SELF-FEEDING SALT-SUPPLEMENT TO GRAZING STEERS UNDER TROPICAL CONDITIONS

C. F. CHICCO,¹ T. A. SHULTZ,² J. RIOS,³ D. PLASSE ² AND M. BURGUERA ²

Centro de Investigaciones Agronómicas and Facultad de Ciencias Veterinarias, Maracay—Venezuela

BEF production in Venezuela is essentially carried on under grazing conditions. The use of concentrate supplements to reduce body weight losses during the dry season and to insure more accelerated gains during the rainy season is practically unknown.

With the increased demand for meat and the establishment of price differentials for an improved product, ample justification exists to initiate research on the practice of supplementation for animals under grazing conditions and the regulation of concentrate consumption using high salt levels.

The incorporation of salt in the supplement to regulate intake has been demonstrated by some authors to be practical for beef cattle (Cardon et al., 1951; Riggs, Colby and Sells, 1953; Savage and McIlvan, 1954; Meyer et al., 1955; Kroger and Carroll, 1964) and sheep (Weir and Miller, 1953; Weir and Torrell, 1953), while others have observed limitations to this practice (Hentges et al., 1967; Wagnon, 1965).

The objectives of this experiment were to evaluate the effect of self-feeding a 30% salt-supplement to beef cattle grazing average quality tropical pasture on animal performance, some rumen processes and hemat values, apparent digestibility and carcass characteristics.

Materials and Methods

Thirty-six crossbred Brahman x Red Poll (Br x RP), Brahman x Charolais (Br x Ch) and Brahman x Brown Swiss (Br x BS) steers averaging 22 months of age were uniformly assigned to three treatments: pasture (control), pasture+basal-30% salt-supplement fed ad libitum, and pasture+-basal supplement fed equally to the intake less the salt of the preceding group by weekly adjustments. The basal-30% salt-supplement was offered in portable wind protected feeders once weekly at 30% level above preceding week consumption. All animals grazed at a rate of two animals/hectare on Pangola pastures (Digitaria decumbens) having on average 5.5% crude protein (dry matter basis).

The supplement consisted of 57% rice polish, 40% sesame meal and 2.8% bone meal. In the basal-30% salt-supplement, 30% of the ingredients were replaced by common salt. In addition to the forage and supplement a commercial salt-mineral mix (table 2) was offered ad libitum to the animals in the control and basal supplement treatments.

The duration of the experiment was 120 days with monthly weighings preceded by an 18-hr. fasting period. At the end of the treatment, blood samples were taken from all animals and analyzed for sodium by standard flame photometer using an external indicator, chlorine and chloride by routine volumetric procedures using silver nitrate, hemoglobin by conventional alkaline hematin procedure and hematocrit by the standard Wintrobe method.

Upon completion of the trial, two animals per treatment were used to determine apparent digestibility and nitrogen balance by a 7-day total fecal and urinary collection preceded by a 7-day adjustment period.

All animals were sacrificed and dressing percentage, carcass grade (U.S.D.A. 1965), rib-eye area (McBee and Wiles, 1967) and kidney weight were determined.

Simultaneously, two fistulated steers per treatment were used to evaluate dietary effects upon rumen microbial nitrogen (Winter, Johnson and Dehority, 1964), volatile fatty acids (Erwin, Marco and Emery, 1961) and cellulose digestion by nylon bag suspensions (Hopson, Johnson and Dehority, 1963). Standard methods were used for determination of cellulose (Crampton and Maynard, 1938) and nitrogen (A.O.A.C., 1965). The data were treated by analysis of variance and the differences between means by the Duncan’s multiple range test.
Results and Discussion

Body weight gains and consumption data (table 1) show that the control animals gained less (P<.05) than those supplemented and no significant differences were observed between the salt and the basal supplemented groups. Similar observations have been reported by other authors (Meyer et al., 1955; Weir and Miller, 1953; Weir and Torrell, 1953). The intake of the basal-30% salt-supplement was consistently variable throughout the experiment (850±345 g/anim./day) as also reported by Hentges et al. (1967). Variability in consumption of supplements having a high salt content has been related to effects of pastures, seasons and age of cattle with more variation in older animals, especially gestating cows (Waggon, 1965).

No significant differences were observed among treatments for plasma sodium, chloride and chloride concentrations and hemoglobin and hematocrit values (table 2). This is in agreement with previous reports (Riggs et al., 1953; Weir and Miller, 1953) which indicate that animals can tolerate high amounts of salt in the diet under normal feeding conditions when water is readily available.

No appreciable differences were observed for concentrations of individual volatile fatty acids (table 3) between the supplemented groups. However, the total of these components was significantly lower (P<.05) in the salt-supplement due to a greater acetic and propionic acid concentration in the basal-supplemented group. The molar concentration of acetic and of the total volatile fatty acids was significantly lower (P<.01) in the control group as compared with the supplemented groups.

A similar pattern was observed in rumen microbial nitrogen with the control being significantly lower (P<.01) than the other treatments and the basal supplement higher (P<.01) than the basal-30% salt-supplement. Corresponding results for ruminal cellulose digestion indicate that both supplementations improved (P<.01) utilization of this type of forage, though the celluolytic activity in the supplemented groups was significantly lowered (P<.05) when the high salt level was incorporated in the ration. Infusion of high salt levels into the rumen has been reported not to affect in vitro cellulose digestion or rumen motility over a period of several days (Kroger and Carroll, 1964). In addition, the total digestibility of cellulose (table 4), as well as the dry matter and protein digestion, was not affected by the treatments. Similar results have been reported for the digestibility of dry matter and protein (Meyer et al., 1955; Archer et al., 1952) and cellulose (Kroger and Carroll, 1964; Cardon, 1953). On the other hand, observations have indicated a beneficial effect of salt on dry matter digestibility (Riggs et al., 1953), while others have shown a significant reduction in crude fiber and organic matter utilization (Nelson et al., 1955).

Nitrogen balance data showed a significantly greater intake (P<.05) and urinary losses (P<.01) of nitrogen for the supplemented groups. Nitrogen retention was significantly (P<.01) depressed by the high salt ration due to increased (P<.01) urinary losses. However, differences among treatments in the nitrogen balance data when expressed as percent of the nitrogen intake, were not significant. Negative nitrogen retention with high salt intake has been reported in previous trials (Nelson et al., 1955; Riggs et al., 1953) but was not observed in experiments with fattening rations having lower salt levels (Meyer et al., 1955). Renal function, as affected by salt loading (Weeth and Lesperance, 1965; Gottschalk, 1960), indicates that reabsorption of the osmotic load decreases and a highly

<table>
<thead>
<tr>
<th>Observations</th>
<th>Control</th>
<th>Basal-30%</th>
<th>Basal-suppl.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Initial weight, kg</td>
<td>281</td>
<td>320</td>
<td>328</td>
</tr>
<tr>
<td>Final weight, kg</td>
<td>328</td>
<td>327</td>
<td>342</td>
</tr>
<tr>
<td>Daily gains, g</td>
<td>325c</td>
<td>474d</td>
<td>316a</td>
</tr>
<tr>
<td>Daily supplement intake, g</td>
<td>...</td>
<td>290</td>
<td>865</td>
</tr>
<tr>
<td>Salt consumed, g/day</td>
<td>...</td>
<td>261</td>
<td>...</td>
</tr>
<tr>
<td>Salt, Mineral Mix consumedb</td>
<td>31</td>
<td>...</td>
<td>21</td>
</tr>
</tbody>
</table>

a Means based on 12 animals per treatment.
b The salt mineral mix contained 50% common salt and 50% commercial mineral mix having on analysis (%): Ca, 10.0; P, 6.5; Mg, 2.0; Mn, 0.10; Fe, 0.20; Cu, 0.12 and Zn, 0.10.

c Significantly different (P<.05).
TABLE 3. EFFECT OF SUPPLEMENTS UPON SOME RUMEN PROCESSES a, b

<table>
<thead>
<tr>
<th>Observations</th>
<th>Control</th>
<th>Basal-30% Suppl.</th>
<th>Basal-suppl.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acetic acid, mM/liter</td>
<td>55.8 (69.8)</td>
<td>59.3 (68.2)</td>
<td>61.0 (68.6)</td>
</tr>
<tr>
<td>Propionic acid, mM/liter</td>
<td>13.3 (16.6)</td>
<td>14.8 (17.0)</td>
<td>15.8 (17.8)</td>
</tr>
<tr>
<td>Butyric acid, mM/liter</td>
<td>9.1 (11.4)</td>
<td>10.7 (12.3)</td>
<td>10.0 (11.2)</td>
</tr>
<tr>
<td>Isovaleric acid, mM/liter</td>
<td>1.0 (1.2)</td>
<td>1.2 (1.4)</td>
<td>1.2 (1.4)</td>
</tr>
<tr>
<td>Valeric acid, mM/liter</td>
<td>0.8 (1.0)</td>
<td>0.9 (1.1)</td>
<td>0.9 (1.0)</td>
</tr>
<tr>
<td>Total VFA (C2-C6), mM/liter</td>
<td>80.9 c</td>
<td>86.9 df</td>
<td>88.9 de</td>
</tr>
<tr>
<td>Microbial Nitrogen, mgN/100 ml</td>
<td>176.0 c</td>
<td>219.0 d</td>
<td>238.0 de</td>
</tr>
<tr>
<td>Cellulose digestion 48 hr., %</td>
<td>38.2 c</td>
<td>45.3 df</td>
<td>49.6 de</td>
</tr>
</tbody>
</table>

* Means based on four determinations per animal, two animals per treatment.
* Means in parentheses are volatile fatty acids concentrations (Molar %).
* e, a Means in the same line bearing different superscript letters are significantly (P<.01) different.
* f, e Means in the same line bearing different superscript letters are significantly (P<.05) different.

correlated increase in excreted urinary nitrogen occurs.

Carcass data (table 5) demonstrate that dressing percentage, rib-eye area and slaughter grade were not affected by the limited amount of supplement or salt content used in this growth trial. It has been reported, however, that a 12.8% salt level in a fattening supplement significantly reduced carcass grades in steers and wethers (Meyer et al., 1955).

Although no differences were observed among treatments for kidney weights, an increase was noted in the high salt treatment and histological examinations revealed osmotic nephritis. Some previous observations (Meyer et al., 1955; Riggs et al., 1953) did not show kidney damage due to salt intake. Nevertheless, significant increases in kidney weights were observed when a fattening ration contained 9.4% salt (Meyer et al., 1955). Detailed studies on renal function in ruminants receiving high salt loads suggest that detrimental alterations in the kidney could occur, (Weeth and Lesperance, 1965; Nelson et al., 1955; Pistor, Nesbitt and Cardon, 1950).

Comparing the different crossbred animals used in this experiment (table 6) it is apparent that the Brx BS steers gained slightly more weight than the Brx RP or the Brx Ch animals, but had significantly lower (P<.05) dressing percentages, rib-eye areas (P<.10) and carcass grades (P<.10). The carcass grades from the animals of this trial are comparable to observations of Brahman x Shorthorn (Carpenter et al., 1961) and Brahman x Hereford carcasses (McCormick and Southwell, 1957).

The lower dressing percentages observed in this experiment as compared to previous reports of Brahman crossbred steers (Carpenter et al., 1961; McCormick and Southwell, 1957; Carroll, Rollins and Ittner, 1955) may be explained by differences in feeding regimes and age.

TABLE 4. EFFECTS OF SUPPLEMENTS UPON APPARENT DIGESTIBILITY AND NITROGEN RETENTION a, b

<table>
<thead>
<tr>
<th>Observations</th>
<th>Control</th>
<th>Basal-30% Suppl.</th>
<th>Basal-suppl.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dry matter digest., %</td>
<td>55.3</td>
<td>58.4</td>
<td>63.9</td>
</tr>
<tr>
<td>Cellulose digest., %</td>
<td>60.0</td>
<td>61.5</td>
<td>63.5</td>
</tr>
<tr>
<td>Protein digest., %</td>
<td>67.6</td>
<td>64.0</td>
<td>65.4</td>
</tr>
<tr>
<td>Nitrogen balance</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Intake, gN/day</td>
<td>98.6 e</td>
<td>129.0 f</td>
<td>118.4 f</td>
</tr>
<tr>
<td>Fecal loss, gN/day</td>
<td>32.0 (32.5)</td>
<td>46.4 (36.0)</td>
<td>41.0 (34.6)</td>
</tr>
<tr>
<td>Urinary loss, gN/day</td>
<td>63.6 e (64.5)</td>
<td>84.5 e (65.5)</td>
<td>74.3 e (62.8)</td>
</tr>
<tr>
<td>Nitrogen retained, gN/day</td>
<td>3.0 e (3.0)</td>
<td>-1.9 a (-1.5)</td>
<td>3.1 e (2.6)</td>
</tr>
</tbody>
</table>

* Means based on two determinations per animal, two animals per treatment.
* Means in parentheses are percentages of the nitrogen intake.
* e, f Means in the same line bearing different superscript letters are significantly (P<.01) different.
* a, t Means in the same line bearing different superscript letters are significantly (P<.05) different.
Summary

The effects of self-feeding a 30% salt-supplement were evaluated in crossbred Brahman steers grazing tropical pastures. Animal performance, rumen and hematic values, digestibility and carcass characteristics were studied.

Body weight gains were increased (P<.05) by supplementation and were not significantly altered when a high salt level (30%) was incorporated in the concentrate. No appreciable differences were observed in blood sodium, chloride and chlorine concentration or hematocrit and hemoglobin values.

Rumen total volatile fatty acids were increased by supplementation (P<.01) with differences for acetic acid being significant (P<.01). Salt intake did not reduce individual VFA's notably but did depress (P<.05) the total of these. A similar pattern of results was observed for cellulose digestion in the rumen. A highly significant (P<.01) increase of microbial nitrogen in rumen contents was found in the supplemented groups, the basal being greater than the basal-30% salt-supplement.

Apparent digestibility of dry matter, cellulose or protein was not significantly affected by treatments. Less (P<.01) nitrogen was retained in the animals consuming the high salt ration due to increased (P<.01) urinary losses.

The feeding regimes used in this trial did not affect dressing percentages, rib-eye or carcass grade. Enlarged kidneys showing osmotic nephritis were observed from animals on the salt-concentrate diet.

Brahman x Brown Swiss steers had slightly more rapid body weight gains than the Brahman x Red Poll or Brahman x Charolais animals but had reduced dressing percentages (P<.05), rib-eye area and carcass grade (P<.10).

Literature Cited


McBee, J. L., Jr. and J. A. Wiles. 1967. Influence or

---

TABLE 6. EFFECT OF CROSSBREDS UPON GROWTH AND CARCASS TRAITS *

<table>
<thead>
<tr>
<th>Breed type</th>
<th>Daily gains (g)</th>
<th>Dressing percentage (%)</th>
<th>L. dorsi b (cm²)</th>
<th>Carcass grade (U.S.D.A.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Brahman x Charolais</td>
<td>427</td>
<td>53.5 e</td>
<td>52.2 e</td>
<td>3.6 e</td>
</tr>
<tr>
<td>Brahman x Red Poll</td>
<td>431</td>
<td>53.2 e</td>
<td>51.7 e</td>
<td>3.7 e</td>
</tr>
<tr>
<td>Brahman x Brown Swiss</td>
<td>462</td>
<td>51.6 a</td>
<td>51.5 a</td>
<td>3.2 e</td>
</tr>
</tbody>
</table>

* Means based on 12 animals per breed type.

b Measurements between eighth and 9th rib.

c 2=Standard, 3=Good, 4=Choice.

d, e Means in the same column bearing different superscript letters are significantly (P<.05) different.

t, g Means in the same column bearing different superscript letters are significantly (P<.10) different.
marbling and carcass grade on the physical and chemical characteristics of beef. J. Anim. Sci. 26:701.


