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I am submitting herewith a thesis written by Ernest Lee Moody entitled "Preliminary Studies in Preconditioning Beef Feeder Calves." I recommend that it be accepted in partial fulfillment of the requirements for the degree of Master of Science, with a major in Animal Science.

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PRELIMINARY STUDIES IN PRECONDITIONING BEEF FEEDER CALVES

A Thesis

Presented for the

Master of Science

Degree

The University of Tennessee, Knoxville

Ernest Lee Moody

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ABSTRACT

Three hundred and eighteen weanling steer calves purchased from cooperating Tennessee feeder-calf producers were used in four preliminary trials during 1974-75 and 1975-76 to investigate the use of industry cattle to study factors affecting the general health and performance of feeder calves subject to the stress of normal industry shipment procedures and to compare preconditioning procedures imposed at the farm of origin and at the first point of assembly in the transportation chain. In the first two trials, 80 calves were divided into four treatment groups which were vaccinated for blackleg, malignant edema, leptospirosis, infectious bovine rhinotracheitis, paraenfluenze-3 and pasturella at various times before and during shipment. One control group was not vaccinated and one group was weaned and fed concentrates for 20 days prior to shipping. The calves were shipped direct from the farm of origin to the Middle Tennessee or Highland Rim Experiment Station (180 miles).

Various shipment and preconditioning procedure did not affect the health or subsequent performance of the steers in the feedlot. It was concluded that the effects of preconditioning treatment could not be evaluated unless the calves were exposed to sale-barn environment and to more shipping stress than was involved in these trials. In addition, it appeared that standardization of the concentrate ration fed during the preconditioning period was necessary for satisfactory results.

During 1975-76, 238 calves were subjected to one of the following

treatments (1) Control, not preconditioned and subject to normal industry shipment stress, (2) not preconditioned but fed a high-energy, high-antibiotic ration at the sale barn and/or order buyer assembly barn, (3) preconditioned, weaned 30 days prior to shipping and fed a commercial concentrate ration and (4) not preconditioned but loaded on the trucks near the farm of origin without being subjected to the sale-assembly barn stress. Eighteen calves each were subjected to treatments 1, 2, and 3, assembled at a commercial auction barn, held for 96 hours and shipped 600 miles enroute to the Highland Rim Experiment Station (HRES). Forty-six calves were subjected to each of the four treatments and hauled 1150 miles to a commercial feedlot in Kansas.

Calves weaned and fed at the farm of origin tended to gain faster than those that nursed their dams, without supplemental feed, during the preconditioning period on the farm of origin. In addition, the responses to weaning and feeding on the farm of origin varied in the calves shipped to Kansas. This was due to differences among the ability of the cooperating producers to feed weanling calves and to variation in pasture quality and quantity among farms. These factors resulted in a significant ($P<.01$) farm-by-treatment interaction. It appears that this will be a problem in future studies if true samples of Tennessee beef cattle producers are obtained. Loss of weight during the first 24 hours in the sale barn (auction-sale barn environment) and total loss during the 96 hours (auction-sale and order-buyer assembly barn environment) was less for the cattle fed the high-energy high-antibiotic ration during this period.

However, calves fed the concentrate ration at the assembly barn lost more weight during transit than those fed hay. Gain during the first 3 to 5 weeks in the feedlot was higher, death loss was less, and incidence of clinical respiratory disease was lower for calves fed a concentrate ration, either at the farm of origin or at the first assembly point.

This study suggest that weanling calves purchased from co-operating feeder calf producers 30 days prior to shipment can be used to study shipping stress and factors affecting the incidence of clinical respiratory disease resulting from shipment. However, these calves must be subjected to sale-barn, assembly-barn stress and/or exposed to bacterial or viral source of infection present in these barns if normal shipping problems are to be encountered with the control (not preconditioned and subjected to normal industry shipping procedure) cattle. Although, the number of observations (groups of calves) were not large enough to draw conclusion from this study, some consistent trends were observed in both of the 1975-76 trials. This study suggests also that improvement in the general health and/or feedlot performance may result from providing additional energy to calves for 30 days prior to moving them from the farm of origin or by providing a high-energy, high-antibiotic ration for 3-5 days at the first point of assembly.

Future studies should include evaluation of supplemental energy and medication (feeding antibiotics or immunization against various pathogens) at the farm of origin and at the first assembly point, factors affecting truck stress and factors affecting sale barn stress.

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CHAPTER I

INTRODUCTION

The predominant type of beef cattle operation in Tennessee is the cow-calf operation which derives its primary income from the sale of feeder calves. The beef cow population in Tennessee is approximately 1.3 million head and over three-quarters of a million head of feeder calves are exported annually. Therefore, the production and sale of feeder calves is a vital part of the agricultural economy of the state.

In recent years, the market for Tennessee feeder calves has declined due to a number of factors. One of these is the declining image with respect to susceptability of these calves to shipping fever and the subsequent unsatisfactory performance in the western feedlots. The reasons for this unsatisfactory performance are complex and interrelated, but generally all have a common basis, that of stress. The effects of stress on calves is likewise complex, usually including weakness, sickness, and the accompanying loss of appetite which further complicates the first two symptoms of stress.

Stress is a major component of shipping fever complex (SFC), which is the term most often applied to the reasons for poor performance during the early phase in feedlots. The other two components usually associated with SFC are bacterial and non-bacterial infection. Both of these components would probably be minor or

non-existent without stress, which allows the invasion of micro-organisms.

Several means of preventing SFC have been formulated in recent years. These procedures are generally referred to as Preconditioning Plans and are usually very similar in design. The purpose of preconditioning is to reduce stress on feeder calves, thereby reducing the incidence or severity of SFC. It is considered that preconditioning would make Tennessee feeder calves more acceptable to the western feedlots and this provide a more profitable market to the producers of calves.

The objectives of this study were (1) to investigate the feasibility of studying factors affecting the general health and performance of feeder calves subjected to normal industry shipment procedures and (2) to compare the effects of preconditioning procedures imposed at the farm of origin and and at the first point of assembly.

CHAPTER II

LITERATURE REVIEW

According to Jensen and Mackey (1971) research on Respiratory Disease Complex associated with shipment of feeder calves was sporadic before 1960. Accelerated investigations have been made since that time but most research has been concentrated on specific bacterial or viral aspects of the complex. Numerous reports indicate that failures to reproduce shipping fever with bacterial pathogens led investigators to postulate that other agents were the primary cause of infection. Hoerlein (1973) suggested that the etiology of shipping fever is complex and imperfectly understood. He further suggested that at least one factor from each of three main categories--stress, non-bacterial infection and bacterial infection--is required to produce the syndrome.

Although some surveys and research reports have indicated that preconditioning programs have been ineffective under certain conditions (Meyer et al., 1970 and Knight et al., 1972), it has been reported that preconditioned cattle had less sickness (Bridson, 1972, Woods et al., 1970 and Olson et al., 1973). Specific recommendations with respect to preconditioning practices vary, depending on the geographical location and individual preferences. Most reports indicate a further need for research studies under actual shipping conditions.

I. EFFECT OF MARKETING STRESS

The first stress experienced by feeder calves is that of being weaned. How the calves are handled after weaning, such as the stress

of various marketing systems in which the calves are sold, may contribute to death loss encountered after calves arrive in the feedlot. Norman (1974) reported the effect of three specific marketing systems on subsequent death loss in the feedlot. When death loss among preconditioned calves which were moved direct from the farm to the feedlot was considered to be 100 percent or normal, (1) auction calves short-hauled to a pre-conditioning yard and then long-hauled to the feedlot 30 days later, (2) auction calves long-hauled to a preconditioning yard and then short-hauled to the feedlot 30 days later and (3) auction calves long-hauled directly to the feedlot had 106.2, 466, and 500 percent normal death loss, respectively.

Earlier work, reported by Greathouse et al. (1969), indicated that calves shipped directly from the farm to the feedlot had less shipping shrink than did those shipped indirectly through a feeder-calf sale (3.3 percent vs. 4.9 percent). However, these differences in weight were non-existant 35 days after shipping.

In agreement with the above work, studies by Britt and Henderson (1973) suggested that local calves hauled short distances had less shrink but a higher treatment rate than calves purchased and hauled long-distances. Calves purchased locally were trucked 183 miles 6.5 hr.), those purchased in North Carolina were trucked 983 miles (33 hr.) and Tennessee calves were trucked 662 miles (29 hr.). The number of calves requiring treatment was 33, 18 and 30 percent; and shrink, based on purchase weight, was 5.1, 9.2 and 6.9 percent for the three groups, respectively.

Woods et al. (1973), Hillier (1971), and Norman (1974) suggested

that direct shipment of calves from farm to feedlot would prevent much of the clinical respiratory distress. However, they added that the auction system of marketing feeder calves will be continued for some time due to the large percentage of feeder calves which originate from small herds.

II. EFFECT OF TYPE OF CATTLE

Feedlot death loss increased as the purchase weight of feeder calves decreases according to Norman (1974). Considering calves weighing over 500 pounds to have normal (100 percent) death losses, the comparative losses of calves weighing 451 to 500, 401 to 450, 350 to 400 and under 350 pounds were 180, 316, 238 and 292 percent of normal, respectively. Self (1969) reported a study in which yearling steers and steer calves, purchases by order buyers in seven states, were trucked an average of 600 miles to Iowa feedlots. Purchase weight was 679 and 506 pounds, percent shrink was 9.2 and 9.5 percent, and number of days to regain purchase weight was 16 to 19 days for yearlings and calves, respectively.

III. EFFECT OF EARLY WEANING

It has been shown that early-weaned calves gained faster (31 lb.) than did calves allowed to remain with their dams (6 lb.) during a 29 day preconditioning period (Greathouse et al. 1969). During shipping, the early weaned calves lost more weight (6.3 vs. 1.6 percent), and during the post-weaning period (35 days) the early weaned calves gained less (0.74 vs. 0.98 lb. per day).

However, when the rate of gain during the 64 day pre- and post-weaning period was examined, the early-weaned calves had superior gains (0.89 vs. 0.63 lb./animal/day)..

In studies reported by Woods et al. (1973), it was found that preconditioned (early weaned and vaccinated) calves lost less weight (4.4 vs. 5.7 percent) during shipping than did non-preconditioned calves and fewer (63. vs. 73) required treatment for acute respiratory disease. In the feedlot, the preconditioned calves gained 1.63 lb. per day compared to 1.10 lb. per day for non-preconditioned calves. Earlier reports by Woods et al. (1970) indicated that 5.5 percent of early-weaned calves required treatment for respiratory disease in the feedlot, as compared to 31.1 percent of those calves weaned immediately before shipping.

IV. COST OF EARLY WEANING

During the 29-day preconditioning period mentioned above (Greathouse et al., 1969), supplemental feed cost for the early-weaned calves was $4.26 per head. Woods et al. (1973) reported that the preconditioning cost of calves weaned and vaccinated 3 to 4 weeks prior to shipping was $6.69 per calf. However, calves in the same study which were not preconditioned had clinical treatment costs in the feedlot of $8.44 per head. Meyer et al. (1970) found that the cost of vaccinating preconditioned calves was $1.77 (including labor) and that the feed cost per calf, during a 34 day preconditioning period, was $12.19. When weight loss during the preconditioning period was included, the cost became $14.54 per head or $2.95 per 100 lb. weight.

V. EFFECT OF VACCINATION

Type of Vaccination

Four combinations of immunizing agents were compared in studies conducted by Olson et al. (1973). The five treatments included immunizations for the following: (1) Infectious Bovine Rhinitis (IBR), Parainfluenza--Type 3 (PI3) given intramuscular, and pasturella sp., (2) IBR-PI3 intramuscular, (3) IBR-PI3 intranasal and pasturella sp., (4) IBR-PI3 intranasal, and (5) non-vaccinated controls. In the feedlot, incidence of bovine respiratory disease during the first five weeks was 22, 22, 20, 16 and 20 percent, respectively. During the same period, the average daily gain was 0.17, 0.20, 0.11, 0.42, and 0.06 lb. for the five treatment groups, respectively.

In another study, Knight et al. (1972) reported vaccinated calves (IBR, PI3, pasturella sp., leptospirosis, blackleg and malignant edema) returned $7.61 per head more than non-vaccinated calves during a 192 day feeding period.

Time of Vaccination

Olson et al. (1973) worked with calves which had been weaned two weeks prior to sale and accustomed to eating feed. The calves were divided into three groups as follows: (1) vaccinated on arrival at the feedlot, (2) vaccinated 48 hours after arrival and (3) unvaccinated controls. The subsequent incidence of respiratory disease during the first 36 days was 44, 28, and 28 percent, respectively. For the same period, average daily gain was 0.26, 0.20 and 0.06 lb. for the three groups, respectively.

In another study, Knight et al. (1972) weaned calves three weeks prior to shipping and subjected them to three vaccination programs: (1) vaccinated 3 weeks prior to weaning, (2) vaccinated at weaning, and (3) non-vaccinated control. During the first 45 days in the feedlot, incidence of sickness was 9.6, 20.2 and 16.4 percent, respectively. Death loss was 0, 1.92, and 2.48 percent, respectively. At the end of the feeding trial, the cumulative average daily gain was 2.58, 2.54 and 2.50 lb. for the three groups, respectively.

VI. EFFECT OF RATION

Calves originating in East Texas were fed one of four rations following arrival at the feedlot by Hale et al. (1974): (1) ground alfalfa hay, (2) ground alfalfa hay plus 4 lb. grain per head per day, (3) 50 percent concentrate--50 percent ground alfalfa or (4) 75 percent concentrates--25 percent ground alfalfa hay. Average daily gain during the first 27 days was 1.27, 1.72, 1.55 and 1.46 lb., respectively. Hale and his co-workers concluded that a starting ration for newly received calves should contain some grain. They also concluded that a ration containing 40 to 50 percent concentrate (grain) was as effective as a ration containing 75 percent grain when evaluation was based on daily gain and feed intake. The concentrate level of the ration appeared not to have an effect on the total number of medications required.

Several researchers, Britt and Henderson (1973), Embry (1968), Lynch et al. (1969) and Meyer et al. (1970) have reported satisfactory

dry matter consumption when high quality corn silage was supplemented with protein (NPN or oil meals) and 1 to 4 lb. of grain per day. Other researchers found, however, that they could feed a commercially prepared preconditioning ration successfully (Bridson, 1972; Hillier, 1971; and Roark, 1971).

Research done by Eng (1968) indicated that the basic need of an incoming calf is readily available energy. From this work he suggested the forage level in a preconditioning or starting ration should not be greater than 50 percent. For smaller calves, he suggested that forage levels as low as 30 percent may be advantageous.

In 1969, Klosterman and Johnson fed newly arrived cattle the following four rations: (1) medium quality grass-legume hay, (2) dehydrated alfalfa pellets, (3) corn silage treated with 30 lb. urea or (4) a complete pelleted concentrate ration. Average daily gain during the first 27 days was 0.52, 1.14, 0.84, and 2.12 lb. for the four groups, respectively. The number of cases of shipping fever complex and the number of treatments required was greatest for calves fed corn silage and lowest for those fed the hay ration.

Later, Roark (1971) suggested that in view of the factors favorable for forage production in the Southeast, pre- and post-weaning rations should contain maximum forage consistent with satisfactory gains and health programs.

VII. EFFECTS OF WORMING METHODS

Three weeks prior to marketing, Woods et al. (1973) wormed calves with thiabendazole boluses. At marketing, the wormed calves

had an average of 54 nematode eggs per gram of feces compared to 805 eggs per gram of feces for non-wormed calves.

In work done with injectable tramisol (Taylor et al., 1974), it was found that egg counts (Cooperia-ostertagia-Trichostrongylus and Naemonchus-Oesophagostomum groups) were reduced to zero in each heifer treated. However, egg counts from similar heifers treated with thiobenzole pellets in the feed were higher (30 counts of 0, 1 of 30, 1 of 37, and 1 of 3).

VIII. EFFECT OF RESPIRATORY DISEASE TREATMENT

In a study reported by Olson et al. (1973), calves were treated within 6 to 12 hours following onset of clinical disease with either (1) oral sulfonamide for four consecutive days or (2) oral sulfonamide plus a sustained release oral sulfonamide. Response to treatment was favorable in most cases. There was a resulting decrease of rectal temperature and clinical improvement within 24 hours following the first treatment. Reduction in rectal temperature was similar ($P>0.979$) for the two treatments.

In studying initial therapy for early cases of acute respiratory disease Woods et al. (1972) used a combination consisting of intravenous or intraperitoneal injection of sulfonamides (Sulfamethozine sulfathiazole, sulfapyradine-Norden Laboratories) in conjunction with oral dosage for sustained effect (Sulfamethazine spanbolet-Norden Laboratories). They suggested that early treatment in this method prevented relapses and lung abscessation which commonly occur in cattle with mixed respiratory infection.

IX. SUMMARY

It is generally agreed that direct shipment of calves from farm of origin to the feedlot reduced the incidence of clinical respiratory disease. However, there is evidence to indicate that reduced early gain due to morbidity is overcome by the end of a backgrounding or finishing period. Only limited information is available with respect to cost and return of preconditioning to cow-calf producers. Available information suggests that if feedlot performance, or the total beef cattle industry is considered, preconditioning is advantageous. However, additional data regarding the impact of various stress factors is necessary in order to establish preconditioning systems which are mutually advantageous to the producer and feedlot operators.

CHAPTER III

EXPERIMENTAL PROCEDURES

I. PHASE 1, 1974-75

Source of Calves

Eighty Angus feeder steers ranging in weight from 300-600 pounds were obtained from cooperating Tennessee feeder-calf producers. All calves were still on pasture with their dams and none were receiving creep feed.

Weighing of Calves

All calves were weighed using scales which were located on the farms of the producers or on portable scales which were borrowed from cooperating agencies. At the first weighing on the farm, the calves were randomly assigned to the various preconditioning treatments described in Table 1 and identified with color-coded, numbered eartags.

Vaccination of Calves

The calves were divided by treatments pertaining to time of vaccination and type of vaccination. The various vaccinations used for treatments 2, 3 and 4 were: Blackleg-malignant edema, leptospirosis, infectious bovine rhinotracheitis, parainfluenza-3, and pasturella. (Table 1).

Worming and Internal Parasite Treatment

Calves in Treatments 2, 3 and 4 were wormed by injection of Tramisol (thiabenazole) either 20 days prior to shipping or on the farm immediately prior to shipping. These calves were also treated

Table 1. Description of Treatments Used in 1974-1975 (Phase 1)

	Treatment Number and Abbreviated Name			
	1	2	3	4
	Control	Vac.[1] and wormed day shipped	Vac. and wormed 20 days prior to shipping	Weaned, vac. and wormed and started on feed 20 days prior to shipping
1. Weaned 20 days prior to sale				X
2. Nursed dam last 20 days before sale	X	X	X	
3. Fed preconditioning ration[2] on farm for 20 days before sale				X
4. Vaccinated and wormed day of shipping		X		
5. Vaccinated and wormed 20 days prior to shipping			X	X
6. Not vaccinated or wormed[3]	X			

[1]Vaccination for Blackleg, Malignant edema, leptospirosis, infectious bovine rhinotracteitis, Parainfluenza, pasturella sp. and pafenges.

[2]Feed supplied by farm owners.

[3]All calves had been vaccinated for blackleg and malinant edema earlier.

for grubs by means of a systemic pour-on insecticide (Warbex) on the farm.

Trucking

The calves were trucked directly from the farm of origin to the Middle Tennessee (MTES) or Highland Rim (HRES) experiment stations (Table 2) by a commercial trucking company.

Feedlot Facilities

Finishing facilities at MTES and HRES were utilized for the initial trails. At MTES, the facilities include 16 pens, each having room for five calves. The eight pens at HRES each have a capacity of five calves. Calves were fed corn silage ad lib, 1 lb. csm, 3 lb. of ground shelled corn and 3 lb. mixed grass hay per animal per day during the first 30 days in the finishing lot.

II. PHASE 2, 1975-76

Source of Calves

Feeder steers of mixed breed, both purebred and cross-bred, were obtained from cooperating producers across the state. Castration and dehorning, if necessary, had been done earlier by the producers. All calves were nursing their dams and none were creep-fed. The calves ranged in weight from 350-600 pounds, and averaged approximately 450 pounds.

Weighing and Identification of Calves

On the first farm visit, all steers were weighed and randomly assigned to one of the four treatments shown in Table 3. Weights were taken at various time of day but generally following a period of 3 to 5

Table 2. Number of Animals Per Treatment in Various Experiments

	Year	Station	Treatment 1	2	3	4
1.	1974-1975[1]	HRES	10	10	10	10
2.	1974-1975[1]	MTES	10	10	10	10
3.	1975-1976[2]	HRES	18	18	18	18
4.	1975-1976[2]	Kansas Feedlot	46	46	46	46

[1] Treatments 1974-1975 described in Table 1.

[2] Treatments 1975-1976 described in Table 3.

Table 3. Description of Treatments Used in 1975-76 (Phase 2)

	Treatment Number and Abbreviated Name			
	1 Weaned fed farm	2 Fed sale barn	3 Normal industry	4 Shipped direct
1. Nursed dam last 30 days before sale		X	X	X
2. Weaned 30 days prior to sale	X			
3. Fed preconditioning ration[1] on farm for 30 days prior to sale	X			
4. Fed high-energy, high-antibiotic ration[2] for 4 days at sale barn		X		
5. Fed hay at sale barn/ order-buyer barn	X		X	
6. Shipped direct from farm				X

[1]Ration described in Table 4.

[2]Ration described in Table 5.

hours without feed or water. At this time a color-coded, numbered eartag was installed.

Weaning and Feeding

Also on the initial farm visit, calves which were assigned to the Treatment 1 (weaned and fed 30 days prior to shipping) were weaned and penned and feeding of the ration described in Table 4 was begun. Calves on all farms were fed the concentrate ration free choice plus pasture or hay. Calves in the other groups were allowed to remain with their dams without supplemental feeding.

Management at the Sale Barn

The calves in Treatment groups 2, 3 and 4 were transported to the sale barn by the producers on the morning of sale day. Upon arrival, they were weighed and penned according to treatment. After a period of 8 hours, calves designated to be fed at the sale barn (Treatment 2) were given free choice access to the ration described in Table 5. They were fed this ration for the remainder of the time in the sale barn. Calves in the other treatments received hay after 24 hours and ad libitum thereafter. All calves had access to water after 24 hours (after the 24 hour weight had been obtained). All calves were then held for an additional 72 hours (for a total of 96 hours in the sale barn) after which they were shipped either to HRES or to a commercial feedlot in Kansas. As far as was possible, an attempt was made to simulate normal sale barn routine during the first 24 hours and normal order-buyer assembly barn conditions were simulated during the last 72 hours.

Table 4. Ration Fed on Farm (Treatment 1)

Ingredient	lb/ton
No. 2 yellow corn (steam rolled)	623
Soybean meal (44% CP)	300
Alfalfa meal pellets (17% CP)	100
Cottonseed hulls	840
Molasses	100
Animal fat	20
Trace mineralized salt	10
Limestone	7
Vitamin A (I.U./ton)	2M
Aureomycin (mg/ton)	8000

Table 5. High-Energy, High-Antibiotic Ration Fed at Sale Barn (Treatment 2)

Ingredient	lb/ton
Ground corn	640
Cottonseed hulls	900
Soybean meal	140
Calcium carbonate	14
Dicalcium phosphate	6
Salt	10
Molasses	80
Propylene glycol	100
Vitamin-trace mineral premix	10
Chlortetracycline premix[1]	100

[1]0.5g chlortetracycline per lb. of complete feed.

Trucking

The calves were loaded onto commercial trucks for transport to the respective feedlots, with calves from each treatment being loaded into both top and bottom decks, both in the front and rear sections of the trailers. The calves being shipped to HRES were then hauled for 30 hours or a distance of 600 miles enroute. Calves shipped to the Kansas feedlot were hauled 1150 miles which required about 48 hours.

Management on Arrival

For experiment 2 (in the Kansas feedlot), the calves were subjected to a normal commercial feedlot regime management and were fed a commercial concentrate rations mixed by the feedlot. The calves subjected to each preconditioning treatment were penned together.

Calves at HRES were weighed on arrival; and offered corn silage, one half lb. cottonseed meal, 2 lb. of cracked corn and ground hay ad lib. The following day the calves were weighed, vaccinated and penned. Silage, concentrates, and hay were fed during the subsequent period.

Later Feedlot Management

Calves shipped to Kansas were subjected to the normal feedlot management practiced. Records were maintained on feed consumption, morbidity and mortality. The calves were weighed upon arrival and after 35 and 70 days in the feedlot. Similar records were maintained, on the steers at HRES, with feed consumption, gains, and sickness rates being recorded. Calves which were suspected of respiratory problem were temperatured twice daily and were treated for sickness

on the basis of body temperature (104°F or above) and returned to their respective pens. Sick calves were not isolated from healthy calves.

Statistical Analysis

Least-squares procedures were used to access the effect of preconditioning treatment, farm of origin and interaction between the two variables on the various dependent variables (gain or loss in weight etc.). When the F test indicate a significant effect for a class of effects, mean separation was done using the Student-Newman-Kuel procedure. Since the cattle shipped to the Kansas feedlot were penned by treatment, only one observation was available with respect to all variables except gain during the preconditioning period on the farm of origin. Therefore, no statistical analysis was done for these variables.

CHAPTER IV

RESULTS AND DISCUSSION

I. PHASE 1 (1974-75)

Experiment 1

This experiment involved 40 head of Angus feeder steers, processed on three cooperating farms according to the prescribed treatments shown in Table 1 (p. 13), and fed at the Highland Rim Experiment Station (HRES).

The results of this experiment are shown in Table 6. There were no significant differences due to treatment in any of the parameters reported. The on-the-farm gains tended to be higher for the steers which were weaned and started on feed, and the loss during shipping tended to be greater than the steers which had been allowed to continue nursing. However, it should be noted that the feed used during the preconditioning period was supplied by the farmers from whom the calves were purchased; thus, leading to variation in the quality of feed. Also, no attempt was made to determine how many of the calves which remained with their dams had already been naturally weaned.

With respect to feedlot performance, the steers which had been weaned and fed on the farm gained faster during the first 20 days in the feedlot and from the day of shipping to day 20 in the feedlot, indicating a better state of health after shipping. This tendency toward better performance could probably be explained by the fact that these steers were already trough-broke and accustomed to eating, rather than nursing.

Table 6. Average Performance of Preconditioned Steers at HRES (1974-75)

	Control	Vacc. & wormed day shipped	Vacc. & wormed 20 days prior to shipping	Weaned Vacc. & wormed started feed 20 days prior to shipping
No. of animals	10	10	10	10
Initial wt. on farm of origin (10/2)	477	456	491	468
Wt. shipping day (10/22)[1]	505	490	518	508
Gain (Initial to Shipping)	28	34	27	40
Wt. at station (10/22)[2]	475	460	484	478
Loss during shipping	30	30	34	30
Gain 20 days at station (11/12)	66	63	64	76
Gain shipping at 20 days	36	33	30	46

[1] All calves were shipped from farm to HRES (180 miles).

[2] Calves were weighed immediately after unloading.

Experiment 2

This experiment was done with 40 head purchased and processed on the farms of two cooperating producers, as described for Treatments 1 thru 4 (Table 1, p. 13). The 40 steers bought at the feeder calf sale and the 40 steers which were bought and processed on the farms of the producers were placed in the feedlot at MTES and handled similarly to the steers at HRES previously mentioned. The performance of these steers is shown in Table 7.

The calves which were weaned and fed on the farm gained faster during the on-the-farm period. During shipping, the calves which had been wormed and vaccinated 20 days prior to shipping lost more weight, but they gained more weight during the first 20 days in the feedlot. In view of the fact that this particular group of calves was heavier initially and that the gains from the day of shipping to 20 days in the feedlot were similar, it could be assumed that the type of treatment made no difference. In comparing treated versus non-treated calves however, the non-treated calves lost more weight during shipping, and had lower gains both during the first 20 days at the feedlot and for the period of shipping day to day 20.

One calf at MTES showed mild clinical symptoms of respiratory disease and none of those at HRES showed clinical symptoms. No death loss occurred in either group.

Table 7. Average Performance of Preconditioned Steers at MTES (1974-75)

	Control	Vacc. & wormed day shipped	Vacc. & wormed 20 days prior to shipping	Weaned vacc. & wormed started feed 20 days prior to shipping
No. of animals	10	10	10	10
Initial Wt. on farm of origin (10/12)	475	438	512	470
Wt. shipping day	503	463	540	505
Gain (Initial to Shipping)	28	25	28	35
Wt. at station (10/22)	484	452	514	491
Loss during shipping	19	11	26	14
Gain 20 days at station (11/12)	26	27	41	29
Gain shipping to 20 days	7	16	15	15

II. PHASE 2 (1975-76)

Feeder calves were purchased from 10 cooperating producers in differing areas across Tennessee were processed according to the respective treatments listed in Table 2 (p.15). They were shipped to the Highland Rim Experiment Station (54) or to a commercial feedlot in Kansas (184) where they were fed post-weaning.

Experiment 1

This study involved 54 feeder steers purchased from three cooperating feeder-calf producers. One group of 18 calves were weaned about 28 days prior to shipping and were fed the preconditioning ration plus either hay or pastures. The remaining 36 calves nursed their dam with no creep-feed during this period. The respective groups were processed according to Treatments 1, 2, and 3 described in Table 3 (p. 16). At the end of the 28-day preconditioning period all calves were hauled to an auction barn by the respective producer. The calves were weighed upon arrival and were subjected to normal sale management of a crowded auction barn with about 600 cattle being sold during the sale. One group of 18 calves (Treatment 1) was fed a complete ration (free choice) containing propylene glycol and aureomycin (Table 5, p. 18) after about eight hours in the auction barn. The two groups (treatments 1 and 2) were fed grass hay free choice after about 24 hours in the sale barn. The calves were individually weighed after 24 hours in the auction barn. During the first 24 hours they were subjected to a normal auction barn environment. Following the sale, they were held in the barn for an additional 72 hours under an environment similar

to an order buyers assembly barn. During the last 72 hours the calves had access to water and either the complete concentrate ration or hay. All calves were individually weighed just prior to being loaded on the truck for shipment to HRES.

The parameters measured and the results obtained are listed in Tables 7 and 8. Average initial weight at the farm of origin was similar for all treatments, but average daily gain during the 28-day on-the-farm period was significantly ($P<.20$) higher for the weaned and fed calves (33 lb.) than for the other groups (6 lb.). Calves that were weaned and fed on the farm and the control calves (normal industry management) lost more weight ($P<.05$) during the period at the sale barn, with the control calves losing a similar amount of weight. The calves which received the high-energy, high antibiotic ration at the sale barn lost little weight during the first 24 hours in the sale barn and actually gained weight (7 lb.) during the next 72 hours in the sale barn, while the other two groups continued to lose weight (27 and 37 lb.).

During shipment from the sale barn to HRES, calves which had been fed in the sale barn lost more ($P<.05$) weight (51 lb.) than those subjected to normal industry management (33 lb.) or those weaned and fed on the farm of origin (37 lb.).

From the time of arrival at HRES to day 14 in the feedlot, the weaned and fed calves gained faster ($P<.01$) than the other two groups. A similar trend was evident for the gains from initial weight at the farm of origin to day 14 in the feedlot. However, when the net gains from the sale barn departure to day 14 in the feedlot were evaluated,

Table 8. Average Performance of Preconditioned Steers in 1975-76 at HRES by Treatment, H-433 H-1

	Control	High energy Antibiotic ration S. B.[1]	Preweaned fed 28 days
Number calves	18	18	18
Initial Wt.[2]	422	434	435
Gain Initial Wt.[3] to S. B. (28 days)	-7[b]	-4[b]	33[a]
Loss 24 hr. S. B.	-21[a]	-4[b]	-28[a]
Loss 96 hr. S. B.	-27[b]	7[a]	-37[a]
Loss on truck	-33[b]	-51[a]	-37[b]
Gain 14 day station	60[b]	43[b]	95[a]
Gain initial to 14 days	16[a]	22[a]	60[b]
Gain S. B. to 14 days	23[a]	25[a]	22[a]
No. of animals that died	1	1	0
Temperature (F)	103.7[a]	104.1[a]	103.5[a]

[1]Average daily consumption was 7.0 lb. per animal.

[2]All weights and gains are in pounds.

[3]Treatment means superscripted with different letters are significantly different (P<.05).

no significant difference ($P<.05$) among the treatments were found. This suggested that the higher overall gains of the weaned and fed group was primarily due to better performance during the on-the-farm period. Individual body temperatures taken after about 96 hours in the feedlot were similar ($P<.05$) for the three groups. However, mortality and morbidity values suggested that calves weaned and fed on the farm of origin were healthier upon arrival at the feedlot.

As is shown in Table 8, average initial weights taken at the farm of origin was significantly different among farms. Calves from farm 8 were heavier than those from farm 9. However, other parameters were similar in magnitude. Calves from farm 8 gained faster ($P<.2$) during the first 14 days at the feedlot than those from farm 9. Calves from farm 7 tended to gain faster from initial weight at the farm of origin to day 14 in the feedlot and from out weight at the sale barn to day 14 but these differences were not significant.

Experiment 2

For this study, 184 steer claves were purchased from seven cooperating feeder calf producers across the state. They were processed according to the four treatments listed in Table 2 (p. 15), assembled at a commercial auction barn and shipped to a cooperating commercial feedlot at Oberlin, Kansas. Forty-six calves were subjected to each of the farm of origin and sale barn management procedures described for Treatments 1, 2, and 3 in Experiment 1. A fourth group of 46 calves were shipped direct from the farm of origin without exposure to the sale barn environment. The parameters measured and results obtained are listed in Table 9.

Table 9. Average Performance of Preconditioned Steers in 1975-1976 By Farm of Origin (HRES)

	Farm #		
	7	8	9
Number calves	26	16	13
Initial weight[1]	406	468	432
Gain[2] initial wt. to S. B. (ADG)	12 (.42)	2 (.08)	4 (.14)
Loss 24 hr. at S. B.	-16	-20	-18
Loss 96 hr. at S. B.	-20	-16	-20
Loss on truck	-33	-46	-45
Gain 14 day at station	66	84	43
Gain initial to 14 days	45	24	16
Gain S. B. to 14 days	30	22	12
No. of calves that died	1	0	1
Temperature (F)	103.8	103.8	103.6

[1] All weights and gain are in pounds.

[2] Gain calculated on 28 day basis.

Calves weaned and fed on the farm of origin gained an average of 39 pounds, above shrink which occurred between the farm of origin and the sale barn, during the 30 day preconditioning period compared to 27 pounds for those not weaned and fed (Table 10). However, there were significant differences among farms for this trait. Average daily gain by Farm-Treatment subgroups are shown in Table 11. Analysis of this parameter presented in Table 12 shows a significant treatment by farm interaction ($P<.01$). This interaction was due to the fact that gains of calves in all treatments were similar on farms 1 and 6, but on Farm 7 calves which were not weaned and fed gained faster than those which were weaned and fed. This effect is shown in Figure 1, where for the sake of simplicity, only interactions between Treatment 1 and 2 and Farms 1, 3, 4, and 7 are shown. This interaction was anticipated based on the experience of the various producers with respect to feeding beef calves and because of differences in pasture quality and management practices on the various farms. On Farm 4 pasture quality and quantity were high while on Farm 3 pasture quality and quantity was low. In addition, calves fed at Farm 7 were self-fed and several cases of digestive problems occurred. It appears that this will be a problem in future studies if true samples of Tennessee beef cattle producers are obtained.

After arrival at the sale barn, calves were penned by treatment groups and individual weights were not obtained. Therefore, the remainder of the parameters to be discussed were only pen averages and could not be subjected to statistical analysis since only one observation per treatment was available.

Table 10. Average Performance of Preconditioned Steers Shipped To Kansas 1975-1976

	Normal Industry	Fed sale barn	Weaned Fed farm	Shipped direct
No. of animals	46	46	46	46
Weight at sale barn, lb.	471[a1]	466[a]	478[b2]	--
Gain farm to sale barn, lb.	26	27	39	--
Loss 24 hr. sale barn, lb.	-31	-20[3]	-31	--
Total loss sale barn, lb.	-17	-10	-15	--
Weight shipped (11/8), lb.	454	456	463	495
Initial weight feedlot (11/10), lb.	419	407	430	453
	(7.7)[4]	(10.8)	(7.1)	(9.3)
Loss on truck, lb.	35	49	33	42
Total loss sale barn and truck, lb.	52	59	48	42
Weight 12/15/75 (35 day), lb.	505	527	506	509
Weight 1/19/75 (70 day), lb.	624	640	619	620
Death loss (70 day) (%)	5	3	2	8
	(10.9)	(6.5)	(4.3)	(17.4)
Number of calves treated (70 day)	11	10	10	17
Number treatments per calf	4	3	4	5
Vet. med. cost (35 day), $	$65.68	36.78	43.20	68.59
Feed/animal/day 1st 28 days, lb.	14.4	14.2	14.8	15.0
A.D.G. 1st 35 days				
A.D.C. 1st 70 days	2.9	3.3	2.7	2.4

[1]Treatment means superscripted with different letters are significantly different (P<.05).

[2]Calves consumed an average of 9.3 lb. of the preconditioning ration per day for 30 days.

[3]Calves consumed an average or 7.3 lb. of the high-energy, high-antibiotic ration per day during the four days in the Sale Barn.

[4]Percent shrink is listed in parentheses.

[5]Percent death loss.

Table 11. Average Daily Gain of Calves by Farm-Treatment Subclasses from Initial Weight at Farm to Initial Weight at the Sale Barn (1975-76)

Farm	Treatment 1	Treatment 2	Treatment 3	Treatment 3	Ave.[1] daily Feed Con./calf.
1	0.56	0.48	0.66	1.01	7.9
3	-.30	0.48	1.49	1.31	13.1
4	1.87	1.48	2.98	2.24	8.7
5	-.12	0.46	1.48	0.88	8.3
6	0.96	0.96	0.62	0.62	9.0
7	1.28	1.45	0.74	1.92	9.0
8	2.31	1.98	1.94		

[1] Overall average was 9.3 lb. per calf per day.

Table 12. Analysis of Variance of Gain During the Preconditioning Period for Calves Shipped to Kansas (1975-1976)

Source	df	Mean Squares
TMT	2	3.04**
Farm	5	8.38**
TMT & Farm	10	1.88**
Error	91	0.43

**(P<.01)

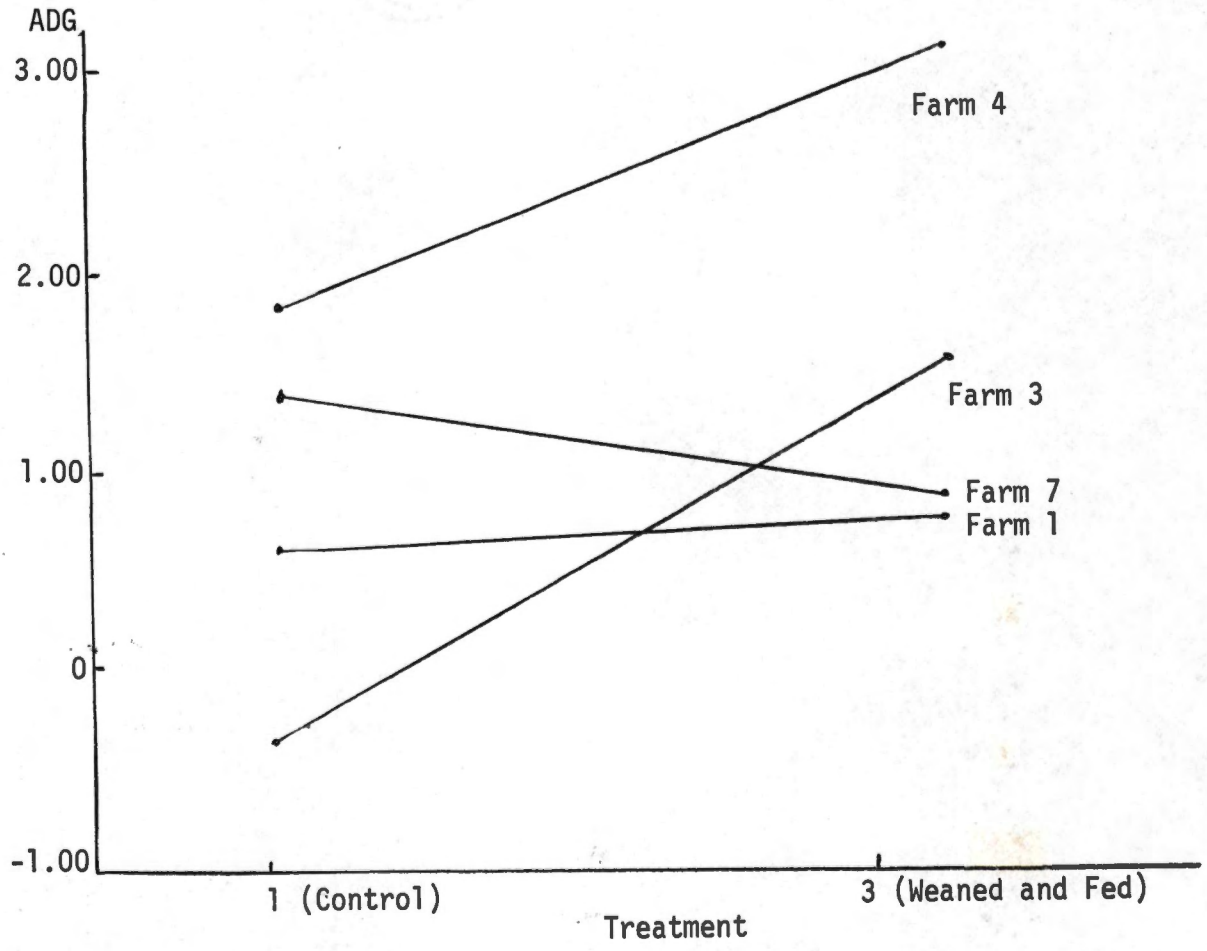


Figure 1. Farm-by-treatment interaction with respect to gain during the 30-day preconditioning period in 1975-76.

Calves which were fed the high energy, high antibiotic ration (seven pounds per animal per day), at the sale barn lost less weight (20 lb.) during the first 24 hours in the sale barn than the other groups (31 lb.) and gained weight (7 lb.) during the following 72 hours at the sale barn. Thus, the total loss in the sale barn was less for calves fed the high-energy, high antibiotic ration than the other groups. The weaned and fed calves lost a similar amount to the control calves.

On the day of shipping, the calves which were shipped direct from the farm were heavier than the calves held 96 hours in the sale barn since they had not been exposed to stress associated with the sale barn. The three groups which had been exposed to the sale barn had similar average weights at the end of the 96 hour period.

Calves in Treatment 4 (shipped direct) were assembled at several points near the various farms on the morning they were shipped. The calves were weighed individually and loaded on the trailers. Calves from this group were loaded on both decks of each truck and the loading of each deck was completed by including calves from each of the three treatments at the sale barn. Therefore, calves designated as shipped direct were exposed to other calves during the 48 hours in transit but were not exposed to the 96 hour sale barn stress.

After 35 days in the feedlot, calves which had been fed the high-energy, high antibiotic ration in the sale barn were about 20 pounds heavier than the other three groups, which had similar weights (505 to 509 pounds). The same trend with respect to weight was also observed after 70 days in the feedlot.

Calves were loaded on two trucks (92 calves per truck) and, in order to minimize differences in truck environment, the trucks traveled together. One truck had mechanical problems about 250 miles from the feedlot. After attempts at repair failed, one truck delivered its load to the feedlot and returned for the other load which had been unloaded at a sale barn in Oklahoma. Therefore, time of arrival at the feedlot of the two loads differed by about 10 hours. All calves were held over-night in the feedlot before the initial feedlot weight was taken. The length of time in transit (average of about 48 hours) and the fact that blizzards occurred on three consecutive days after the calves had been in the feedlot for about two weeks may have increased the degree of morbidity and mortality and perhaps reduced the rate of gain. However, calves in all treatments were equally subjected to these extra stresses, except calves in Treatment three were scattered less than the other groups during the third blizzard, and no adjustment was made for these stresses. Only calves with temperatures of over 104°F and diagnosed as having pneumonia were included in the morbidity values but most initial medical treatments occurred prior to the blizzards.

Death loss during the first 70 days in the feedlot was the highest for the calves which had been shipped direct from the farm (17 percent). The second highest death loss was in the normal industry management group (11 percent), and the death loss for the calves which had been fed either on the farm or at the sale barn was similar (4 percent and 6 percent, respectively).

The number of calves requiring treatment for respiratory

disease was higher in calves shipped direct (17) than in the control (11), those fed at the sale barn (10) and those weaned on the farm of origin (10). The average number of treatments required per calf was 5, 4, 3 and 4 for the four groups, respectively.

The veterinary medical costs for the calves at the feedlot during the first 35 days were highest for the calves which had been shipped direct from the farm ($68.59), with the normal calves being a close second ($65.68). The medical costs for the calves which had been fed in the sale barn were lowest ($36.78), and the costs for the group which had been fed on the farm were intermediate ($43.20). The feed per-animal-per-day was similar for all groups during the first 28 days in the feedlot. The ADG for the first 35 days in the feedlot was highest for the group which were fed in the sale barn (3.43 lb.) compared to 2.46 lb. for the normal industry group, 2.17 lb. for the weaned and fed group, and 1.60 lb. for the group which was shipped direct. The 70 day ADG showed a similar ranking. The calves which were fed in the sale barn were highest (3.3 lb.). Average daily gain for the normal industry group was 3.3 lb., 2.7 lb. for the weaned and fed groups and 2.9 lb. for the group which was shipped direct.

CHAPTER V

SUMMARY

Three hundred and eighteen weanling steer calves purchased from cooperating Tennessee feeder-calf producers were used in four preliminary trials during 1974-75 and 1975-76 to investigate the use of industry cattle to study factors affecting the general health and performance of feeder calves subject to the stress of normal industry shipment procedures and to compare preconditioning procedures imposed at the farm of origin and at the first point of assembly in the transportation chain. In the first two trials, 80 calves were divided into four treatment groups which were vaccinated for blackleg, malignant edema, leptospirosis, infectious bovine rhinotracheitis, paraenfluenze-3 and pasturella at various times before and during shipment. One control group was not vaccinated and one group was weaned and fed concentrates for 20 days prior to shipping. The calves were shipped direct from the farm of origin to the Middle Tennessee or Highland Rim Experiment Station (180 miles).

Various shipment and preconditioning procedure did not effect the health or subsequent performance of the steers in the feedlot. It was concluded that the effect of preconditioning treatment could not be evaluated unless the calves were exposed to sale-barn environment and to more shipping stress than was involved in these trials. In addition, it appeared that standardization of the concentrate ration fed during the preconditioning period was necessary for satisfactory results.

During 1975-76, 238 calves were subjected to one of the following treatments: (1) Control, not preconditioned and subject to normal industry shipment stress, (2) not preconditioned but fed a high-energy, high-antibiotic ration at the sale barn and/or order buyer assembly barn, (3) preconditioned, weaned 30 days prior to shipping and fed a commercial concentrate ration and (4) not preconditioned but loaded on the trucks near the farm of origin without being subjected to the sale-assembly barn stress. Eighteen calves each were subjected to treatments 1, 2, and 3, assembled at a commercial auction barn, held for 96 hours and shipped 600 miles enroute to the Highland Rim Experiment Station (HRES). Forty-six calves were subjected to each of the four treatments and hauled 1150 miles to a commercial feedlot in Kansas.

Calves weaned and fed at the farm of origin tended to gain faster than those that nursed their dams, without supplemental feed, during the preconditioning period on the farm of origin. In addition, the responses to weaning and feeding on the farm of origin varied in the calves shipped to Kansas. This was due to differences among the ability of the cooperating producers to feed weanling calves and to variation in pasture quality and quantity among farms. These factors resulted in a significant ($P<.01$) farm-by-treatment interaction. It appears that this will be a problem in future studies if true samples of Tennessee beef cattle producers are obtained. Loss of weight during the first 24 hours in the sale barn (auction-sale environment) and total loss during the 96 hours (auction-sale and order-buyer assembly barn environment) was less for the cattle fed the

high-energy high-antibiotic ration during this period. However, calves fed the concentrate ration at the assembly barn lost more weight during transit than those fed hay. Gain during the first 3 to 5 weeks in the feedlot was higher, death loss was less, and incidence of clinical respiratory disease was lower for calves fed a concentrate ration, either at the farm of origin or at the first assembly point.

This study suggests that weanling calves purchased from cooperating feeder calf producers 30 days prior to shipment can be used to study shipping stress and factors affecting the incidence of clinical respiratory disease resulting from shipment. However, these calves must be subjected to sale-barn assembly-barn stress and/or exposed to bacterial or viral source of infection present in these barns if normal shipping problems are to be encountered with the control (not preconditioned and subjected to normal industry shipping procedure) cattle. Although, the number of observations (groups of calves) was not large enough to draw conclusions from this study, some consistent trends were observed in both of the 1975-76 trials. This study suggests also that improvement in the general health and/or feedlot performance may result from providing additional energy to calves for 30 days prior to moving from the farm of origin or by providing a high-energy, high-antibiotic ration for 3-5 days at the first point of assembly.

Future studies should include evaluation of supplemental energy and medication (feeding antibiotics or immunization against various pathogens) at the farm of origin and at the first assembly point, factors affecting truck stress and factors affecting sale barn stress.

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