COMPARATIVE STUDIES OF A COCCIDIOSTAT (BAYCOX) AND CHITOSAN AGAINST COCCIDIOSIS IN BROILER CHICKENS

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Abstract

The study was aimed at detecting the effects of Baycox and Chitosan on the development of coccidiosis on a broiler farm. The study involved 80 six-week-old-broiler chickens divided into two equal groups. Each group was divided into four subgroups: control (I); Baycox-treated (II); Chitosan treated (III); and Baycox- and Chitosan-treated (IV). Baycox was applied for 2 d in a concentration of 25 ppm in drinking water. Chitosan was used for 6 d at a daily dose of 0.6 g/bird. The coccidial infection intensity was expressed as the intestinal mean total lesion score (MTLS) and coccidial index. The coccidial infection intensity was determined twice within 6 d following the administration of each drug. The combined application of Baycox and Chitosan produced the best results: neither pathological changes nor the presence of coccidial oocysts were observed in the intestines. The results of separate administration of Baycox and Chitosan were comparable; the MTLS values were 0.35 and 0.4, respectively.

Key words: chickens, coccidiosis, Baycox, Chitosan.

Coccidiosis poses a serious problem for broiler chicken production in Poland. The disease is controlled with coccidiostats or with vaccine (19), and Baycox (Bayer) is one of the best preparations for the coccidia control (7, 8). Recently, compounds that stimulate the non-specific immunity against coccidia have gained interest. Chitosan, the simplest chitin derivative, has many biological, chemical, and physical properties and can be used in a wide range of application in medicine, veterinary practice, cosmetics and the food industry, agriculture, and biotechnology (1, 3, 4, 9, 14, 18). Chitosan has been reported to show potent immunological effects, such as activation of macrophages (10, 11, 15) and stimulation of non-specific host resistance (5, 11, 12, 14).

The present study was aimed at determining effects of simultaneous application of Chitosan and the coccidiostat (Baycox) on coccidiosis control.

Material and Methods

The study involved 80 six-week-old broiler chickens obtained from a farm heavily contaminated by coccidia (a high oocyst incidence). The chickens were kept in an electrically heated poultry house and fed an appropriate feed and water ad libitum. The basic diet contained 18% of total protein, 8% of fat, 4% of crude fibre, 0.4% of methionine, 0.3% of cysteine, 18% of tryptophan, 0.9% of lysine, 1% of calcium, and 0.5% of phosphorus. The chickens were not vaccinated against coccidial infection and the feed was without coccidiostat. The chickens were divided into two equal groups. Each group was divided into four equal subgroups: control I (a, b); Baycox-treated II (a, b); Chitosan-treated III (a, b); and Baycox- and Chitosan-treated IV (a, b). Baycox was applied for 2 d in a concentration of 25 ppm in drinking water. Chitosan, a deacetylated product of chitin, was produced from krill shell by the Sea Fisheries Institute in Gdynia, according to the requirements of the Polish National Standard PN-89/A-86850. In this study, chitosan adipate was used. The drug was applied for 7 d at a daily dose of 0.6 g/bird. The properties of chitosan adipate are as follows: dry mass (%) – 2.8±0.01; shear viscosity – 65.7±1.62; acid content – 27.0±0.1; pH – 5.6±0.04 (2).

The chickens were killed by cervical dislocation six days after the treatment and their intestinal mean total lesion scores (MTLS) were graded from 0 to 4 on an arbitrary scale described by Johnson and Reid (6), modified by Schmid (17). The birds’ oocyst indices were determined before death. The data were analysed using the method of Schmid (17).
Table 1
Summary of the intestinal lesion scores of the experimental groups

<table>
<thead>
<tr>
<th>Group</th>
<th>MTLS in chicken intestine *</th>
<th>Average MTLS from 20 chickens¹</th>
<th>Oocyst index</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Control</td>
<td>2.4</td>
<td>2.5</td>
<td>2.5</td>
</tr>
<tr>
<td>Baycox</td>
<td>0.3</td>
<td>0.2</td>
<td>0.3</td>
</tr>
<tr>
<td>Chitosan</td>
<td>0.6</td>
<td>0.3</td>
<td>0.3</td>
</tr>
<tr>
<td>Baycox+Chitosan</td>
<td>0.01</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

Each entry in the table is an average of data for 20 chickens

¹ The average was established from the results obtained in the parts of intestine (1-4)

Explanation:
1. Duodenum
2. Central small intestine
3. Lower small and large intestines
4. Caecum

Results

The following Eimeria species has been established in the examined chickens: E. acervulina, E. maxima, E. necatrix, E. brunette, and E. tenella.

The effects produced by Baycox and Chitosan on the development of coccidiosis in the chickens studied are shown in Table 1. The best results were obtained when a combined Baycox and Chitosan treatment was applied. In the subgroup 4a, the chickens showed neither intestinal lesions nor the presence of oocysts in faeces. In the subgroup 4b, only single cases of lesion scores in the small intestine were found. MTLS in Baycox-treated subgroups (II a,b) was slightly lower (0.33) than that in the Chitosan-treated ones (III a,b) (0.48). No significant differences in the oocyst output between subgroups II a,b and subgroups III a,b were observed. The post-treatment oocyst indices in these groups amounted to 1 (1-50 oocysts in 1 g of faeces). The control subgroups (I a,b), MTLS was very high (2.33 - Table 1), with the oocyst index exceeding 3 (more than 300 oocysts in 1 g of faeces).

Discussion

Baycox is a well-known coccidiostat, particularly useful for controlling poultry coccidiosis (7, 8). The mechanism of prevention of chicken coccidial infection by Chitosan is not well known. However, it was established that the mechanism of Chitosan activities is of cationic nature, may be also engaged in the oxygen-independent mechanism of intracellular killing of microorganisms. This compound has been reported to show potent immunological effects such as macrophage and neutral granulocyte activation. Nishimura et al. (10) established that some chemically modified derivatives of chitin (Chitosan) were most active on the suppression of meth-A-tumour cells growth and stimulated non-specific host resistance against E. coli infection. These authors informed that in the group of mice infected subcutaneously with E. coli and treated with chitosan, 50%-80% of the animals survived. No animals survived in the control group. Iida et al. (5) established that mice infected with Sendai virus died from severe pneumonitis, but 57% of the animals survived after intranasal administration of 0.1 mg of Chitosan 1 d before being infected. These authors also reported on the influence of the treatment with Chitosan on host resistance to E. coli infection in mice. Subcutaneous or intraperitoneal application of 500 µg of Chitosan protected 40% to 45% of mice. In vitro studies on the antibacterial and fungicidal activities of Chitosan were performed by Balicka-Ramisz et al. (3). The authors established that this compound was characterised by high activity against some bacteria (Escherichia coli, Pseudomonas aeruginosa, Staphylococcus aureus, Salmonella paratyphi) and fungi (Candida albicans, Trichophyton mentagrophytes, Microsporum canis). Some authors informed (10, 11, 15) that chitosan was shown to influence the mechanisms acting at the early phase of defence system such as: a) accumulation and activation of macrophages, b) activation of natural killer cells, and c) induction of interferon. Okawa et al. (12) observed the protective effect of Chitosan against Pseudomonas aeruginosa and Listeria monocytogenes infection in mice. Mice pre-treated with Chitosan showed the resistance to intraperitoneal infection with both microbes.

The results obtained by Ramisz et al. (14) revealed that Chitosan enhances the peritoneal macrophages activity. Three days after intra-peritoneal administration of 500 µg of chitosan, the phagocytosis index was three times, and after six days five times higher comparing with the control group. It was established, that Chitosan stimulated the non-specific host resistance, too (5, 10, 16). Our results gave the information on the possibility to control coccidial...
infection with Chitosan adipate salt. This phenomenon could be explained through the stimulation of non-specific resistance and repression of the development of schizonts. The best results (total cure) were obtained in subgroups IV after application of Chitosan and Baycox (MTLS – 0). After Chitosan administration in subgroups III, the results were only slightly higher (MTLS – 0.4) comparing with the results obtained in groups II where Baycox was applied only (MTLS – 0.36).

Our results also indicate that the immune response enhancement by Chitosan may be of a practical importance in improving immunisation programmes in poultry production.

References