The study was conducted to evaluate the effect of adding dehydrated garlic flakes (Nor-Spice, Bayer®) in nursery feed for piglets on growth after weaning. A total of 192 weaning piglets were divided into 4 treatments. The first treatment was designed as the control. Three thousand ppm of dehydrated garlic flakes and antimicrobial agents for controlling diarrhea were added in the nursery feed for the second and the third treatment, respectively. The fourth treatment received 500 ppm of dehydrated garlic flakes and antimicrobial agents in the nursery feed. Average daily gain, feed conversion rate, daily feed intake, and daily diarrheal score were measured. There was no significant difference (p>0.05) in the average daily gain, feed conversion rate, daily feed intake and diarrheal score of piglets among the treatments. However, dead piglets were examined and it was found that edema disease was the primary cause of death. The number of sick and dead piglets from edema disease in the first treatment was higher (p<0.01) than that of the other three treatments. It might be possible that dehydrated garlic flakes could lessen the impact of naturally occurred outbreak of edema disease.

Keywords: colibacillosis, dehydrated garlic flakes, nursery feed, piglets, growth performance

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Effect of Adding Dehydrated Garlic Flakes into Nursery Feed on Growth and Health Performance in an Incidence of Colibacillosis

Introduction

Postweaning stress and opportunistic microorganisms cause diarrhea and decrease growth in weaning piglets (van Beers-Schreurs et al., 1992). At the time of weaning, young piglets are submitted to many stressors resulting in showing signs of malabsorption syndrome known as Non-Infectious Diarrhea (NID) which is characterised by increased excretion of fatty acids and carbohydrate in feces, watery stools and degenerative changes in villi of the small intestine. As a consequence, opportunistic pathogens particularly enterotoxigenic Escherichia coli strains (ETEC), and rotavirus take advantage of the presence of this diarrhea and cause the postweaning diarrhea syndrome (PWDS) (Spencer and Howell, 1989).

Postweaning diarrhea can be controlled by making changes to existing management to reduce stress and by eliminating the predisposing causes of infection (Mackinnon, 1998; Madec et al., 1998; McDonald et al., 1999). The most common and effective method is feeding and injection of antibiotics to prevent proliferation of the bacteria (Kyriakis et al., 1998; Bertschinger and Fairbrother, 1999). Unfortunately, many bacteria especially postweaning colibacillosis strains of E. coli are showing increasing resistance to the commonly used antimicrobial (Hunter et al., 1994; Johnson et al., 1994; Mathew et al., 1998; Jonkers et al., 1999). Furthermore, as a result of concern about possibility of transmission of antimicrobial resistance from food animals to humans, there is growing restrictions on the use of antimicrobial agents in the pig industry. Without other effective means to control enteric infections in piglets, the pig industry will be faced with increased production cost and welfare problems due to sick piglets.

Improvements in postweaning diarrhea, growth rate and efficiency of feed utilization have been achieved by supplementing starter diets with CHEMYDE superscript RTM polymer (Hampson et al., 2000), copper sulfate (Smith et al., 1997), and zinc oxide (Carlson et al., 1999; Hill et al., 2000). All supplements are recognized as having antibacterial activity and the ability to stimulate growth. Garlic, one of the herbal therapies in human, is indicated by German Commission E for
use in the support of dietary measures for treating hyperlipoproteinemia and for prevention of arteriosclerosis. Garlic has been reported to have antiplatelet, antibacterial, antifungal, antihypertensive, antihyperlipidemc, and anti-inflammatory properties (Klepser and Klepser, 1999). For its antibacterial activity, garlic has a broad spectrum against gram positive and gram negative bacteria. It has been shown to effectively treat *Helicobacter pylori* infection in humans (Ernst, 1999). Garlic was found to be efficacious in treating experimental shigellosis in rabbits (Chowdhury et al., 1991). Samanta and Dey (1991) reported the effect of feeding garlic as a growth promoter in boilers. Garlic (*in vitro*) can inhibit *E. coli*, the major pathogen of postweaning diarrhea in piglets (Johnson and Vaughn, 1969; Kumar and Sharma, 1982; Sasaki et al., 1999). The objective of this study was to determine the effect of supplement dehydrated garlic flakes on growth performance and severity of diarrhea in postweaning piglets.

### Materials and methods

#### Animals, housing and diets

This trial study was carried out on a commercial pig farm in northeastern Thailand with a 1200 sows under production. A total of 192 weaned piglets, of the same genetic origin, 22±2 days old, were weighed and moved from the farrowing pens to a nursery house. They were allocated into 12 pens with 16 piglets each. All pens measured 1.5x3.0 m; the floor consisted of fully slotted-metal (trinar, cross-sectional profile). All the piglets were allowed to access ad libitum feed (meal form) and water. A weaning diet formulated to contain 21% crude protein and 3600 Kcal metabolizable energy was used as the basic weaning ration for feeding the piglets. Heat lamps and shelter were used until the pigs showed no behavioral signs of chilling. The initial temperature of the nurseries was 34°C, and the temperature was subsequently lowered around 1.5 °C each week.

#### Experimental Design

A randomized block design was used for the trial with 3 blocks and 4 treatments. The piglets were allocated accordingly complete to their body weight at weaning to one of three blocks which were 4.3 - 5.6 kg (Block 1), 5.7 - 6.9 kg (Block 2), and 7.0 - 8.1 kg (Block 3) body weight. Then, within each block, the piglets were randomly assigned to treatment groups. The control treatment (Control) was offered only the basic weaning ration. The second treatment (Garlic) was offered the basic weaning ration added with dehydrated garlic flakes (Nor-Spice,
Bayer®) 3000 ppm. The third treatment (Drug) was offered the basic weaning ration with Zinc oxide 1000 ppm, Zinc bacitracin 700 ppm and Colistin 150 ppm to control piglets diarrhea. The fourth treatment (GarlicDrug) was offered the basic weaning ration with Zinc oxide 1000 ppm, Zinc bacitracin 700 ppm and Colistin 150 ppm to control diarrhea and dehydrated garlic flakes 500 ppm.

Piglets and feeders were weighted weekly for a 20 days experimental period to determine average daily gain (ADG), feed conversion rate (FCR) and daily feed intake (DFI) as indicator of measure production efficiency. The number of dead and sick piglets in each pen was recorded. Average daily diarrhea score (ADDS) was evaluated to measure severity of diarrhea. Diarrhea in each piglets was assessed visually and characterised accordingly to the following scales: 0 = no diarrhea, 1 = soft faeces, 2 = fluid faeces, and 3 = projectile diarrhea. The maximal theoretical daily diarrhea score was 48 (16 piglets x scale 3 = 48). Death piglets were submitted for diagnosis at the Veterinary Laboratory, Khon Kaen University.

Statistical Analysis

The data were analyzed using a general linear model in SAS 6.12 (Proc GLM) for ADG, FCR, DFI, and ADDS with block and treatment effects in the model. Chi-square test (Proc Freq in SAS 6.12) was used to evaluate the effect of treatment on mortality and morbidity.

Results

Growth performance and diarrheal score of the experimental piglets were shown in Table 1. The analyses revealed that the average daily gain, feed conversion rate, daily feed intake and diarrheal score did not differ among treatments (p>0.05). Four piglets were removed from the experiment because they were stunted (very small, thin, and coarse hairs, resulting in different total number of piglets in each group) (Table 2).
Table 1  ADG (average daily gain), FCR (feed conversion rate), DFI (daily feed intake) and ADDS (average daily diarrhea score) of postweaning piglets (means±SD)

<table>
<thead>
<tr>
<th></th>
<th>Control</th>
<th>Garlic</th>
<th>Drug</th>
<th>GarlicDrug</th>
<th>C.V.</th>
</tr>
</thead>
<tbody>
<tr>
<td>ADG (kg)²</td>
<td>0.27±0.03</td>
<td>0.29±0.00</td>
<td>0.33±0.12</td>
<td>0.30±0.02</td>
<td>23.003</td>
</tr>
<tr>
<td>FCR⁴</td>
<td>2.08±0.14</td>
<td>1.90±0.15</td>
<td>1.90±0.69</td>
<td>1.88±0.078</td>
<td>19.951</td>
</tr>
<tr>
<td>DFI (kg)⁴</td>
<td>0.55±0.03</td>
<td>0.55±0.02</td>
<td>0.57±0.01</td>
<td>0.56±0.02</td>
<td>3.791</td>
</tr>
<tr>
<td>ADDs⁴</td>
<td>40.67±8.14</td>
<td>54.50±16.26</td>
<td>22.33±16.04</td>
<td>35.33±33.61</td>
<td>57.404</td>
</tr>
</tbody>
</table>

² means among each treatment are not significantly different (p>0.05).

A few days before the end of the experiment, 11 piglets were sick. The clinical signs included partial ataxia, convulsion, swelling of eyelids, diarrhea, and some piglets had sudden death. Three dead piglets were sent to the Veterinary Laboratory and hemolytic E. coli was isolated from every piglet. Based on epidemiological data, clinical signs, gross pathology, and bacterial culture, the outbreak was diagnosed as edema disease. It was interested that analysis of the number of sick and dead piglets showed a highly significant difference (p<0.01) between the control and each of the other treatments (Table 2).

Table 2  Number of sick and dead piglets.

<table>
<thead>
<tr>
<th>piglets</th>
<th>Control⁶</th>
<th>Garlic⁷</th>
<th>Drug⁷</th>
<th>GarlicDrug⁷</th>
</tr>
</thead>
<tbody>
<tr>
<td>sick</td>
<td>10</td>
<td>1</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>dead</td>
<td>5</td>
<td>1</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>total</td>
<td>46</td>
<td>47</td>
<td>47</td>
<td>48</td>
</tr>
</tbody>
</table>

⁶ and ⁷ : highly significant differences (p< 0.01)

⁸ : piglets were also included in the sick group.

**Discussion**

There was no significant difference in the ADG, FCR, DFI and ADDS among the piglets fed either basic ration, ration with 3,000 ppm of garlic flakes, ration with antimicrobial agent, or ration with 500 ppm of garlic flakes and antimicrobial agents. As we mentioned that postweaning
diarrhea can be controlled by making changes to existing management to reduce stress and by elimination predisposing causes of infection (Mackinnon, 1998; Madec et al., 1998; McDonald et al., 1999). Enteritis in young pigs caused by E. coli is generally considered to be a disease of poor or inappropriate management (Mackinnon, 1998). It might be possible that the farm had appropriate management during the experimental period that can minimize diarrhea to the less extent. It was shown that in spite of the presence of ETEC 0149 in intestines of 28 percents of weaned pigs in a group, none of them developed diarrhea (Hampson et al., 1985).

At first, the experiment was planned for a 5 weeks period to detect the effect of adding supplements on growth and feed utilization. Due to the outbreak of E. coli infection during the study, the experiment was shortened and ended at about 2-3 days after the outbreak occurred. The outbreak was diagnosed as edema disease based on epidemiological data, clinical signs, gross pathology, and bacterial culture. Serotyping or genetic analysis for confirmation of etiology agent had not been done since bacterial culture is accepted as a method of diagnosis for causative agent such as E. coli in swine (Bosworth, 1999) and the diagnosis of acute edema disease can be done by such method (Bertschinger and Fairbrother, 1999). The number of sick and dead E.coli infected piglets during this outbreak (Table 2) revealed that there was a highly significant difference between the control treatment and each the other treatments. However, there was no significant difference (p>0.05) among treatment groups (Group 2, 3 and 4).

From these results, it is concluded that 3000 ppm of dehydrated garlic flakes in the ration of treatment 2 have the same effects as antimicrobial agents in the ration of treatment 3. Adding 500 ppm of dehydrated garlic flakes to the ration containing antimicrobial agents (treatment 4) did not increase the efficacy of promoting growth and controlling the outbreak. Therefore dehydrated garlic flakes might be used control severity of edema outbreak cause by E.coli.

The future challenge experiments or in vitro experiments should be done to determine the antimicrobial effects of garlic on field strains of pathogenic E. coli.

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References


