A series of feeding experiments were undertaken with weaner cattle to assess the effects on liveweight performance of supplementing a basal diet of molasses, urea and roughage with various protein and energy supplements. The supplements included extruded soyabeans, a mixture of extruded soyabeans and crushed maize grain, or soyabeans and crushed maize extruded together. These experiments indicate there was no beneficial effect on liveweight performance of including maize in an extruded whole soyabean supplement given to cattle consuming a molasses/roughage based diet either under feedlot or grazing conditions.

INTRODUCTION

Liquid molasses combined with roughage and a source of non-protein nitrogen and bypass protein has been widely used as a production ration for lot fed cattle (Preston and Willis 1974). Inclusion of a source of starch from maize grain in this diet has been shown to increase the intake of molasses, and growth rate and food conversion ratio in cattle (Preston and Willis 1974, Sundstrom and Walker 1977). Liquid molasses/urea and bypass protein has also been used as a production supplement to cattle grazing dormant, low quality pastures (Llewelyn et al. 1978; Gulbransen 1982).

For ruminants to increase production on these molasses/urea/roughage (MUR) based diets, metabolisable energy (ME) intake must be increased. Provision of some high energy supplements can substitute for the basal dietary material such that overall liveweight performance is unchanged. However provision of high energy supplements which provide no effective rumen load may increase ME intake and increase liveweight performance (Kempton 1982a).

Appreciable amounts of dietary starch can escape ruminal fermentation and enter the intestines in both cattle and sheep depending on the nature of the cereal grain fed. For example, the amounts of starch in barley and wheat entering the small intestine is low compared with maize and sorghum (Waldo 1973). Physical processing techniques including fine grinding (Morgan 1977) and micronising (McNeill et al. 1975) can increase the passage of undigested starch particles to the intestine. Also, physical processing of cereal grains may denature the protein matrix surrounding starch granules, and alter the density of particles such that they escape fermentation more readily (Waldo 1973). The dry extrusion process as used in the development of texturised plant proteins (Holay and Harper 1982) characteristically reduces the degradability of proteins in ruminal fluid (Stern et al. 1980) and alters the degradation characteristics of cereal grain starch in ruminal fluid (Kempton 1983).

Kempton (1983) assessed the effects of dry extrusion on the degradation characteristics of soyabeans and maize which had been processed together. In a preliminary feeding experiment with cattle on a MUR based diet, supplementation with soyabeans and maize extruded together produced a significantly greater liveweight response than a mixed supplement of extruded soyabeans and crushed maize (Kempton 1982b). The following experiments further evaluate the effects...
of providing various protein and energy supplements on liveweight performance of weaner cattle under feedlot and grazing conditions.

MATERIALS AND METHODS

Experiment 1

Forty Hereford steers (242 ± 5.5 kg) were allocated at random to each of four diets. All steers were given free access to a basal diet of molasses (containing (w/w) 3% urea and 0.5% minerals (Minavit, Cooper, Aust. Pty. Ltd.)) and 1-2 kg hay/hd/d. The urea was dissolved in water (30% w/w) and mixed with molasses using a compressed air system. Treatments were (a) basal diet (b) basal diet + 0.5 kg/hd/d heat treated protein (HTP), (c) basal diet + 0.47 kg/hd/d HTP and 0.33 kg/hd/d crushed maize (HTPM), and (d) basal diet + 0.47 kg/hd/d HTP and 0.33 kg/hd/d crushed maize extruded together (GS2). The formulation for the HTP and GS2 were as follows: (i) HTP (heat treated protein); 95.2% whole soyabean and 4.8% Na bentonite extruded at 140°C, (ii) GS2; 54.2% whole soyabean, 41.2% maize grain and 4.6% Na bentonite extruded at 144°C.

The experiment was designed to continue for 100 d, however after 54 d, rain caused unmanageable conditions in the feedlot and the experiment ceased. Food intake and weight gain were recorded at weekly intervals.

Experiment 2

Four groups of ten Hereford heifers (244 ± 3.15 kg) were given the same basal diet and experimental treatments as for Expt. 1.

In an attempt to avoid metabolic disorders related to molasses toxicity, the level of roughage offered was increased to 3 kg/hd/d, and the urea was mixed directly into the molasses. No water was included in the molasses/urea mix. The experiment continued for 91 d.

Experiment 3

Four groups of 15 Hereford mixed sex weaner cattle (185.5 ± 6.20 kg) were randomly allocated to one of four 40 ha paddocks. There were 9 heifers and 6 steers in each treatment group. Each paddock had some creek frontage. The paddocks were unimproved and contained Danthonia, Bothriocloa and Aristida spp. The dry matter (DM) yields were estimated to be 4,000 kg/DM/ha. The cattle were weighed every 21 d and the treatment groups rotated between paddocks. All groups received 300 kg of molasses per week over the experimental period. Treatments were (kg supplement per group per feed); (a) 2 kg urea + 2 kg salt; (b) 2 kg urea + 2 kg salt + 15 kg soyabeans extruded at 140°C (HTP); (c) 2 kg urea + 2 kg salt + 14 kg HTP + 10 kg cracked maize (HTPM); (d) 2 kg urea + 2 kg salt + 24 kg HTP + cracked maize extruded at 140°C (GS2). The HTP and GS2 supplements contained 5% bentonite. The supplements were fed on top of the molasses three times per week in open troughs.

RESULTS

Experiment 1—Animal health, feed intake and liveweight performance

Five animals died from cerebrocorticonecrosis (CCN) which has similar aetiology to polioencephalomalacia (PE) in lambs (Mella et al. 1976).

The early onset of CCN in the animals necessitated change in the regime adopted for feeding molasses and hay. The amounts of molasses and hay offered
were varied in an attempt to prevent further metabolic disorders. Consequently, the feed intake data for this experiment cannot be used with confidence and so the only mean liveweight gains of steers in each group over the 54 d feeding period are given in Table 1. The results suggested a possible beneficial effect of providing a supplement of extruded soybeans and maize on liveweight performance, as measured over the short duration of this experiment.

Table 1 Liveweight performance of steers given a molasses/hay based diet in Experiment 1 and supplemented with various protein and energy supplements.

<table>
<thead>
<tr>
<th>Molasses/hay + supplement</th>
<th>Molasses/hay</th>
<th>HTP</th>
<th>HTP + maize</th>
<th>GS2</th>
<th>SE Mean</th>
</tr>
</thead>
<tbody>
<tr>
<td>Initial liveweight (kg)</td>
<td>241</td>
<td>243</td>
<td>244</td>
<td>243</td>
<td>5.4</td>
</tr>
<tr>
<td>Average daily gain (g/d)</td>
<td>447&lt;sup&gt;a&lt;/sup&gt;</td>
<td>576&lt;sup&gt;b&lt;/sup&gt;</td>
<td>627&lt;sup&gt;bc&lt;/sup&gt;</td>
<td>736&lt;sup&gt;c&lt;/sup&gt;</td>
<td>48</td>
</tr>
</tbody>
</table>

<sup>a,b,c</sup>Values with the same superscript are not significantly different (p>0.05).

Experiment 2 - Animal health, feed intake and liveweight performance

No metabolic disorders were observed until after day 52 when roughage was accidentally not provided for one day. Two animals died of CCN within seven days.

Mean values for liveweight performance and dry matter (DM) intake of heifers in Expt. 2 are given in Table 2. Liveweight gain was significantly (p<0.05) increased by all supplements from 280 g/d to 510 g/d, however contrary to previous experiments (Kempton 1982b; Expt. 2) there was no significant difference between any of the feed supplements on liveweight gains or molasses intake. Mean intake of molasses/urea was 2.4 kg DM/d.

Table 2 Liveweight performance of heifers given a molasses/hay based diet in Experiment 2 and supplemented with various protein and energy supplements.

<table>
<thead>
<tr>
<th>Control</th>
<th>Supplement</th>
<th>HTP</th>
<th>HTPM</th>
<th>GS2</th>
<th>SE Mean</th>
</tr>
</thead>
<tbody>
<tr>
<td>Initial liveweight (kg)</td>
<td>215</td>
<td>229</td>
<td>226</td>
<td>227&lt;sup&gt;b&lt;/sup&gt;</td>
<td>3.2</td>
</tr>
<tr>
<td>Liveweight gain (kg/d)</td>
<td>0.28&lt;sup&gt;a&lt;/sup&gt;</td>
<td>0.49&lt;sup&gt;b&lt;/sup&gt;</td>
<td>0.48&lt;sup&gt;b&lt;/sup&gt;</td>
<td>0.55&lt;sup&gt;b&lt;/sup&gt;</td>
<td>0.05</td>
</tr>
<tr>
<td>DM intake (kg/d)</td>
<td>5.54</td>
<td>6.26</td>
<td>6.74</td>
<td>6.33</td>
<td></td>
</tr>
<tr>
<td>PCR</td>
<td>19.8</td>
<td>12.8</td>
<td>12.9</td>
<td>11.5</td>
<td></td>
</tr>
</tbody>
</table>

<sup>a,b</sup>Values with the same superscript are not significantly different (p>0.05).

Experiment 3

Mean intake of molasses/urea was 2.1 kg DM/hd/d. Liveweight gain (g/d) was significantly (p<0.05) increased by all supplements from 112 g/d to 304 g/d. There was no significant (p>0.05) difference between supplements.

DISCUSSION

The results support earlier studies that liveweight gain can be increased by supplementing a MUR diet with a source of bypass protein (see Preston and Willis 1974; Llewelyn et al. 1978).
The liveweight trends in Expt. 1 indicate a possible liveweight advantage in steers in response to supplementing a MUR based diet with a mixture of soyabean and crushed maize extruded together (GS2) compared to a mixture of extruded soyabeans plus crushed maize (HTPM). However in view of the recurring problems of molasses toxicity (CCN), the wet conditions of the feedlot, and the short duration of the experiment these results need to be assessed with caution. The similar liveweight trends reported by Kempton (1982b) were possibly influenced by the use of drought affected animals in poor body condition and may have reflected compensatory gain.

Inclusion of an extruded supplement of maize and soyabean (GS2) in a basal diet of MUR in Expt. 2 and 3 did not increase liveweight performance in weaner cattle above that achieved by supplementing with a bypass protein (HTP). These liveweight responses indicate a beneficial effect of supplementing the basal diet with a source of bypass protein as extruded soyabeans, but no additional response to providing a source of energy as maize grain when either crushed or extruded with the soyabeans. The efficiency of supplement conversion into liveweight was 1.02, 1.67 and 1.45 for Expt. 2, and 2.0, 4.1 and 3.6 kg supplement/kg gain in Expt. 3 for the HTP, HTPM and GS2 supplements respectively.

In these experiments, several animals suffered from CCN related to the ingestion of molasses/urea. At first the molasses was diluted with water (30% w/w) and the level of roughage was increased to 1.5% bodyweight in an effort to overcome the problem. These measures were inadequate since the animals tended to increase intake of the diluted molasses. In the final two experiments, urea was mixed directly into the molasses using a paddle mixer (Pharoah and Bellert 1977), without the inclusion of water. No cases of molasses toxicity were observed until roughage was accidentally withheld for one day during Expt. 2. The incidence of CCN therefore appears to be related to an overconsumption of molasses resulting from a reduction in fibre intake, or dilution of the molasses content in the mixture.

REFERENCES


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