Effects of pelleting temperature on microencapsulated AviPlus® and the gastrointestinal recovery of thymol in broiler chickens.

R. Barea*, F. Rudeaux*, B. Tugnoli‡ and A. Piva*††

* Vetagro S.p.A., 42124, Reggio Emilia, Italy
† University of Bologna, 40064 Ozzano Emilia, Italy
‡ Corresponding author: andrea.piva@unibo.it

OBJECTIVES

Thermal treatment of poultry feed is common practice to improve the biological and nutritional value of some ingredients (i.e., soybean) and to sanitize the feed from Salmonella or prevent pathogens and spoilage bacteria contamination (LEAVER, 2008; JONES, 2011). Pelleting temperature varies widely among commercial feed production plants and, depending also on geographical distribution, can range from 65°C and 85°C (LEESON and SUMMERS, 1991). The higher the temperature the more elevated is the risk that feed additives, either nutritional (i.e., vitamins and amino acids), technological (enzymes), or zootechnical (probiotics, organic acids, plant extract constituents), that are normally included in poultry diets, might be damaged. A certain degree of loss of activity is therefore expected when these additives are included pre-pelleting, but the extent might be extremely variable depending on the additive itself and on the technology of production. Moreover, as in the case of zootechnical additives, their efficacy is further compromised by the loss of activity along the intestine as they are rapidly metabolized and/or inactivated by gastric and intestinal enzymes. AviPlus®P (Vetagro SpA, Italy), a zootechnical feed additive approved by the EU Commission for safe and effective poultry production (EU regulation 849/2012), is a microencapsulated blend of citric and sorbic acids, thymol and vanillin embedded in a matrix of vegetable hydrogenated lipids. The efficacy of AviPlus®P on growth performance in chickens has been clearly demonstrated (EFSA, 2012) and the technology used for the production of this additive has already been proven effective in delivering active principles in the cecum of broilers (GRILLI et al., 2007) and pigs (PIVA et al., 2007). The objective of this experiment was to assess if feed pelleting at different temperatures impacted the intestinal availability of AviPlus®P in broilers.

MATERIAL AND METHODS

Experimental diets were prepared and pelleted at the Research Institute of Feed Technology of the International Research Association of Feed Technology (Germany), whereas the in vivo study was conducted at Centro Ricerche per la Zootecnia e l’Ambiente (Italy). One hundred and twenty male Ross 308 (2,991 ± 87 g BW) were divided in 3 groups and fed one of the following diets for 7 days: a wheat-soybean meal based diet in mash form containing AviPlus®P providing thymol at 243 mg/kg (CTR); CTR diet pelleted at 75°C (P75); and CTR pelleted at 85°C (P85). At the end of the feeding study chickens were euthanized to collect gizzard, ileum, and ceca contents. Thymol was selected as a marker to trace AviPlus®P in the intestinal contents and in feed and was analyzed by SPME-GC-MS. In
order to minimize variability between subjects, samples were pooled from 4 subjects (n=10). The percentage of thymol concentrations from gizzard (µg/g of DM) which reached the ileum and ceca was statistically analyzed with one-way ANOVA test and differences among groups were evaluated by Tuckey’s post-test (SAS Inst. Inc., Cary, NC). Results are given as least squares means (LSM) and residual standard deviation (RSD).

RESULTS

Thymol concentration in feed was not affected by pelleting, either at 75°C or 85°C. The recovered amount was in fact 2% lower than expected (238 mg/kg vs. 243 mg/kg) which might be due to the variability of the analysis. Moreover, thymol was recovered from the gastrointestinal tract contents of chickens in all the treatments. Table 1 shows the percentage of thymol recovered in ileum and ceca (expressed as % of gizzard contents). Animals fed the non-pelleted CTR diet had the highest thymol concentration in ileum and ceca (24.5% and 22.08% of the gizzard content, respectively), and a progressive reduction was observed in P75 fed birds (16.2% in ileum and 13.24% in ceca), even though means were not significantly different from CTR group. Chickens fed P85 diets presented significantly lower thymol contents than CTR (12.2% in ileum and 9.4% in ceca; P<0.05).

Table 1. Thymol recovered in ileum and ceca (expressed as % of gizzard contents) of broilers from control diet containing AviPlus®P (CTR, mash feed), CTR pelleted at 75°C (P75) and 85°C (P85):

<table>
<thead>
<tr>
<th></th>
<th>ileum</th>
<th>P75</th>
<th>P85</th>
<th>RSD</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ileum</td>
<td>24.5b</td>
<td>16.2ab</td>
<td>12.2a</td>
<td>9.30</td>
<td>0.04</td>
</tr>
<tr>
<td>Ceca</td>
<td>22.08b</td>
<td>13.24ab</td>
<td>9.35a</td>
<td>9.14</td>
<td>&lt;0.01</td>
</tr>
</tbody>
</table>

abMeans in the same row with different superscripts differ significantly (P < 0.05).

To our knowledge, there is no specific information on how pelleting process may affect intestinal availability of thymol from a protected feed additive in chickens. The progressive lower concentration of thymol from gizzard to the ceca could be associated with the action of digestive enzymes which degrade the lipid protection matrix of the additive, allowing the active principles release in the intestinal lumen. In piglets, PIVA et al. (2007) observed that an identical protective lipid matrix prevented the metabolization of sorbic acid, allowing 15% of total sorbic acid detected in the stomach to reach the colon. Another fact which could be related to the disappearance of thymol in the gastrointestinal tract is the possible absorption by the intestinal mucosa (MICHELS et al., 2008). Nevertheless, a faster disappearance of thymol could be delayed with a protection matrix such in AviPlus®P, which allow thymol to reach subsequent intestinal sections with more relevant microbial activity.

CONCLUSIONS

This study showed that the protective lipid matrix used for microencapsulation of AviPlus®P allowed a slow-release of thymol to the distal part of the gastrointestinal tract of...
chickens. The pelleting process had an effect in reducing the amount of thymol which reached the ileum and ceca from gizzard, yet maintaining a biologically relevant concentration. Thus, the microencapsulation technology used allowed the protection and subsequent slow-release of the active ingredient even after pelleting at 85°C.

**LITERATURE CITED**


