VFA and Bacterial Production Rates in the Rumen of Buffalo Calves Fed on Diets Containing Urea and Oil as a Source of Energy

Neelam Kewalramani and B. N. Gupta

Dairy Cattle Nutrition and Physiology Division, National Dairy Research Institute, Karnal-132001

Abstract

Nine rumen fistulated male Murrah buffalo calves, randomly divided into 3 equal groups were fed on isonitrogenous rations wherein 40 per cent of DCP was met by urea through impregnation on wheat straw. Groundnut oil was added at 0 g (ULE), 150 g (UME) and 400 g (UHE) levels in the 3 groups. The addition of groundnut oil depressed the DM intake (P < 0.05) and also the CF digestibility (P < 0.05). VFA production rate, the bacterial production rate and the N efficiency were significantly different due to treatment effect. However, the bacterial production rates in gisew VFA were significantly (P < 0.05) higher in UHE group (29.11 ± 3.02) than in other groups (ULE = 19.71 ± 0.88; UME = 25.15 ± 3.34).

Inclusion of fat in diet is known to affect the composition and metabolic activity in the rumen1. In the present study the bacterial and volatile fatty acids production rates in the rumen of buffalo calves fed on rations containing urea and various levels of groundnut oil as a source of energy were determined.

Materials and Methods

Nine rumen fistulated male Murrah buffalo calves of about 1 year of age were randomly divided into 3 groups of 3 each and fed on isonitrogenous rations. Forty per cent of the DCP requirement was provided through urea impregnated wheat straw and the rest through the concentrate mixture (maize crushed 70; wheat bran 27; mineral mixture 3) to all the animals. The energy in the 3 groups was provided according to NRC requirements but the groundnut oil at 0 g (ULE), 150 g (UME) and 400 g (UHE) was added to the concentrate mixture. 120 g urea was dissolved in 1 litre of water along with molasses (300 g) and mixed with 3 kg wheat straw which was fed as the basal roughage to all the animals. Water was provided ad lib twice daily. After a preliminary feeding period of 21 days, the animals were given the daily ration in 12 equal parts at 2 hourly intervals to bring the animals to a steady state.

Single isotope dilution technique using 1, 2, 14C-sodium acetate (200-250 μCi/animal) was followed to determine the TVFA production rate3. The scintillation fluid consisted of naphthalene 60 g, PPO 4 g, POPOP 0.2 g, methanol 100 ml, ethylene glycol 20 ml and the volume was made up to 1 litre with dioxane. The samples were counted in a scintillation counter (Packard-PERLAS Model BPLD No. 00009). The specific radioactivity was expressed in dpm/m mole of TVFA. The decline in the specific radioactivity was extrapolated to zero time and the pool size of VFA (P, m mole) was calculated:

\[ P = \frac{\text{dose injected (mCi)}}{A (\text{mCi/m mole VFA})} \]

where \( A = \text{SR}_0 \) (sp. activity at zero time)

The entry rate (E, m mole VFA/min) was also calculated,

\[ E = P \times m, \text{ where } m \text{ is the rate constant (min}^{-1}.\)

Bacterial production rates were estimated in vivo using 35S-sodium sulphate4. Ammonia-N, NPN and total-N in the rumen fluid were determined by the microKjeldhal method5. A 7-day metabolism trial was also conducted to determine the N-balance.

Results and Discussion

The dry matter intake (g/Wt.75) in ULE, UME and UHE groups was 78.92 ± 3.67, 75.09 ± 5.89 and 74.20 ± 3.40, respectively. Except for the CF digestibility, which decreased significantly (P < 0.05) the digestibilities of other nutrients did not differ in the 3 groups (Table 1). Further, CF digestibility was significantly higher in ULE group as compared to UME and UHE groups42.

The concentration and production rates of TVFA in the respective groups in (Table 2) and did not differ in the 3 groups. Added oil in these diets thus did not contribute to the VFA pool.

Except for the NH3-N concentration in the SRL, which was significantly (P < 0.05) higher in UME group than the other groups the concentrations of total-N, NPN and TCA precipitable N did not differ in the 3 groups (Table 3). In the present study the feeding of the animals was done at 2 hourly intervals and it seems that the release of NH3-N and its subsequent incorporation into TCA precipitable N was at a
**Table 1: Digestibility coefficients of various feed nutrients**

<table>
<thead>
<tr>
<th>Treatments</th>
<th>Dry matter</th>
<th>Organic matter</th>
<th>Crude protein</th>
<th>Crude fibre</th>
<th>Ether extract</th>
<th>Nitrogen free extract</th>
</tr>
</thead>
<tbody>
<tr>
<td>ULE</td>
<td>64.99±0.38</td>
<td>65.08±1.89</td>
<td>64.13±1.25</td>
<td>69.51±2.76a</td>
<td>73.65±1.56</td>
<td>64.73±2.56</td>
</tr>
<tr>
<td>UME</td>
<td>64.31±1.74</td>
<td>65.64±2.05</td>
<td>65.14±0.13</td>
<td>59.47±2.40b</td>
<td>79.64±3.66</td>
<td>65.76±3.20</td>
</tr>
<tr>
<td>UHE</td>
<td>63.47±0.63</td>
<td>64.55±0.93</td>
<td>64.12±0.35</td>
<td>51.37±1.45b</td>
<td>86.19±2.68</td>
<td>63.60±1.62</td>
</tr>
</tbody>
</table>

a, b figures bearing different superscripts in a column differ significantly (P < 0.05).

**Table 2: TVFA production rates and their concentration in the rumen**

<table>
<thead>
<tr>
<th>Treatments</th>
<th>Conc. of TVFA (m mole/100 ml SRL)</th>
<th>Pool size (m mole)</th>
<th>Turnover time (min)</th>
<th>Production rates of TVFA (m mole/min)</th>
</tr>
</thead>
<tbody>
<tr>
<td>ULE</td>
<td>5.66±0.42</td>
<td>1271.63±52.87</td>
<td>236.00±4.00</td>
<td>5.39±0.15</td>
</tr>
<tr>
<td>UME</td>
<td>7.15±0.37</td>
<td>1285.45±76.18</td>
<td>258.33±21.89</td>
<td>5.16±0.38</td>
</tr>
<tr>
<td>UHE</td>
<td>6.39±0.39</td>
<td>1206.20±194.26</td>
<td>265.00±5.01</td>
<td>4.53±0.68</td>
</tr>
</tbody>
</table>

**Table 3: Concentration of ruminal nitrogenous constituents (mg/100 ml SRL)**

<table>
<thead>
<tr>
<th>Treatments</th>
<th>Ammonia-N</th>
<th>Total-N</th>
<th>NPN</th>
<th>TCA ppt. N</th>
<th>TCA ppt. N (as % of total-N)</th>
</tr>
</thead>
<tbody>
<tr>
<td>ULE</td>
<td>24.41±0.97a</td>
<td>73.50±1.40</td>
<td>40.95±0.71</td>
<td>32.52±1.92</td>
<td>44.39±1.11</td>
</tr>
<tr>
<td>UME</td>
<td>37.52±2.9b</td>
<td>66.97±2.03</td>
<td>43.57±1.68</td>
<td>23.41±1.08</td>
<td>34.80±1.45</td>
</tr>
<tr>
<td>UHE</td>
<td>24.22±2.86a</td>
<td>61.37±3.99</td>
<td>36.11±4.60</td>
<td>25.26±5.79</td>
<td>39.16±7.78</td>
</tr>
</tbody>
</table>

a, b figures bearing different superscripts in a column differ significantly (P < 0.05).

**Table 4: Nitrogen balance data**

<table>
<thead>
<tr>
<th>Treatments</th>
<th>N-intake (g/day)</th>
<th>Faecal-N excretion (g/day)</th>
<th>Urinary-N excretion (g/day)</th>
<th>N-balances (g/day)</th>
<th>N-balances per kg live wt. (mg/day)</th>
<th>Urinary-N excretion (as % of total-N intake)</th>
<th>N-retention (as % of digestible-N)</th>
</tr>
</thead>
<tbody>
<tr>
<td>ULE</td>
<td>94.40±2.75</td>
<td>23.79±0.21</td>
<td>25.63±3.49</td>
<td>34.94±4.21</td>
<td>565.33±77.23</td>
<td>27.15±3.66</td>
<td>57.61±5.86</td>
</tr>
<tr>
<td>UME</td>
<td>84.37±9.36</td>
<td>29.52±1.45</td>
<td>20.50±1.16</td>
<td>34.34±6.61</td>
<td>586.65±87.23</td>
<td>25.04±3.49</td>
<td>61.52±5.23</td>
</tr>
<tr>
<td>UHE</td>
<td>82.37±4.28</td>
<td>28.50±0.48</td>
<td>20.83±1.37</td>
<td>35.03±5.34</td>
<td>573.29±68.70</td>
<td>25.45±5.05</td>
<td>60.95±7.95</td>
</tr>
</tbody>
</table>

**Table 5: Bacterial production rates in the rumen**

<table>
<thead>
<tr>
<th>Treatments</th>
<th>Pool size</th>
<th>Turnover time (min)</th>
<th>Production rates of bacteria (g/day)</th>
<th>g/100 g DOM</th>
<th>g/mole TVFA</th>
</tr>
</thead>
<tbody>
<tr>
<td>ULE</td>
<td>65.39±0.95</td>
<td>315.00±14.73</td>
<td>152.45±1.62</td>
<td>5.25±0.10</td>
<td>19.71±0.88a</td>
</tr>
<tr>
<td>UME</td>
<td>40.91±6.63</td>
<td>341.33±60.36</td>
<td>176.15±17.53</td>
<td>6.31±0.64</td>
<td>24.15±3.34ab</td>
</tr>
<tr>
<td>UHE</td>
<td>43.28±1.26</td>
<td>343.66±45.04</td>
<td>186.31±19.24</td>
<td>6.35±0.96</td>
<td>29.11±3.02p</td>
</tr>
</tbody>
</table>

a, b figures bearing different superscript in a column differ significantly (P < 0.05)

very even pace and as such no definite trend was visible in the various nitrogenous fractions in the SRL in the 3 groups. The N-balance, urinary-N excretions as per cent of total-N intake, and per cent retention of digested-N did not differ in the 3 groups (Table 4). Addition of oil as an extra source of energy in an otherwise isonitrogenous diet did not have any adverse effect on the overall N metabolism in the animals.

The bacterial production rates (g/d) were 152.43±4.63, 176.15±17.50 and 186.31±19.21 (Table 5) in the ULE, UME and UHE groups respectively and were non-significant, when expressed in g/100g digestible organic matter intake (DOMI). Assuming that bacteria contain 10.5 per cent nitrogen, the efficiency of dietary N incorporation into bacterial protein was calculated and the values were 17.00±0.99, 21.97±0.32 and 23.72±2.11 per cent in the respective groups. Bacterial production rates calculated as g/mole VFA were significantly (P < 0.05) higher in UHE group than ULE group. Efficiency of microbial protein synthesis in g/mole VFA, thus increased with the increase in the level of oil in the diet (Table 5). Czernawski reported that the addition of 30-60 mg linseed oil fatty acids to 100 ml rumen fluid activated the protozoa but the amount of 150 mg or more made them sluggish.

The results of this study, thus, showed that the incorporation of oil as a source of energy did not contribute towards the VFA pool in the rumen but it affected the consumption of dry matter and the digestibility of CF.

Acknowledgement

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REFERENCES