Short communication

Effects of dietary humates on growth and an aspect of cell-mediated immune response in newborn kids

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Abstract

Forty-eight newborn female kids were divided into three uniform groups of 16 animals: control (C), low dosage (LD) and high dosage (HD). In the first week the LD group was given an oral humate preparation (5 ml/d); in weeks 2 and 3 they were given 10 ml/d, and in weeks 4–8 they were given 15 ml/d. The HD group received double the LD doses and group C received no humates. Daily group feed intake and individual body weight (BW) were recorded on days 1, 21, 42, and 56. Skin test, as an indirect index of cell-mediated immune responsiveness, was performed on days 21 and 42. Daily milk consumption per group was greater in the HD (2.01 kg/d) and LD (2.06 kg/d) groups than group C (1.86 kg/d), BW and ADG were significantly greater in the treated groups than group C. Feed conversion rate per group was higher in the HD group than LD and C groups. Skin was thicker on day 21 (but not day 42) in treated groups than group C.

Humate administration at both dosages for 8 weeks improved growth performance in the newborn kids and also had an effect at 21 d on skin reaction to phytohemagglutinin suggesting a possible effect on cell-mediated immune response.

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1. Introduction

During past years researchers focused on maintaining immune responses in lactating animals around parturition with different nutritional additives (Agazzi et al., 2001, 2004; Pinotti et al., 2003; Overton and Waldron, 2004; Drackley et al., 2005) while animal performance in the early postnatal period has been neglected. Low birth weight is a major predictor of early kid mortality before the 45 d of age (Pijoan, 1986; Singh et al., 1990). In the early days of life lambs are subject to mortality of various causes including starvation, pneumonia, and diarrhea (Peeler and Waynangu, 1998) due to enterotoxigenic strains of \textit{Escherichia coli}, \textit{Rotavirus} and \textit{Clostridium perfringens} (Radostits et al., 1999).

Humates are derived from the breakdown of organic plant material mainly by soil bacteria (Visser, 1973) and consist mainly of humus, humic acid, fulvic acid, ulmic acid, and trace minerals (Stevenson, 1994). Starting from 1924 (Haanen, 1924) humates compounds have been reported to have significant antiseptic properties as well as positive effects on hyperacidity and other gastric disturbances in humans (Reichert, 1966). Moreover they have been found to have antimicrobial and anti-inflammatory properties (Van Rensburg et al., 2001).

Humates have been investigated in some areas of animal husbandry. Lenk and Benda (1989), and Griban et al.
(1991) used humate-derived compounds to improve the natural resistance of cattle, while Kühnert et al. (1991) treated diarrhea and other digestive disorders in cats and dogs with humic acid. Humates added to feed or water improved the growth performance of poultry (Eren et al., 2000; Kocabağlı et al., 2002).

No data are available on the effects humate administration to newborn kids. We therefore investigated the effects of dietary supplementation of a humate preparation on the growth performance of young kids and the skin response to phytohemagglutinin (PHA) as an indicator of cell-mediated immune response.

2. Materials and methods

On the day of birth, 48 female kids were divided into three groups (control C, low dose LD, and high dose, HD) of 16 animals each, homogenous for birth date and initial live weight. The animals were fed ad libitum reconstituted milk (milk powder composition: crude protein 22.90%, crude fat 25.00%, crude fiber 6.60%, lysine 1.79%, methionine 0.56% as fed). During the first week the LD group was administered per group an oral supplement (5 ml/d) of humates as a drench diluted in the milk, containing fulvic and humic acids (courtesy of Frag, Milan; composition supplied by the manufacturer: inert minerals 63.00%, Leonardite 27.00%, CP 3.30%, Fe 2.42%, S 1.52%, Ca 0.82%, P 0.50%, K 0.30%, Na 0.17% as fed). In weeks 2 and 3 they given 10 ml/d, and in weeks 4–8 they were given 15 ml/d. The HD group received 10, 20 and 30 ml/d of humate supplement, respectively, over the same three periods, while group C received no humate supplementation. Daily milk consumption over the study period of 56 d was recorded per group. Individual body weight (BW) was recorded on days 1, 21, 42 and 56, and average daily gain (ADG) and feed conversion ratio (FCR, as ratio of ADG to daily milk consumption through the experimental period) were calculated.

Changes in double skin thickness 0, 8, 16, and 24 h after injection of 250 μg of phytohemagglutinin (PHA) were determined as an indicator of cell-mediated immune response as reported by Lacetera et al. (1999). On days 21 and 42 of life.

2.1. Statistical analysis

The ANOVA of the parameters, body weight, dietary supplementation, was performed using the MIXED procedure of SAS as repeated measures (SAS/STAT, Version V8, 1999, SAS Inst., Inc., NC, USA). The model contained the effects of type of treatment as dietary supplementation with humic acids, time (day) of treatment, and their interaction, random effect of animals nested within treatment, and residual error, with individual animals considered the experimental units.

Also skin thickness analysis in relation to humate supplementation was submitted to the MIXED procedure, considering skin thickness before PHA injection (time 0) as covariate. The statistical package used was.

The applied model in both performance parameters and skin test was

$$Y_{ij} = \mu + T_i + D_j + (T \times D)_{ij} + e_{ij}$$

where $Y_{ij}$ = independent variable body weight, skin test; $\mu$ = general mean; $T_i$ = effect of $i$th treatment ($i = 1–3$); $D_j$ = effect of day of sampling, hour of sampling for skin test; $(T \times D)_{ij}$ = effect of the interaction between treatment and time; $e_{ij}$ = casual effect of each observation.

3. Results and discussion

Daily milk consumption was greater in the HD (2.01 kg/d) and LD (2.06 kg/d) groups than group C (1.86 kg/d). BW did not differ significantly between the three groups at the beginning of the trial, confirming that they were homogeneous. On days 21, 42 and 56, the HD group had significantly higher BW than the LD and C groups. On day 42 the LD group had significantly higher BW than group C ($P < 0.05$); on days 24 and 56 the HD and LD groups had significantly higher

<table>
<thead>
<tr>
<th>Days</th>
<th>C</th>
<th>LD</th>
<th>HD</th>
<th>S.E.M.</th>
<th>$T$</th>
<th>$D$</th>
<th>$T \times D$</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>BW (kg)</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td>1</td>
<td>3.40</td>
<td>3.37</td>
<td>3.31</td>
<td>0.123</td>
<td>ns</td>
<td>ns</td>
<td>ns</td>
</tr>
<tr>
<td>21</td>
<td>6.86A</td>
<td>6.88A</td>
<td>7.77B</td>
<td>0.229</td>
<td>***</td>
<td>***</td>
<td>ns</td>
</tr>
<tr>
<td>42</td>
<td>10.29Aa</td>
<td>10.39Ab</td>
<td>11.53B</td>
<td>0.341</td>
<td>***</td>
<td>***</td>
<td>***</td>
</tr>
<tr>
<td>56</td>
<td>11.71A</td>
<td>12.55Ba</td>
<td>12.91Bb</td>
<td>0.460</td>
<td>***</td>
<td>***</td>
<td>ns</td>
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<tr>
<td></td>
<td>ADG (kg/d)</td>
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</tr>
<tr>
<td>1–21</td>
<td>0.165A</td>
<td>0.163A</td>
<td>0.213B</td>
<td>0.019</td>
<td>**</td>
<td>**</td>
<td>ns</td>
</tr>
<tr>
<td>21–42</td>
<td>0.163</td>
<td>0.167</td>
<td>0.179</td>
<td>0.019</td>
<td>**</td>
<td>**</td>
<td>ns</td>
</tr>
<tr>
<td>42–56</td>
<td>0.101Aa</td>
<td>0.154Ab</td>
<td>0.060B</td>
<td>0.017</td>
<td>***</td>
<td>***</td>
<td>ns</td>
</tr>
<tr>
<td>1–56</td>
<td>0.148A</td>
<td>0.162B</td>
<td>0.170C</td>
<td>0.021</td>
<td>***</td>
<td>**</td>
<td>ns</td>
</tr>
</tbody>
</table>

$T =$ treatment; $D =$ day; $T \times D =$ treatment per day interactions. $A\text{--}C P < 0.01$; $A\text{--}B P < 0.05$; $** P < 0.001$; $*** P < 0.01$; ns: non significant.
BW than group C. Finally, on day 56 the HD had significantly higher BW than the LD group (Table 1).

ADG was significantly higher in the LD and HD group than group C starting on day 43. Overall ADG (1–56 d) was 9.5% ($P < 0.01$) and 14.9% ($P < 0.01$) higher in the LD and HD groups, respectively, than group C according with founding by Eren et al. (2000) and Kocabagli et al. (2002), and FCR (10–56 d) was higher in LD (0.083) and HD (0.085) groups than C (0.080). Reactions to PHA injection (days 21 and 42) increased from 0h in all three groups. There were no differences between the groups in terms of skin thickness at PBS injection sites and hence these were not used to correct PHA-induced thickness. Double skin thickness at 21-d differed significantly between the three groups at 8, and 16 h after PHA injection. Higher values were detected for groups C, LD, and HD, respectively, than group C according with founding by Eren et al. (2000) and Kocabagli et al. (2002), and FCR (10–56 d) was higher in LD (0.083) and HD (0.085) groups than C (0.080).

4. Conclusion

Although the mechanism of improved growth performance by humates administration is still unclear, we hypothesized that in newborn kids the positive effect might be mediated by improved cell-mediated immune responses, since humates has been reported to decrease the frequency of digestive disorders and diarrhea (Kühnert et al., 1991) thereby permitting greater nutrient absorption.

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References


