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The Response of Male Zebu Calves To Creep Feeding, Castration, Diethylstilbestrol and Supplemental Feeding on Pasture

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Response of male Zebu calves to creep feeding...

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THE RESPONSE OF MALE ZEBU CALVES TO CREEP FEEDING, CASTRATION, DIETHYLSTILBESTROL AND SUPPLEMENTAL FEEDING ON PASTURE

L. Quinn[1], G. O. Mott[2], W. V. A. Bisschoff[3] and G. Leme da Rocha[4]

Summary

Supplements were fed to male Zebu calves grazing Colonial Guinea grass pastures during pre- and post-weaning periods, to determine their effect upon animal performance and carcass characteristics. The effect of castration and implantation of diethylstilbestrol was also studied.

The rate of gain during the pre-weaning period and post-weaning winter period was increased by the supplements when fed at two kilograms per animal per day. A high-protein supplement was superior to a low-protein supplement during the winter-dry season when the pasture was of poor quality, but this advantage disappeared during the following summer season. During the total period of 370 days, the calves receiving the supplements weighed an average of over 30 kilograms more than animals receiving no supplement.

Castration reduced the rate of gain by 56 grams per animal per day and stilbestrol increased the rate of gain by 60 grams per animal per day, so that the response to stilbestrol was equal to the detrimental effects of castration.

With respect to carcass characteristics, the supplements increased the dressing percentage and the size of the rib-eye area but had no effect upon the percentage of kidney fat or thickness of surface fat. The steer carcasses

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had a higher percentage of kidney fat, a greater thickness of surface fat, but a smaller rib-eye area than the corresponding bull carcasses. The implantation of stilbestrol appeared to have no effect upon these characteristics, although it did increase the dressing percentage.

Introduction

The beef industry of South Central Brazil has as its foundation the Zebu animal, *Bos indicus*, of which there are several breeds, and the utilization of pasture forage as the only source of feed. In general, the animals exist under a very low level of nutrition, and cattle used for beef are frequently not slaughtered until they are four to six years of age. Even though Brazil is the second-ranking producer of beef in the world, with a cattle population exceeding 79 million head in 1963, only about 7,000,000 head of cattle are slaughtered each year. The relatively small proportion of the cattle killed each year is due to the advanced age of the animals, which is a consequence of the low level of nutrition and relatively slow rate of gain. In the past 20 to 30 years, the Zebu animal has become the dominant species in the American tropics. The principal reason for the Zebu's popularity is their resistance to parasites and infectious diseases together with their ability to thrive in warm climates.

The peak period for the weaning of calves of the Zebu breeds in Central Brazil is during the months of May-June, which is at the end of the wet summer season and the beginning of the dry winter season. At this time, the calf is not only subjected to the shock of weaning, but the males are also castrated and turned to pasture just when the quality and quantity of pasture forage are diminishing. The purpose of this research was to determine the influence of creep feeding of the suckling calf, starting about two months prior to weaning, and then continuing with supplemental feeding on pasture until the animals approached slaughter condition and weight. In addition to the different feeding regimes, the influence of castration and diethylstilbestrol upon animal performance was also studied.

Experimental Methods

This trial was carried out on Fazenda Jangada in the Araçatuba district in the state of São Paulo. In this region of Brazil, there is a six to seven months' warm, wet season, generally from October to April, followed by five to six months of cool, dry weather approximately from May to September. The rainfall records for the period during which this experiment was conducted are presented graphically in Figure 1. The rainfall during the June, July and August period of 1962 was negligible, and the rains did not begin until late September. The temperature records for the period of the experiment are given in Table 1.

The experiment was located at an elevation of about 1200 ft. The soils are classified as *Bauru superior*, sandy loam, with a soil reaction of pH 6.0.

The Experimental Pastures

Pastures of 20 to 26 ha. each were laid out in an area of very uniform Colonial Guinea grass (*Panicum maximum* Jacq.) pastures which were established about 14 years ago. Two pastures (field replications) were allotted to each of the four feeding regimes (see Table 2) in this

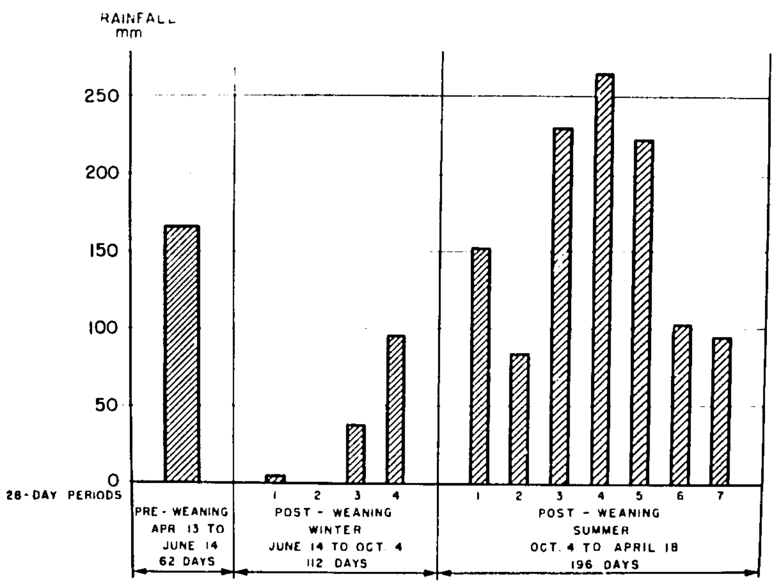

Figure 1. Rainfall by periods corresponding to weighing times of cattle.

TABLE 1. Average maximum and minimum temperature readings corresponding to animal weigh periods.

Period	Days	Daily averages		
		Max.	Min.	Av.
	number	°C	°C	°C
Pre-weaning				
April 13 – June 14, 1962	62	26.1	14.3	20.2
Post-weaning—Winter season				
June 14 – July 12, 1962	28	24.3	10.5	17.4
July 12 – Aug. 9, 1962	28	26.0*	12.4*	19.2*
Aug. 9 – Sept. 6, 1962	28	28.3	14.5	21.4
Sept. 6 – Oct. 4, 1962	28	29.9	17.7	23.8
Post-weaning—Summer season				
Oct. 4 – Nov. 1, 1962	28	27.2	16.9	22.1
Nov. 1 – Nov. 29, 1962	28	30.6	18.7	24.7
Nov. 29 – Dec. 27, 1962	28	30.4	20.6	25.5
Dec. 27, 1962 – Jan. 24, 1963	28	30.5	21.7	26.1
Jan. 24 – Feb. 21, 1963	28	31.3	21.1	26.2
Feb. 21 – Mar. 21, 1963	28	32.6	21.6	27.1
Mar. 21 – Apr. 18, 1963	28	30.7	19.0	24.9

*Average of 27 days.

trial, thus providing 40 to 50 ha. per treatment. No fertilizer or other type of treatment was applied to the pasture, since all the variables in the experiment pertained to the animals.

The carrying capacity of all pastures was sufficient for the number of animals indicated in Table 2 during both the wet and dry seasons. Additional animals were used to maintain the grazing pressure near optimum during periods when forage was in excess of that needed by the tester animals. The extra animals were used only to keep the pastures in an optimum grazing condition, and the data reported herein are for only the tester animals.

The Experimental Animals

A large number of Zebu cows and calves of the Nellore breed were made available by Fazenda Jangada, from which a very uniform group of cows, with a single male calf at their side, was selected for the experiment (see Figure 2). The calves were all born during the months of September and October 1961 and were six to seven months of age at the start of the experiment on April 13, 1962. About one-half of the total number of calves in each pasture received an implant of 24 mg. diethylstilbestrol on April 13 and another 24 mg. on November 1. The calves were weaned on June 14, at which time about one-half of the calves within the implanted and unimplanted groups within each pasture were castrated, leaving the remainder uncastrated.

The cattle were weighed at the beginning and end of the 62-day pre-weaning period and then at 28-day intervals after the calves were weaned. On each weigh date after weaning, the calves were weighed after an overnight fast. Water was always available in each pasture, and a complete mineral mix containing salt and trace minerals was fed free choice. The composition of the mix was as follows. In 100 kg. of mineral mix:

59.54 kg. common salt
40 kg. bone meal
200 gm. copper sulphate
200 gm. iron sulphate
60 gm. cobalt sulphate

Although only about one-fourth of the animals were considered ready for slaughter on April 18, 1963, five animals from each of the 16 treatment groups—80 animals in total—were selected for slaughter, which represented a little less than one-half the tester animals (see Table 2). These animals continued on their respective treatments for an additional 15 days beyond the termination date, when they were walked 36 miles to the slaughterhouse. They were slaughtered on May 8, and slaughter and carcass data were obtained.

The Supplemental Feeds

The supplements fed consisted of mixtures of corn-and-cob meal and a protein source of either peanut meal or cottonseed meal. The composition of the feeds and the

TABLE 2. Schematic plan of treatments: Supplemental feeding on pasture, Fazenda Jangada, April 13, 1962 to April 18, 1963.

Treat-ment No.	Between-pasture variables — Feeding treatments (daily ration/head): Pre-weaning April 13 to June 14, 1962 62 days	Post-weaning June 14, 1962 to April 18, 1963 308 days	Within-pasture variables: DES per calf	Castrated	No. of tester calves
	Calves not creep fed				
1	Pasture only	Pasture only	48 mg.°	yes°°	11
				no	12
			none	yes°°	10
				no	11
2	Pasture only	Pasture +1760 gm. c.c.m. + 480 gm. c.s.m.	48 mg.°	yes°°	10
				no	11
			none	yes°°	10
				no	11
	Calves creep fed				
3	Pasture +2050 gm. c.c.m. + 185 gm. p.m.	Pasture +2005 gm. c.c.m. + 240 gm. c.s.m.	48 mg.°	yes°°	12
				no	11
			none	yes°°	11
				no	13
4	Pasture +1850 gm. c.c.m. + 375 gm. p.m.	Pasture +1760 gm. c.c.m. + 480 gm. c.s.m.	48 mg.°	yes°°	10
				no	11
			none	yes°°	10
				no	11

° 24 mg. stilbestrol implanted on April 13, 1962 plus a second implant of 24 mg. November 1, 1962.

°° Castration effected at weaning, June 14, 1962.

Abbreviations: c.c.m. = corn-and-cob meal; p.m. = peanut meal; c.s.m. = cottonseed meal.

amounts fed are tabulated in Table 3. The change from peanut meal to cottonseed meal at weaning time was made solely on the basis of availability of the oil meals. All rations were fed on an equal T.D.N. basis. The low-protein ration contained about 9% and the high-protein ration 12.4% of digestible protein.

During the pre-weaning period, the calves were creep fed and the method used is illustrated in Figure 2.

Figure 2. Calves feeding within creep during pre-weaning period. Note cows on outside of creep.

TABLE 3. Composition of supplements fed and the estimated daily T.D.N. and digestible protein consumption.

Ration	Fed per animal per day				
	Total feed	T.D.N.		Dig. Prot.	
	grams	%	grams	%	grams
Low-protein, pre-weaning					
Corn-and-cob meal	2050	73.2	1501	5.4	111
Peanut meal	185	77.3	143	47.6	88
Total	2235		1644		199
Low-protein, post-weaning					
Corn-and-cob meal	2005	73.2	1468	5.4	108
Cottonseed meal	240	75.1	180	37.4	90
Total	2245		1648		198
High-protein, pre-weaning					
Corn-and-cob meal	1850	73.2	1354	5.4	100
Peanut meal	375	77.3	290	47.6	178
Total	2225		1644		278
High-protein, post-weaning					
Corn-and-cob meal	1769	73.2	1288	5.4	95
Cottonseed meal	480	75.1	360	37.4	180
Total	2249		1648		275

Results and Discussion

Since the experiment covered three distinct phases, namely the pre-weaning, the post-weaning winter-dry season and the post-weaning summer-wet season, the results will be discussed for each of these periods as well as combinations of successive periods. Below is a key to the table numbers 4 through 10 indicating the periods for which the results are tabulated. After the pre-weaning period, the results obtained for each of the two successive post-weaning periods were influenced not only by the prevailing treatments, but also by the previous treatments.

Key to table numbers indicating periods for which results are tabulated

Table No.	Pre-weaning period	Post-weaning period	
		Winter-dry season	Summer-wet season
	April 13, 1962 – June 14, 1962	June 14, 1962 – October 4, 1962	October 4, 1962 – April 18, 1963
4	62 days	112 days	196 days
5	62 days		
6		112 days	
7	174 days		
8			196 days
9		308 days	
10	370 days		

In Brazil, the most common practice is to castrate the male calves at weaning time and not to use diethylstilbestrol. For this reason, in this experiment, the animals which meet this description, namely castrated males not treated with diethylstilbestrol and grazed on pasture alone without any supplemental feeding, will be considered the control animals during the post-weaning periods. In Table 4 are given the average initial weights followed by the final weights for the successive periods. The gain per animal, together with the increase over the control treatment, is also given for each of the combined successive periods.

The influence of the supplements upon the accumulated liveweight gain per animal is illustrated in Figure 3.

Pre-weaning Period

Since treatments 1 and 2 during the pre-weaning period did not receive any creep feed, the average gain of the two groups of nonimplanted animals is considered the control gain for that period. Both the low- and the high-protein supplement were about equally effective in increasing the rate of gain during the 62-day pre-weaning

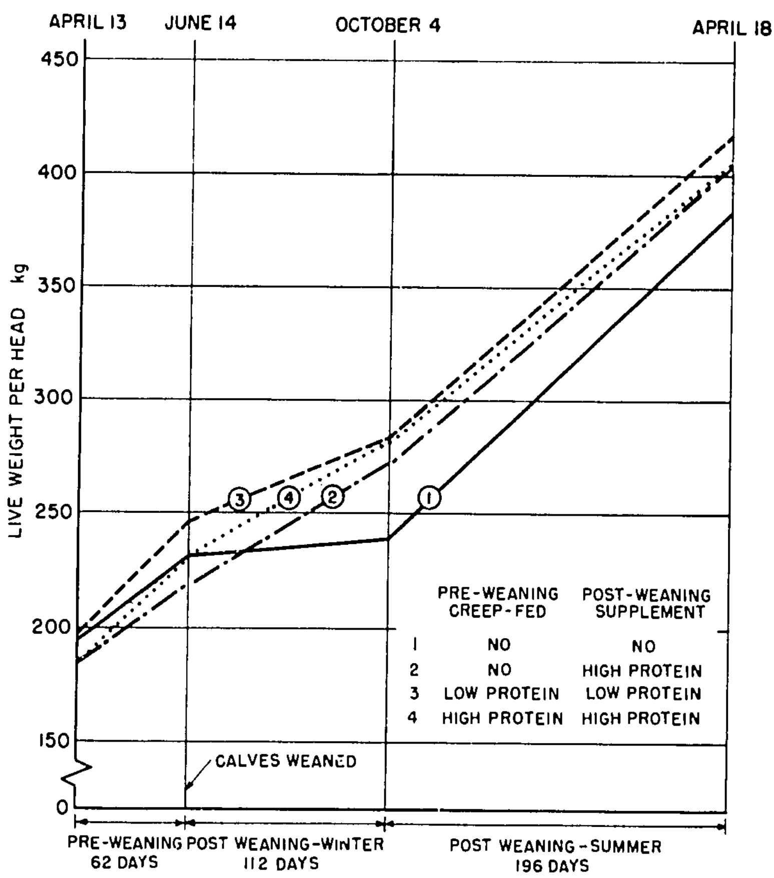

Figure 3. Influence of supplementation upon gain in liveweight.

TABLE 4. Animal responses to creep and supplemental feeding on pasture and to diethylstilbestrol and castration, April 13, 1962 to April 18, 1963 — 370 days.

Treatment No.	Treatment variables (2 reps.): Between pasture: Pre-weaning creep fed	Between pasture: Post-weaning supplement	Within pasture: DES°	Within pasture: Castrated°°	Tester animals	Pre-weaning, April 13 to June 14, 1962 – 62 days: Av. initial weight	Av. final weight	Gain/animal	Inc. over control (32.4 kg)	Post-weaning, Winter, June 14–Oct. 4, '62 – 112 days: Av. final weight	Gain/animal	174-day accumulated: Gain/animal	Inc. over control	Post-weaning, Summer, Oct. 4, '62–Apr. 18 '63 – 196 days: Av. final weight	Gain/animal	370-day accumulated: Gain/animal	Inc. over control
					number	kg	kg	kg	kg	kg	kg	kg	kg	kg	kg	kg	kg
1	No	No	Yes	Yes	11	192.6	233.6	41.0	8.6	245.6	10.8	51.8	16.1	395.8	150.2	202.0	41.6
			Yes	No	12					244.3	11.8	52.8	17.1	393.0	148.7	201.5	41.1
			No	Yes	10	198.1	232.0	33.9	—	232.5	1.8	**35.7**	—	357.2	124.7	**160.4**	—
			No	No	11					242.1	9.0	42.9	7.2	383.6	141.5	184.4	24.0
2	No	H.P.	Yes	Yes	10	182.2	220.3	38.1	5.7	273.0	51.1	89.2	53.5	410.4	137.4	226.6	66.2
			Yes	No	11					276.2	57.3	95.4	59.7	413.0	136.8	232.2	71.8
			No	Yes	10	186.3	217.3	**31.0**	—	256.6	39.0	70.0	34.3	382.4	125.8	195.8	35.4
			No	No	11					270.5	53.5	84.5	48.8	410.9	140.4	224.9	64.5
3	L.P.	L.P.	Yes	Yes	12	199.6	248.6	49.0	16.6	283.1	36.5	85.5	49.8	414.4	131.3	216.8	56.4
			Yes	No	11					295.6	44.8	93.8	58.1	446.0	150.4	244.2	83.8
			No	Yes	11	195.5	243.9	48.4	16.0	270.1	25.7	74.1	38.4	389.7	119.6	193.7	33.3
			No	No	13					282.0	38.5	86.9	51.2	419.0	137.0	223.9	63.5
4	H.P.	H.P.	Yes	Yes	10	183.9	235.9	52.0	19.6	289.2	49.8	101.8	66.1	411.8	122.6	224.4	64.0
			Yes	No	11					284.1	51.4	103.4	67.7	417.3	132.2	236.6	76.2
			No	Yes	10	184.6	228.6	44.0	11.6	267.1	37.7	81.7	46.0	378.8	111.7	193.4	33.0
			No	No	11					284.4	56.5	100.5	64.8	415.9	131.5	232.0	71.6

° Stilbestrol implanted; 24 mg. April 13, 1962 and 24 mg. November 1, 1962.
°° Castration effected at weaning, June 14, 1962.
NOTE: Control gains in **boldface** type.

period (Table 5). The increase was about 200 gm. per animal per day, which represents a 34% increase over the control. The implantation of stilbestrol also increased the rate of gain 92 gm. per animal per day, although the calves were only 6 to 8 months of age.

Post-weaning Winter Season

The results for the post-weaning winter season of 112 days are given in Table 6. Since the quality of the forage decreases markedly during the dry season, the effectiveness of the supplements was very evident. Where no supplement was fed, the rate of gain was only 74 gm. per day, the low-protein supplement increased the rate of gain by 177 gm. per day and the high-protein supplement by nearly 290 gm. per day.

TABLE 5. The influence of creep feeding and diethylstilbestrol implants upon the daily gains of suckling calves, pre-weaning period April 13 to June 14, 1962 – 62 days.

Treatment		With stilbestrol (24 mg.)°		Without stilbestrol		Av. for feeding treatments	
No.	Pre-weaning creep fed	Av. daily gain	Inc. for creep	Av. daily gain	Inc. for creep	Av. daily gain	Inc. for creep
		gm.	gm.	gm.	gm.	gm.	gm.
1	No	661 } 638	—	547 } 523	—	604 } 581	—
2	No	615 }		500 }		558 }	
3	L.P.	790	152	781	258	786	205
4	H.P.	839	201	710	187	774	193
Average		726		634			
Increase for DES			92		—		

Significant differences from analysis of variance, using David B. Duncan's multiple range test for 5% levels:

Treatments

1 2 3 4

NOTE: Any two treatments not underscored by the same line are significantly different. Any two underscored by the same line are not significantly different.

Probabilities (P): Treatments $P<0.05$

Stillbestrol $.005<P<0.01$

C.V. = 19%

° Implanted April 13, 1962.

NOTE: Control gains in **boldface** type.

The response to diethylstilbestrol was quite different when implanted on castrated and uncastrated male calves, indicating an interaction of these two factors. Stilbestrol increased the average daily gain of castrated animals 99 gm. and of uncastrated animals only 17 gm. For animals not treated with stilbestrol, castration reduced the average daily gain per animal by 120 gm., and

TABLE 6. The influence of supplemental feeding, stilbestrol implants and castration upon the performance of calves in the post-weaning winter-dry season of June 14 to October 4, 1962—112 days.

Treatment			With stilbestrol (24 mg.)°				Without stilbestrol				Av. for feeding treatments	
			Castrated°°		Not castrated		Castrated°°		Not castrated			
No.	Pre-weaning creep fed	Post-weaning supplement	Av. daily gain	Inc. for sup.	Av. daily gain	Inc. for sup.	Av. daily gain	Inc. for sup.	Av. daily gain	Inc. for sup.	Av. daily gain	Inc. for sup.
			gm.	gm.	gm.	gm.	gm.	gm.	gm.	gm.	gm.	gm.
1	No	No	**96**	—	**105**	—	**16**	—	**80**	—	**74**	—
2	No	H.P.	456	360	512	407	348	332	478	398	448	374
3	L.P.	L.P.	326	230	400	295	229	213	344	264	325	251
4	H.P.	H.P.	445	349	459	354	337	321	504	424	436	362
Av. DES × Castr.			331		369		232		352			
Av. Stilbestrol					350				**292**			
Inc. for DES						58				—		
Av. Castration							**282**		360			
Inc. for No Castr.								—		78		

Significant differences from analysis of variance, using David B. Duncan's multiple range test for 5% levels:

Treatments

1 2 3 4

NOTE: Any two treatments not underscored by the same line are significantly different. Any two underscored by the same line are not significantly different.

Probabilities (P):		
	Treatments	$0.001<P<0.005$
	Stilbestrol	$0.001<P<0.005$
	Castration	$P<0.001$
	Stilbestrol × Castration	$0.01<P<0.025$

C.V. = 29%

° Implanted April 13, 1962.
°° At weaning, June 14, 1962.
NOTE: Control gains and averages in **boldface type.**

Figure 4. Supplemental feeding during post-weaning period, animals nearing marketable finish at about 18 months of age.

for animals treated with stilbestrol castration reduced the average daily gain per animal by 38 gm. The overall effect of stilbestrol was to increase the rate of gain by 58 gm. per animal per day, and for no castration the increase was 78 gm. per animal per day.

Pre-weaning Period plus Post-weaning Winter Season

By combining the results for the first two periods, the effect of the various treatments for the 174-day period may be studied (Table 7). At the end of this period, all three groups receiving supplemental feed showed a higher rate of gain than the control group receiving only pasture. There was an indication that the calves receiving a high-protein supplement during both the pre-weaning and post-weaning winter period had a higher rate of gain than the other groups (treatment 4), but as will be pointed out later this advantage completely disappeared during the subsequent summer season. By the end of the 174-day period, animals which had received the high-protein supplement from the beginning were showing an average increase over their respective controls of 51 kg. (Table 4). In terms of average daily gain, the high-protein animals gained an average of 294 gm. over and above their respective controls (Table 7). Those that received the high-protein supplement only after the weaning period (treatment 2) showed an average increase over the controls of 224 gm. per animal per day. This was almost indentical to the increase that was obtained from

TABLE 7. The influence of supplemental feeding, stilbestrol implants and castration upon the performance of calves in the combined pre-weaning period and post-weaning winter-dry season April 13 to October 4, 1962—174 days.

Treatment			With stilbestrol (24 mg.)°				Without stilbestrol				Av. for feeding treatments	
			Castrated°°		Not castrated		Castrated°°		Not castrated			
No.	Pre-weaning creep fed	Post-weaning supplement	Av. daily gain	Inc. for sup.	Av. daily gain	Inc. for sup.	Av. daily gain	Inc. for sup.	Av. daily gain	Inc. for sup.	Av. daily gain	Inc. for sup.
			gm.	gm.	gm.	gm.	gm.	gm.	gm.	gm.	gm.	gm.
1	No	No	**298**	—	**303**	—	**205**	—	**246**	—	**263**	—
2	No	H.P.	513	215	548	245	402	197	486	240	**487**	**224**
3	L.P.	L.P.	491	193	539	236	426	221	499	253	**489**	**226**
4	H.P.	H.P.	585	287	594	291	470	265	577	331	**557**	**294**
Av. DES × Castr.			472		496		376		452			
Av. Stilbestrol					484				414			
Inc. for DES						79				—		
Av. Castration							424		474			
Inc. for No Castr.								—		50		

Significant differences from analysis of variance, using David B. Duncan's multiple range test for 5% levels:

Treatments

1 2 3 4

NOTE: Any two treatments not underscored by the same line are significantly different. Any two underscored by the same line are not significantly different.

Probabilities (P):		
	Treatments	$0.001<P<0.005$
	Stilbestrol	$P<0.001$
	Castration	$0.01<P<0.025$
	Stilbestrol × Castration	$0.10<P<0.25$

C.V. = 21%

° Implanted April 13, 1962.

°° At weaning, June 14, 1962.

NOTE: Control gains and averages in **boldface type**.

the low-protein supplement which was fed during both the pre- and post-weaning winter season (treatment 3). The average daily increase in gain in that treatment was 226 gm.

The interrelationship between diethylstilbestrol and castration continued to be evident, with the castrated males without stilbestrol showing the lowest rate of gain and the uncastrated males with stilbestrol having the greatest rate of gain. Castration had the effect of reducing the rate of gain 24 gm. per steer per day with stilbestrol and 76 gm. per steer per day without stilbestrol. These results strongly suggest that stilbestrol has substituted for an inherent function in the uncastrated male and hence very little response was obtained from stilbestrol in uncastrated males. The overall effect of stilbestrol was to increase the average daily gain by 70 gm., and castration had the effect of reducing the average daily gain by 50 gm. per animal per day.

Post-weaning Summer Season

During the post-weaning summer season, the animals which did not receive supplementary feed (treatment 1) showed gains equal to or greater than the supplement-fed groups. Much of this was due to the carry-over effect of the very low gains that were obtained from the control group compared with the relatively high gains made by the supplement-fed groups during the previous 174-day period (Table 8). During the summer months, under good-quality pasture conditions, all the animals were at a high nutritional level, and as a consequence the control cattle had a higher rate of gain during this period.

The effect of castration and stilbestrol continued to show some very interesting relationships during the summer period (Table 8). Castration reduced the average daily gain by 35 gm. where the animals were implanted with stilbestrol, and the depression was 88 gm. per animal per day without stilbestrol. On the other hand, stilbestrol increased the rate of gain of castrated males by 77 gm.

and by only 24 gm. in the uncastrated males. During this summer period, the bulls showed an average daily increase in gain of 61 gm. over the steers, and diethylstilbestrol increased the average daily gain by 50 gm. The stilbestrol had the effect of just about offsetting the depression in average daily gain resulting from castration.

TABLE 8. The influence of supplemental feeding, stilbestrol implants and castration upon the performance of calves in the post-weaning summer-wet season October 4, 1962 to April 18, 1963 — 196 days.

Treatment			With stilbestrol (48 mg.)°				Without stilbestrol				Av. for feeding treatments	
			Castrated°°		Not castrated		Castrated°°		Not castrated			
No.	Pre-weaning creep fed	Post-weaning supplement	Av. daily gain	Inc. for sup.	Av. daily gain	Inc. for sup.	Av. daily gain	Inc. for sup.	Av. daily gain	Inc. for sup.	Av. daily gain	Inc. for sup.
			gm.	gm.	gm.	gm.	gm.	gm.	gm.	gm.	gm.	gm.
1	No	No	766	—	759	—	636	—	722	—	721	—
2	No	H.P.	701	−65	698	−61	642	6	716	−6	689	−32
3	L.P.	L.P.	670	−96	767	8	610	−26	699	−23	687	−34
4	H.P.	H.P.	626	−140	680	−79	570	−66	671	−51	637	−84
Av. DES × Castr.			691		726		614		702			
Av. Stilbestrol					708				658			
Inc. for DES						50				—		
Av. Castration							653		714			
Inc. for No Castr.								—		61		

Significant differences from analysis of variance, using David B. Duncan's multiple range test for 5% levels:

Treatments

1 2 3 4

NOTE: Any two treatments not underscored by the same line are significantly different. Any two underscored by the same line are not significantly different.

Probabilities (*P*):		
	Treatments	$P=0.10$
	Stilbestrol	$0.001<P<0.005$
	Castration	$P<0.001$
	Stilbestrol × Castration	$0.025<P<0.05$

C.V. = 12%

° 24 mg. implanted April 13, 1962 and 24 mg. November 1, 1962.

°° At weaning, June 14, 1962.

NOTE: Control gains and averages in **boldface** type.

Combined Post-weaning Winter Season and Post-weaning Summer Season

During the winter season, the supplements fed on pasture gave much higher rates of gain than pasture alone (Table 6, Figure 2). As seen from Table 8, however, the rates of gain during the summer months were less for all the groups receiving supplements. This had the effect of wiping out much of the advantage for supplements which was evident at the end of the dry season, so that the differences between feeding treatments were greatly minimized by the end of the following wet summer season (Table 9). It will be noted that the rate of gain for treatment 2 which received the supplement only after weaning appears to be greater than for the other supplement groups. However, this group had a much lower rate of gain during the pre-weaning period, so that much of the higher rate of gain during the post-weaning period can be accounted for on the basis of compensatory gain (Tables 5 and 9).

Castration reduced the rate of gain by 36 gm. with stilbestrol and 98 gm. without stilbestrol. The overall effect of stilbestrol was to increase the rate of gain by 53 gm. per animal per day, and the overall effect of castration was to reduce the average daily gain per steer by 67 gm.

Pre- and Post-weaning Periods

An examination of the results as shown in Tables 4 and 10 for the entire period of 370 days reveals that each of the supplement treatments produced gains of about the same order of magnitude over the control treatment. The early advantages for creep feeding and the advantage for the high-protein supplement during the dry winter season completely disappeared during the final summer season.

Differences were evident, however, in the responses to stilbestrol and to castration, but those responses did not appear to be related to whether the animals received supplemental feed or not. For the entire experiment,

TABLE 9. The influence of supplemental feeding, stilbestrol implants and castration upon the performance of calves in the combined post-weaning winter-dry season and summer-wet season June 14, 1962 to April 18, 1963—308 days.

Treatment			With stilbestrol (48 mg.)°				Without stilbestrol				Av. for feeding treatments	
			Castrated°°		Not castrated		Castrated°°		Not castrated			
No.	Pre-weaning creep fed	Post-weaning supplement	Av. daily gain	Inc. for sup.	Av. daily gain	Inc. for sup.	Av. daily gain	Inc. for sup.	Av. daily gain	Inc. for sup.	Av. daily gain	Inc. for sup.
			gm.	gm.	gm.	gm.	gm.	gm.	gm.	gm.	gm.	gm.
1	No	No	**523**	—	**521**	—	**411**	—	**489**	—	**486**	—
2	No	H.P.	612	89	630	109	535	124	629	140	602	116
3	L.P.	L.P.	545	22	634	113	472	61	570	81	555	69
4	H.P.	H.P.	560	37	599	78	485	74	610	121	564	78
Av. DES × Castr.			560		596		476		574			
Av. Stilbestrol					578				**525**			
Inc. for DES						53				—		
Av. Castration							**518**		585			
Inc. for No Castr.								—		67		

Significant differences from analysis of variance, using David B. Duncan's multiple range test for 5% levels:

Treatments

1 2 3 4

NOTE: Any two treatments not underscored by the same line are significantly different. Any two underscored by the same line are not significantly different.

Probabilities (P):	Treatments	$0.025<P<0.05$
	Stilbestrol	$P<0.001$
	Castration	$P<0.001$
	Stilbestrol × Castration	$0.01<P<0.025$
C.V. = 13%		

° 24 mg. implanted April 13, 1962 and 24 mg. November 1, 1962.
°° At weaning, June 14, 1962.
NOTE: Control gains and averages in **boldface type**.

castration reduced the average daily gain by 30 gm. with stilbestrol and by 82 gm. where no stilbestrol was implanted. The overall effect, then, of stilbestrol was to increase the average daily gain by 60 gm., and the overall effect of castration was to reduce the rate of gain by 56 gm., so that the two effects essentially balanced each other. The lowest-gaining animals were the steer calves which had not been implanted with stilbestrol, and the highest-gaining animals were the bulls which had received two implants of stilbestrol.

TABLE 10. The influence of supplemental feeding, stilbestrol implants and castration upon the performance of calves in the combined pre- and post-weaning periods April 13, 1962 to April 18, 1963—370 days.

Treatment			With stilbestrol (48 mg.)*				Without stilbestrol				Av. for feeding treatments	
			Castrated**		Not castrated		Castrated**		Not castrated			
No.	Pre-weaning creep fed	Post-weaning supplement	Av. daily gain	Inc. for sup.	Av. daily gain	Inc. for sup.	Av. daily gain	Inc. for sup.	Av. daily gain	Inc. for sup.	Av. daily gain	Inc. for sup.
			gm.	gm.	gm.	gm.	gm.	gm.	gm.	gm.	gm.	gm.
1	No	No	**546**	—	**544**	—	**434**	—	**498**	—	**506**	—
2	No	H.P.	612	66	627	83	529	95	608	110	594	88
3	L.P.	L.P.	586	40	660	116	524	90	605	107	594	88
4	H.P.	H.P.	606	60	639	95	523	89	627	129	599	93
Av. DES × Castr.			588		618		502		584			
Av. Stilbestrol					603				543			
Inc. for DES						60				—		
Av. Castration							545		601			
Inc. for No Castr.								--		56		

Significant differences from analysis of variance, using David B. Duncan's multiple range test for 5% levels:

Treatments

1 2 3 4

NOTE: Any two treatments not underscored by the same line are significantly different. Any two underscored by the same line are not significantly different.

Probabilities (P):	
Treatments	$0.025<P<0.05$
Stilbestrol	$P<0.001$
Castration	$P<0.001$
Stilbestrol × Castration	$0.01<P<0.025$

C.V. = 11%

* 24 mg. implanted April 13, 1962 and 24 mg. November 1, 1962.
** At weaning, June 14, 1962.
NOTE: Control gains and averages in **boldface** type.

TABLE 11. Live and dressed weights, and carcass quality characteristics of 80 tester steers.

No.	Treatments* Supplement	DES	No. of animals	Type of animal	Live weight May 3, 1963	Dressed weight May 8, 1963	Dressed wt. incl. kidney fat, diaphragm & tenderloin	Conformation grade	Quality grade	Carcass grade	Maturity	Marbling	Color
					kg.	kg.	kg.						
1	None	Yes	5	Steer	438	228	240	Std+	Std	Std	C	Sl	S.D.R.
			5	Bull	439	230	240	Com	Com−	Com−	B	Sl	S.D.R.
		No	5	Steer	390	207	218	Gd−	Gd−	Std+	B	Sl	L.R.
			5	Bull	431	223	231	Com+	Ut+	Com−	C	T	S.D.R.
2	High protein — not creep fed	Yes	5	Steer	426	237	249	Gd−	Std	Std	C	Sl	S.D.R.
			5	Bull	418	237	247	Gd−	Ut+	Com−	D	T	D.R.
		No	5	Steer	401	219	232	Std+	Gd−	Gd−	B	Sm	L.R.
			5	Bull	436	251	258	Gd−	Ut+	Com−	C	T	D.R.
3	Low protein — creep fed	Yes	5	Steer	447	247	260	Gd−	Std−	Std	C	T	S.D.R.
			5	Bull	482	269	279	Com+	Ut+	Com−	C	T	D.R.
		No	5	Steer	429	238	250	Gd	Std+	Gd−	B	Sl	L.R.
			5	Bull	458	245	253	Com+	Ut	Ut+	C	T	D.R.
4	High protein — creep fed	Yes	5	Steer	442	248	260	Gd−	Gd−	Std+	B	Sm	L.R.
			5	Bull	453	256	265	Gd−	Ut	Ut+	C	T	S.D.R.
		No	5	Steer	389	210	222	Std+	Std+	Std+	B	Sl	L.R.
			5	Bull	447	247	255	Com+	Ut	Ut+	C	T	D.R.

*See Table 3 for schedule of treatments. The post-weaning feed supplements were continued for 15 days after the termination of the trial on April 18, 1963 up to the time the animals were walked to the slaughterhouse approximately 36 miles from the experimental site.

Key to abbreviations:

Conformation, quality and carcass grades	Maturity	Marbling	Color
Gd = Good	A to D = Young to Old	Sm = Small	L.R. = Light Red
Std = Standard		Sl = Slight	S.D.R. = Slightly Dark Red
Com = Commercial		T = Traces	D.R. = Dark Red
Ut = Utility			

NOTE: The steer and bull carcasses were graded according to official United States standards. The IRI Research Institute wishes to acknowledge the assistance of David K. Hallett, Marketing Specialist of the Livestock Division, United States Department of Agriculture, Washington, who flew to Brazil specifically for the purpose of grading these carcasses.

Figure 5. Grading chilled carcasses on the rail.

Carcass Evaluation*

At the end of the trial on April 18, five tester animals were selected from each of the 16 experimental groups for the purpose of obtaining carcass information. The 80 animals were continued an additional 15 days on their respective experimental treatments, after which they were walked to the slaughterhouse a distance of 36 miles. They were killed on May 8. The results of the carcass evaluations are given in Tables 11 to 16.

There was a fairly wide range in carcass characteristics for individual carcasses; however, the average—by treatment group—while showing some differences, does not indicate any dramatic differences. The steer carcasses had a higher percentage of kidney fat (Table 14), a greater thickness of surface fat (Table 15), but a smaller rib-eye area (Table 16) than the corresponding bull carcasses. On the other hand, the feeding regimes included in this study gave only small differences in these three

*The carcass evaluations were made by David K. Hallett of the Livestock Division of the Agricultural Marketing Service, U.S.D.A.

TABLE 12. Influence of supplemental feeding, stilbestrol implants and castration upon the dressing percentage of beef cattle — Brazilian standards.

Treatment No.	Pre-weaning creep fed	Post-weaning supplement	With stilbestrol Castr.	With stilbestrol Not castr.	Without stilbestrol Castr.	Without stilbestrol Not castr.	Average Castr.	Average Not castr.	Average for feeding treatments
			%	%	%	%	%	%	%
1	No	No	51.9	52.4	53.0	51.8	52.5	52.1	52.3
2	No	H.P.	55.8	56.7	54.7	57.5	55.2	57.1	56.2
3	L.P.	L.P.	55.3	55.8	55.3	53.6	55.3	54.7	55.2
4	H.P.	H.P.	56.1	56.5	53.8	55.1	55.0	55.8	55.4
Average, with and without stilbestrol			55.1		54.4				
Average, with and without castration							54.5	54.9	54.7

Probabilities (P): Treatments $P<0.001$; Stilbestrol $0.025<P<0.05$; Castration $P=0.025$

C.V. = 2.8%

characteristics, although there is an indication that the rib-eye area was increased slightly by the supplements.

The implantation with stilbestrol appeared to have no effect upon these characteristics.

The lean of the bull carcasses was darker in color and softer, showed less marbling, and had a coarser texture than the corresponding steer carcasses.

The dressing percentages are given for both the Brazilian method (Table 12) and according to U.S. standards (Table 13). Both feeding regimes and the implantation of stilbestrol influenced the dressing percentages. Each of the supplements gave greater dressing percentages than those obtained from the control group, and stilbestrol also increased the dressing percentage.

Interpretation of Results

The ultimate objective of this type of experimentation is to provide information which will be useful in the development of feeding systems to produce beef at the lowest possible cost. From this trial, it is apparent that there are a multitude of factors which need to be con-

TABLE 13. Influence of supplemental feeding, stilbestrol implants and castration upon the dressing percentage of beef cattle – U.S. standards.

Treatment: No.	Treatment: Pre-weaning creep fed	Treatment: Post-weaning supplement	With stilbestrol: Castr.	With stilbestrol: Not castr.	Without stilbestrol: Castr.	Without stilbestrol: Not castr.	Average: Castr.	Average: Not castr.	Average for feeding treatments
			%	%	%	%	%	%	%
1	No	No	54.7	54.6	55.8	53.6	55.3	54.1	54.7
2	No	H.P.	58.6	59.1	58.0	59.2	58.3	59.1	58.7
3	L.P.	L.P.	58.1	57.8	58.2	55.3	58.1	56.5	57.3
4	H.P.	H.P.	58.9	58.5	56.9	56.8	57.9	57.7	57.8
Average, with and without stilbestrol			57.5		56.7				
Average, with and without castration							57.4	56.8	57.1

Probabilities (P): Treatments $P<0.001$
Stilbestrol $0.025<P<0.05$
Castration $0.1<P<0.20$

C.V. = 2.9%

TABLE 14. Influence of supplemental feeding, stilbestrol implants and castration upon the per cent kidney fat in beef cattle.

Treatment No.	Pre-weaning creep fed	Post-weaning supplement	With stilbestrol Castr.	With stilbestrol Not castr.	Without stilbestrol Castr.	Without stilbestrol Not castr.	Average Castr.	Average Not castr.	Average for feeding treatments
			%	%	%	%	%	%	%
1	No	No	4.2	3.2	4.0	2.4	4.1	2.8	3.4
2	No	H.P.	3.9	3.1	4.8	2.0	4.4	2.5	3.4
3	L.P.	L.P.	3.8	2.7	4.0	2.2	3.9	2.4	3.2
4	H.P.	H.P.	3.8	2.6	4.4	2.2	4.1	2.4	3.3
Average, with and without stilbestrol			3.4		3.2				
Average, with and without castration							4.1	2.5	3.3

Probabilities (P): Treatments $0.25<P$
Stilbestrol $0.25<P$
Castration $P<0.001$

C.V. = 22.9%

TABLE 15. Influence of supplemental feeding, stilbestrol implants and castration upon the thickness of fat.

Treatment No.	Pre-weaning creep fed	Post-weaning supplement	With stilbestrol Castr.	With stilbestrol Not castr.	Without stilbestrol Castr.	Without stilbestrol Not castr.	Average Castr.	Average Not castr.	Average for feeding treatments
			in.	in.	in.	in.	in.	in.	in.
1	No	No	.12	.09	.13	.06	.12	.08	.10
2	No	H.P.	.10	.06	.15	.06	.12	.06	.09
3	L.P.	L.P.	.10	.08	.12	.07	.11	.08	.09
4	H.P.	H.P.	.22	.05	.12	.05	.17	.05	.11
Average, with and without stilbestrol			.10		.09				
Average, with and without castration							.13	.06	.10

Probabilities (P): Treatments $0.25<P$
Stilbestrol $0.25<P$
Castration $P<0.001$

C.V. = 40%

Figure 6. Two rib-eye sections cut between 12th and 13th ribs. Left, steer; right, bull. The castrated animals had a quality and carcass grade average of standard to good, while the uncastrated stock was classified utility to commercial.

TABLE 16. Influence of supplemental feeding, stilbestrol implants and castration upon the rib-eye area of beef cattle (between 5th and 6th rib).

Treatment			With stilbestrol		Without stilbestrol		Average		Average for feeding treatments
No.	Pre-weaning creep fed	Post-weaning supplement	Castr.	Not castr.	Castr.	Not castr.	Castr.	Not castr.	
			sq. in.	sq. in.	sq. in.	sq. in.	sq. in.	sq. in.	sq. in.
1	No	No	4.7	4.7	4.6	4.8	4.6	4.8	4.7
2	No	H.P.	5.0	5.0	4.5	5.5	4.8	5.2	5.0
3	L.P.	L.P.	5.1	5.0	4.8	5.4	5.0	5.2	5.1
4	H.P.	H.P.	5.1	5.9	4.7	5.7	4.9	5.8	5.4
Average, with and without stilbestrol			5.1		5.0				
Average, with and without castration							4.8	5.3	5.0

Probabilities (P): Treatments $0.1 < P < 0.2$
Stilbestrol $0.25 < P$
Castration $0.025 < P < 0.05$

C.V. = 17:2%

sidered in making decisions relative to supplemental feeding of grazing animals. Almost 25 kilograms of supplement was required for each kilogram of extra liveweight gain produced during the 370-day period of the trial. However, this does not take into account the possible decrease in pasture consumption per animal as a result of the supplement. The rate of substitution of supplements for pasture forage can only be determined by much more sophisticated experiments which are conducted to determine the consumption rate of forages in combination with various rates of supplemental feeding. If the feeding of supplements does have the effect of decreasing the consumption of forage, then the carrying capacity of the pasture should be increased so that the net effect would be to decrease the amount of supplement required to produce an extra kilogram of beef. Since measurements of carrying capacity were not made in this trial, the effect of supplemental feeding upon this factor cannot be resolved.

The feed conversion into beef was excellent during the pre-weaning and post-weaning winter periods when ratios of 6 to 9 kg. of supplement produced an extra kilogram of liveweight gain. During the following summer season, the supplements produced slightly less gain per animal than was produced on grass alone, so that by the end of the summer period much of the advantage was lost. This seems to indicate that feeding systems and other management practices may have to be developed which will produce slaughter animals near the end of the dry season. In order to bring about these changes, it may be necessary to breed the cows at a different season of the year to allow the calves to make most efficient use of the high-quality forages which are produced during the summer months. The present practices of weaning the calves and castrating the males at the beginning of the dry season when the quality of feed is declining, are some of the contributing factors to the slow growth of the cattle and the advanced age at which they are marketed.

If castrated males are considered the control animals as in this trial, then the implantation of stilbestrol on steers will have almost the same effect upon gains as no castration. This does not mean that the males should not be castrated in practice, unless new feeding systems can be developed which will permit marketing the bulls when they have reached an age of 18 to 24 months. It is very doubtful if the wholesale meat buyer or the housewife will discriminate between steer and bull meat if the slaughter age is less than two years. The results from this trial indicate that the bull carcasses had a lower percentage of waste fat and a larger rib eye than comparable steer carcasses.

The marketing of slaughter cattle in South-Central Brazil reaches a peak at the end of the summer season, and it is during this period that prices are at their lowest level. Five to six months later, at the end of the winter season, there is always a shortage of beef and the price of beef is high. Further research should be undertaken which will lead to the development of feeding systems that will permit marketing of slaughter cattle at less than two years of age and at all periods during the year.

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