Effects of microencapsulated butyric acid supplementation on growth performance and ileal digestibility of protein, gut health and immunity in broilers

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ABSTRACT

The effect of microencapsulated butyric acid (MEBA) on growth performance, ileal digestibility (ID) of protein, gut health and immunity was evaluated in broilers. A total of 336 1-d-old Hubbard Classic broilers chicks were randomly assigned to four dietary treatments (Control, 0.25, 0.35 and 0.45 g/kg of MEBA). Each treatment was replicated three times with 28 birds/replicate. Feed intake, body weight gain, FCR, intestinal morphology, ID of protein and immunity was evaluated. At 35-d of age, three birds/replicate were randomly selected and slaughtered to collect blood, duodenal samples, and ileal digesta. The Improved body weight gain (P = 0.05), FCR (P<0.01), duodenal villous height (P<0.05) and ID (P<0.1) were observed; whereas, unresponsive treatment effect with respect to feed intake (P>0.5) and antibody titer against Newcastle disease (P>0.05) were noted. The results indicated that MEBA improves digestion and absorptive processes which consequently improved the broilers performance.

Key words: Broilers performance, Gut health, Immunity, Ileal digestibility, Microencapsulated butyric acid.

INTRODUCTION

The poultry industry in Pakistan is a well-established sector of agriculture and claimed as the largest industry in Pakistan after cotton. Currently, its contribution to national GDP is 1.3%, whereas its contribution to the agriculture sector, total meat production and in the whole GDP is 5.76%, 26.8% and 1.26%, respectively (Hussain et al., 2015). Better intestinal health and high digestibility of nutrients in broilers are extremely important in order to attain higher body weight and better FCR (Roberts et al., 2015). Maintenance of gut development and health is very important to support development and health of the bird (Choct, 2009). Organic acids (OA) are those potent/effective feed additives that can be used in animal nutrition to achieve higher BW and better FCR (Abdel-Fattah et al., 2008). Among the OA supplements, butyric acid/butyrate (BA) as a suitable candidate to improve gut health results in an improved nutrients absorption throughout the gastrointestinal tract (GIT). Another possible advantage of using BA may include better bioavailability facilitating enterocytes to absorb more nutrients. The BA is a readily available energy source for intestinal villi and stimulates their differentiation and multiplication (Dalmasso et al., 2008), consequently increases feed efficiency (Adil et al., 2011). The butyric acid/butyrate induces the production of host defense peptides when it enters in bloodstream (Guilloteau et al., 2009). These peptides stimulate the repair and develop lower intestinal tract through an increase in cell proliferation (Bartholome et al., 2004). Butyrate produced by the fermentation of carbohydrates are rapidly absorbed and locally affect the large intestine. There are no direct useful effects in small intestines (the main target site of action) of endogenous butyrate obtained (Niewold, 2014). However, the exogenous uncoated BA is readily absorbed and metabolized by crop and proventriculus of birds before reaching the small intestine (Kaczmarek et al., 2016). Consequently, the protection of BA with microencapsulation, such as MicroPEARL® technology (Kemin, Herentals, Belgium), improves BA efficacy. The MicroPEARL® technology helps to prevent rapid absorption of BA in GIT, and thus its utilization far away from the action site of interest, thereby increasing the surface area exposed to the molecule (Smith et al., 2012).

Keeping in view the above-mentioned properties of MicroPEARL® technology, ButiPEARL (microencapsulated butyric acid) was used in the diet of broilers to observe its effect on overall performance of broilers, ileal digestibility of protein, gut health, and immunity in broilers.

MATERIALS AND METHODS

The study was carried out in accordance with the guidelines of Animal Care and Ethics Committee, University of Veterinary and Animal Sciences, Lahore, Pakistan. The
The collected data were analyzed through completely randomized design (CRD) under one-way Analysis of Variance technique (Steel et al., 1997).
Results and Discussion

Data in Table 2 shows that (feed intake) FI (P = 0.9685) was unaffected by supplementation of different levels of MEBA. However, FI was numerically lower in birds fed 0.35g/kg MEBA. The supplementation had a positive influence on body weight gain (BWG) i.e. (P = 0.0222) but the result was more pronounced with 0.45g/kg of MEBA. These findings are in conformity with Levy et al. (2015) and Kaczmarek et al. (2016) who reported that graded levels of MEBA supplementation in broiler diet improved broilers performance without affecting FI. The results are also in line with the findings of Chamba et al. (2014) and Eshak et al. (2016) who described that addition of BA in broilers diets improved BWG. Improvement in BWG and FCR may be due to microencapsulation of butyric acid with palm oil which might be had allowed for the target release of butyrate at the ileum level, resulting in gut health and enhanced protein digestibility. In contrary, Aghazadeh and TahaYazdi (2012) reported that feeding different levels of unprotected butyric acid had no influence on BWG and FCR. This might be due to the feeding of unprotected BA which was absorbed in the gizzard and proventriculus without reaching the target site. Smith et al. (2012) revealed that encapsulating butyrate delays BA absorption, allowing it to reach the small intestine. Butyrate addition had a significant effect on villus height (P = 0.0501), while there was no significant effect on crypt depth (P = 0.1448) and villus to crypt depth ratio (P = 0.1813) of the duodenum (Table 3). Kaczmarek et al. (2016) also found that the supplementation of MEBA had a significant effect on VH. Similarly, morphometric results, in general, are in agreement with the findings of Leeson et al. (2005) and Panda et al. (2009) who reported that BA, regardless of concentrations in feed, increased VH. This can be attributed to the BA that is a readily available energy source for intestinal villi and stimulates their differentiation and multiplication (Dalmasso et al., 2008). However, Levy et al. (2015) did not find any significant effect on gut morphology with the addition of MEBA. Likewise, Smulikowska et al. (2009) reported a non-significant effect of coated BA supplementation on jejunal morphology. The contradictory results of gut morphology might be attributed to the day on which samples were taken out or due to variation in dose rate. Apparent ileal protein digestibility (AIPD) e.g. (P = 0.0098) was higher with a higher level of MEBA supplementation (Table 3). The results regarding AIPD are in line with the findings of Kaczmarek et al. (2016) who reported that encapsulated calcium butyrate supplementation improved ID of amino acid in broilers. Likewise, Jahanian and Golshadi (2015) found that Butyric acid Glycerides (BAG) improved AIPD in laying hens. Dehghani-Tafti and Jahanian (2016) also reported similar findings. The improvement of AIPD may be attributed to Butyric acid

Table 2: Effect of microencapsulated butyric acid on feed intake, body weight gain and feed conversion ratio at 35-d (Means ±SE).

<table>
<thead>
<tr>
<th>Groups</th>
<th>Feed intake (g)</th>
<th>Body weight gain (g)</th>
<th>Feed conversion ratio (g/g)</th>
</tr>
</thead>
<tbody>
<tr>
<td>MEBA-I</td>
<td>3190.8±55.63</td>
<td>1823.5±34.24</td>
<td>1.75±0.01</td>
</tr>
<tr>
<td>MEBA-II</td>
<td>3179.97±69.93</td>
<td>1937.32±23.71</td>
<td>1.6±0.02</td>
</tr>
<tr>
<td>MEBA-III</td>
<td>3177.22±44.83</td>
<td>1940.02±14.45</td>
<td>1.63±0.01</td>
</tr>
<tr>
<td>MEBA-IV</td>
<td>3153.31±48.57</td>
<td>1967.5±30.56</td>
<td>1.60±0.02</td>
</tr>
<tr>
<td>P value</td>
<td>0.9685</td>
<td>0.0222</td>
<td>0.0056</td>
</tr>
</tbody>
</table>

*Means with different superscripts in a column are significantly different (P<0.05).

Table 3: Effect of microencapsulated butyric acid on duodenal villus height, crypt depth, villus height to crypt depth ratio (µm) and apparent ileal digestibility of protein at 35-d (Means ±SE).

<table>
<thead>
<tr>
<th>Groups</th>
<th>Villus height(µm)</th>
<th>Crypt depth(µm)</th>
<th>Villus height to crypt depth ratio(µm)</th>
<th>Apparent ileal digestibility of protein (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>MEBA-I</td>
<td>1043.71±98.20</td>
<td>103.3±8.81</td>
<td>10.21±0.71</td>
<td>70.87±1.41</td>
</tr>
<tr>
<td>MEBA-II</td>
<td>1223.79±53.70</td>
<td>145.33±3.92</td>
<td>8.42±0.34</td>
<td>73.30±0.35</td>
</tr>
<tr>
<td>MEBA-III</td>
<td>1323.33±98.20</td>
<td>147.33±23.91</td>
<td>9.26±1.01</td>
<td>74.66±0.66</td>
</tr>
<tr>
<td>MEBA-IV</td>
<td>1373.33±89.87</td>
<td>130.00±5.13</td>
<td>10.54±0.35</td>
<td>76.72±0.76</td>
</tr>
<tr>
<td>P value</td>
<td>0.0501</td>
<td>0.1448</td>
<td>0.1813</td>
<td>0.0098</td>
</tr>
</tbody>
</table>

*Means with different superscripts in a column are significantly different (P<0.05).

Table 4: Effect of microencapsulated butyric acid on spleen, thymus and bursa of fabricius weights and antibody titer against Newcastle Disease at 35-d (Means ±SE).

<table>
<thead>
<tr>
<th>Groups</th>
<th>Spleen (g)</th>
<th>Thymus(g)</th>
<th>Bursa of fabricius (g)</th>
<th>ND titer</th>
</tr>
</thead>
<tbody>
<tr>
<td>MEBA-I</td>
<td>0.096±0.010</td>
<td>0.108±0.008</td>
<td>0.095±0.006</td>
<td>6.11±0.26</td>
</tr>
<tr>
<td>MEBA-II</td>
<td>0.093±0.006</td>
<td>0.133±0.010</td>
<td>0.128±0.015</td>
<td>6.23±0.35</td>
</tr>
<tr>
<td>MEBA-III</td>
<td>0.098±0.006</td>
<td>0.112±0.005</td>
<td>0.118±0.009</td>
<td>7.00±0.23</td>
</tr>
<tr>
<td>MEBA-IV</td>
<td>0.104±0.005</td>
<td>0.112±0.010</td>
<td>0.113±0.015</td>
<td>6.33±0.28</td>
</tr>
<tr>
<td>P value</td>
<td>0.7884</td>
<td>0.2030</td>
<td>0.3100</td>
<td>0.1142</td>
</tr>
</tbody>
</table>

*Means with different superscripts in a column are significantly different (P<0.05).
supplementation which might be had increased pancreatic fluid, amylase, and dose-dependent secretion of trypsin (Sileikienė et al., 2005); proteolysis of proteins by pepsin produced the peptides which activate the release of hormones including cholecystokinin and gastrin (Adil et al., 2011). In this experiment, there is no significant difference in immune organs, the weight of the immune organs and antibody titer of Newcastle Disease Virus at 35 days of age (Table 4). In accordance with our present findings, Mahdavi and Torki (2009) also found that inclusion of BAG in broilers diet had no significant effect on spleen, thymus and bursa weight at 35 days of age. However, contrary to our investigation, Jahanian (2011) reported that the supplementation of 0.2% BAG improved the ND antibody titer at 12th-day post vaccination. Our results are also against Eshak et al. (2016) who stated that no effect of BA was noticed on immunity in broilers as is observed in the present study that might be attributed due to longer interval among sampling and vaccination days.

CONCLUSION

It can be concluded that microencapsulated butyric acid addition at the levels of 0.25g/kg to 0.45g/kg in broilers diet improves body weight gain, feed conversion ratio, gut health and also increases the protein digestibility.

ACKNOWLEDGEMENT

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REFERENCES


