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Evaluation of Different Feeding Systems in Beef Cattle Production¹

Ismael Carlo, Radaí Mendoza, and Jaime Vélez²

INTRODUCTION

Most beef produced in Puerto Rico comes from cattle fed exclusively on pasture. Of necessity, grazing implies an extensive-type use of high-priced land. Any feeding management factor permitting more intensive land use or a more efficient use of pasture, should help make beef production in Puerto Rico a more economically sound enterprise.

Supplementation of slow-growing pastures during the winter months from December to February may prove economically feasible. To such aim, the Agricultural Experiment Station, Mayagüez Campus of the University of Puerto Rico, designed observations to determine which alternative managerial feeding practices, if any, could be incorporated into beef production to increase annual returns per acre of pasture land.

Results from observations at two Substations, Corozal and Isabela, are presented and analyzed separately.

The data upon which the conclusions are based were the comparative net weight gains and the corresponding dressing percentages of the animals under the different feeding systems at the end of the trials.

EXPERIMENTAL PROCEDURE

One hundred and sixty beef-type, crossbred or grade Brahman and Charolais heifers with initial ages of 7 to 11 months, and average live-weights of 378 to 381 pounds, were included in the observations.

Eighty heifers were randomly assigned to each of the two Substations. The 80 heifers at both the Corozal and Isabela Substation were restrictedly randomized into four treatment-groups of 20 heifers each.

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² Animal Husbandman and Professor, Associate Agronomist and Assistant Agronomist, respectively, Agricultural Experiment Station and College of Agriculture and Mechanical Arts, Mayagüez Campus, University of Puerto Rico, Mayagüez and Río Piedras, P. R.

COROZAL SUBSTATION

The four feeding treatment groups at the Corozal Substation were:

- A. Grazing plus 3 pounds of corn per head per day.
- B. Grazing plus 3 pounds of cane molasses per head per day.
- C. Grazing plus a bulky feed at the rate of 3 pound per head per day when pasture was poor.
- D. Grazing alone.

All animals grazed improved pastures fertilized every 3 months with 5 hundredweights of a 14-4-10 commercial fertilizer per acre. Any necessary liming to keep the soil pH at about 5.8 was applied at the rate of 1 ton per acre per year in a single application. Van Keuren³ states that maximizing beef cattle production from pasture requires, first of all, the maximizing of high-yielding forage varieties nutritionally adequate for the livestock.

The stocking rate was based on two animals per acre of pasture. Bryant et al.⁴ stated that higher animal outputs usually result with a grazing pressure that will provide an opportunity for selective grazing when either continuous or rotational grazing management is used. Factors that affect yield, quality and longevity of pastures grown for animal feed should be considered in a livestock enterprise.

Salt and water were available to the heifers at all times in all treatments. Pasture rotation was also performed to prevent overgrazing by changing the animals from each lot at intervals of 10 to 15 days in accordance to growth rate of the grass. Animals were weighed initially, and monthly thereafter throughout the duration of the trials.

The observations were concluded when a group of 20 heifers first reached an average liveweight of 850 pounds. The rate of animal gain was the criterion for evaluation of the feeding regimes. In addition, some economical aspects of the systems were considered.

The heifers were slaughtered at the Caguas slaughterhouse and their dressing percentages obtained.

ISABELA SUBSTATION

The four feeding treatment groups at the Isabela Substation were:

- I. Bulky feeding ad libitum.
- II. Grazing with a bulky ration finishing period.
- III. Grazing alone.
- IV. Pangola grass soilage ad libitum.

³ Van Keuren, R. W., Symposium on pasture methods for maximum beef cattle production, *J. Anim. Sci.*, 30(1): January 1970.

⁴ Bryant, H. T., Blaser, R. E., Homes, Jr., R. C. and Fontenot, J. P., Symposium on pasture methods for maximum beef cattle production, *J. Anim. Sci.*, 30(1): January 1970.

The kind and management of pasture, allotment of space per animal, and weighing of the heifers were similar to those of the Corozal Substation groups.

Ad libitum bulky feeding (treatment I) was done throughout the trial with the following formula prepared at the Lajas Substation mixing unit:

<i>Ingredient</i>	<i>Percent</i>
Ground yellow corn	30.00
Crude sugarcane bagasse	33.25
Cane molasses	30.00
Fish meal	3.00
Urea	2.00
Salt	1.00
Dicalcium phosphate	0.75
Vitamin A supplement	2,000 I.U./lb.

After a grazing period of 200 days, the heifers on treatment II were stratified by weight into two sub-groups of 10 animals each, and put on a finishing ration. The heifers on ad libitum bulky feeding from treatment I were similarly stratified. One each of the two sub-groups of 10 heifers from treatment I was then added to a corresponding sub-group from treatment II, and the resulting two groups of 20 animals were placed on the finishing bulky ration for 198 days, in contiguous dry-lot corrals.

The formula for the finishing bulky ration offered ad libitum was:

<i>Ingredient</i>	<i>Percent</i>
Ground yellow corn	35.00
Crude sugarcane bagasse	25.00
Cane molasses	32.50
Fish meal	4.00
Urea	1.75
Salt	1.00
Dicalcium phosphate	0.75
Vitamin A supplement	2,000 I.U./lb.

The grazing-alone group of treatment III was kept on pasture throughout the duration of the trials.

Pangola grass soilage was fed ad libitum for 216 days to treatment IV heifers. Poor performance forced the termination of the soilage observations and group IV heifers were thenceforth on grazing alone.

RESULTS AND DISCUSSION

ISABELA SUBSTATION

The analyses of the data shown on table 1 indicate no significant difference between the following treatments compared on weight gains through 360 days:

1. Treatment I (ad libitum bulky feeding) vs. treatment II (grazing/finishing).
2. Treatment I (ad libitum bulky feeding) vs. treatment III (grazing alone).
3. Treatment II (grazing/finishing) vs. treatment III (grazing alone).

There was a significant difference in favor of treatment II over treatment IV (Pangola grass soilage/grazing).

Highly significant differences were found between treatment I and treatment IV and between treatment III and treatment IV. In both cases the difference was against those heifers in the Pangola grass soilage/grazing group. The growth curve of the heifers in all treatments is shown in figure 1.

As indicated previously, heifers under treatment IV were switched to grazing alone because of poor performance while on soilage. These heifers recovered, and gained weight very acceptably soon after they were switched to pasture alone. Through the 216 days on soilage, the total average gain of

TABLE 1.—Average liveweights and gains (pounds) of heifers in different treatments at the Isabela Substation

Treatment	Average weights			Rate of gain
	Initial	Final	Gain	
I Bulky feeding	397.91	837.59	439.68	1.18
II Grazing + finishing	394.00	820.04	426.04	1.16
III Grazing alone	377.00	740.05	363.05	1.01
IV Soilage	356.91	702.32	345.41	.90

only 122.14 pounds represented an average daily gain of only 0.56 pound; and during the 164 days on grazing alone, the total average gain was 223.27 pounds, for an average daily gain of 1.36 pounds. The overall average gain was 345.41 pounds with a corresponding average daily gain of 0.90 pound.

The average bulky feed consumption for treatment I was 17.33 pounds per day per animal and 39.28 pounds for the Pangola grass soilage group.

The dressing percentage was obtained by dividing the hot carcass weight by the "shrunk" liveweight recorded immediately before slaughtering. The bulky-fed group (treatment I) had a dressing percentage of 64.26, the highest of the three groups, which was significantly different when compared to treatment III (grazing alone) that dressed 62.30 percent, or to treatment II (grazing/finishing) that dressed 62.23 percent. There was no significant difference between treatments II and III.

Under the conditions of these observations, the analyses of the data indicate that Pangola grass soilage is unsuitable for rearing beef cattle.

The data also indicate that treatment I showed no better weight gains

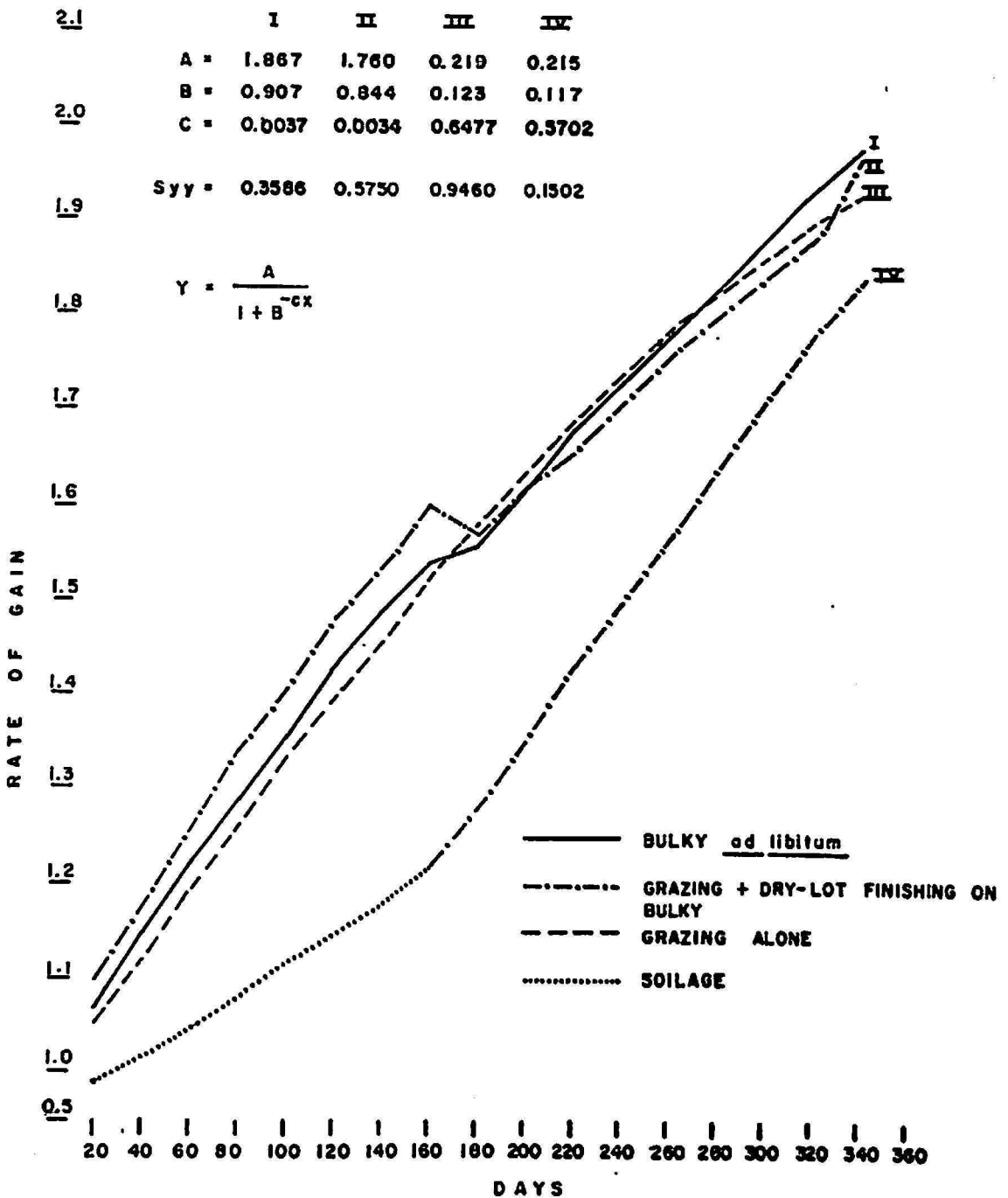


FIG. 1.—Growth curve for all heifers in the different feeding managements at Isabela Substation.

than treatment III, and that treatment II was no better in weight gains than treatment I.

Concentrate feeding is more costly than grazing alone; similarly, the use of soilage, due to the need for machinery and considerable extra labor also costs more than grazing. However, soilage or concentrate feeding should not be completely disregarded, especially where expensive land must be used intensively or where pasture production is inadequate.

Better quality of beef produced is another consideration about the use of concentrate feeding either ad libitum or in finishing period; whenever such beef is preferred and paid for, the producer may consider such types of feeding. However, up to now, the industry in Puerto Rico does not pay differentially for better grades of beef.

COROZAL SUBSTATION

Results of the year-long observations at the Corozal Substation, shown in table 2, indicate that:

1. There was high significance between the following:
 - a. Treatment A (grazing plus 3 pounds of ground yellow corn per head per day) over the other three treatments.
 - b. Treatment B (grazing plus molasses) over treatment C (grazing plus seasonal concentrate supplementation).

TABLE 2.—Average liveweights and gains (pounds) of heifers in different treatments at the Corozal Substation

Treatment	Average weights			Rate of gain	Economic gains/heifer
	Initial	Final	Gain		
A Grazing + ground corn	361.30	849.30	488.00	1.22	—\$ 6.90
B Grazing + molasses	384.80	767.45	382.65	1.06	+ 4.99
C Grazing + concentrate supplementation when poor pasture	399.85	757.26	357.41	0.97	+ 18.96
D Grazing alone	365.60	737.52	371.92	0.93	+ 31.60

- c. Treatment D (grazing alone) over treatment C (grazing plus seasonal concentrate supplementation).

2. There was no significant difference between treatment B (pasture plus molasses) and treatment D (grazing alone).

The growth curve for all the heifers in the different treatments (fig. 2) indicates no significant difference between treatments from 20 up to 60 days on trials. At 80 days, there was a highly significant difference between treatment A and either treatment B or treatment D. The same was true at 100 days, including treatment C. From then on, the differences continued in the same relationship until the heifers reached 220 days on the trials, when a significant difference was detected between treatment D and treatment C. From 240 days up to termination at 360 days, the results were as shown at the beginning of this section.

The results obtained in the Corozal Substation trials indicate that molasses supplementation (treatment B) had no advantage over grazing alone (treatment D). Therefore, there is no justification in spending money on

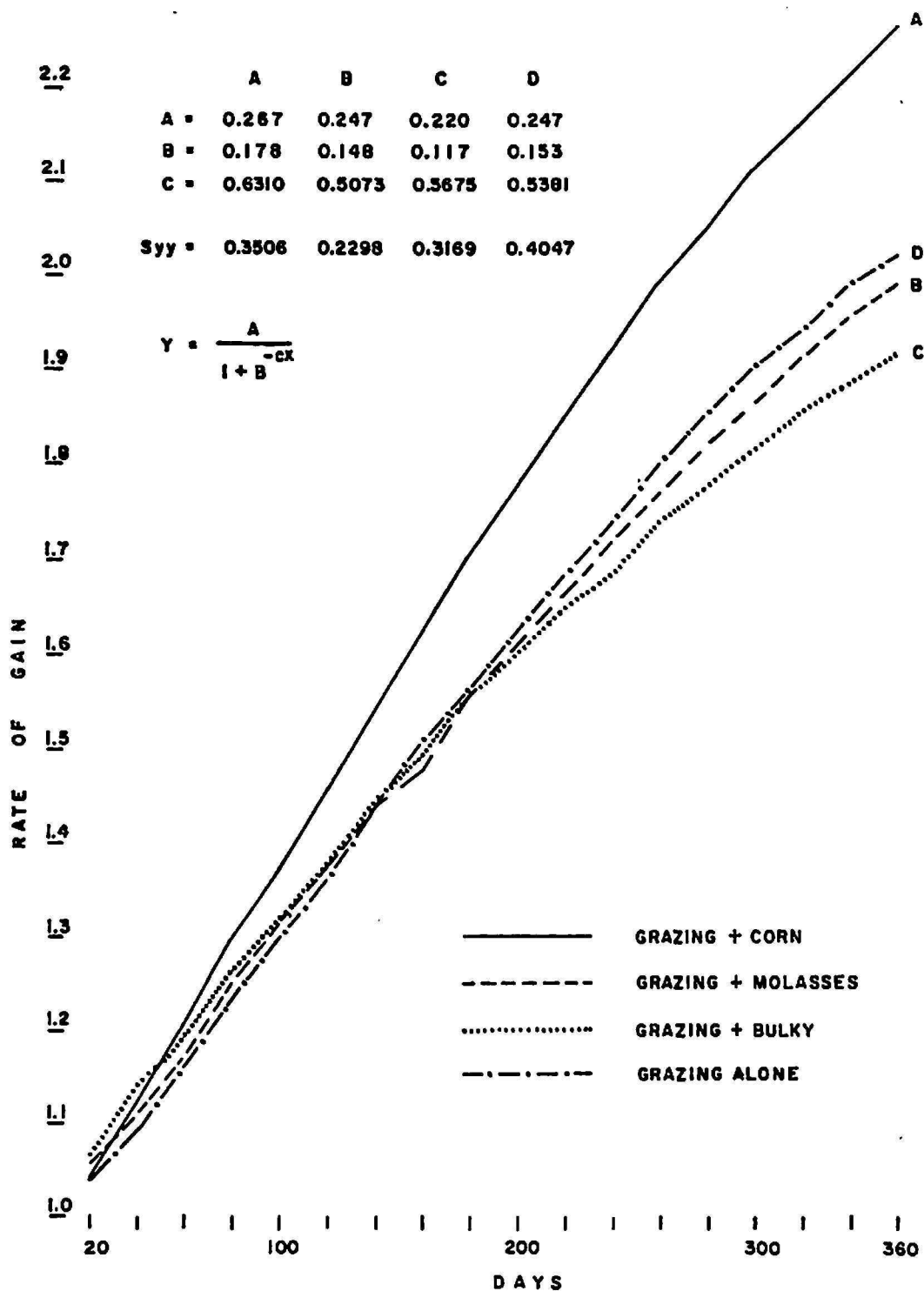


FIG. 2.—Growth curve for all heifers in the different feeding managements at Corozal Substation.

molasses and on the extra labor to handle it, to obtain the same results as from grazing alone.

The statistical superiority of the corn supplementation (treatment A) over the other three treatments is offset when the economic aspects are considered. Let it be assumed that "feeders" be bought and sold at \$18 per

arroba⁵ (which is equivalent to \$28.80 per carcass hundredweight) on the hoof, with cost of corn at \$4.00 per hundredweight, of molasses at \$1.80 per hundredweight, of use of pasture at \$5.00 per animal per month, of bulky feed at \$2.50 per hundredweight, and feeding cost to be 75 percent of total cost of production. By using the actual initial and final weights of these heifers, the following can be determined: A net loss of \$6.90 per animal on treatment A (grazing plus corn supplementation); a net gain of \$4.99 per heifer on treatment B (molasses supplementation); a net gain of \$18.96 per heifer on treatment C (seasonal concentrate supplementation to grazing); and a net gain of \$31.60 per head on treatment D (exclusive grazing). Expressed in terms of land use, with two animals per acre as in these trials, the corresponding net loss or net profits will be doubled.

Heifers from the Corozal Substation were slaughtered at the Caguas slaughterhouse and dressing percentages were 60.70 for those on treatment A, 60.40 for those on treatment B, 59.10 for those on treatment C, and 59.03 for those on treatment D. Dressing percentage for treatment A was significantly different over that for treatments C and D. No statistical analysis for treatment B was made, although these heifers dressed an average of 60.40 percent. Therefore, no significant difference could be assumed between treatments A and B, nor between B and C or D.

The figures obtained clearly indicate that providing any type of concentrate supplementation to grazing animals increases dressing percentage over that of animals on exclusive grazing.

Two points of interest have become evident from slaughter data obtained from these heifers:

1. The dressing percentage of all heifers slaughtered under these observations, irrespective of feeding management, was substantially higher than the 40 percent routinely paid for animals of this type in Puerto Rico.
2. There is a general discrimination against heifers among buyers who claim a lower dressing percentage than for males. Dressing percentages of these heifers are comparable to those obtained from bulls and steers in previous observations reported by this Station.⁶

The dressing percentage data on heifers disprove both misconceptions referred to, and should be a factor of importance in their eventual redress in economic favor of the cattle grower.

⁵ An arroba is equivalent to 25 pounds.

⁶ Carlo, I., Arcelay, C. L., Mendoza, R., Ramírez, W., and Cestero, H., *Evaluación de Datos Obtenidos de Toros y Novillas Procedentes del Primer Cruce Entre Toros de Razas para Carne con Vacas Lecheras Desechadas*, Agr. Exp. Sta. Univ. P.R. Bull. 225, July 1970.

SUMMARY

Different feeding systems for beef cattle production were studied at the Corozal and Isabela Substations of the Agricultural Experiment Station, University of Puerto Rico. The data for each location were analyzed separately. Observations at Isabela indicate that Pangola-grass soilage is not suitable for rearing beef cattle. Ad libitum feeding of a bulky ration showed no comparative advantage over grazing alone in weight gains of the heifers. Similarly, a finishing period on ad libitum bulky feed was no better than grazing alone.

The dressing percentage for the ad libitum bulky-fed group was 64.26 percent compared to 62.30 percent for the group on grazing alone and to 62.23 percent for the group on grazing plus a finishing period on ad libitum bulky feed. There was no significant difference between these two latter groups. The soilage group was not slaughtered.

Data from the Corozal Substation indicate that corn supplementation was superior to the other treatments in regard to weight gains of the heifers. However, when economical aspects are considered, corn supplementation may prove unjustifiable. The molasses supplementation was no better than grazing alone.

The dressing percentage of the corn supplemented heifers was significantly different from grazing alone (60.70 vs. 59.03 percent) and from grazing plus concentrate supplementation when pastures were poor (60.70 vs. 59.10 percent). Dressing data for the molasses-fed group (60.40 percent) were not statistically analyzed because individual liveweights of heifers were not obtained for reference against the corresponding "hot carcass" weights.

RESUMEN

La Estación Experimental Agrícola del Recinto Universitario de Mayagüez de la Universidad de Puerto Rico, llevó a cabo una serie de pruebas con diferentes sistemas de alimentación en novillas para carne. Los datos obtenidos en las Subestaciones de Isabela y Corozal se presentan y se analizan separadamente.

En la Subestación de Isabela se demostró que la yerba Pangola picada, suministrada a las novillas ad libitum, no es adecuada para la crianza de este tipo de ganado y que una ración de concentrados, tipo "bulky", igualmente suministrada, tampoco dio buenos resultados al compararse con el pastoreo solamente. Tampoco lo fue el pastoreo con una ración ad libitum de alimento concentrado, tipo "bulky", en su etapa final de engorde, al compararse con el pastoreo solo.

El rendimiento en canal fue significativamente mejor en el grupo que recibió el concentrado "bulky" ad libitum (64.26 por ciento), que en el que estuvo a pastoreo solamente, el cual rindió 62.30 por ciento, y que el que se sometió a un periodo final de engorde, el cual rindió 62.23 por ciento. No hubo diferencia significativa entre estos dos últimos sistemas de alimentación. El grupo que se alimentó exclusivamente con yerba Pangola cortada no se consideró para los efectos del análisis, ya que los animales no se sacrificaron.

En la Subestación de Corozal se demostró que la ganancia en peso de las novillas cuya alimentación se suplementó con maíz molido fue significativamente superior a las que se sometieron a dos otros sistemas de alimentación. También se demostró que la miel, como alimento suplementario, no fue de utilidad alguna al compararse con el pastoreo solo. Sin embargo, la suplementación del pastoreo con maíz molido conlleva tales gastos por concepto de alimentos, que hace que el negocio no sea lucrativo para el ganadero.

El rendimiento de las novillas que recibieron un suplemento de maíz indicó una diferencia significativa sobre las que se alimentaron al pastoreo exclusivamente (60.70 vs. 59.03 por ciento) y al pastoreo suplementado con un concentrado del tipo "bulky" cuando el pasto escaseó (60.70 vs. 59.60 por ciento). El análisis estadístico del rendimiento real (60.40 por ciento) del grupo cuya alimentación fue suplementada con miel no se llevó a cabo porque el peso vivo individual de cada novilla no se anotó para poder correlacionarlo con el peso respectivo de su canal inmediatamente después de sacrificar el animal.