was tested. Following an intravenous injection, the passage of exogenous L-Thyroxine (T4), and exogenous triiodothyronine (T3) into the bull ejaculate, was measured in 8 bulls. Either T4 (45 mg) or T3 (37.5 mg) was injected into the jugular vein. Bulls were electroejaculated at 20, 40, 60, 120, 180-minutes and 24 hours post injection. Blood samples were taken during the electroejaculation process. During the control period, the bulls received no thyroid hormone injection.

1. Plasma concentrations ($\bar{X} \pm$ SEM) of T4 (total) increased from 66 $\pm$ 5 (base-line) to 1318 $\pm$ 105 ng/ml at 20-minutes after T4 injection. At 180-minutes, the plasma T4 concentration was 769 $\pm$ 50 ng/ml (Figure 1).

2. Semen concentrations of T4 increased from less than 1.2 ng/ml (base-line) to 4.7 $\pm$ 1.9 ng/ml at 120-minutes, but not before.

3. Plasma concentrations of T3 (total) increased following the injection of T4. However, T3 was not detectable in semen of T4 injected bulls. Plasma concentrations of T3 increased from 1.1 $\pm$ 0.25 (base-line) to 598 $\pm$ 76.3 ng/ml at 20-minutes after injection of T3. At 180-minutes, the plasma T3 concentration was 217 $\pm$ 70 ng/ml.

4. Semen concentrations of T3 increased from less than 0.1 ng/ml (base-line) to 4.6 ng/ml at 20-minutes.

5. It was concluded that T3 passed into the ejaculate faster and to a greater (2.6 - 3.8-times) degree than T4.

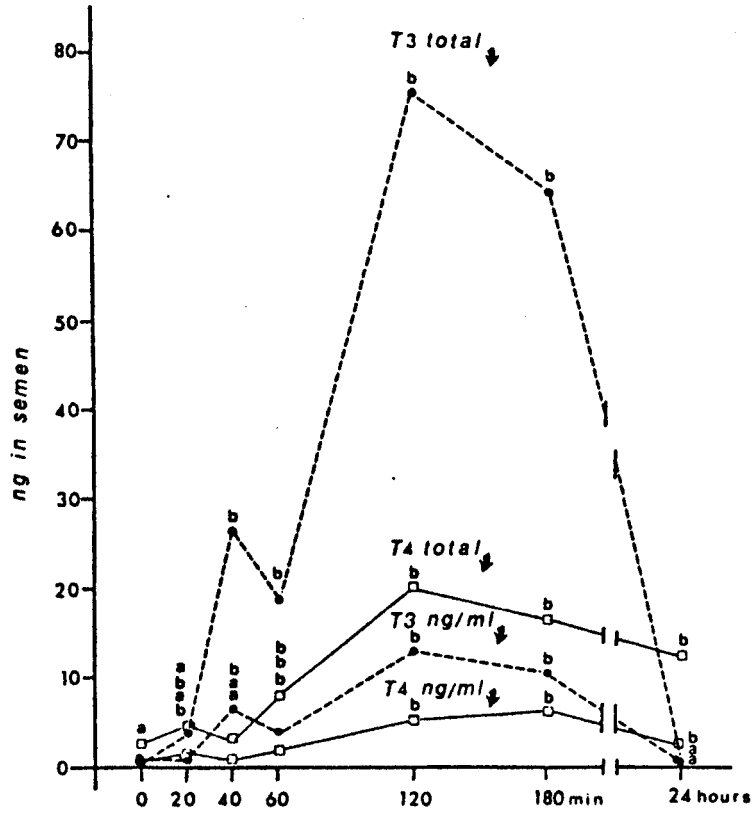


Figure 1. Concentrations (ng/ml) and "total" (ng per ejaculate) T3 and T4 in the semen of bulls injected intravenously with either T3 or T4 respectively. Dot and square indicates mean values. The coefficient of variation of T3-total throughout the experiment varied from 22% to 63%; while that of T4-total varied from 31% to 74%. (a,b) Similar and different superscript indicates nonsignificant and significant ($P < 0.05$) differences as compared with controls (0-time) respectively. Superscripts have been arranged in the same order as dot and square have been drawn.

REPRODUCTIVE BIOLOGY OF THE BULL. PASSAGE OF EXOGENOUS CORTISOL AND PROGESTERONE INTO THE EJACULATE COLLECTED BY ARTIFICAL VAGINA AND ELECTROEJACULATION

H. Eiler, J. D. Smalling, C. S. Armstrong and W. A. Lyke

The knowledge of the type of substances that can be ejaculated, when administered systemically to males, is of interest in physiology, demography, therapeutic, diagnostic and epidemiology studies. In previous work we have reported that within 20 minutes of the injection (iv.) of estradiol, cortisol, progesterone and testosterone, the native hormone was found in the ejaculate of sexual mature bulls, collected by aid of an artificial vagina (AV). In this work a mixture of cortisol (113 mg) and progesterone (100 mg) was injected (iv.) into six bulls. Bulls were electroejaculated (EE) at 0, 20, 40, 60 120, and 180 minutes post injection. Three weeks later the experiment was repeated using an artificial vagina.

1. Semen concentrations of cortisol (RIA), at the 20-minute sample, were (Mean $\pm$ SEM) 207 $\pm$ 52 ng/ml and 146 $\pm$ 36 ng/ml in the AV and EE, respectively. Thereafter, cortisol concentrations declined gradually (Table 1).

2. Control values of semen cortisol were 8 $\pm$ 1.2 and 9 $\pm$ 1.4 ng/ml for AV and EE, respectively.

3. Semen concentrations of progesterone (RIA), at the 20-minute sample, were 9.0 $\pm$ 0. and 5.1 $\pm$ 0.1 ng/ml in the AV and EE, respectively. Thereafter, progesterone concentrations declined gradually. Control values of semen progesterone were 1.5 $\pm$ 0.1 and 1.0 $\pm$ 0.1 ng/ml in the AV and EE, respectively (Table 3).

4. When the total output (hormone concentration x ejaculate volume) of cortisol and progesterone was calculated, the difference between the clearance rate of steroids collected by AV and EE, was negligible.

5. When the semen clearance rate was reported as a function of steroid concentrations, without correcting for ejaculate volume, AV values were consistently greater than that recorded by EE.

6. It was concluded that when the clearance rate of steroids in semen is used as a test for male function, total output of marker should be calculated. It was also confirmed that the ejaculate clearance rate of cortisol was larger than that of progesterone.

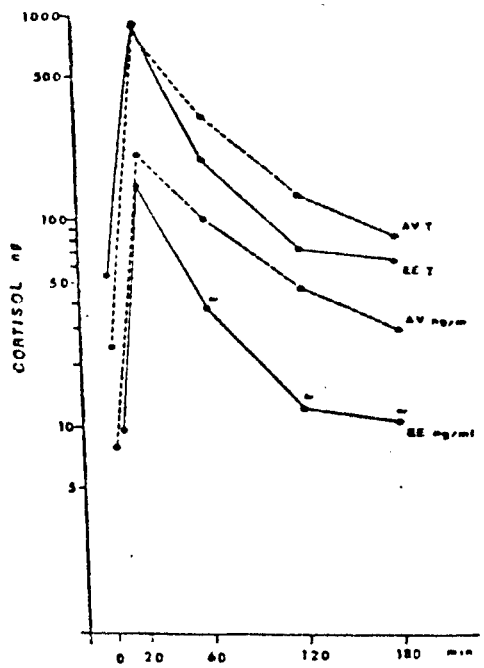


Figure 1. Cortisol in semen of bulls injected cortisol plus progesterone at 0-time. AV collection of semen by artificial vagina; EE collection of semen by electroejaculation; T total; ng/ml nanograms per milliliter.

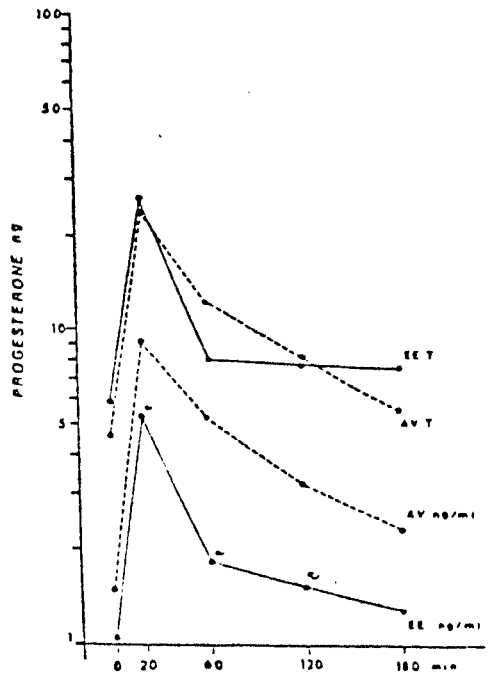


Figure 2. Progesterone in semen of bulls injected cortisol plus progesterone at 0-time. (See legend Figure 1)

PREDICTING NATURAL BREEDING PERFORMANCE VIA EXAMINATIONS OF PROSPECTIVE HERD SIRES

J. D. Smalling and D. W. Michel

In the state of Tennessee, it requires 40,000 bulls, in natural service for three heat cycles (72 days), to inseminate the estimated one million beef cows. This is assuming that each bull is exposed to 25 cows. A number of these bulls are young and unproven in the breeding pasture. An unknown number of these bulls are sterile or subfertile and leave approximately one-fourth of their cows open each year.

Beginning in 1979 and continuing for three breeding-calving periods, twelve virgin yearling Angus bulls at the University of Tennessee Plateau Experiment Station (PES) and eight Polled Hereford bulls at the Tobacco Experiment Station (TES) were evaluated. The bulls were first electroejaculated in March prior to their natural breeding pasture exposure and then again in July following their removal from the breeding pasture. The semen was evaluated for various qualitative traits including volume, concentration and color. From each collection 400 spermatozoa stained with a live-dead stain, were examined to determine the percent live cells, the number and kind of abnormal cells and the percent intact acrosomal caps (PIA) on the sperm heads. Also, the circumference of the scrotum and testicular tone of each bull was determined.

Natural service efficiency of the bulls was measured post-parturition. This was done by determining the estrous period in which the female conceived; then, using the gestation lengths (AN-279 days, PH-285 days) the average number of periods of the breeding group for each bull was calculated. The design of the experiment and a brief resume of the results obtained is shown in table 1.

Although no significant differences in semen quality nor in physical structures were detectable between the bulls at the pre- or post breeding evaluation periods, the bulls at the TES required a highly significant ($P<.01$) greater number of services (cycles) to cause their females to conceive than did those at PES.

Table 1. Objective measurements of young prospective herd sires in an attempt to predict natural reproductive performance

Bulls (N)	Collection period	Stations	Intact acrosomes (%)	Scrotal circumference (cm)	Testicular tone (units)	Cycles per conception (N)
36	Pre-breeding	PES	56.7 ± 5.8	35.3 ± .5	11.35 ± .04	1.50[a]
36	Post-breeding	PES	66.3 ± 5.2	34.3 ± .3	10.79 ± .03	
24	Pre-breeding	TES	77.6 ± 5.5	32.7 ± .5	11.29 ± .04	1.73[b]
24	Post-breeding	TES	65.8 ± 7.8	33.1 ± .8	11.05 ± .07	
60	Pre-breeding	Both	65.4 ± 4.2	34.2 ± .4	11.33 ± .03	1.60
60	Post-breeding	Both	66.1 ± 4.3	34.0 ± .3	10.87 ± .04	
60	Both	Both	65.8 ± 2.9	34.2 ± .3	11.4 ± .03	

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

ROUND BALE SILAGE

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

The use of the large round baler to store low moisture silage would be advantageous to small farmers in rainy weather. Two experiments were conducted at the Dairy Experiment Station (Lewisburg) with alfalfa-orchardgrass stored as silage and sealed under .06 mm polyethylene plastic film. Silage in experiment 1 was baled at 35 to 45% moisture and that of experiment 2 was baled at 50 to 55% moisture. Three treatments were compared: (1) treatment 1 - round bale silage (1/2 normal size) in black individual bag, (2) treatment 2 - round bale silage (1/2 normal size) in white individual bag, and (3) treatment 3 - round bale silage (full size) grouped under a common black plastic sheet. The bales were implanted with thermocouples at a 1 foot depth and at the center of bales to record temperature changes during fermentation. Observations were also made on 177 round bales of silage made from rain damaged hay and stored by several cover and sealing modes. Figure 1 shows temperature changes at the 1 foot depth and at the center of silage bales during fermentation in experiment 1.

1. Bales within white plastic bags had significantly lower temperatures ($P<0.01$) than bales within black plastic bags.

2. In experiment 1, single bales in black plastic bags had lower temperature than the group of bales stored under a black plastic sheet.

3. A comparison of experiment 1 and experiment 2 suggests that 50% moisture is the minimum moisture content for good silage preservation.

4. Excellent round bale silage can be made for short term storage (3 months).

5. Polyethylene plastic becomes brittle and breaks easily after the onset of cold winter weather.

6. Polyethylene plastic film is prone to damage by rodents, racoons, shot from hunters, and other miscellaneous hazards. Round bale silage deteriorates rapidly once punctures occur.

7. Evaporation from the silage bales occurs on warm days and condensation occurs under the plastic at night. This evaporation-condensation cycle causes water to puddle under every bale.

8. The practice of salvaging rain damaged hay by making round bale silage is a risky procedure. The moisture content of hay when rain occured seems to be a factor in determining preservation. Although the moisture content may be satisfactory, successful ensiling seems unlikely if the rain occurs after the hay was dry enough to rake.

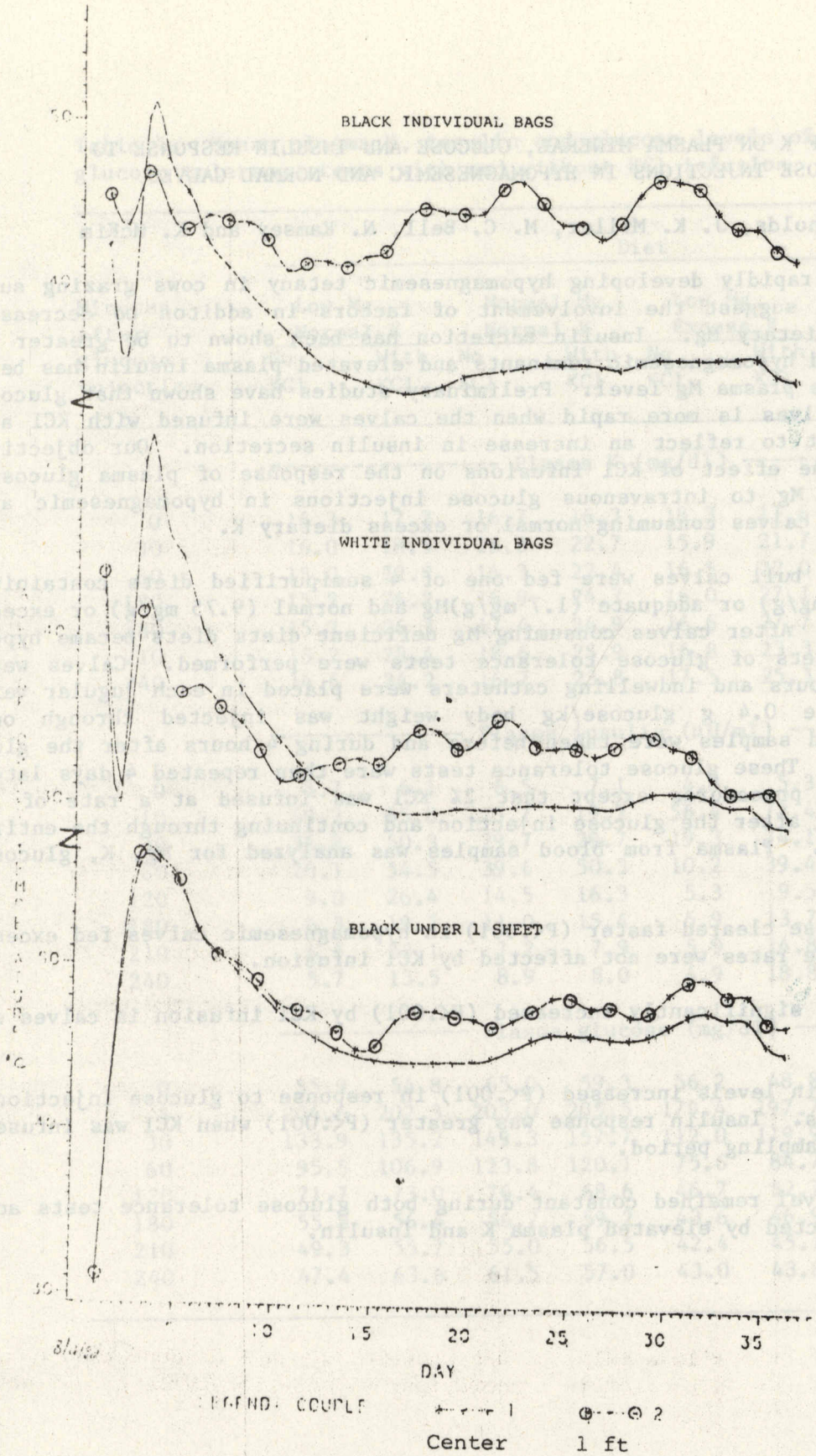


Figure 1. Temperature changes at 1 foot depth and at the center of silage bales during fermentation in experiment 1.

EFFECT OF K ON PLASMA MINERAL, GLUCOSE AND INSULIN RESPONSE TO GLUCOSE INJECTIONS IN HYPOMAGNESEMIC AND NORMAL CALVES

C. K. Reynolds, J. K. Miller, M. C. Bell, N. Ramsey and K. McKim

Occurrences of rapidly developing hypomagnesemic tetany in cows grazing succulent pastures suggest the involvement of factors in additon to decreased absorption of dietary Mg. Insulin secretion has been shown to be greater in hyperkalemic and hypomagnesemic ruminants and elevated plasma insulin has been shown to depress plasma Mg level. Preliminary studies have shown that glucose clearance in calves is more rapid when the calves were infused with KCl and this was thought to reflect an increase in insulin secretion. Our objective was to study the effect of KCl infusions on the response of plasma glucose, insulin, K and Mg to intravenous glucose injections in hypomagnesemic and normomagnesemic calves consuming normal or excess dietary K.

Twelve Holstein bull calves were fed one of 4 semipurified diets containing deficient (0.2 mg/g) or adequate (1.7 mg/g)Mg and normal (9.75 mg/g) or excess (42.22 mg/g) K. After calves consuming Mg deficient diets diets became hypomagnesemic, 2 sets of glucose tolerance tests were performed. Calves were fasted for 24 hours and indwelling catheters were placed in each jugular vein one hour before 0.4 g glucose/kg body weight was injected through one catheter. Blood samples were taken before and during 4 hours after the glucose injection. These glucose tolerance tests were then repeated 4 days later using identical procedures except that 2% KCl was infused at a rate of 10 ml/min beginning after the glucose injection and continuing through the entire sampling period. Plasma from blood samples was analyzed for Mg, K, glucose and insulin.

1. Plasma glucose cleared faster ($P<.001$) in hypomagnesemic calves fed excess K. Clearance rates were not affected by KCl infusion.

2. Plasma K was significantly increased ($P<.001$) by KCl infusion in calves on all 4 diets.

3. Plasma insulin levels increased ($P<.001$) in response to glucose injections in all calves. Insulin response was greater ($P<.001$) when KCl was infused during the sampling period.

4. Plasma Mg level remained constant during both glucose tolerance tests and was not affected by elevated plasma K and insulin.

Table 1. Means plasma K, insulin and glucose levels of calves during glucose tolerance tests with and without KCl infusion

Minutes after glucose injection	Diet							
	Low Mg, Normal K		Normal Mg, Normal K		Low Mg, Excess K		Normal Mg, Excess K	
	No KCl	With KCl	No KCl	With KCl	No KCl	With KCl	No KCl	With KCl
	Plasma K (mg/dl)							
0	16.3	17.2	16.7	16.3	18.3	17.6	16.2	17.8
30	16.0	18.5	15.8	22.7	15.9	21.7	15.5	21.0
60	15.0	22.2	16.3	22.4	16.5	22.0	15.8	23.5
120	15.2	26.2	16.9	24.7	16.0	27.1	17.9	23.7
180	15.2	26.3	17.4	24.9	16.6	27.7	17.9	23.7
210	15.2	28.4	18.6	25.9	16.8	23.3	16.3	23.3
240	14.6	24.2	16.7	23.8	17.5	25.3	16.5	22.2
	Plasma insulin (μU/ml)							
0	5.7	6.1	6.5	7.1	4.8	5.3	7.2	6.9
10	69.2	65.0	25.7	19.2	56.4	72.4	22.6	45.8
30	36.9	50.3	29.7	29.7	19.3	74.1	13.0	56.6
60	20.1	54.5	39.6	50.3	10.2	39.4	13.5	51.4
120	9.0	26.4	14.5	16.3	5.3	9.5	10.7	25.0
180	6.3	19.7	11.0	15.4	5.9	13.7	8.8	9.9
210	6.5	22.1	7.2	7.9	5.9	14.8	6.4	7.6
240	5.7	13.5	8.9	8.0	4.9	18.8	7.6	7.1
	Plasma glucose (mg/dl)							
0	55.9	54.8	65.0	59.3	56.2	48.8	49.1	50.8
5	204.6	202.3	203.0	205.5	179.4	197.7	202.7	192.8
30	133.9	135.2	149.3	157.7	112.0	119.9	134.4	148.6
60	95.5	106.9	123.8	120.1	75.6	84.7	113.9	113.6
120	71.7	73.0	76.4	68.6	46.7	52.7	67.7	77.3
180	55.8	56.4	56.7	59.2	43.6	46.9	42.8	62.4
210	49.3	55.7	55.0	56.5	42.4	45.1	39.0	57.6
240	47.4	63.6	61.5	57.0	43.0	43.8	37.1	52.9

DIETARY Mg AND K EFFECTS ON PLASMA MINERALS AND GLUCOSE IN CALVES

C. K. Reynolds, J. K. Miller, M. C. Bell, K. McKim and N. Ramsey

Hypomagnesemia may develop in certain lactating cows within a few days after switching from stored feed to fresh spring pasture. While spring pasture may be low in Mg, high in K, or both, this rapid onset of tetany suggests possible involvement of other factors in addition to low forage Mg and decreased Mg absorption. Elevated plasma K in response to high K intake has been shown to increase plasma insulin levels. Insulin in turn may depress plasma Mg concentrations. Previous research has shown the effect of elevated plasma K on insulin secretion to be greater in hypomagnesemic calves. The objective of this study was to follow responses of plasma minerals and glucose levels in calves to abrupt changes from a control diet to diets containing adequate or deficient Mg combined with normal or excess K.

Sixteen Holstein bull calves fed a semipurified diet containing adequate Mg and normal K levels were changed abruptly to one of four randomly assigned experimental diets. The diets contained deficient (0.2 mg/g) or adequate (1.7 mg/g) Mg and normal (9.75 mg/g) or excess (42.22 mg/g) K. Blood plasma sampled through the 11th day after the diet change was analyzed for Mg, Ca, K and glucose.

1. Plasma Mg levels dropped rapidly after calves were switched to Mg deficient diets and were significantly lower within 4 days.

2. Plasma K level was higher ($P<.001$) in calves fed excess K.

3. Plasma Mg was lower when excess K was fed to calves receiving both adequate and deficient levels of dietary Mg.

4. Plasma Ca level was not significantly affected by dietary treatment.

5. Plasma glucose level was not significantly affected by dietary treatment when baseline levels were included in the statistical model. Glucose level did remain lower in calves fed Mg deficient diets.

Table 1. Mean plasma Mg, Ca, K and glucose levels of calves changed abruptly to experimental diets

Days after diet change	Diet 1 Low Mg, normal K	Diet 2 Normal Mg, normal K	Diet 3 Low Mg, excess K	Diet 4 Normal Mg, high K
	Plasma Mg (mg/dl)			
0	1.94	1.99	1.98	1.98
1	1.72	1.99	1.68	1.88
2	1.53	1.99	1.50	1.88
4	1.45	2.01	1.32	1.77
7	1.16	2.14	1.08	1.85
9	1.05	2.13	0.93	1.94
11	0.96	2.16	0.74	1.95
	Plasma Ca (mg/dl)			
0	8.67	8.47	8.18	8.65
1	9.11	8.92	8.77	8.78
2	8.82	8.80	8.52	8.60
4	8.82	9.13	8.65	8.82
7	8.85	8.98	8.48	8.75
9	8.85	8.87	8.52	9.18
11	9.35	9.79	8.76	9.88
	Plasma K (mg/dl)			
0	15.33	15.68	15.20	15.91
1	16.02	15.59	16.97	18.09
2	15.64	14.32	17.00	18.00
4	16.05	15.76	17.12	17.48
7	15.55	15.03	18.56	17.51
9	16.20	15.70	17.48	17.94
11	13.77	14.92	18.14	17.57
	Plasma Glucose (mg/dl)			
0	63.64	70.90	58.62	64.34
1	63.42	70.98	61.90	64.30
2	60.64	68.38	61.44	64.28
4	61.54	77.92	60.59	72.16
7	64.36	66.53	60.59	72.16
9	70.18	67.99	59.38	67.75
11	62.12	69.60	58.05	63.75

HYPOMAGNESEMIA IN YOUNG CALVES AND REPLETION OF MAGNESIUM EFFECTS ON PLASMA AND CSF MINERAL LEVELS

K. A. McKim, M. C. Bell, J. K. Miller, C. K. Reynolds,
M. H. Sims and N. Ramsey

Grass tetany, a metabolic disorder associated with hypomagnesemic causes losses on the average of 1% to the cattle industry every year. The normal blood serum Mg level in cattle is between 2.0 and 3.0 mg/dl with a level below 1.0 mg/dl considered to be severely hypomagnesemic. Researchers are continually looking for models of adult lactating cows to study hypomagnesemia. We are continuing to use young dairy calves for this purpose. The objective of this study was to produce hypomagnesemia in calves and compare mineral metabolism with calves having normal Mg levels and to study hypomagnesemia effects on nerve, muscle, and tissue samples. An additional objective was to compare an oral repletion of 30% $MgCl_2$ solution on plasma and CSF Mg, Ca, and K levels.

Two trials were conducted with 8 Holstein bull calves per trial. The calves were assigned to 1 of 4 semi-purified diets which consisted of: (1) Mg deficient, (2) adequate in Mg and K, (3) Mg deficient plus excess K, and (4) adequate in Mg and excess K. After the calves fed the Mg deficient diet were depleted to below 1.0 mg of Mg/dl of plasma, a balance trial was conducted. Immediately following the balance phase of the experiment calves were orally drenched with 50 ml of 30% $MgCl_2$ solution. Plasma was analyzed for Mg, Ca, and K.

1. Calves dying in tetany exhibited lesions and hemorrhages typically associated with tetany convulsions.

2. Calves fed the Mg deficient diets were in a negative balance for Mg as compared to calves fed Mg adequate diets.

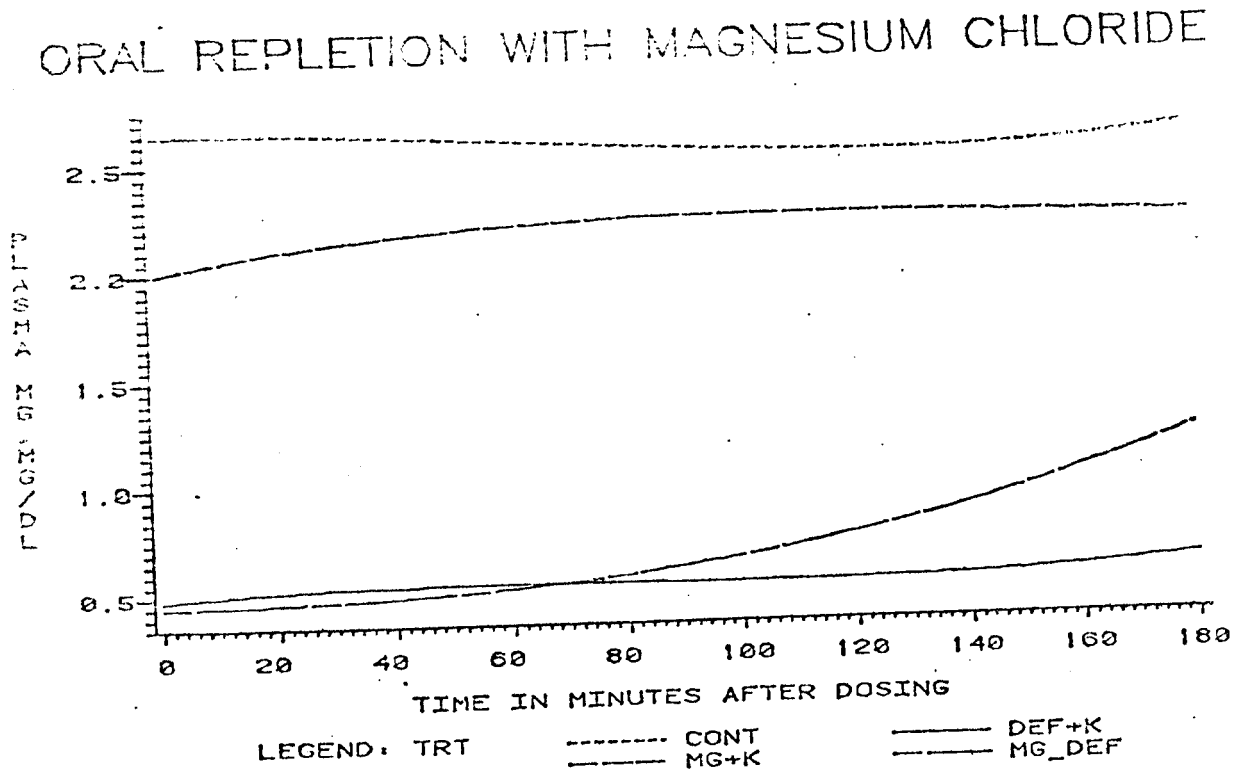
3. Calves fed the Mg deficient, Mg deficient-high potassium, or Mg adequate-high potassium diet had a significantly lower urine Mg excretion than calves fed the Mg adequate diet.

4. Of the 6 calves exhibiting tetany, four were successfully orally repleted; however, calves orally repleted with 50 ml of 30% $MgCl_2$ solution had increases in plasma and CSF Mg minimal to the increases from rectal infusions done previously.

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

Component	Treatment 1	2	3	4
No. of calves	2	4	4	3
Intake	.222[a]	2.889[b]	.200[a]	2.238[b]
Urinary excretion	.006[a]	.227[b]	.008[a]	.084[a]
Fecal excretion	.337[a]	1.652[b]	.278[a]	1.360[b]
Balance	-.121[a]	1.010[b]	-.086[a]	.794[b]

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



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 seven years at Ames Plantation comparing three systems of farrow-to-finish pork production. System I is a pasture system. Fifteen acres of orchardgrass-ladino clover pasture are utilized for spring farrowing and finishing of the pigs during the summer. An additional 18 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 7-8 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 5-7 weeks, and are then moved to one of the two finishing barns. Sufficient sows and/or gilts are maintained to insure 24 litters at each farrowing. Sows are bred and gestated on pasture in Systems I and II. A confinement breeding and gestation barn has been in use for two years in System III. 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 7-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, pigs marketed per litter and days to 230 lb market weight are generally similar for each system.

2. Conception rate continues to be slightly lower in System III, probably because of earlier weaning. Confinement breeding has not lowered conception rate in System III, however.

3. Feet and leg and other structural problems have not occured in a higher frequency in System III after moving the breeding herd from pasture to confinement.

4. The pounds of feed required to produce a pound 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. Seven-year average of sow, litter and pig performance of three swine production sysstems at Ames Plantation, years 1976-1982

	System		
	I	II[1]	III
Sow herds maintained	1	2	3.3[2]
Number sows/system	29.3	63.7	107.2
Number litters produced/yr	48	108	190
Conception rate, %	83	80	78
Litters produced/sow/yr	1.64	1.69	1.78
Pigs produced/sow/yr (weaned)	12.6	13.0	13.6
Pigs marketed/sow/yr	11.9	11.8	12.4
Pigs farrowed/litter	10.4	10.6	10.4
Pigs farrowed alive/litter	10.1	10.0	9.8
Pigs weaned/litter	7.6	7.7	7.7
Pigs weaned of born alive, %	75	77	78
Pig birth wt., lbs	3.4	3.4	3.2
Pig wean wt., lbs	35.0[3]	31.8[4]	18.3[5]
Final nursery wt., lbs	---	---	50.5
Average daily gain, nursery, lb[6]	---	---	0.70
Market wt., lbs	231	222	217
Days to 230 lb. mk. wt.	206	210	211
Lbs. of feed required to produce a lb. of live pork[7]	4.16	4.20	3.88

[1]Some adjustment made in production figures for unusual "predator losses" during some finishing periods in 1979, 1980 and 1982.

[2]Three sow herds maintained during years 1976-78, 1981-82; 4 herds 1979-80.

[3]Eight (8) week weaning.

[4]Seven to eight (7-8) week weaning.

[5]Four to five (4-5) week weaning.

[6]Days in nursery varied with weaning age.

[7]Includes breeding herd feed, creep feed, grower and finisher feed.

MANAGEMENT OF PURCHASED FEEDER PIGS

F. B. Masincupp, J. P. Hitchcock, E. Brooks and R. Freeland

A total of 816 purchased feeder pigs have been utilized in this experiment over a period of two years. The pigs were purchased through the Cookeville Feeder Pig Sale by Jolley's Feeder Pigs, Inc. To simulate the stress associated with the normal movement and transportation of most purchased feeder pigs, they were hauled to Jolly's facility after purchase on sale day and moved to the Plateau Experiment Station the following day. The pigs were purchased out of the USDA No. 1-2 grade averaging 45 pounds. Trials were begun in January and July of each year. The grain portions of the 16% CP rations were either 100% corn, 90% corn 10% alfalfa meal, or 90% corn 10% ground oats. The antibiotic combinations were ASP-250 in the feed and sulvitalite in the water. The wormers were dichlorovos in the feed, piperazine in the feed or water and levamisole hydrochloride in the feed or water.

The pigs were housed in a 40 pen, curtain walled, pit ventilated, partially slatted floor finishing unit. There were six pigs per pen with nipple waterer and two hole self-feeder. Pig weights were recorded upon arrival, one week, three weeks, six weeks, ten weeks, fourteeen weeks and at pen average weight of 230 pounds at which time a pen was taken off test. A factorial experiment design was used to determine the effects of ration, antibiotic combination and wormer.

1. The death loss was slightly over 1% for pigs on all treatments which is lower than expected for purchased pigs. There were no differences in death loss due to treatment.

2. Pig shrink from time of purchase to time of arrival at the station was 5% (45 vs. 42.6 lbs.).

3. Ration, antibiotic combination, wormer combinations changed performance during the first three weeks but no differences were noted by the time the pigs reached market weight (Table 1).

4. Performance was improved during the first three weeks on rations utilizing corn, 10% oats and ASP250 in the feed for three weeks and neomycin in the water for one week. Performance due to wormer was not significantly different. Pigs receiving levamisole in the water tended to gain faster than others, and pigs on dichlorovos tended to gain slower than the rest of the pigs (Table 1).

Table 1. Three week performance due to ration, antibiotic and wormer

	ADG (lb)	FE
Corn rations[1]	1.22	2.16
10% oat rations[1]	1.25	2.07
Corn rations[2]	1.07	2.61
10% alfalfa meal rations[2]	1.07	2.72
ASP-250 and neomycin[2]	1.06	2.66
Furox and sulvitalite[2]	1.07	2.67
Dichlorovos[2]	1.05	2.70
Levamisole hydrochloride[2]	1.08	2.62

[1]One season, Exp. 4.
[2]Two seasons, Exp. 2 and 3.

AN ATTEMPT TO CONTROL THE SEX-RATIO OF OFFSPRING IN SWINE BY MATERNAL ACTIVE IMMUNIZATION TO THE HISTOCOMPATIBILITY-Y (H-Y) ANTIGEN

T. W. Parrott, H. G. Kattesh, J. R. Hembree and C. A. Shivers

One current interest in animal science research is to develop a method to alter the sex ratio of offspring from farm animals. A practical method in which the sex of all offspring from a production animal could be predetermined would be of great economical value to the animal industry. The expression or nonexpression of the H-Y antigen has been shown to be the phenotypic sex-determining factor in a number of mammalian species. Also, in vitro presence of the H-Y antibody (immune response to the H-Y antigen) causes formation of ovarian folliculoids from XY cells of the dissociated neonatal testis. This study was undertaken to determine if H-Y antibodies in the maternal circulation (in vivo) could alter the sex ratio of their offspring.

Twenty-two six month old crossbred gilts were used in this study. The treatment consisted of six injections with fetal testicular material (H-Y antigen source) obtained from slaughterhouse material. The fetal testicular material was homogenized with 50% normal saline, by weight, and then frozen for later use. On each of the injection dates the material was thawed and combined 1:1 with Freund's adjuvant to achieve a final injection volume of 1.5 cc per gilt. Each injection was administered subcutaneously. The initial injection, in which Complete Freund's adjuvant was used to enhance the immune response, was given on the day the gilts were mixed and moved to pasture lots. Subsequent injections were performed using Incomplete Freund's adjuvant; two injections at weekly intervals and the final three injections at bi-weekly intervals. Prior to each injection, a 20 ml blood sample was obtained from each gilt for determination of serum H-Y antibody titer. Gilts were hand bred, upon detection of estrus, using a mature Duroc boar. The pregnant gilts were slaughtered at 50+ days of gestation, reproductive tracts recovered, and the sex ratio of the offspring determined.

1. Data was collected on eight of the twenty-two gilts initially assigned to the experiment.

2. The sex-ratio of the fetuses from the treated gilts did not differ from the expected results predicted from a normal population (predicted sex-ratio: 51% male, 49% female; Table 1).

3. It was concluded from these results that the treatment, as prescribed, was incapable of altering the sex ratio in swine.

Table 1. Fetal number, by sex, from gilts injected pre-breeding with porcine H-Y antigen

Gilt no.	No. of fetuses		
	Total	Sex	
		Female	Male
1.	9	3	6
2.	9	2	7
3.	17	11	6
4.	5	3	2
5.	5	2	3
6.	11	4	7
7.	11	7	4
8.	12	7	5
Total:	79	39	40
Percent:		49	51

EFFECT OF SUPPLEMENTAL METHIONINE ON PERFORMANCE OF 1 TO 3-WEEK OLD BROILERS FED CORN-SOYBEAN MEAL DIETS AT TWO ENERGY LEVELS

N. S. Mitchell and K. R. Robbins

In practical corn-soybean meal poultry diets, the sulfur amino acids (methionine and cystine) are usually first limiting. Poultry utilize relatively large amounts of sulfur amino acids during both the growing and reproductive portions of their life. Therefore, studies on their requirements must be conducted at several ages. In proportion to body weight, feed consumption increases with increasing size. As weight increases, more of the feed is used for maintenance and a small portion is used for protein synthesis. Since amino acids contribute to this protein, it has been suggested that their levels may also decrease in the growing animal. However, there is still some debate in the case of sulfur-bearing amino acids.

A preliminary study was designed to assess the effect of supplemental dietary methionine on the performance of 1- to 3-week old broilers fed corn-soybean meal diets at two energy levels. The composition of the basal diet may be found in Table 1. Basal diet 1 was calculated to contain 2970 ME (Kcal/kg) and .73% methionine. Both basal diets were calculated to contain 23% crude protein. However, to improve the validity of requirement estimates, and to further characterize the experimental diets, methionine bioavailability will be determined in the corn and soybean meal used. Ten experimental diets that consisted of a factorial arrangement of 2 energy levels x 5 levels of supplmental methionine were used. Each treatment was randomly assigned to triplicate groups of 6 chicks each. In diets 1-5, methionine was incrementally increased from .74% total methionine which is below the requirement recommended by the NRC, to .98% total methionine which exceeds the recommended level. Diets 6-10 contained the same methionine levels but employed the high energy basal diet.

1. The effect of dietary energy level was significant ($P<.01$) for gain and gain/feed (Table 2).

2. The comparison of 0% vs .06-.24% supplemental DL-methionine was significant ($P<.05$) for gain and gain/feed on the high energy treatments.

3. From a practical standpoint it can be stated that added methionine seemed to improve gains numerically even in the low energy diet although it was not statistically significant. However, the significant gain response in chicks fed the methionine-supplemented high energy diets suggests that metabolizable energy, rather than methionine, is the first-limiting nutrient in corn-soybean meal diets.

4. In diets containing adequate energy, the young broiler's sulfur amino acid requirement is near .80%.

Table 1. Composition of the corn-soybean meal basal diet

Ingredient	%	
	Basal 1	Basal 2
Corn	60.39	54.32
Soybean meal	36.42	37.49
Corn oil	0	5.00
Limestone	.50	.50
Dicalcium phosphate	1.20	1.20
Salt	.50	.50
Vitamin premix	.60	.60
Coban	.10	.10
BMD-25	.05	.05

Table 2. Effect of supplemental methionine on performance of 1 to 3-week old broilers fed corn-soybean meal diets at two energy levels[a,b]

Added DL-methionine (% of diet)	Dietary energy level (Kcal ME/kg)					
	2970			3232		
	Gain (g)	Feed consumed (g)	Gain/feed (g/kg)	Gain (g)	Feed consumed (g)	Gain/feed (g/kg)
0	352	791	445	397	795	499
.06	353	800	442	415	794	523
.12	355	797	445	435	793	549
.18	384	797	482	430	785	548
.24	367	796	461	433	787	550

[a]Means of triplicate groups of six chicks (3 males + 3 females). Average initial weight was 148 g.

[b]Pooled SEM for gain, feed consumed, and gain/feed were 15.63, 4.3 and 20, respectively.

EFFECT OF SUPPLEMENTAL METHIONINE ON PERFORMANCE OF 3 TO 5-WEEK OLD BROILERS FED CORN-SOYBEAN MEAL DIETS AT TWO ENERGY LEVELS

N. S. Mitchell and K. R. Robbins

In the previous report we discussed the effect of supplemental methionine on performance of 1- to 3-week old broiler chicks. Previous work has suggested a direct relationship between the amino acid composition of keratoid tissue and the amino acid needs for maintenance of the older bird. Feathers represent 4 to 7 percent of the chicken's weight, and are a keratoid tissue high in protein which utilize a large portion of circulating amino acids during synthesis. Therefore, we investigated the methionine requirement of the older bird during this period of intense feather production.

The composition of the basal diet may be found in Table 1. Basal 1 was calculated to contain 3045 ME (Kcal/kg) and .66% methionine whereas basal 2 contained 3307 ME (Kcal/kg) and .65% methionine. Both basal diets were calculated to contain 20% crude protein. Ten experimental diets that consisted of a factorial arrangement of 2 energy levels x 5 levels of supplemental methionine were used. Treatments were randomly assigned to triplicate groups of 6 chicks each. In diets 1-5 methionine was incrementally increased from .66% to .90% methionine + cystine. The same methionine levels were used in diets 6-10 but here the energy level was increased.

1. There was no gain response to supplemental methionine.

2. The effect of dietary energy level was significant ($P<.01$) for gain, feed consumed and gain/feed.

3. Contrary to results with the younger birds, the 3 to 5-week old broilers require no supplemental methionine when fed a corn-soybean meal diet. However, such diets are still limiting in metabolizable energy content.

Table 1. Composition of the corn-soybean meal basal diets

Ingredient	%	
	Basal 1	Basal 2
Corn	68.05	61.97
Soybean meal	28.85	29.95
Corn oil	0	5.00
Limestone	.50	.50
Dicalcium phosphate	1.20	1.20
Salt	.40	.40
Vitamin premix	.60	.60
Coban	.10	.10
BMD-25	.05	.05

Table 2. Effect of supplemental methionine on performance of 3 to 5-week old broilers fed corn-soybean meal diets at two energy levels[a,b]

Added DL-methionine (% of diet)	Dietary energy level (Kcal ME/kg)					
	3045			3307		
	Gain (g)	Feed consumed (g)	Gain/feed (g/kg)	Gain (g)	Feed consumed (g)	Gain/feed (g/kg)
0	653	1025	637	717	1015	706
.06	645	988	653	705	989	713
.12	665	986	674	705	1010	698
.18	653	975	682	680	1024	664
.24	612	1026	596	737	975	756

[a]Mean of three groups of six chicks (3 males and 3 females). Average initial weight was 438 g.

[b]Pooled SEM for gain, feed consumed, and gain/feed were 14.69, 20.98 and 23.09, respectively.

EFFECT OF SUPPLEMENTAL CHOLINE ON THE RESPONSE TO SUPPLEMENTAL METHIONINE IN 1 TO 2-WEEK OLD BROILERS FED CORN-SOYBEAN MEAL DIETS

N. S. Mitchell and K. R. Robbins

Methionine and choline are two related nutrients required for optimum performance of poultry. Methionine fulfills three major metabolic roles. It is an indispensable amino acid, a precursor of the amino acid cystine, and a precursor of choline. It is through choline that methionine provides one carbon units for purine and pyrimidine synthesis, for example. However, the bird's ability to synthesize choline is low. Thus, it is necessary to supplement most poultry diets with both methionine and choline. But, the quantitative aspects of this have been debated since it was first reported in 1943.

The debate has centered around the metabolic relationships between dietary methionine and choline. Current work has indicated that a major part of the apparent supplemental methionine requirement is really a requirement for methyl group donors which can be supplied either by methionine or by choline. And since the price of methionine is about 2½ times that of choline, interest from an economic standpoint is substantial.

A study was conducted to determine if the methionine dose response is affected by supplemental choline in a corn-soybean based diet. The composition of the basal diet is listed in Table 1. The basal diet was calculated to contain .65% methionine + cystine and 1221 ppm choline. The corn and soybean meal used was from the same lot as in the previous report. Therefore, bioavailability results will be the same when completed. Ten experimental diets that consisted of a factorial arrangement of 2 choline levels x 5 levels of supplemental methionine were used. Each treatment was randomly assigned to triplicate groups of 6 chicks each. In diets 1-5, methionine was incrementally increased from .65% to .81% total sulfur amino acids. The same levels were used in diets 6-10, but there was also an addition of 500 mg choline/kg diet.

1. Improved gain was noted by the addition of methionine in the diets not supplemented with choline. However, this response was not statistically significant.

2. The comparison of 0% vs .04-.16% supplemental DL-methionine was significant ($P<.05$) for gain and gain/feed in those diets containing excess choline.

3. The results clearly indicate that choline-unsupplemented corn-soy diets were first limiting in choline; that methionine cannot replace the requirement for supplemental choline; and that excess choline cannot replace the need for supplemental methionine. Hence, in practical diet formulation, the requirements for choline and methionine must be considered separately.

Table 1. Composition of the corn-soybean meal basal diet

Ingredient		%
Cornstarch	to	100.00
Corn		31.85
Soybean meal		37.49
Corn oil		5.87
Limestone		.50
Diacalcium phosphate		1.20
Salt		.50
Choline-free vitamins		.60
Coban		.10
BMD-25		.05

Table 2. Effect of supplemental choline on the methionine dose response in 1 to 2-week old broilers fed corn-soybean meal diets[a,b]

Added DL-methionine (% of diet)	Added choline (mg/kg)					
	0			500		
	Gain (g)	Feed consumed (g)	Gain/feed (g/kg)	Gain (g)	Feed consumed (g)	Gain/feed (g/kg)
0	175	302	582	180	280	642
.04	180	285	630	184	289	636
.08	186	299	648	194	293	662
.12	195	297	654	194	293	660
.16	182	297	613	208	298	698

[a]Mean of three groups of six male chicks. Average initial weight was 105 g.

[b]Pooled SEM for gain, feed consumed, and gain/feed were 5.18, 9.36 and 21.0, respectively.

BIOLOGY OF THE OVARY. EFFECT OF EXOGENOUS LUTEINIZING HORMONE RELEASING HORMONE (LHRH) ON THE REPRODUCTIVE FUNCTION OF LAYING HENS AND COCKERELS

A. L. Gordon and H. Eiler

Ovulation of the mature follicles is caused by pituitary release of LH. The hypothalamic hormone LHRH (GnRH) is responsible for the release of testosterone in the male by stimulating the leydig cells. The purpose of this research was to determine the effect on the laying hen of a continuous infusion of LHRH over a six day period. A companion study was conducted on cockerels. Twenty-four 64 week old laying hens were intrajugularly infused with either 857 or 429 μg synthetic LHRH using a subcutaneously implanted osmotic pump. Eighteen 12 week old cockerels were similarly infused with 214 μg synthetic LHRH. At the end of the six day period, one hour before death, hens and cockerels were intravenously injected with 10 μCi tritiated estradiol or 10 μCi tritiated testosterone, respectively. Tissue samples were taken for histological study (Table 1).

1. Egg production declined to 17-42% of that of control hens during the treatment period. Egg production in sham hens decreased to 35% of controls.

2. LHRH-treated hens and sham hens exhibited decreased whole ovarian weight without a reduction in stroma ovarian weight. Magnum function was severely reduced by significantly reduced tissue cross sectional area, increased ciliated and secretory cell number, and absence of luminal secretions. Circular tunica muscularis thickness and villi diameter were significantly reduced in the shell gland. The numbers of normal microscopic and atretic microscopic follicles per 100 μm^2 and the size of these microscopic follicles were not significantly affected by LHRH treatment. Pituitary alcian blue periodic acid-Schiff positive basophil cell number (gonadotrophs) per 1000x field was not significantly different between control and LHRH hens.

3. LHRH-treated cockerels exhibited significantly reduced number of basophil cells per 1000x field, and significantly increased chromaffin cell number percentage as compared to control cockerels.

4. The uptake of tritiated estradiol in magnum, shell gland, and ovarian stroma was not significantly different as compared to controls. The ovarian stroma consistently retained more tritiated estradiol of any tissue studied. The testicular uptake of tritiated testosterone was not significantly different in treated versus control group.

5. These results indicate that in the laying hen LHRH infusion could not overcome the effect of stress induced follicular and oviductal atrophy, and that probably the results observed probably were not due to an LHRH deficiency.

Table 1. List of tissues and criteria used in the histological evaluation of laying hens continuously infused with LHRH for a 6-day period

Magnum:
External diameter (mm)
Cross sectional area (mm^2)
Tissue cross sectional area (mm^2)[1]
Tunica muscularis thickness (μm)
Luminal secretions
akbumen (PAS positive)[2]
Epithelial cell height
Epithelial cell number (per 50 μm)
culiated cells
secretory cells
Secretory activity of submucosa
number of glands per 4375 μm^2
number of PAS positive granules per 450 μm^2
Shell gland:
Tunica muscularis thickness (μm)
circular
longitudinal
Villi
height (μm)
diameter (μm)
number per 1250 μm
epithelial cell height (μm)
Ovary:
Normal microscopic follicles
number per 100 μm^2
diameter (μm)
Atretic microscopic follicles
number per 100 μm^2
diameter (μm)
Anterior pituitary:
AB-PAS positive basophils per 1000x field

[1]Tissue cross sectional area = total area-luminal area.
[2]PAS positive = periodic acid-Schiff positive staining material.

THE EFFECTS OF PHOTOPERIOD ON PLASMA CORTICOSTERONE LEVELS AND THEIR RELATIONSHIP TO GLAUCOMA IN THE FOWL

H. V. Shirley and S. A. Osei

That the brooding of chicks in either continuous light or continuous darkness results in eye enlargement (buphthalmos) and increased intraocular pressure (glaucoma) has been demonstrated in numerous experiments at the Tennessee Station as well as by other workers.

To determine if these lighting environments act as stressors on the bird, plasma corticosterone levels were measured by radioimmunoassay procedure at 2-hr intervals over a 24-hr period. Three light treatments: 12L:12D, 24L:0D, and 0D:24L were imposed on Rhode Island Red cockerels from 1 day to 10 weeks of age. Measurements of eye size, intraocular pressure and adrenal size were also made. The diurnal patterns for plasma corticosterone are presented in Table 1.

1. Costicosterone levels were increased by both the continuous lighting and continuous darkness when compared with the alternating light and dark treatment.

2. The diurnal rhythm of plasma corticosterone was present in all 3 treatments with peaks being reached in the early morning hours.

3. Buphthalmia and glaucoma were present in both continuous light and continuous dark but not in the 12L:12D treatment.

4. Adrenal weights were increased ($P<.05$) by the 24L:0D and 0L:24D treatments.

5. It was concluded that certain light regimes do constitute a stressful situation resulting in increased corticosterone secretion by the adrenals and that avian glaucoma is related to hypercorticoidism.

Table 1. Effects of photoperiod and time on corticosterone levels in chicken plasma

Time	Plasma corticosterone in ng/ml 12L:12D	24L:0D	0L:24D
9 a.m.	$3.86\pm1.40^{a1*}$	$7.31\pm0.66^{ab1**}$	$7.79\pm1.18^{ab1**}$
11 a.m.	$5.66\pm1.28^{abcde*}$	$7.82\pm0.99^{ab**}$	$8.58\pm1.66^{abc**}$
1 p.m.	$10.10\pm1.56^{e*}$	$7.35\pm0.24^{ab**}$	$12.93\pm2.57^{cde**}$
3 p.m.	$9.11\pm0.75^{cde*}$	$5.71\pm0.79^{ab**}$	$6.58\pm1.67^{ab**}$
5 p.m.	$4.80\pm0.65^{abc*}$	$7.02\pm0.84^{ab**}$	$7.33\pm1.30^{ab**}$
7 p.m.	$5.55\pm1.88^{abcde*}$	$6.14\pm1.29^{ab*}$	$7.14\pm0.78^{ab**}$
9 p.m.	$4.90\pm0.65^{abc*}$	$7.82\pm0.64^{ab**}$	$7.56\pm1.15^{ab**}$
11 p.m.	$6.89\pm0.80^{abcde*}$	$9.43\pm1.34^{abc*}$	$13.68\pm1.15^{de***}$
1 a.m.	$7.32\pm1.20^{abcde*}$	$8.01\pm1.65^{abc*}$	$15.99\pm2.30^{e**}$
3 a.m.	$8.78\pm0.66^{bcde*}$	$12.17\pm1.80^{c***}$	$10.77\pm2.43^{abcd**}$
5 a.m.	$9.44\pm1.16^{de**}$	$8.04\pm0.54^{abc*}$	$13.91\pm1.60^{de***}$
7 a.m.	$8.31\pm1.50^{abcde*}$	$9.50\pm0.63^{abc*}$	$9.79\pm0.78^{abcd*}$
No of birds per mean	8	8	8

Overall means	8.50^{a2}	96	9.70^{b2}	96	12.20^{c2}	96
Daytime means	6.50^{a}	48	6.90^{a}	48	8.40^{b}	48
Night means	7.60^{a}	48	9.20^{b}	48	12.00^{c}	8

[1]Figures in a column having different letter superscripts are different (P>0.05).

[2]Figures (means) in a row having different superscripts are different (P>0.05)--refers only to figures in bottom table.

*Figures in a row having different numbers of asterisks are different (P>0.05).

OCHRATOXICOSIS IN LAYING HENS

H. V. Shirley and S. H. Tohala

Ochratoxins are mold produced substances and ochratoxicosis is a disease caused by Ochratoxins. The ochratoxin-producing fungi are included in the genera aspergillus and penicillium. These fungi and ochratoxins are widely distributed in stored feed ingredients that might be used in poultry feeds.

Ochratoxicosis in poultry is a disease not readily recognized. Its onset may be insidious and its symptoms have generally been unfamiliar. Following the discovery that ochratoxicosis was occurring in laying flocks on the Cherokee Farm, an experiment was designed to study the effects of several levels of the toxin on layers to provide poultrymen a set of symptoms by which the presence of the disease in their flocks may be ascertained.

Ochratoxin was mixed in the feed at levels of 0, 0.25, 0.50, 1.0 and 2.0 ppm and fed to layers for a period of 12 weeks.

1. While differences were not statistically significant ($P = <.05$), egg production decreased as ochratoxin level was increased (Table 1).

2. The percent of eggs with blood and meat spots increased as ochratoxin was increased. Albumin quality, as measured in Haugh Units, was not affected (Table 2).

3. A very significant and economically important decrease in egg shell quality occurred at the higher ochratoxin levels. There was, like wise, a significant reduction in body weight at the higher levels (Table 3).

4. Other symptomatic effects of the higher ochratoxin levels included pale kidneys, increased water consumption, increased soiling of abdominal feathers, enlarged and pale colored livers and paler combs.

5. The increased water consumption and the excretion of urates onto abdominal feathers constitutes one of the more easily recognized symptoms of this disease and reflects damage of the kidneys by the toxin.

6. Mortality at the 2 ppm level was 7.14% compared with 0 mortality in the untreated group.

It should be pointed out that the levels of Ochratoxin used in this experiment were low and may be exceeded in naturally occurring ochratoxicosis. The potential for serious economic loss from ochratoxin contamination of feed is great.

Table 1. The effect of ochratoxin on egg production

Ochratoxin ppm	% Hen-day egg production			
	1st 4 weeks	2nd 4 weeks	3rd 4 weeks	Entire period
0	81.62	80.48	79.39	80.50
0.25	79.52	78.44	78.75	78.90
0.5	78.78	79.16	78.76	78.90
1	79.39	79.26	79.05	79.24
2	77.90	76.28	76.54	76.91

Table 2. The effects of ochratoxin on egg blood and meat spots and egg Haugh units

Ochratoxin ppm	% Blood and meat spots			Average Haugh units		
	4 weeks	8 weeks	12 weeks	4 weeks	8 weeks	12 weeks
0	10.0	5.0	7.5	73.25	72.50	73.00
0.25	7.5	10.0	10.0	72.75	70.75	72.25
0.5	15.0	15.0*	20.0	72.75	74.25	73.25
1	17.5	15.0*	17.5	73.75	71.75	73.50
2	22.5*	17.5*	22.5*	73.00	73.25	72.00

Table 3. The effect of ochratoxin on egg specific gravity and body weight

Ochratoxin ppm	Average specific gravity			Average gms gain or loss		
	4 weeks	8 weeks	12 weeks	4 weeks	8 weeks	12 weeks
0	3.40	3.10	2.97	13.60	14.60	59.46
0.25	3.32	2.40	2.32*	4.82	9.92	59.46
0.5	2.45	2.25*	2.10**	-28.00*	10.00	20.00
1	3.05	2.35	2.00***	-24.96*	3.46	-40.35***
2	2.42	1.95**	2.07***	-41.32**	-47.53**	-75.20***

Significantly different from control group. *($P \leq .05$); **($P \leq .01$); and ***($P \leq .005$).

MAGNESIUM, CALCIUM AND POTASSIUM BALANCES IN LAMBS FED LOW OR ADEQUATE MAGNESIUM AND ADEQUATE OR EXCESSIVE POTASSIUM[1]

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

Grass tetany, which has been recognized for many years in cows grazing lush and highly productive pasture, was shown to result from Mg deficiency more than 50 years ago. Over the years, a marked increase in incidence of grass tetany has coincided with more intensive pasture management, particularly increased K fertilization. Our objective was to compare effects of normal or excessive levels of dietary K on plasma concentrations and intake-excretion balances of Mg, Ca and K in growing lambs fed diets adequate or deficient in Mg. The lambs were used as models of cows on pasture.

Thirty-six weaned lambs divided into four groups of nine lambs each were fed diets containing 0.01 or 0.2% Mg and 0.5 or 3.6% K in a factorial arrangement of treatments. After plasma Mg concentrations of deficient lambs had fallen to 25% of control, feed, blood plasma, feces and urine were collected during a 5-day balance period and analyzed for Mg, Ca and K. Results were summarized in Table 1.

1. The very low Mg intakes of lambs fed Mg deficient diets resulted from the very low Mg content in feed together with reduced feed intake as Mg deficiency developed. Consumption of feed, and thus of Mg, was reduced further by excess K.

2. Urinary and fecal Mg were both reduced markedly when Mg intake was restricted but the reductions were insufficient to prevent negative Mg balance. Urinary Mg loss was lowered by excess dietary K but fecal Mg loss was increased, further reducing Mg balance.

3. Plasma Ca was lower in Mg-deficient lambs. Lower feed intake in Mg-deficient lambs reduced Ca intake but fecal excretion of Ca was reduced even more, resulting in slightly higher apparent absorption of Ca.

4. Excess dietary K raised fecal K only slightly; most of the excess K was excreted in urine. Potassium balance was reduced by low Mg intake but raised by high K intake. Plasma K concentrations were increased by excess K but were not affected by Mg intake.

5. Results were consistent with an adverse effect of high dietary K on utilization of Mg.

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[1]Supported by U.S. Department of Agriculture Grant No. 901-15-168.

Table 1. Metabolism of Mg, Ca and K in lambs fed deficient or adequate Mg and normal or excess K

Element and measurement	Normal K		Excess K	
	Low Mg	Adequate Mg	Low Mg	Adequate Mg
Magnesium				
Intake[a,b,cc,dd]	57	1223	49	1016
Feces[a,b,c,d]	97	434	122	582
Urine[a,b,ccc]	39	320	13	204
Balance[a,b,c,d]	-79	469	-89	230
Calcium				
Intake[a,b]	2174	3578	2287	2862
Feces[a,b]	1543	2671	1577	2217
Urine	14	37	27	35
Balance	617	870	682	610
Potassium				
Intake[a,b,c,dd]	1864	3080	15814	18763
Feces[a,b]	68	123	171	198
Urine[a,b,c]	1438	3465	13808	15186
Balance[a,c,d]	357	-508	1835	3380
Blood plasma	---------- (mg/dl) ----------			
Magnesium[a,b]	.68	2.42	.51	2.37
Calcium[a,b]	9.47	10.40	9.78	10.46
Potassium[a,c,dd]	13.85	16.14	18.54	17.16

[a,b,c,d]Significance: a, treatment; b, Mg effect; c, K effect; d, Mg x K interaction. Single letter, $P<.01$; double letter, $P<.05$; triple letter, $P<.10$.

EFFECTS OF KETONE BODIES ON ALIMENTARY AND HEPATIC KETOGENESIS IN FED SHEEP

J. M. Fernandez and R. N. Heitmann

Single pulse dose challenges of β-hydroxybutyrate (BOHB) depress plasma free fatty acids (FFA) and cause a transitory increase in plasma insulin concentrations in fed and fasted sheep. Since FFA are direct precursors of acetoacetate (AcAc) and BOHB production, it can be postulated that ketone bodies may act through a negative feed back mechanism to inhibit alimentary and hepatic ketogenesis. The objective of this research was to determine the effects of a constant infusion of BOHB on the net fluxes of AcAc, BOHB, FFA, insulin, and glucagon across the portal-drained viscera (PDV) and liver in fed sheep.

Chronic, indwelling catheters were surgically implanted into the femoral artery and hepatic, portal, mesenteric, and femoral veins of five normal, three diabetic-insulin treated, and three diabetic untreated ewes. Para-aminohippuric acid (PAH) was infused into the mesenteric vein at 0.764 ml/min in order to measure the blood flow rates across the downstream tissues by the Fick principle. Following three pre infusion sampling periods BOHB was infused into the femoral vein at approximately 0.4 $g/kg^{3/4}/hr$, a rate slightly exceeding maximum ketone body utilization and therefore simulating a state of ketosis. Blood samples were withdrawn simultaneously from the femoral artery, hepatic vein and portal vein at three fifteen minute intervals prior to ketone body infusion and at four thirty minute intervals following ketone body infusion and measured for AcAc, BOHB, FFA, PAH, insulin and glucagon. Venoarterial differences (V-A) were calculated for the hepatic vein minus the artery [representing total splanchnic (TS) flux], hepatic vein minus the portal vein (representing approximately 80% of the hepatic flux) and portal vein minus the artery (representing the PDV flux).

1. Arterial concentrations and V-A for AcAc, BOHB, and FFA are reported in Table 1.

2. In normal, fed animals there was significant hepatic utilization and PDV production of AcAc. Ketone body infusion increased these rates. There was net TS, hepatic, and PDV production of BOHB. However, the simulated ketosis depressed TS net BOHB production by increasing hepatic production with a concomitant PDV switch to utilization. Ketosis depressed FFA concentrations and diminished their net TS and hepatic utilization.

3. Diabetic, treated sheep had net TS, hepatic, and PDV fluxes similar to those of normal, fed animals indicating that an insulin surge is not required for the observed changes in ketogenesis during ketosis.

4. In diabetic, untreated animals there were no longer any significant net ketone body fluxes by any of the splanchnic tissues. However, trends similar to those observed in normal and diabetic, treated sheep were observed for net FFA fluxes. Therefore, it appears that at least a functional insulin receptor is required for the maintenance of ketogenesis.

Table 1. Concentrations and venoarterial differences in μm/l.

Treatment	A		H-A		H-P		P-A	
	Pre-Infusion	Infusion	Pre-Infusion	Infusion	Pre-Infusion	Infusion	Pre-Infusion	Infusion
	---------- Acetoacetate ----------							
Normal	35.6± 5.5	195.5± 14.1	-2.2± -5.4	-24.6± 8.2	-14.6± 5.2	-63.2± 5.9	12.4± 4.3	38.6± 4.6
Diabetic, Treated	46.3± 8.9	213.0± 14.6	-16.3± 9.1	-66.6± 10.0	6.1± 19.3	-143.4± 15.7	10.2± 6.9	76.9± 14.7
Diabetic, Untreated	411.9± 103.3	418.9± 103.4	28.6± 29.0	11.3± 6.8	45.5± 55.1	1.9± 2.9	-16.9± 26.2	9.5± 3.8
	---------- Betahydroxybutyrate ----------							
Normal	565± 66.6	4105± 719	244± 54.8	105± 62.5	155± 31.1	369± 43.5	89.0± 27.9	-264± 65.3
Diabetic, Treated	1023± 109	4321± 306	481± 44.6	353± 102	426± 47.9	850± 273	55.3± 53.0	-497± 370
Diabetic, Untreated	13771± 4046	19537± 3820	754± 606	822± 471	422± 669	615± 498	332± 183	207± 198
	---------- Free fatty acid ----------							
Normal	868± 126	529± 113	-128± 45	-31± 30	-203± 21	-93± 19	75± 26	62± 16
Diabetic, Treated	1186± 186	684± 16	-258± 61	-54± 5	-270± 87	-123± 14	12± 15	69± 13
Diabetic, Untreated	1933± 163	1719± 192	-285± 77	-216± 5	-333± 98	-234± 75	49± 50	17± 75

A = Artery; H = Hepatic vein; P = Portal vein.

EFFECTS OF BETAHYDROXYBUTYRATE ON PLASMA INSULIN IN MATURE WETHERS

R. N. Heitmann

Single pulse doses of ketone bodies have decreased elevated plasma free fatty acid concentrations in the rat and dog and both basal and elevated concentrations in the sheep. Free fatty acids are direct precursors for hepatic ketogenesis. The ability of ketone bodies to inherit 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 negative feedback mechanism has not been elucidated but may be at the pancreatic level — an increased production of insulin, an antilipolytic hormone — or directly at the adipose level — an increased receptor affinity for insulin or an increased free fatty acid uptake. The objective of this research was to determine the effects of a single pulse dose on plasma insulin concentrations.

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 20 g of β-hydroxybutyrate. The experimental design was a combination of a latin square and randomized complete block (Table 1) in order to remove any confounding between dose and degree of fast. Pre-pulse dose 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 insulin.

1. Plasma insulin was increased within 15 minutes of the β-hydroxybutyrate challenge at all levels of dose and all degrees of fasting. However, plasma insulin returned to initial concentrations within 30 minutes.

2. As expected, fasting decreased plasma insulin concentrations. However, degree of fast had no effect on level of insulin response to ketone body challenge or on time required to return to pre-challenge concentrations.

3. Level of dose was directly related to degree of insulin response to ketone body challenge with the 20 g dose being the most and the 4 g dose being the least efficacious. However, level of dose had no effect on the time required for insulin concentrations to return to pre-challenge concentrations.

4. Since plasma free fatty acid depression in response to a β-hydroxybutyrate challenge is prolonged but elevated insulin is transitory, it is suggested that the initial decline of plasma free fatty acids may be due to an increased pancreatic release of insulin but that the maintenance of low levels of plasma free fatty acids might be controlled at the adipose tissue itself.

Table 1. Experimental design

Exp.	Days fasted	β-hydroxybutyrate dosed (g) 4	12	20
1	0	1,2*	3,4	5
2	1	5	1,2	3,4
3	3	3,4	5	1,2
4	5	1,2	3,4	5
5	0	5	1,2	3,4
6	1	3,4	5	1,2
7	3	1,2	3,4	5
8	5	5	1,2	3,4
9	0	3,4	5	1,2
10	1	1,2	3,4	5
11	3	5	1,2	3,4
12	5	3,4	5	1,2

*Animal number

Table 2. Plasma insulin concentrations (μ units/ml) in fed and fasted mature wethers following ketone body challenge

Dose (g)	Sampling time (min)	Days fasted 0	1	3	5
4	0	45.9 ± 17.8*	55.2 ± 31.4	21.8 ± 4.0	11.4 ± 3.5
	15	73.1 ± 32.9	45.7 ± 20.7	31.2 ± 5.6	19.5 ± 5.0
	30	67.7 ± 30.6	33.0 ± 15.5	40.9 ± 15.2	12.2 ± 4.1
	45	63.5 ± 32.0	36.7 ± 11.1	41.3 ± 20.8	14.4 ± 5.5
	60	67.5 ± 42.4	37.9 ± 10.8	34.3 ± 9.4	13.5 ± 3.1
12	0	80.5 ± 17.5	38.8 ± 11.3	20.5 ± 3.9	12.4 ± 4.2
	15	85.9 ± 16.4	58.0 ± 17.3	36.4 ± 19.3	34.3 ± 17.0
	30	67.0 ± 16.7	29.3 ± 7.0	20.5 ± 6.9	19.0 ± 7.4
	45	45.8 ± 8.2	22.8 ± 5.1	14.4 ± 3.2	19.5 ± 10.7
	60	45.7 ± 9.8	25.0 ± 6.3	12.7 ± 1.1	14.4 ± 3.9
20	0	72.6 ± 22.1	44.5 ± 7.5	10.7 ± 3.2	11.7 ± 2.1
	15	97.3 ± 37.4	60.6 ± 7.9	57.8 ± 22.7	53.6 ± 26.1
	30	75.0 ± 36.4	35.3 ± 14.4	23.9 ± 6.8	22.6 ± 6.1
	45	89.5 ± 57.5	25.4 ± 5.3	13.8 ± 2.6	13.2 ± 1.8
	60	83.4 ± 52.0	25.0 ± 4.9	8.7 ± 0.8	9.3 ± 1.2

*Means ± SEM

EFFECTS OF WHOLE STILLAGE:FESCUE SILAGE ON RUMEN VOLATILE FATTY ACIDS

R. N. Heitmann and D. M. Britton

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 whole stillage and can be used for animal feeds. An earlier study showed that whole stillage could be successfully stored in the ensiled form with mature fescue hay at concentrations of 60-75% whole stillage. However, apparent digestibilities of dry matter, crude protein, ether extract and crude fiber as well as percent total digestible nutrients were all higher on those silages with greater concentrations of whole stillage. A second study showed that this increased digestibility with increased concentrations of whole stillage could not be explained by changes in ruminal pH or protozoa populations or concentrations. Since ruminants derive approximately 80% of their energy from volatile fatty acids, the objective of this research was to determine the effects of whole stillage:fescue silages on rumen volatile fatty acid concentrations.

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 volatile fatty acids. Following the five day fescue period each group was randomly assigned to either a 70:30 or a 65:35 whole stillage:fescue hay ration. The animals were adapted to the ration over a five day period and changes in rumen volatile fatty acids were measured on a daily basis. After adaptation to the silage, rumen volatile fatty acids continued to be monitored daily for an additonal five days.

1. All volatile fatty acid concentrations increased two fold or more (Table 1) when the animals were switched from a fescue hay to a whole stillage: fescue diet, indicating a higher rate of fermentation on the silage regimes.

2. However, the molar percents of acetate decreased while those of butyrate and valerate increased (Table 2).

3. Therefore, the decrease in the acetate/propionate ratio observed on the silage diets (Table 1) was not due to an increase in the relative rate of propionate production but rather to a decrease in the relative rate of production of acetate.

4. There were no differences between the 70:30 and the 65:35 whole stillage: fescue silages on rumen volatile fatty acid concentrations (Table 1) or molar percents (Table 2).

Table 1. Volatile fatty acid concentrations, (mM/l)

	Fescue hay		Whole stillage/fescue silage	
	Group 1[a]	Group 2[b]	Group 1[a]	Group 2[d]
Acetate	29.1 ± 10.7[c]	18.6 ± 2.79	43.8 ± 7.85**	40.3 ± 4.63**
Propionate	5.81 ± 1.55	4.22 ± 0.67	11.3 ± 1.14**	11.9 ± 1.65**
Isobutyrate	0.35 ± 0.05	0.35 ± 0.06	0.93 ± 0.23*	0.87 ± 0.18*
Butyrate	1.82 ± 0.40	1.27 ± 0.16	7.64 ± 1.85*	6.03 ± 0.49**
Isovalerate	0.39 ± 0.12	0.39 ± 0.11	1.16 ± 0.29	0.87 ± 0.18*
Valerate	0.00 ± 0.00	0.00 ± 0.00	1.00 ± 0.25*	0.88 ± 0.17**
Ac/Pr[d]	4.89 ± 0.49	4.51 ± 0.18	3.97 ± 0.28*	3.50 ± 0.12**

[a]Group assigned to the 70:30 whole stillage:fescue silage.
[b]Group assigned to the 65:35 whole stillage:fescue silage.
[c]Mean ± SEM.
[d]Acetate/Propionate ratio.
*Different from fescue hay, (P<.10).
**Different from fescue hay, (P<.05).

Table 2. Volatile fatty acid molar percents

	Fescue hay		Whole stillage/fescue silage	
	Group 1[a]	Group 2[b]	Group 1[a]	Group 2[d]
Acetate	75.84 ± 2.38[c]	74.35 ± 0.81	66.73 ± 2.17*	66.00 ± 1.35**
Propionate	16.19 ± 1.33	16.79 ± 0.85	17.42 ± 1.18	19.41 ± 0.57*
Isobutyrate	1.25 ± 0.43	1.61 ± 0.31	1.49 ± 0.35	1.44 ± 0.18
Butyrate	5.17 ± 0.55	5.42 ± 0.59	11.11 ± 1.67*	10.15 ± 0.88**
Isovalerate	1.51 ± 0.72	1.85 ± 0.54	1.81 ± 0.30	1.55 ± 0.19
Valerate	0.00 ± 0.00	0.00 ± 0.00	1.43 ± 0.36*	1.43 ± 0.22**

[a]Group assigned to the 70:30 whole stillage:fescue silage.
[b]Group assigned to the 65:35 whole stillage:fescue silage.
[c]Mean ± SEM.
*Different from fescue hay, (P<.10).
**Different from fescue hay, (P<.05).

BIOLOGY OF THE OVARY. EFFECT OF BULL SEMEN ON OVULATION IN THE RABBIT

H. Eiler and W. A. Lyke

For decades it has been accepted that ovulation in the rabbit (induced ovulator) is caused by LH release, from the pituitary gland, following neurogenic stimulus during mating. However, the endocrine effect of semen during ejaculation has not been considered. Five groups of six does each were infused intravenously with either 2 ml of bull semen in saline (20 ml); bull plasma 2 ml in saline or rabbit plasma 2 ml in saline. Saline infusion, 20 ml was used as saline control. In additon, a group of rabbits that were not subjected to experimental manipulation was used as untreated control group. Forty-eight hours later the ovaries were removed and the corpus hemorrhagicus (CH) counted. Plasma progesterone was also measured at the end of the experiment. Results are presented in table 1.

1. Eighty-three percent of the rabbits that received infusion of semen presented CH in the ovaries (Table 1, Picture 2).

2. The incidence of rabbits that presented CH, that received no semen infusion varied from 0 to 25 percent.

3. Plasma progesterone is under analysis.

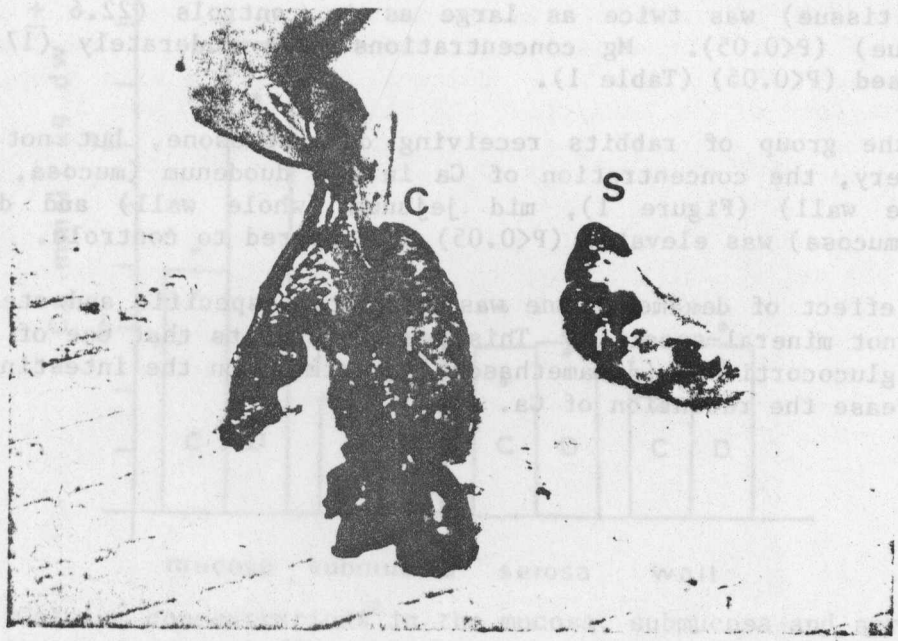
4. It was concluded that in the semen of bulls there is substance(s) that can induce the formation of CH.

5. There is indication that semen collected by electroejaculation was not effective in inducing the formation of CH.

TABLE 1.

EFFECT OF THE INFUSION OF BULL SEMEN, BULL PLASMA AND RABBIT PLASMA ON THE FORMATION OF CORPUS HEMORHAGICUS (CH) IN THE RABBIT

TREATMENT	NO. OF RABBITS WITH CH/n	%
CONTROLS		
Untreated (not infused)	0/6	0
Saline infused	1/6	16.7
Infused with bull plasma	1/4	25.0
Infused with rabbit plasma	1/6	16.7
INFUSED WITH BULL SEMEN	5/6	83.7%



Picture 2. Effect of bull semen (injected i.v.) on the rabbit ovary. C- Control ovary S - Ovary from a rabbit injected with bull semen F- Follicles Notice the hemorrhage and enlargement of follicles in rabbit "S" ovary. However, in this rabbit, the follicle did not ovulate as a consequence of semen injection.

STEROIDAL HORMONE FUNCTIONS. RETENTION OF CALCIUM IN THE INTESTINAL WALL OF THE RABBIT

H. Eiler and W. A. Lyke

For many years it has been recognized that a decrease in intestinal absorption of calcium has been associated with high-doses of glucocorticoid administration. The reason for this is unknown. Rabbits were treated with pharmacological doses of either dexamethasone, estrogen or progesterone during one week. Two mls of solution containing Ca (plus Mg, K and Na) were infused into a double-ligated (4 cm apart) gut loop (jejunum). In addition, an adjacent loop was double-ligated, but received no infusion. Uterine horns were treated in the same way as the gut and were used as controls to test for organ specificity. After infusing the organs with the calcium solution, they were returned into the abdominal cavity for a 4-hour period. Dexamethasone treatment was given to a different group of rabbits in which neither surgery was performed nor mineral solution was infused into the lumen of the intestine. In this experiment, calcium concentrations were measured in the mucosa, submucosa and serosa layer obtained from the duodenum, mid jejunum and distal jejunum.

1. In rabbits subjected to surgery, the concentration of Ca in the whole wall of the intestine of the dexamethasone-treated rabbits (45.4 $\pm$ 2.6 mM/kg dry tissue) was twice as large as in controls (22.6 $\pm$ 3.2 mM/kg dry tissue) ($P<0.05$). Mg concentrations were moderately (17 percent) increased ($P<0.05$) (Table 1).

2. In the group of rabbits receiving dexamethasone, but not subjected to surgery, the concentration of Ca in the duodenum (mucosa, submucosa and whole wall) (Figure 1), mid jejunum (whole wall) and distal jejunum (submucosa) was elevated ($P<0.05$) as compared to controls.

3. The effect of dexamethasone was both organ-specific and steroid-specific, but not mineral-specific. This result suggests that one of the effects of the glucocorticoid (dexamethasone) treatment on the intestinal wall was to increase the retention of Ca.

Table 1. Concentration of minerals in the intestinal wall of rabbits injected with either Dexamethasone, Estrogen, or Progesterone.

Treatment	millimoles/kg dry tissue			
	Ca^{++}	Mg^{++}	K^{+}	Na^{+}
Control	22.6 ± 3.2^{b}	39.8 ± 2.0^{b}	179.0 ± 25.1^{a}	424.1 ± 26.3^{a}
Dexamethasone	45.4 ± 2.6^{a} (101%)	46.4 ± 1.2^{a} (17%)	261.6 ± 27.9^{a} (46%)	387.1 ± 13.9^{a} (-9%)
Estrogen	23.0 ± 2.2^{b} (2%)	35.7 ± 1.1^{b} (-10%)	185.7 ± 8.9^{a} (4%)	446.7 ± 16.1^{a} (5%)
Progesterone	21.4 ± 2.0^{b} (-5%)	37.9 ± 1.5^{b} (-5%)	256.3 ± 29.3^{a} (43%)	390.6 ± 23.8^{a} (-8%)

Numbers are mean ± SEM for 5 rabbits. In parenthesis is percentage of change as compared to controls.

$^{(a,b,c)}$ Similar and different superscripts under the same column indicate non-significant and significant ($P \leq 0.05$) differences respectively.

Notice the marked increase in concentration of calcium in the intestinal wall of the Dexamethasone group.

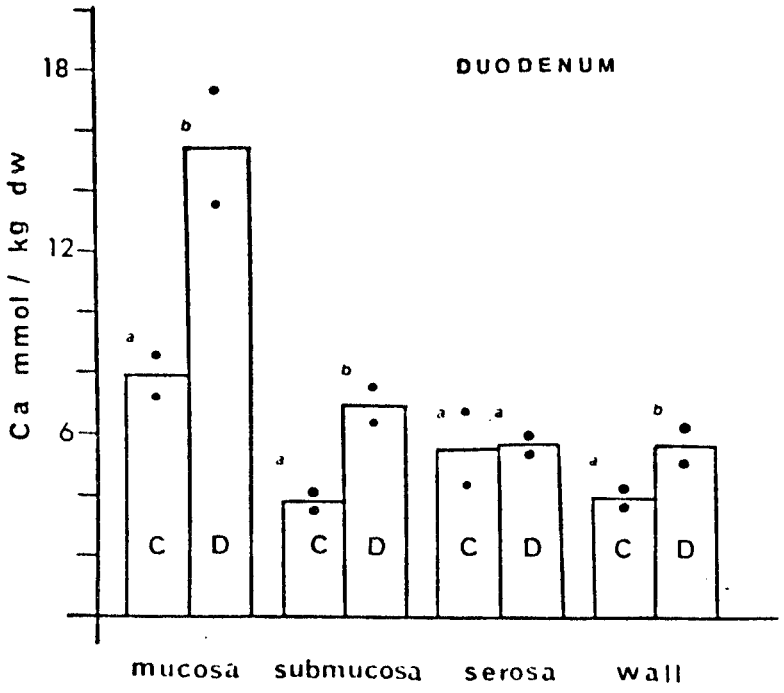


Figure 1. Calcium concentrations in the mucosa, submucosa and serosa layer of the duodenum of control (C) rabbits and rabbits treated with dexamethasone (D). (A,B) Different superscripts indicate significant ($P < 0.05$) differences as compared to controls, while the same superscript indicates no differences. Dots indicate dispersion values (SEM).

BIOLOGY OF THE UTERUS. HOMOTRANSPLANT OF THE INTESTINE TO THE UTERUS

H. Eiler, S. Kincaid and W. A. Lyke

Fertilization and embryo development can be completed away from the reproductive tract on the intestine. The question arose how critical is the uterine tissue in the reproductive process?

An Intestinal loop, having an intact blood supply was transplanted to the middle portion of the uterine horn. End to end utero intestine anatomosis was completed. Temporary drainage was placed in the transplanted intestine. Twelve rabbits were operated on and seven rabbits survived the procedure for a 2-3 month period. At the end of the 3 month period the rabbits were sacrificed for evaluation of experiment. Findings follow:

1. The surgical technique allowed satisfactory anatomosis, without massive infection in 3 rabbits. Figure 1 shows that the point of anatomosis of the uterine and intestine in rabbit was almost indistinguishable from the contralateral horn, that received no transplant.

2. In one rabbit the transplanted intestine appeared atrophic. However, the histological section showed a relatively normal intestinal epithelium (figure 2). Necrosis of the mucosa surface of the uterus was histologically apparent. Intestinal villi and crypts of lieberkuhn were present in the transplanted intestine. Columnar epithelium with goblet cells lined some regions of the intestine. In this rabbit (figure 2) the lumen of the organ, at the place of the end to end anatomosis, was patent. Mating of the operated rabbits did not result in either pregnancy or ovulation.

3. We are satisfied with the outcome of this research. We feel confident that the replacemnt of a segment of the uterus by a segment of the intestine can be done. One of the objectives of this work is to study the reproductive potential of a nonreproductive tissue, such as the intestine. Depending upon the result, this approach will permit us further study on the mechanism of implantation in the uterus.

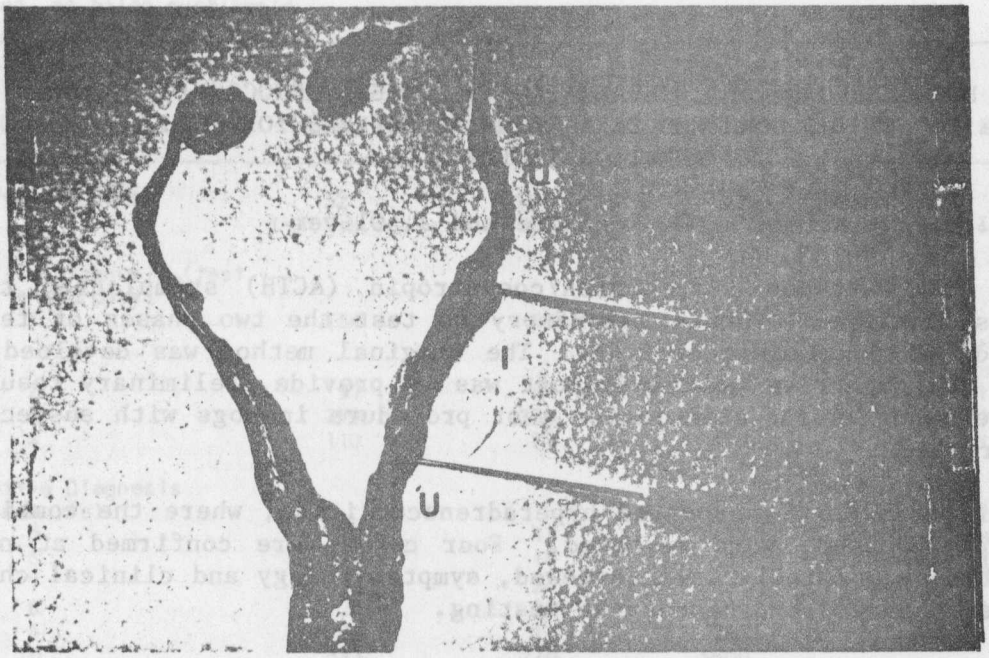


Figure 1. The end to end anatomosis line is shown by the needle tips. The tissue within the two needles is the intestinal segment at two months after transplant. The left one is the control horn.

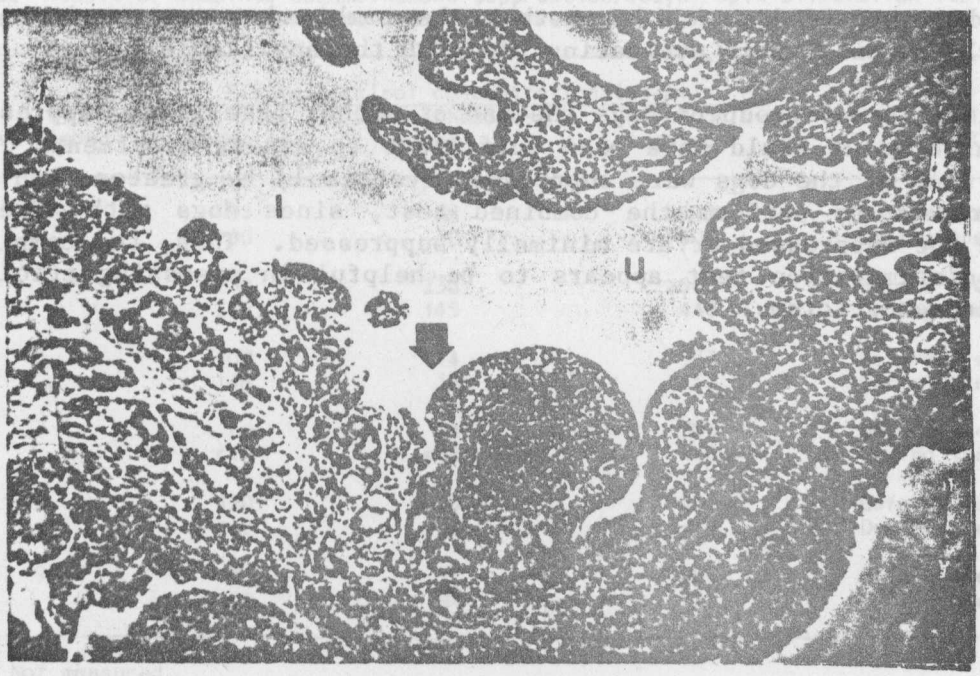


Figure 2. Histological section of the end to end utero (U) intestine (I) anatomosis. The place of anatomosis is shown by the arrow. The endometrium and the intestinal epithelium are relatively normal.

STEROIDAL HORMONE FUNCTIONS. EVALUATION OF HYPERADRENOCORTICISM IN THE DOG BY THE COMBINED DEXAMETHASONE SUPPRESSION/ACTH STIMULATION TESTING

H. Eiler, A. M. Legendre and J. Oliver

The combined dexamethasone suppression/cosyntropin (ACTH) stimulation test procedure, was developed in this laboratory to test the two phases of feedback regulation of cortisol secretion. The original method was develoed in normal dogs. The objective of this report was to provide preliminary results of the combined suppression/stimulation test procedure in dogs with suspected hyperadrenocorticism.

Thirteen clinical cases of suspected hyperadrenocorticism, where the combined test procedure was used, were reviewed. Four cases were confirmed at necropsy, or by biopsy. In all cases reviewed, symptomatology and clinical chemistry supported the result of endocrine testing.

1. Base-line cortisol concentration was high or supranormal in all 13 dogs reported on (Tables 1 and 2).

2. Subnormal suppression with dexamethasone (11-87% of base line) was consistent with supranormal response to test ACTH. Considerable variation occurred between dogs for base-line, suppressed or stimulated cortisolemia.

3. In six dogs, the clinical regimen of mitotane (o'p'-DDD) was followed with the combined test procedure. Review of combined testing results in this group of dogs provided no evidence that the combined test procedure was particularly meaningful in evaluating o'p'-DDD therapy (Table 2).

4. It seems that in our group of dogs the use of either base-line, suppressed or stimulated value would have been sufficient to assess treatment. The fact that some of the dogs were suppressed (cortisol) by greater than 50% provides reason to perform the combined test, since dogs with adrenal tumors are not suppressed or are minimally suppressed. Thus, the combined suppression/stimulation test appears to be helpful in assessing etiology of hyperadrenocorticism.

Table 1. Result of combined dexamethasone suppression/cosyntropin stimulation test in dogs diagnosed as being cushingoid

Case number	Plasma cortisol concentration (ng/ml) Baseline	Dexamethasone-treated	Cosyntropin-treated	Comments
Normal test result[a]	32 (<10 to 58)	ND (<10)	132 (81 - 163)	Mean (range) From Eiler & Oliver[1]
Definitive diagnosis (test result + necropsy)				
1	134	53[b]	537	Chromophobe adenoma-adrenal cortical hyperplasia
2	97	NM	>600	Adrenal cortical hyperplasia
3	259	230	>600	Adrenal cortical hyperplasia
4	110	29	450	Adrenal cortical hyperplasia
Presumptive Diagnosis (test results)				
5	100	13	450	In these cases (5-13), symptomatology and clinical chemistry results supported endocrine testing results
6	102	14	337	
7	60	24	580	
8	120	20	400	
9	50	17	280	
10	343	270	>600	
11	75	51	>600	
12	77	62	380	
13	85	44	360	

[a]Normal test result with conditions and assay in our laboratory.
[b]All dogs under this column suppressed with dexamethasone between 11 and 87% of base line (53 $\pm$ 7.8%, mean $\pm$ SEM).
ND: Non-dectable (<10 ng/ml). NM: Not measured.

Table 2. Result of combined dexamethasone suppression/cosyntropin stimulation test in dogs diagnosed as being cushingoid and undergoing treatment with o'p'-DDD

Case number	Plasma cortisol concentration (ng/ml) Baseline	Dexamethasone-treated	Cosyntropin-treated	Comments
2	97	NM	>600	Before treatment started
	100	40	600	During treatment
3	259	230	>600	Before treatment started
	225	145	440	During treatment
6	102	14	337	Before treatment started
	148	18	152	During treatment
7	60	24	580	Before treatment started
	<10	<10	<10	During treatment
8	120	20	400	Before treatment started
	<10	<10	<10	During treatment
9	50	17	280	Before treatment started
	32	NM	32	During treatment

NM: Not measured.
Notice o'p'-DDD treatment caused moderate fall in the response to ACTH stimulation (dogs 2, 3 and 6), in these dogs both baseline and suppressed values remained supranormal despite o'p'-DDD treatment. o'p'-DDD treatment caused subnormal response to test ACTH (dogs 7-9), baseline and dexamethasone values were also low. Thus, in evaluating o'p'-DDD therapy the combined test provided three different, apparently correlated measurement of cortisolemia.

ACKNOWLEDGMENTS

A. The Animal Science Department would like to thank the following firms or organizations for their support of the programs of the department.

HANNAH SUPPLY CO., Albertville, Alabama, for swine feeding equipment.

INTERNATIONAL MINERAL CORP., Terre Haute, Indiana, for funds in support of reproductive efficiency studies.

CIBA-GEIGY, Asheville, North Carolina, for funds in support of beef research.

JACK DANIEL DIST. CO., Lynchburg, Tennessee, for funds and supplies.

UNITED STATES DEPARTMENT OF AGRICULTURE, for funds in support of research on shipping fever, beef management, breeding and nutrition and hypomagnesemia.

FOOD AND DRUG ADMINISTRATION, HHS Dept., for a grant to support research on iodine in milk and meat.

CHORE TIME EQ., INC., Millford, Indiana, for swine feeding equipment.

B. Thanks to the following firms for providing research supplies.

A. L. Labs, Inc., Englewood Cliffs, New Jersey.
Archer-Daniels-Midlands, Memphis, Tennessee.
Burnett Produce, Morristown, Tennessee.
Calvin Baird Co., Chattanooga, Tennessee.
Central Soya, Chattanooga, Tennessee.
Digussa Corp., Teterboro, New Jersey
Domain Industries, New Richmond, Wisconsin.
Nulabs Div. of Pioneer Hi-Bred International, Inc., Durant, Iowa.
P. H. White, Dyersburg, Tennessee.
Roche Chemical Div., Hoffman LaRoche, Inc., Nutley, New Jersey.
Tennessee Farmers Cooperative, Inc., LaVergne, Tennessee.

C. The following individuals and firms supported our research program by permitting us to use their facilities.

Algood Livestock Auction Co., Algood, Tennessee.
Carl Roger Trucking Co., Livingston, Tennessee.
Lay Packing Co., Knoxville, Tennessee.
Peoples Livestock Sales Barn, Cookeville, Tennessee.

D. Thanks to the following groups for providing services for research.

Tennessee State Department of Agriculture, Nashville, Tennessee.
Tennessee Veterinary Diagnostic Laboratory, Nashville, Tennessee.
Veterans Research Hospital, Nashville.

E. Special thanks goes to the following divisions of the Institute of Agriculture: Agricultural Extension Service, College of Agriculture and College of Veterinary Medicine for cooperation in the research programs.

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.
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   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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