Effect of Antimicrobial Peptides on Intestinal Histology in Piglet Production

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Abstract: Antimicrobial peptides are widely used in animal diets as feed additives because of their broad-spectrum and high-efficiency antimicrobial activity, and are one of the alternatives to antibiotics. There are more studies on the addition of antimicrobial peptides to pig diets in China. There are only 10 articles abroad. In this paper, the mechanism of action of antimicrobial peptides and their application in piglet and sow diets were reviewed in order to provide some guidance for production practice.

Antimicrobial peptide is a kind of peptide produced by biological defense system against exogenous pathogens. It has many activities such as anti-bacteria, fungi, fungi, viruses, protozoa, cancer cells, and is not easy to produce drug resistance. It has broad application prospects (Anchunju et al., 2003). Cecropin antimicrobial peptide was first discovered by Swedish scientist Boman in 1980 after the induction of Cecropin chrysalis with Negative communicating bacilli and E. coli. Studies have found that it not only has broad-spectrum antimicrobial effect, but also has certain killing effect on viruses, fungi, tumors and so on (Boman, 1995).

The cecropin antimicrobial peptide used in this experiment is a genetically engineered product synthesized by artificial design and successfully expressed in Bacillus subtilis (Chen et al., 2009). In vitro experiments have proved that it can effectively inhibit harmful bacteria such as Escherichia coli, Staphylococcus aureus and Salmonella. At present, cecropin antimicrobial peptide has been successfully fermented in fermentation tank. Therefore, cecropin antimicrobial peptide can be directly applied to the diet of weaned piglets. The purpose of this paper is to explore the effect of cecropin antimicrobial peptide on the growth performance of weaned piglets and promote its application in animal production.

1. Materials and Methods

1) 240 healthy weaned piglets with initial body weight of 11.64 (+2.30) kg were selected for the experiment.

2) The weaned piglets in the trial design experiment were randomly divided into 4 treatments according to the principle of similar weight and similar genetic basis. Each treatment was 6 replicates, and 10 pigs (male and female half) per replicate (circle). The experimental design was as follows: the control group, namely the antibiotic group (basal diet + 200mg/kg10% +1000mg/kg10%, bacilli zinc sulfate), test group 1, two group and three group. Cecropin antimicrobial peptides 250, 500 and 750 mg/kg were added to the basic diet. The trial period is 28 days, which is managed and recorded by a special person, and other daily management is carried out normally.

3) The corn soybean meal based diet was used in the trial feeding experiment, and the pig trial basal diet and premix were formulated according to the NRC (1998) pig nutrition requirement standard. The composition and nutritional level of the basic diet in the experiment are shown in Table 1. The formula of 4% premix in the diet of each experimental group is shown in Table 2. Cecropin antimicrobial peptide is provided by Beijing Zhongnong Yingtai Biotechnology Co., Ltd.

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Table 1 Basic Diet Composition and Nutrition Level

diet	content	Nutrition level	content
Corn /%	33.5	Crude protein/%	19.71
Expanded corn/%	26	Digestive Energy/(Mcal/kg)	3.39
Peeled soybean meal/%	12	Lysine /%	1.37
Expanded whole-fat soybean/%	12	Methionine /%	0.43
Whey powder /%	5	Threonine /%	0.91
Soybean protein concentrate/%	2.5	Tryptophan /%	0.25
Fish meal /%	5	Calcium /%	0.8
Premix /%	4	Phosphorus /%	0.6

Table 2 4% Premix Formulag/kg

Form	Antibiotic group	Test set	Test two groups	Test three groups
Copper sulfate pentahydrate/%	25	25	25	25
Zinc sulfate monohydrate/%	9.85	9.85	9.85	9.85
Ferrous sulfate monohydrate/%	10.80	10.80	10.80	10.80
Manganese sulfate monohydrate/%	2.6	2.6	2.6	2.6
Calcium iodate /%	5	5	5	5
Sodium selenite/%	5	5	5	5
50% choline chloride/%	15	15	15	15
10% sulfuric acid antagonist/%	5	0	0	0
10% Bacillus Peptide Zinc/%	25	0	0	0
Silkworm/%	0	6.25	12.5	18.75
Antioxidants/%	7.5	7.5	7.5	7.5
Multivitamin/%	6	6	6	6
Frankincense /%	10	10	10	10
Sweeteners /%	10	10	10	10
Zinc oxide (first two weeks)/%	75	75	75	75
Calcium hydrogen phosphate (17% P, 21% Ca)/%	212.5	212.5	212.5	212.5
Stone powder /%	207.5	207.5	207.5	207.5
Table salt /%	75	75	75	75
L-LYS，98 %/%	50	50	50	50
DL-Met，98 %/%	15	15	15	15
L-Thr，98 %/%	37.5	37.5	37.5	37.5
Medical stone /%	190.75	214.5	208.25	202

4) Feeding and management test pigs were kept in closed pig houses, and the cement floor and the floor were half well ventilated. During the experiment, the pigs were fed once a day in the morning and in the afternoon. The pigs were fed and drinked freely. The pigs were disinfected, repelled and immunized according to the routine procedure of the pig farm.

5) Growth performance indicators and methods: At the beginning and end of the experiment, weight was weighed one by one on an empty stomach, and the average daily gain (ADG), average

daily feed intake (ADFI) and feed conversion rate (FCR) were calculated. Diarrhea rate: Every day to observe the situation of piglet defecation, every morning and evening to check the anus of piglets, observe whether there is fecal contamination and redness and make a good record. The frequency and index of diarrhea reflect the severity of diarrhea.

SAS statistics were used to analyze the test data and variance analysis was carried out. Duncan's multiple comparisons were made when the difference was significant.

2. Results

Feed intake, daily gain and feed conversion of experimental piglets are shown in Table 3. There was no significant difference in body weight among the groups at the beginning of the experiment (P=0.99), and the average daily gain during the experiment period showed a trend of improvement compared with the antibiotic group (P>0.05). However, from the trend of each index, the performance of the experimental group with cecropin antimicrobial peptide was better than that of the antibiotic control group. Compared with the antibiotic control group, the feed conversion rate was significantly improved. The feed conversion rates of the experimental group, the experimental group and the experimental group were 18.29% (P < 0.01), 7.93% (P < 0.05) and 14.02% (P < 0.05) lower than those of the antibiotic control group, respectively. There was no significant difference in daily intake among groups (P=0.291). The intake of the experimental group, the experimental group and the experimental group decreased by 14.29%, 7.69% and 8.79% respectively compared with the antibiotic control group (P > 0.05). This proved that the weaned piglets in the experimental group reduced their intake and production cost without affecting daily gain.

Table 3 Effects of Silkworm Antimicrobial Peptide on Production Performance of Weaned Piglets

group	Initial weight /kg	Final weight /kg	ADG/kg	ADFI/kg	FCR	Diarrhea rate /%
Antibiotic group	11.6	27.15	0.56	0.91	1.64^{A}	5.24^{a}
Test set	11.74	28.17	0.59	0.78	1.34^{C}	3.53^{b}
Test two groups	11.61	27.3	0.56	0.84	1.51^{B}	2.46^{b}
Test three groups	11.6	28.16	0.59	0.83	1.41^{C}	1.87^{c}
SEM	0.37	0.77	0.02	0.02	0.03	0.89
P value	0.999	0.952	0.807	0.291	< 0.001	0.045

Note: There are significant differences between different capital letters in the same column (P < 0.01), different lower-case letters (P < 0.05), and the same letters (P > 0.05).

3. Discussion

1) Compared with traditional antibiotics, antimicrobial peptides not only kill bacteria, fungi, parasites and viruses, but also kill cancer cells. In addition, antimicrobial peptides play an important role in innate and acquired immunity. The target of traditional antibiotics for cells is usually a single individual or population, while antimicrobial agents are usually used to kill cancer cells. The target of antimicrobial peptides is not so specific, which may be mixed with multiple targets. In terms of drug resistance, the frequency of antimicrobial resistance of traditional antibiotics is 10-7-10-10, or only generations are produced at sub-MIC concentration. For antimicrobial peptides, drug resistance generally cannot be produced directly, and it is necessary to induce many generations under sub-MIC before antimicrobial peptides can be produced relatively independently. Its antimicrobial activity can also be synergistic with other factors, showing higher activity. Among antimicrobial peptides, antimicrobial peptides have synergistic effect with traditional antibiotics, and also with lactoferrin, lysozyme and other factors to improve activity (Marr et al., 2006).

The results showed that the performance of weaned piglets was improved by adding different doses of cecropin antimicrobial peptide in diet.

2) Antimicrobial Peptides used as feed additives can withstand high temperature during pelleting. The pellet feed was used in this experiment. The results showed that the biological activity of antimicrobial Peptides was not lost. The bactericidal mechanism of antimicrobial Peptides was unique, and the pathogens were not easily resistant to antimicrobial Peptides. The antimicrobial Peptides could be produced on a large scale by industrial fermentation of engineering bacteria for a week. Short period, low production cost and not affected by season and climate change and other external environment.

4. Conclusion

The results showed that the feed conversion rate, growth promotion and diarrhea resistance of weaned piglets fed with cecropin antimicrobial peptide were better than those of antibiotic group (10% sulfuric acid antimicrobial 200 mg/kg and 10% bacitracin zinc 1000 mg/kg). Among them, the effect of cecropin antimicrobial peptide added 250mg/kg was the best.

References

[1] Andreu D, Rivas L. Animal antimicrobial peptides: An overview [J]. Peptide Science, 1998, 47(6):415-33.

[2] Boman H G, Nilsson I, Rasmuson B. Inducible Antibacterial Defence System in Drosophila [J]. Nature, 1972, 237(5352):232-5.

[3] Brogden K A. Antimicrobial peptides: pore formers or metabolic inhibitors in bacteria?[J]. Nature Reviews Microbiology, 2005, 3(3):238-50.

[4] Yoon J H, Ingale S L, Kim J S, et al. Effects of dietary supplementation of antimicrobial peptide-A3 on growth performance, nutrient digestibility, intestinal and fecal microflora and intestinal morphology in weanling pigs[J]. Animal Feed Science & Technology, 2012, 177(1–2):98-107.