Effectiveness of Xiang-Qi-Tang against Avian Pathogenic *Escherichia coli*

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**ABSTRACT**

Xiang-Qi-Tang (XQT) is a Chinese medicine containing *Rhizoma Cyperi* (40 g), *Andrographis paniculata* (30 g) and *Astragalus membranaceous* (30 g). The purpose of this study is to investigate the therapeutic effects of XQT on Avian Pathogenic *Escherichia coli* (APEC)-infected chickens. The chickens were pretreated with XQT 12 h before being inoculated with 10⁸ colony forming unit (CFU) of APEC by subcutaneous injection, and then the mortality and the indexes of health status of chicken in each group were detected. The results showed that high dosage and middle dosage of XQT could significantly decrease the mortality of the chickens challenged with APEC. We further found that XQT improved the infected chickens’ health status through improving the water consumption, feed intake, bodyweight gain, routine blood parameters and decreasing the incidences of pericarditis and perihepatitis. The results of present study suggest that XQT can effectively treat chicken colibacillosis as a potential agent.

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**INTRODUCTION**

Chicken colibacillosis is caused by avian pathogenic *Escherichia coli*, occurring in different types of chicken. The infection results in severe economic losses in the global poultry industry due to reducing poultry meat and egg production (Ron, 2006). Antibacterial agents and inactivated or subunit vaccines are applied to cure or prevent this disease at present. However, because of the mutation of APEC and its complicated pathogenic mechanisms, the vaccines and antibacterial agents are often invalid (Gyles, 2008). Furthermore, antimicrobial agents are continuously or unreasonably fed to chickens, which cause serious drug residues in meat or egg and affect human health (van den Bogaard et al., 2001). Now, food safety becomes an increasing public health concern all over the world. People urgently want to find some safe and effective agents to solve the above knotty issues.

The traditional herbal medicine has lots of advantages in curative effect, security, and controlling drug resistance and residue (Kogure et al., 2008; Kim et al., 2012; Ou et al., 2013), so it is more important for prevention and treatment of livestock infectious disease. In our previous study, we had screened a Chinese medical formula named Xiang-Qi-Tang (XQT) for curing chicken colibacillosis through a series of experiments in vitro and in vivo. XQT is composed of *Rhizoma Cyperi*, *Andrographis paniculata* and *Astragalus membranaceous* with an optimal ratio. The current study was planned to further observe its therapeutic effect on APEC-infected chickens.

**MATERIALS AND METHODS**

A total of 180, day-old white leghorn specific pathogen free (SPF) chicks, were obtained from the Experimental Animal Center of Jilin University, randomly divided into six groups and treated as shown in Table 1. *Escherichia coli* (E. coli) O78 (CVCC1418) was purchased from the China Veterinary Culture Collection Center and prepared for APEC suspension to a concentration of 5×10⁸ colony forming unit (CFU)/ml. 0.2 ml APEC suspension (containing 10⁸ CFU) challenged with chickens in each group except the control group through subcutaneous injection. XQT were prepared as our previous study (He et al., 2011). The final concentration of XQT solution was 1 g/ml, which was diluted to serial concentrations to be administered in XQT-treated group 12 h before inoculation with APEC.
On days 1, 2, 3, 4, 5 and 6 after challenge with APEC, water consumption, feed intake, body weight and death in each group were monitored.

After the end of the experiment, body weight (BW) gain and mortality in each group were calculated. Five surviving birds were randomly selected for blood collection through jugular vein for the determination of complete blood count (CBC). Then, all of the chickens in each group were killed and necropsied and the incidence of pericarditis and pericarditis were detected.

The data are expressed as mean ± standard deviation. Differences in the mortality, BW gain and the incidence of pericarditis and pericarditis of groups were assessed by Fisher’s exact test. Other statistical evaluations were performed using one-way ANOVA (Dunnett’s t-test) and Student’s t-test. Statistical difference was accepted at P<0.05.

RESULTS AND DISCUSSION

All of the chickens challenged with APEC appeared the clinical symptoms of chicken colibacillosis about 4 h after inoculation, including depression, ruffled feathers, no reaction to acoustics, lesser balance, closed eyes, decreased water consumption and feed intake. Results of the monitoring of water consumption and feed intake were shown in Fig. 1 and 2. After 1 day of inoculation, the water consumption and feed intake in each drug-treated or APEC-treated group were significantly decrease, compared with the control group (P<0.01). These actions may result largely from the proliferation of APEC in vivo. Because it is reported that APEC could induce a large release of cytokines in brain such as nitric oxide (NO) and interleukin (IL) -1 which were responsible for the repression of the drinking and feeding behavior (Becskai et al., 2008). After 2 days, the water consumption and feed intake in XQT high dosage group, middle dosage group and ofloxacin group began to restore to normal levels, which were higher than APEC group (P<0.05, or P<0.01). This effect was similar to those of antibiotics such as ofloxacin.

After being injected with APEC, the death peak of infected chickens was 24 to 48 h. The data in table 2 showed that, after the end of the experiment, the mortality in XQT high dosage group and middle dosage group were significantly (P<0.05, or P<0.01) decreased as compared to APEC group. These results suggest that XQT may prevent the proliferation of APEC. This effect was attributed to the antibacterial activity of Andrographis paniculata in XQT, which can directly kill APEC (Mishra et al., 2009). After the APEC proliferation being prevented, the health status of the infected chickens could be improved, which was indicated by the growth values. So, the BW gain in each group in our study was detected. The increase of BW gain were observed in XQT high dosage group and middle dosage group as compared to APEC group (P<0.05, or P<0.01). This effect was similar to those of antibiotics such as ofloxacin.

Table 2: Effects of XQT on mortality and BW gain in each group

<table>
<thead>
<tr>
<th>Group</th>
<th>No. of Death (%)</th>
<th>Marijuana (g)</th>
<th>Relative growth rate (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control group</td>
<td>0</td>
<td>42.1</td>
<td>53.5**</td>
</tr>
<tr>
<td>APEC group</td>
<td>15</td>
<td>8.1</td>
<td>9.7</td>
</tr>
<tr>
<td>Ofloxacin group</td>
<td>0</td>
<td>41.6</td>
<td>52.6**</td>
</tr>
<tr>
<td>High dosage group</td>
<td>13.3**</td>
<td>41.8</td>
<td>52.9**</td>
</tr>
<tr>
<td>Middle dosage group</td>
<td>6</td>
<td>22</td>
<td>26.8*</td>
</tr>
<tr>
<td>Low dosage group</td>
<td>4</td>
<td>4.9</td>
<td>6.5</td>
</tr>
</tbody>
</table>

Table 3 presents the number of red blood cells, white blood cells and thrombocytes. Challenge with APEC could adversely affect these routine blood parameters in chickens. The results showed that red blood cells and thrombocytes in APEC-infected chickens were destroyed by APEC, the number of these two cells were markedly decreased as compared to the uninfected chickens. XQT could ameliorate such adverse effects. The high or middle dosage of XQT significantly increased the number of red blood cells and thrombocytes (P<0.05 or P<0.01). Because the APEC was the direct spoiler of these two cells, we presumed that XQT’s protective effect might be due to the anti-APEC activity of its active components. In addition, APEC infection in vivo caused white blood cell...
membranaceus and inflammatory diseases through suppressing nuclear component of (2012) reported that andrographolide, an active et al. biological activities in lots of literatures. For example, Lu potential anti-inflammatory or anticoagulant activity. The effect of XQT on these cells suggested that it had role respectively in inflammation and coagulation. The consumption, feed intake, BW gain, routine blood parameters and decreasing the incidences of pericarditis and perihepatitis. These results suggest that XQT can be a candidate agent for prevention of or therapy for avian colibacillosis, even be of help to other infectious diseases in poultry.

**Conclusion:** XQT could decrease the mortality of the chickens challenged with APEC, and benefit the infected chickens’ health status through improving the water consumption, feed intake, BW gain, routine blood parameters and decreasing the incidences of pericarditis and perihepatitis. Therefore, XQT exhibiting anti-inflammatory and anticoagulant properties may be one of the mechanisms of its treatment of chicken colibacillosis.

**REFERENCES**


