POSTWEANING GROWTH OF BRAHMAN AND SANTA GERTRUDIS STEERS UNDER FEEDLOTS IN THE SUBTROPICS

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Summary

Postweaning performances of steer from 11 to 18 months of age under intensive feedlot condition were examined in Brahman and Santa Gertrudis cattle breeds which have been established in Paraguay. Fitting of growth data in each breed to an empirical growth model with non-linear least square analysis resulted in the following age(t; months) – weight(w; kg) function made out each breed: $w=638.26(1-2.341e^{-0.10965t})$ for Brahman and $w=716.38(1-2.365e^{-0.10741t})$ for Santa Gertrudis. The estimated mature size of Brahman steers(638 kg) was 11% lower than that of Santa Gertrudis steers(716 kg). However, slightly larger k value (rate of maturing) of Brahman steer in the mechanistic model suggested relatively earlier maturing tendency in the breed. No significant differences in dressing percentage (Brahman, 59.3%; Santa Gertrudis, 58.8%) of chilled carcass weight to live-weight were observed between breed.

(Key Words: Postweaning Growth, Feedlot, Brahman, Santa Gertrudis, Mechanistic Model)

Introduction

The Brahman breed(*Bos indicus*) of beef cattle and its cross, the Santa Gertrudis (*Bos indicus* X *Bos taurus*), have been used extensively for meat production in tropical and subtropical areas of South America. It is generally accepted that these cattle breeds tolerate parasites, heat and nutritional fluctuations in natural grassland (Kennedy and Chirchir, 1971; Frisch, 1973; Butterworth, 1985). By contrast, in the presence of minimal environmental stresses, an inherently higher appetite and a capacity to gain may be characteristic of European cattle breeds compared with the African or Indian Zebu breeds (Ledger et al., 1970). In feedlots, the major differences in postweaning performances between African or Indian Zebu type and European breeds, have been identified in temperate areas (Baker et al., 1973). However, very few studies have described the growth behaviour of Brahman and its crossbred steer acclimatised to the tropical and subtropical grazing that is available for intensive feeding systems in South America and possibly might be used in other tropical and subtropical countries.

The present paper deals with the analyses of postweaning growth and carcass characters of Brahman and Santa Gertrudis steers under feedlot feeding conditions in Paraguay.

Materials and Methods

Animals and experimental design

Ten Brahman and 10 Santa Gertrudis weaned steers (10 months of age) were selected from a larger group of animals grazing on natural grassland in eastern Paraguay. Each was transported 350 km to the research station attached to National University of Asuncion located in Eastern Paraguay approximately at latitude 25°S on a low-fertility, sandy soil. All 10 animals of each breed were allocated to an experimental feedlot pen. All animals were fed ad libitum on mixtures of sorghum silage prepared in the research station and high concentrate which contained fixed amounts of energy and protein. These ingredients

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are the main agricultural products and byproducts and available commercially in Paraguay. Three types of concentrates were used to adjust the nutrient requirements of steers (table 1). A given amount of sorghum silage and concentrate mixtures were given twice a day according to the feeding regime based on the liveweights (table 2). After adaptation to silage and high concentrate(A) ration for 1 month, the feeding trial was conducted in August 30, 1985. Liveweights of animals were measured monthly from 11 to 18 months of age. At 18 months of age, 5 Brahman and 6 Santa Gertrudis steers selected ramdomly were slaughtered to compare dressing percentages of total chilled carcass weights to the liveweights at slaughter. The steers were removed from feed and water 23 hours before slaughter. Slightly heavier left side of carcass reported in Brahman and Santa Gertrudis (Cole et al. 1964) were not significant in the present experiment.

TABLE 1. COMPOSITION (G/KG) OF THREE TYPES OF CONCENTRATE MIXTURES GIVEN TO STEERS IN FEEDLOT

Ingredients	Concentrate type		
	A	B	C
Cracked maize	475	529	639
Wheat bran	409	400	300
Cottonseed meal	35	10	10
Soybean meal	20	10	5
Coconut meal	20	10	5
Bone meal	30	30	30
Salt	10	10	10
Mineral pre-mix[1]	1	1	1
Estimated nutrient values (dry matter basis)[2]			
Crude protein	140	120	110
Metabolisable energy(MJ)	12.3	12.4	12.5

[1] Determined mineral contents with atomic absorbance spectrophotometry were contributing as follows: calcium 18.3%(w/v), phosphorus 11.88%, magnesium 0.06%, sodium 0.24%, potassium 0.10%, iron 0.50%, zinc 13μg/g, copper 137μg/g, managanese 49μg/g.
[2] Calculated values from NRC feeding standard (National Research Council, 1984)

TABLE 2. FEEDING REGIME OF SORGHUM SILAGE AND CONCENTRATE MIXTURES

Liveweight (kg)	Sorghum silage (kg/day)	Concentrate mixture	
		type	(kg/day)
200-250	6.0	A	4.5
250-300	6.0	A	5.5
300-350	5.0	B	8.0
350-400	5.0	B	8.0
400-450	4.5	C	9.0
450-500	4.5	C	10.0

See table 1 for description of concentrate types

Statistical analysis

Data on liveweight were fitted to the non-linear growth curve described by Brown et al. (1976), a modification of Brody's three parameter model ($w=\alpha(1-e^{-kt})$) (Brody, 1964). Fitting of the observed individual value in each breed steer to the model were computed by a FORTRAN program of Gauss-Newton iterative method (Hartley, 1961). The mechanistic model gives

$$w=\alpha(1-\beta e^{-kt}) \quad (1)$$

known as the monomolecular growth function. Where, k is the rate constant of the growth pattern and indicates the rate of approach to asymptotic weight(α) during the self-inhibiting phase of growth. β indicates the fitted parameter related to early weight and maturing changes.

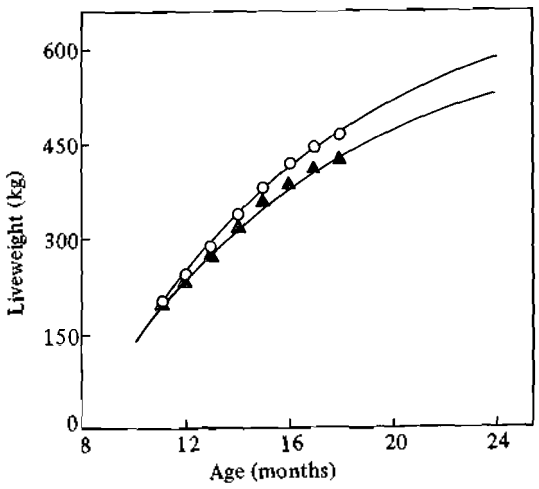

Figure 1. Postweaning growth profiles of Brahman (▲) and Santa Gertrudis (●) steers under feedlot in eastern Paraguay, and that predicted by a mechanistic growth model.

Results and Discussion

In general, growth models are well known to be mechanistic rather than empirical ones (Draper and Smith, 1980). figure 1 shows the successively diminished growth rates with ageing for both breeds steers and highly significant suitability of the theoretical curve to each mean practical value. Non-linear regression function of each breed for growth curve was fitted successfully as follows:

Brahman;

$$w(kg)=638.26(1-2.341e^{-0.10965t}),$$

Santa Gertrudis;

$$w(kg)=716.38(1-2.365e^{-0.10741t}).$$

The k value is positively related to postnatal rate of maturing of steer. As a consequence, the slightly larger k values for the Brahmans indicates relatively earlier maturing in comparison with the Santa Gertrudis. Brown et al. (1976) provided evidence of an inverse relationship between rate of maturing and mature size, suggesting that the more rapid growth of a European X Brahman crossbreds resulted in a lighter mature weight than the purebred European breed. In the present experiment, the mean mature size of Brahman steer estimated from non-linear least square analysis was 11% lower than that of Santa Gertrudis steer. Additionally, since growth rate indicates the first derivative of equation(1) with respect of time, rate of gain can be given by the following equation.

$$\text{Daily gain} = \int_{t0}^{t1} \alpha\beta k e^{-kt}\, dt/t1\text{-}t0$$

If steers were fed as in the experiment from postweaning (11 months of age) to 2 years of age, each mean daily gain in Brahman and Santa Gertrudis would extrapolate to 0.87kg/day and 1.00kg/day. It has been reported that the ratio of energy intake(voluntary feed intake) to basal metabolism is constant between breeds, although fasting metabolic rates per kg liveweight in Brahman crossbred steers are lower than that of European type breed steers (Frisch and Vercoe, 1977). Thus, the difference of growth rate between breeds suggested the inherent characteristics of breed in efficiency of feed utilization attributed ultimately to its quality. In the feeding of tropical pasture forages which are usually slowly digested, Brahman crossbred cattle may digest forage to a greater extent that European type cattle because of longer retention time of digesta in the alimentary canal (Kennedy, 1982; Hunter and Siebert, 1986). In contrast, on feedlots minimized of environmental stresses, utilization efficiencies of dietary protein and energy on high concentrate ration may be low in Zebu type steer. These tendencies of growth performance in Zebu crossbred steers may be stressed by dominance of pedigree of the Zebu breed.

TABLE 3. AVERAGE DAILY GAIN(ADG) AND FEED CONVERSION EFFICIENCY (FCE) FROM WEANING TO THE SLAUGHTER WEIGHT AT 18 MONTHS OF AGE IN BRAHMAN AND SANTA GERTRUDIS

Breed	ADG (kg/day)	FCE (Feed/gain)
Brahman	1.14	11.64
Santa Gertrudis	1.32	10.34
5% LSD	0.07	1.25

TABLE 4. CHILLED CARCASS WEIGHTS AND THE DRESSING PERCENTAGES OF TOTAL CHILLED CARCASS TO LIVEWEIGHT IN BRAHMAN AND SANTA GERTRUDIS SLAUGHTERED AT 18 MONTHS OF AGE

Breed	Number Slaughtered	Carcass weight (kg)	Dressing percentage
Brahman	5	226	59.3
Santa Gertrudis	6	246	58.8
5% LSD		39	3.9

Table 3 shows no significant differences in dressing percentage of total chilled carcass weight of liveweights between Brahman and Santa Gertrudis steers at 18 months of age. The feedlot feeding for 11 months, however, gives Santa Gertrudis an additional fat trim in the carcass of 4.6% ($P < 0.05$), compared with Brahman (3.4%). At the same age, Brahman bulls have been shown to differ in carcass characters from European breed bulls (Jenkins et al., 1981). Although direct evidence is not available in the present experiment, for economical meat production in Paraguay, breed differences in carcass characters of tropical and subtropical beef cattle breeds remain to be elucidated in concert with their feedlots growth behaviour.

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