Rearing of Young Steers on Bahiagrass and Application of Compensatory Growth at Finishing Period for Beef Production

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Bahiagrass, a perennial tropical grass for pasture, shows vigorous growth in the summer season. It is regarded to be promising, particularly in warm lowlands of southeastern Japan, as a substitute for cool temperate grasses which suffer from growth depression in summer. It was first introduced to Japan in 1956, when Pensacola bahiagrass from U.S.A. was grown for trial at the Kyushu National Agricultural Experiment Station. At present, bahiagrass is planted to about 960 ha in the Kyushu region as single seeding or mixed-seeding with dallisgrass.

The Livestock Division of the above Station carried out the grazing experiment on bahiagrass pasture for 6 times during a period from 1964 to 1972 as a part of the studies on "nutrition and beef production of fattening young steers grazing on pasture" and on "compensatory growth of fattening young steers". The purpose of the study was to develop a beef production system in which a labor-saving grazing on pasture is practiced at an early half stage of young steer fattening, followed by the finishing fattening by concentrate at a later half stage, with an aim of reducing costs of beef production.

In this grazing experiment conducted in 6 years, nutrient intake pattern, body weight gain, grazing behavior, productivity of beef at each developmental stage of steers, and the effect of finishing fattening by compensatory growth were examined. Since it had been already known that, in case of young steer fattening with much use of roughage, the supply of much roughage in an early stage and much concentrate in a later stage can give better body weight gains[10], the grazing treatment was taken up in this study.

Rotational grazing at the grazing intensity of 0.68–1.08 are of bahiagrass pasture/head/day, and 1–2 days grazing/plot with an internal of 14–15 days was practiced using a total (in 6 years) of 21 Japanese brown beef steers and 8 Japanese black beef steers, both 8–10 months of age. The grazing period was 140–154 days, except 90 days in 1965, and the number of steers used in each year's experiment was 3–8. The pasture used was that of Pensacola bahiagrass sown in August 1961 at the rate of 0.5 kg/are. Green forage intake and digestibility were measured by digestion trials (Plate 1) with 3 days of preliminary and 2 days of faeces collection period at 14–15 days of interval, using the chromogen and total faeces collection method in 1964 and the chromogen-chromium oxide technique in other years. The grazing experiment in 1965, 1966, 1970 and

Plate 1. The digestion trial on bahiagrass pasture (1966)

1972 included a plot in which supplemental concentrate was supplied at the rate of 1.0–2.4 kg/head/day. In parallel to the grazing experiment, a total of 22 Japanese brown beef steers were fed according to the Japanese Feeding Standard for Young Steer Fattening by housing for the whole fattening periods with the purpose of comparisons.

Herbage intake, digestibility, nutrient intake and body weight gains

Seasonal trend of chemical composition of bahiagrass, sampled to simulate the consumed herbage every 14 days is shown in Fig. 1, in which the result of 1969 is indicated as a typical one[7]. In the grazing period of 154 days, the grass showed a good quality with high crude protein and low crude fiber contents in May–June, an early grazing period, but after late June – early July (end of the rainy season) crude protein decreased with an increase of crude fiber content, giving a very poor quality in and after the hot summer. On the other hand, nitrogen free extracts (NFE) showed an increase after August, when the grass headed and set seeds. Digestability of organic matters decreased from about 80% at the early stage of grazing to 67% in early July–late August hot season. Although some increase was observed later, it became lowest in mid-October, the end of grazing.

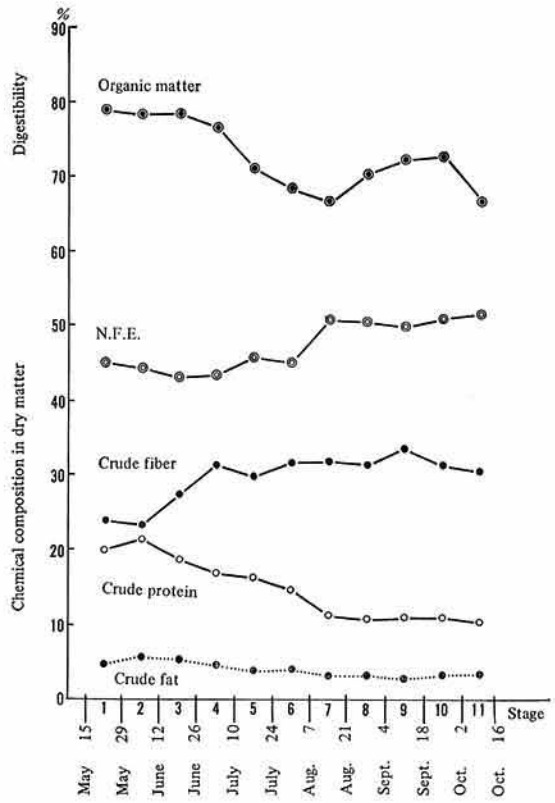

Fig. 1. Seasonal change of chemical composition and digestibility of bahiagrass (1969). Sampled at 14 days interval.

Contents of digestible crude protein (DCP) and total digestible nutrients (TDN) in dry matter of the consumed grass was 8.4±2.2% and 64.1±7.8% respectively[11]. The seasonal change of herbage intake was similar to that of the digestibility of organic matters, and the 6 years average was 19.6±2.3 kg[11]. The intake of dry matter (DM), DCP and TDN per 100 kg of body weight was 1.66±0.19 kg, 0.144±0.049 kg and 1.08±0.22 kg respectively[11].

Table 1 shows intensity rates of utilization of bahiagrass pasture[9], examined in 1972, a final year of the study, with or without the supplemental supply of concentrate (S_1 or S_0) and the limited grazing hours, 4–7 hrs/day (G_1 or G_0). Herbage intake was more influenced by grazing hours than concentrate supplement in an early half period of grazing, showing higher intake in the whole day grazing (G_0) than in limited hours grazing (G_1). However, in a later half period, the concentrate supplement was more influential than grazing hours, giving less intake with the supplement (S_1) than without the supplement (S_0). Thus, the rate of utilization was highest in S_0G_0 plot, and lowest in S_1G_1 plot, because both of S_1 and G_1 treatments reduced the rate of utilization.

Green forage yield per 10 are in a whole grazing period was estimated to be 4,535–4,619 kg from the sum of consumed forage and residual forage in Table 1.

Daily gain of body weight in the grazing period from mid-May to mid-October in 6 years

Table 1. The green forage intake and the rate of utilization of bahiagrass pasture (1972)

Treatment[1]	Green forage intake/day[2]	Green forage intake/10 are	Residual green forage/10 are[3]	Green forage yield/10 are	Rate of utilization
	kg	kg	kg	kg	%
S_1G_1	14.70	2153.8	2381.0	4534.8	47.5
S_1G_0	17.72	2596.4	2082.4	4678.8	55.5
S_0G_1	18.01	2638.8	1908.4	4547.2	58.0
S_0G_0	20.95	3069.6	1597.1	4666.7	65.8

1) S_1: Supplement, S_0: No supplement, G_1: 4 to 7 hrs grazing, G_0: Whole-day grazing.
2) Chromogen-chromium oxide technique.
3) Weighning of all residual forage in a grazing lot on June, July and September.

without concentrate supplement was averaged 0.40±0.23 kg, with greater gains before August and less gains with wider variations after August[1].

A typical body weight gain pattern without concentrate supplement is shown in Fig. 2, together with that of drylot feeding according to the Japanese Feeding Standard (DS plot, expected gain: 1.0 kg, 1970). The grazing plot showed better gains only in an initial 1.5 months period than the drylot feeding plot but later retarded gains although some recovery occurred in September. The similar pattern was observed in each years and which coincides well with a result in Georgia[5], so that it can be regarded as the typical pattern for grazing on bahiagrass.

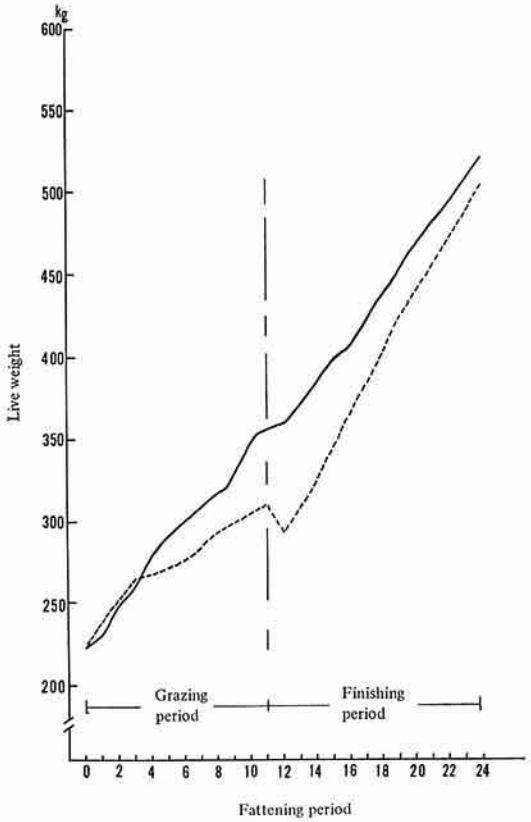

Fig. 2. Live weight changes of young steers (1969).
—— Drylot feeding, ····· Grazing on bahiagrass pasture.

The DCP intake in the grazing period was more than that of Japanese Feeding Standard at an initial stage of grazing, but it decreased rapidly after June. The TDN intake in the grazing period was lower than that of Japanese Feeding Standard at any time: about 80% in an initial stage and 54% at the end of the grazing. Amounts of DM, DCP and TDN intake in the grazing period, expressed in percent to Japanese Feeding Standard, were averaged 74.0±6.5%, 72.5±23.0%, and 74.3 ±10.8% respectively for 6 years, showing a low protein, low calorie intake, which is different from high protein, low calorie intake observed with mix-seeded cool temperate grass pastures[3].

The seasonal pattern of TDN intake was similar to that of body weight gain with some time lag. Significant correlations ($P<.01$), $r=0.389$, -0.587, and 0.356, were observed between daily gain and contents of crude protein, crude fiber and DCP in bahiagrass, respectively[1] Correlations between daily gain and amounts of intake of DM, DCP, and TDN

per 100 kg of body weight were also significant ($P<.01$): $r=0.371$, 0.417, and 0.353 respectively[11]. Furthermore, the daily gain showed significant correlations with digestibility of NFE ($r=0.301$, $P<.05$) and temperature of grazing season ($r=-0.401$, $P<.01$)[11].

As to the relation between daily gain and grazing intensity, it was observed that the higher the intensity the less was the gain, as recognized by Hoveland[2] in bahiagrass pasture. The regression equation obtained is:

$$y=0.9570x-0.5126 \quad (r=0.843)$$

where y=daily gain (kg) in a grazing season
x=grazing area (are)/animal/day

Throughout the all experiments conducted in 6 years, the maximum daily gain obtained without concentrate supplement was about 0.55 kg. Since the lowering of grazing intensity aiming at higher daily gains than that results in a decreased rate of pasture utilization, it is considered reasonable to maintain the grazing area at about 1.1 are/animal/day.

Grazing behavior

The behavior was measured in 1964, 1969 and 1972. Fig. 3 shows the distribution of each behavior in 24 hrs, measured 5 times in 1969[7]. With a lapse of time in grazing, the grazing time decreased gradually, reaching the minimum in mid-July, and then recovered to some extent, whereas the ruminating time increased gradually. Namely, the former decreased with the lowering of grass quality and by the effect of high temperature of summer, while the latter increased with the lowering of grass quality, as recognized by Hancock[1]. Ratio of ruminating time to grazing time showed a close relation with grass quality, as reported by Lofgreen et al.[4]: it increased from 0.6 to about 1.2 in mid-July when the grass quality became very poor[7].

The time used for grazing, ruminating, and resting in the above 1972 experiment[9] was measured in May, July, and September, and shown in an average in Fig. 4. The G_1 and S_1 plots, showed less grazing time than G_0 and S_0 plots, respetcively. The amount of forage intake (in Table 1) corresponds very well to the length of grazing time. The ruminating time showed no difference between treatments, although the S_0 plot seemed to have slightly longer time than the S_1 plot.

The resting time showed no difference among the S_1G_1, S_1G_0, and S_0G_1 plots, but it was apparently shorter in the S_0G_0 plot. It is clear, therefore, that the limited time of grazing or supplemental feeding decreased the grazing

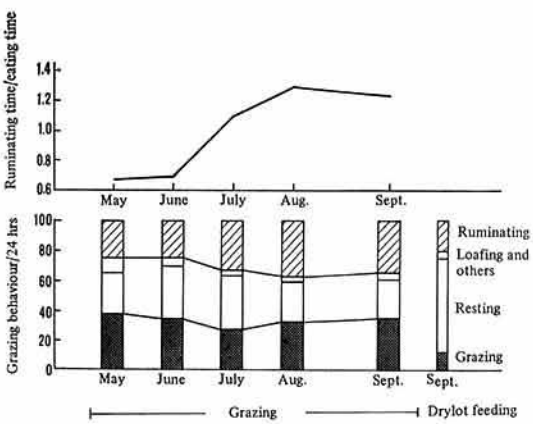

Fig. 3. The behaviour of grazing steers on bahiagrass pasture (1969)

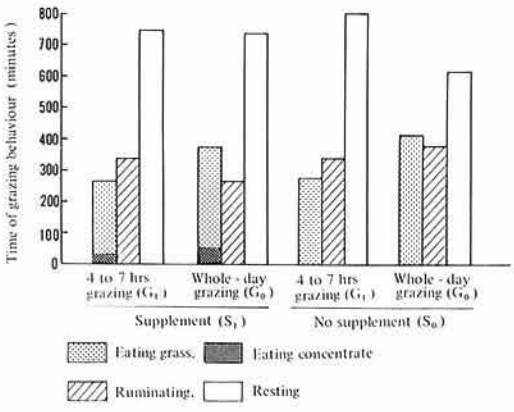

Fig. 4. Effects of supplemental feed and grazing time on grazing behaviour (1972)

time and increased the resting time.

Compensatory growth in finishing period

A total of forage intake during the grazing (140–154 days) was 820–850 kg in terms of air dry matter (87% of which is dry matter). After the end of the grazing, the finishing fattening was practiced using the same amount of feed as that of the control DS plot (drylot feeding for the whole period at the Japanese Feeding Standard). Although the body weight of grazed steers (S_0G_0 plot) was lower than that of DS plot at the end of grazing period, as shown in Fig. 2, a remarkable compensatory growth occurred in the finishing period, and as a result the body weight at the end of finishing period was almost similar to that of DS plot. Such a remarkable compensatory growth was induced by an increased efficiency of energy utilization caused by a realimentation from low nutrition to normal or high nutrition, as well as large reticulorumen which enables an increased intake[6].

In the 1969 experiment[7], which showed the best gain in S_0G_0 plot in the grazing period, the average daily gain for a whole fattening period (336 days) was 0.85 kg, which was almost similar to 0.87 kg of the DS plot. The S_0G_0 plot consumed more roughage than DS plot by 307 kg in air dry matter, but less concentrate by 500 kg in air dry matter. The ratio of roughage: concentrate was 49:51 in the S_0G_0 plot and 34:66 in the DS plot in terms of dry matter.

As to the carcass, the S_0G_0 plot showed lower dressing percentage and thinner rib and back fat than the DS plot, indicating the after effect of low nutrition level in the grazing period. In the 1970 experiment[8], the body weight gain in S_0G_0 plot was very poor, and the plot took 2 more months for the fattening while it consumed more feeds than DS plot. In the S_1G_0 plot, however, the slaughter could be done at the same time as the DS plot, but the saving of concentrate was only 88 kg. Both of S_0G_0 and S_1G_0 plot showed lower dressing percentage and thinner back fat than the DS plot, although meat quality showed no difference. In the 1972 experiment[9], S_0G_0 plot showed the lowest proportion of concentrate consumption in the whole fattening period than other plots with S_1 and G_1 treatment, but resulted in low dressing percentage and slightly thin back fat.

Development of carcass components in fattening

Development of bone, lean meat, and fat meat during the fattening period is shown in Figs. 5 and 6. In the 1969 experiment, the development of carcass, lean meat, and fat meat was very slow during the grazing period (in S_0G_0 plot), and inspite of the remarkable compensatory growth occurred in the finishing period, the final weight of them

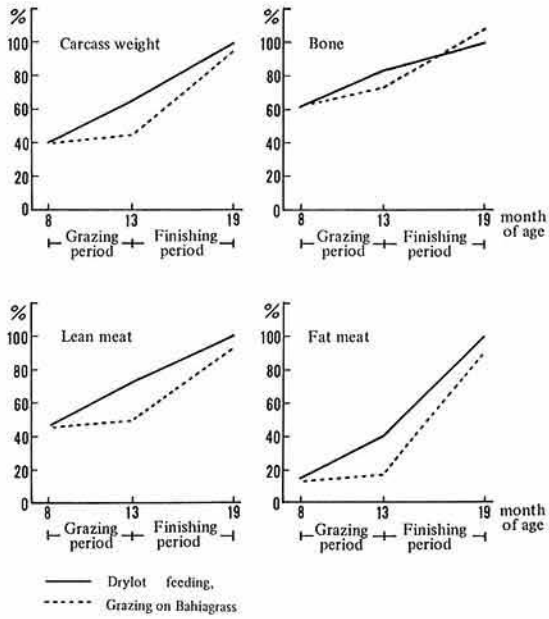

Fig. 5. Carcass components of fattening young steers (1969).
—— Drylot feeding, ----- Grazing on bahiagrass pasture.
Weight of carcass components is shown in percentage, taking the final weight in drylot feeding plot as 100.

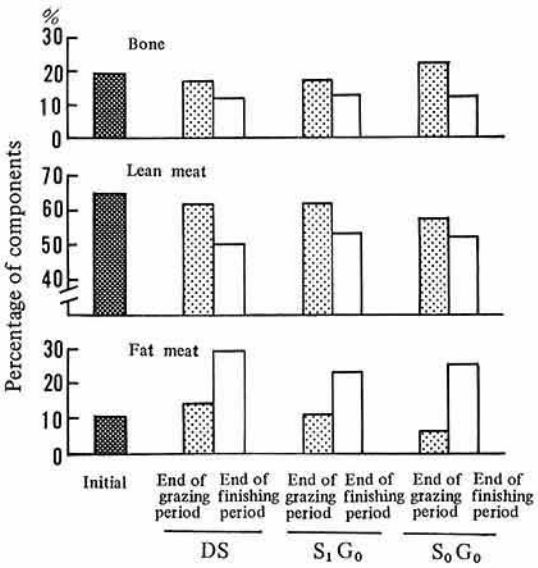

Fig. 6. Percentage of bone, lean meat and fat meat in carcass (1970)
DS: Drylot feeding by Japanese Feeding Standard.
S_1G_0: Whole-day grazing with supplemental feed.
S_0G_0: Whole-day grazing without supplemental feed.

was about 90% of that of DS plot, but the bone development was greater than that of the DS plot. In the 1970 experiment[8], the ratio of bone in the carcass was not changed from the initial ratio or increased during the grazing period in both S_1G_0 and S_0G_0 plots, while the lean meat-ratio showed no big change in the S_1G_0 plot, but it decreased in the S_0G_0 plot. Fat-ratio increased slightly in the S_1G_0 plot, but decreased markedly in the S_0G_0 plot. Thus, it was shown that when the daily gain during the grazing was about 0.25 kg, the ratio of bone in the carcass increased but ratios of lean meat and fat in the carcass were decreased (in S_0G_0 plot). However, at the end of the finishing period, the ratios of bone and lean meat in the carcass were lower than the initial ratios while the ratio of fat was higher than the initial ratio in the all plots. But, the ratios of fat in the carcass in the S_1G_0 and S_0G_0 plot were only 25% and 26% respectively in contrast to 30% in the DS plot.

Conclusion

In southeastern Japan, bahiagrass pasture shows remarkable lowering of grass quality in summer that causes less herbage intake by grazing steers. Together with the adverse effect of high temperature in summer, daily gains of steers grazing on bahiagrass pasture are lower than that of mix-seeded cool temperate grass pastures. However, through the grazing experiment conducted for 6 years, it was found that, unlike the temperate grass pastures, no decay of vegetation occurs in the bahiagrass pasture: even after ten years from the establishment, it can still be utilized for grazing. Therefore, bahiagrass is a promising perennial grass for that region. In addition, there is a possibility to recover the slow growth during the grazing on bahiagrass pasture by the compensatory growth in the finishing fattening. In the fattening aiming at 560 kg of body weight starting from the initial weight of 250 kg, if the practice of grazing in an early half period (140–150 days) of young steer fattening followed by the finishing fattening by drylot feeding is employed, it requires more roughage but less concentrate for the whole period. Although the carcass has heavy bone-ratio, more lean meat-ratio and less fat-ratio, the meat quality is almost similar to that obtained by drylot feeding throughout the whole period, indicating a possibility of producing the meat with consumer's preference.

As shown in the S_1G_0 plot in 1970, the daily gain during the grazing period should be at least about 0.65 kg. Lower gains than this result in prolonged period for finishing fattening and more concentrate consumption. However, supplimental concentrate supply should be avoided because it reduces herbage intake and compensatory growth, although it increases body weight gain to some extent. Therefore, a sufficient amount of bahiagrass at the stage of good quality must be supplied during the grazing in an early half of the fattening period to avoid the supplemental supply of concentrate

as far as possible, and the sufficient amount of concentrate should be supplied during the finishing period of promote the compensatory growth. However, in the single-seeded bahiagrass pasture, steers show low protein, low calorie intakes, so that the reseeding of italian rygrass or the mixed-seeding of legumes will be desirable for bahiagrass pastures.

The most efficient utilization of bahiagrass pasture is to practice a rotational grazing at the rate of 1.1 are/head/day and 2–3 days/plot to maintain the average rate of grazing utilization at about 60%, and to practice the trimming of residual grass for the use as roughage in the finishing period.

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