Feedlot Performance and Carcass Characteristics of Steers Fed High-Energy Rations

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SUMMARY

THREE feeding trials, 24 [pure Zebu and Zebu x Friesian crossbred] steers per each, were conducted to compare 4 rations [treatments] at three different periods of the year.

Four equal and randomly distributed groups of steers were put on 4 different but iso-calorie rations. Levels of crude protein varied from 21.4 to 18.9% as shown in table 1. The steers were individually fed for 56 days to effect 1.12 kg. gain per head daily.

Digestibility levels of the four rations were determined [Table 2]. At slaughter, carcass data were obtained and analysed [Table 4]. Animal performance, and economics of the feeding operation data are presented in Table 3.

Results of these studies showed that the 30-20% cotton seed rations gave significantly [$P < 0.001$] higher total liveweight gains, slightly heavier carcasses and better grades than the other two rations.

Considering results of all the parameters measured and Federal Government of Nigeria's concerted efforts to boost grains and meat production on large scales, ration 3 should be recommended. Because, with abundant supplies of grains and regular supplies of animals, faster throughput and increased gross return per feedlot per annum are feasible.

INTRODUCTION

ANIMAL proteins have long been in inadequate supply in human diets in developing countries even though great numbers of the world livestock are located within these regions. Among the limiting factors for the shortages have been levels and systems of meat production

Feed accounts for at least 80% of the variable costs of beef production (Powell,

1975). That is why rising concentrate prices have been the main factor in increasing costs in many systems of beef production. However, efficient utilization of these concentrates could be one of the solutions to maximising feed economy. While the supply and concentration of energy remains the prime determinant of growth rate of beef cattle.

Meat consumption per person is rising and Nigeria's grain output is also likely to rise (Green Revolution) weather permitting, and surpluses of grain now used exclusively for human food, will be diverted to livestock feed. This increasing demand for meat and the Federal Military Government's awareness (N.A.D.C., 1971) of failing production and her concerted effort to revitalise the failures by doubling the output of animal products in one decade makes it desirable to obtain further information on intensive feeding and management of beef cattle in Nigeria on a year-round basis.

In fattening cattle for markets for slaughter, animals are adequately fed on rich balanced rations so that they grew rapidly and attain desired weights within a short time. At the same time certain economical margin has to be

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achieved. This margin (necessary margin) is the difference between the cost per certain body weight of the animals under investigation and their selling price per the same unit of body weight when fattened and ready for slaughter.

Although the traditional method of feeding beef cattle in most developing world has been based on high-roughage rations all-concentrate rations based on various cereal grains have been successfully fed to cattle in developed countries. Putnam, Oltjen and Bond (1969) reported that all-concentrate rations containing 8- to 9% crude protein were adequate from 360 kg. to slaughter weight. On the other hand, Haskins *et al.* (1967) found more than 11% crude protein was necessary for maximum gain for 244 kg. steers fed all-concentrate rations. It therefore appears that protein is not the limiting factor in a feedlot feeding operation; energy is the major factor. Bolsen *et al.* (1968) have provided evidence that cattle can be successfully and profitably finished on diets containing little or no roughage.

The study reported here was designed to investigate affects of high-energy rations on performance and carcass characteristics of fattened and finished steers and economics of the feedlot operation by inversely varying levels of guinea corn grains with whole undelinted cotton seed.

The reported studies were carried out at the Institute for Agricultural Research Shika, a unit of Ahmadu Bello University, Zaria. The Research Station lies between latitudes 11°N and 12°N, and longitudes 7°E and 8°E at an altitude of 640 metres. It is within Northern Guinea Savanna zone with an average annual rainfall of 1100 mm. Rainy season extends

from late April to early October and a mean maximum temperature ranging from 27°C in the rainy season to 35.0°C in April.

EXPERIMENTAL PROCEDURE

The three feeding trials were conducted in the same facility at different times—covering all the seasons of the year. Cattle were confined in an iron-roofed building, 20 metres long by 7½ metres wide. There was allowance for an outside pen area 20 metres long by 5 metres wide.

The total area was divided into 4 equal size pens each measuring 5 metres by 12 metres. There were 6 steers in each of the 4 pens. Thus, each steer had about 12 square meters of space. The feed trough was under roof and divided with partitions extending back 1.2 metres so that steers could eat individually.

A 56 day-feeding period was chosen to attain a maximum gain to bring animals to a slaughter weight of (363 - 408.5 kgs). This was desirable in line with Powell's (1975) suggestion that the higher the growth rate the lower the slaughter weight at which the margin over feed cost is at its optimum.

At 56 days on the trial, the first two steers per treatment were removed for slaughter. Thus, many animals were on the feed longer than 56 days before slaughter, but feed and liveweight records summarised herein cover only the first 56 days of the experimental period.

At slaughter, carcass data were obtained and analysed (Table 4).

Trial One

Twenty-four (Friesian x White Fulani, and pure White Fulani) steers about

12 to 15 months old averaging 267.0 kg were randomly assigned to 4 treatments according to initial body weight and breed on November 14. After week preliminary period, they individually fed to gain 1.12 kg per head per day according to N.A.S (1970) and Lefgreen and Gerrett (1968) on a four high-energy ration. A groundnut cake level of 20% was constant to the 4 rations but levels of whole undelinted cotton seed were inversely varied with those of guinea corn grain (50 to 20%) as shown in Table 1. Gamba (*Andropogon gayanus*) hay was fed 1.8 kg. per head daily. Water, salt and complete mineral mix were available to all steers at all times.

After one week of feeding each steer was implanted with 15 mg pellet of diethyl stilbestrol (DES) on the right ear to offset the effect of castration (Laflamme *et al*, 1973).

All the animals were weighed fortnightly. Records of feed intake, live-weight changes and labour costs were kept and analysed.

Digestion study of the 4 rations was carried out with 24 steers using chromi oxide as the external indicator; and 8 whether rams in digestion crates. There were two collection periods of 7 days each. Feaces and feed were oven dried and

TABLE 1
Proximate Analysis of the Four Rations* Fed to the Steers

	% D.M.	% C.P.	% C.F.	% E.E.	% Ash	% N.F.E.
(a) Ration I	96.1	21.4	13.34	12.29	4.08	48.95
Ration II	96.1	20.0	8.48	10.34	3.37	57.87
Ration III	95.5	18.9	6.27	7.35	3.31	63.73
Ration IV	95.6	18.9	4.49	6.81	3.49	66.37
Gamba Hay	96.8	2.1	34.63	1.19	7.45	54.67
(b)	*Ration Composition (% Ingredients)					
	Cotton Seed		Guinea Corn		G/Nut Cake	
Ration I	50		30		20	
Ration II	40		40		20	
Ration III	30		50		20	
Ration IV	20		60		20	

TABLE 2
Digestible Nutrients and Energy Levels of the Four Rations Fed to the Steers

	D.DM	DCP	DCF	D.EE	DNFE	kg. TDN	kg. S. Equivalent	Net Energy (Kcals)
Ration I	62.67	62.85	59.57	89.07	64.44	176.60	160.70	375,651.90
Ration II	65.43	65.95	65.61	87.76	66.41	180.32	164.09	385,567.10
Ration III	68.12	64.43	64.28	88.31	71.31	181.84	165.47	386,806.90
Ration IV	67.58	61.68	54.23	81.82	76.21	180.03	163.83	382,965.70

ground in Christy and Norrs Laboratory Mill, before subjecting them to proximate analysis (A.O.A.C., 1970).

Trial Two

On March, 14, 24 steers (14 White Fulani and 10 Freisian x White Fulani crossbred) (about 12 months old averaging 230 kg. were randomly assigned to 4 treatments similar to those used in trial one. Procedures followed, parameters measured, and rations fed were essentially the same in trial two as in trial one except that the animals used in trial two were a bit younger and lighter than those in trial one.

Trial Three

Cattle used were similar to those in trials one and two, but these were somewhat older and heavier in liveweight. Twenty-four steers (8 White Fulani and 16 Fri-

esian x White Fulani crossbred) averaging 273 kg. were randomly assigned to the 4 rations on July 11 as in trials one and two. All other treatments and operations were essentially the same as in the two previous trials. The only major difference was that each of the 24 steers was implanted with 30 mg. of (DES) diethystilbestrol the right ear after the preliminary period of one week. Besides, loin eye area of all the carcasses were measured in trial three (Table 4). This was determined by measuring the cross sectional area of the *Longissimus dorsi* muscle where it is exposed between the 12 and the 13th ribs.

RESULTS

The three trials were analysed as one experiment applying multivariate analysis of variance using each trial as a variable.

TABLE 3

Performance of Steers Fed High-Energy Rations containing Different Levels of Cotton Seed and Guinea Corn and Economics of Fattening Steers

Characteristics	Ration Averages			
	1	2	3	4
Total D.M. intake (kg)	2004.02	2364.21	2479.36	2630.80
Total C.P. intake (kg)	476.79	454.34	438.69	446.98
Cost of concentrate per kg (kobo)	8.10	9.06	10.04	10.98
Cost of total concentrate intake (N1) ¹	177.52	201.30	222.77	257.74
Cost of Gamba hay consumed (N1)	8.73	8.84	9.80	10.44
Total liveweight gain (kg)	338.05	348.69	396.73	379.54
Average daily gain per steer (kg)	0.96±0.15	1.02±0.20	1.10±0.22	1.05±0.20
Revenue from total gain at 44 kobo/kg (N1) ²	148.75	153.42	174.56	167.00
Kg. Concentrate per kg of gain	6.09	5.97	5.34	5.90
Cost per kg. gained (k1)	49.33	54.09	53.61	64.78
Cost per kg. of Ration (kobo)	12.09	13.53	14.96	16.41
Cost of Labour (N1) ³	106.80	106.80	106.80	106.80

- 1 = Prices of feeding stuffs had since gone down.
 2 = Price per kg. of beef had since been doubled.
 3 = Cost of labour had also gone up (Udoji).

Performance and economics of the feeding operation data are presented in table 3. Pens 3 and 4 steers fed rations-3 and 4 (Table 1 (a) had highest dry matter (DMI) intake and they were most efficient in feeds utilisation (Table 3). The mean intake of concentrate was influenced by breed. Feed conversion was most efficient on ration 3 followed by ration 4, then ration 2 and least efficient on ration 1. For test of differences in means between groups (rations), $F=11.9482293$ which is significant at 0.1% level. This shows highly significant differences between means of live-weight gained ($P<0.001$) in favour of ration 3 (Table 3).

crude protein was highest in ration 1, it was not as deigestible as in rations 2 and 3 but equalled ration 4.

Carcass data as shown in Table 4 indicate that better grades were made with animals on rations 3 and 4 with more muscling. Although steers on ration 1 dressed almost as high as those on rations 3 and 4, they tended to put on more external and internal fat. This factor thus reduced the quality of the beef. Data in Table 5 show great homogeneity among the treatments throughout the three trials. This reflects on the high correlation results obtained between treatments and trials.

TABLE 4

Means and Standard Errors of Carcass dressing percent and Loin eye area of Steers Fed high-energy Rations

	<i>Trial 1</i>	<i>Trial 2</i>	<i>Trial 3</i>	
			<i>Dressing %</i>	<i>Loin Eye Area (cm²)</i>
Ration 1	51.60 ± 1.18	51.50 ± 1.73	53.98 ± 1.18	63.80 ± 17.32
Ration 2	52.18 ± 1.70	48.00 ± 3.83	52.50 ± 2.38	54.08 ± 6.70
Ration 3	52.63 ± 2.34	53.75 ± 3.20	53.25 ± 1.26	60.60 ± 3.00
Ration 4	53.65 ± 2.17	54.50 ± 2.64	53.90 ± 1.64	68.33 ± 11.38

The crossbred steers had greater daily liveweight gains than the pure Zebu.

Steers tended to consume almost always all the feeds on offer to steers on rations 4 and 3; while there were always residues for almost all the steers on ration 1 and for several steers on ration 2. In all the 3 trials, there was an inverse relationship between Gamba hay and level of cotton seed in concentrate intake by the steers on ration 1. It was observed that steers on ration 1 excreted the most urinary out put and very soft faeces daily.

Digestion data are presented in Table 2. Dry matter digestibility and thus energy were lowest in ration 1. Although the

TABLE 5

Correlation between Liveweight and trials as influenced by treatments[Rations]

<i>Treatment (Rations)</i>	<i>Trials as Variables</i>		
	1	2	3
1	0.9344	0.9918	0.9982
2	0.9841	0.9813	0.9994
3	0.9823	0.9893	0.9812
4	0.9908	0.9878	0.9991

On the other hand, levels of correlation were not consistent in carcass dressing percentage (Table 6). This is more so in treatment 2, due to effect heterogeneity. On the whole, there were no significant differences among treatments, however, several trends were apparent.

TABLE 6

Correlation between carcass dressing percentage and trials as influenced by Rations

Treatment (Rations)	Trials		
	1	2	3
1	-0.9806	-0.6744	-0.6023
2	-0.6087	-0.8044	0.0288
3	0.2366	-0.2275	-0.0594
4	0.1395	-0.8424	-0.5927

DISCUSSION

Although the steers were fed according to N.R.C. (1970) and Lofgreen and Garret (1968) requirements to gain 1.12 kg. daily, only steers on rations 3 were close to that level 1.10 kg/head daily (Table 3) which is 1.8% less than expected. Their lower daily gain did not result from lower energy intake but probably due to inefficient utilization of the feeds. Another cause might be wide differences in environmental and physiological influence in their feed conversion as opposed to the temperate breeds on which N.R.C. (1970) was based.

A comparison of seasons was made to test the influence of previous treatments on performance of the feedlot steers. As presented in Table 5, the data show no interaction between the previous treatments and subsequent response of animals to the high-energy rations. This was contrary to result obtained by Spuling and Spurling (1972).

Although differences in average daily gain were not significant, efficiency of feed conversion tended to be highest for ration 3 and lowest for ration 1. Too high oil content of ration 1 probably made it less efficient (Kock *et al.* 1973), and less digestible due to coating effect. It also stimulated scouring among the steers. It may be the reason which they

were over fattened with a lot of external fat. A tremendous amount of nitrogen was lost in copiously excreted urine by all steers on ration 1.

Ration 4 did not effect as much light-weight gain as ration 3 even though the former had higher guinea corn level (Table 1 (b)). This may be attributable to the fact that its protein and crude fibre were less digested (Table 2) which agrees with Saba *et al.* (1964, Oltjen *et al.* (1967) and Greathouse *et al.* (1974) due to escape of the grains in faeces.

The Friesian x Zebu crossbred performed better than the pure Zebu steers in all the parameters measured. This may be due to their limited capacity in feed intake, genetical potential, tendency to over fatten before attaining maturity weight and wide differences in the physiological maturity (Allen *et al.*, (1970).

The presence of heterogeneity in treatment three within the three trials might be due to the fact that steers used for trial 2 were much younger and lighter than those used for either trial 1 or trial 2. Nevertheless carcass results of treatments 3 and 4 were more consistent than the other two rations.

Considering the three major factors (finish, fill and hide weight) which cause the greatest variation in dressing percent, the crossbred steers carcasses graded better than those of pure Zebu steers.

The loin eye area has been used as a factor in the evaluation of the meatiness of experimental beef carcasses (Bodwell *et al.*, 1959). A correlation of 0.85 has been reported between the loin eye area at the 12th rib and the percentage of the "edible portions" of beef carcasses (Gahill *et al.*, 1956 quoted by Johnson, 1974). The results indicate that steers on ration 2 significantly effected the lowest loin eye area.

In these trials the low-cotton seed rations (3 and 4) gave significantly higher liveweight gains, slightly heavier carcasses and better grades than the other high-cotton seed rations (1 and 2). However, because such benefits are offset by the higher feed cost, feedlot operations can always be moderated. If the scale of operation is limited, then it may be desirable to feed ration 1 or 2 since interest should be in profit margin. But if there is a regular supply of steer on large scale, then the ration 3 should be recommended because it gives higher liveweight gains and therefore faster throughout and increased gross return per feedlot per annum. That was why steers on ration 3 in these trials were most profitable in the feedlot.

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