ISSN 2304-334-02

UDC 619:636.5.034:549.67:615.33

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ZEOLITES AS ALTERNATIVES TO ANTIBIOTICS AS GROWTH PROMOTERS FOR USE IN POULTRY PRODUCTION

Annotation

The impact of phasing out animal growth promoters could be minimized provided that adequate attention is given to the implementation of alternative disease-prevention strategies and management factors, such as alternative husbandry practices in food animal production.

Results of this study, it can be concluded that Chankanay deposit's zeolite dietary treatment of 5% by weight of the feed showed significant reduction in intestinal counts of E.coli and elevation in intestine Lactobacillus spp. and bifidobacteria counts of chickens compared to control group ($p<0.05$). So the feed additive will increase the amount of useful intestinal bacteria, and suppress the growth of the pathogenic microflora.

Key words: antibiotic, zeolite, growth promoters, feed additive, laying hens, microflora.

Introduction

Antibiotics have been widely used in animal production for decades [1]. Although some are used therapeutically to improve the health and well-being of animals, most were given for prophylactic purposes and to improve growth rate and feed conversion efficiency, as antimicrobial growth performance promoters [2].

The use of antibiotic growth promoters as feed additives to suppress the pathogenic bacteria in the gut has been common in commercial poultry production, however it is banned in Europe [2] because of concerns for the consequences it could have on human health in terms of the selection of antibiotic resistant microbiota and for the presence of residual antibiotics in poultry products [3]. Alternatives to antibiotic growth promoters are required in order to maintain bird health and deliver the productivity improvements that were sometimes associated with their use.

Laying hens are in great need of antibiotic-free pathogen control given antibiotics cannot be used due to residue carry over to eggs. For example, in Queensland, Spotty Liver is emerging as a disease of concern. This disease is caused by Campylobacter species [4] and is currently controlled by antibiotics. Layers colonization with human pathogens such as Salmonella and Campylobacter is an important issue that the industry is grappling with, and for which new solutions are required. Additionally antibiotic-free pathogen control is needed in organic poultry production. There are many alternative products under investigation. Among them zeolites are interesting candidates for selective pathogen control as there is mounting evidence that they are safe and beneficial products [5-7].

Clinoptilolite is a common form of natural zeolite. Zeolites are crystalline, hydrated aluminosilicates of alkali and alkaline earth cations. Zeolites have cation exchange properties and are capable of trapping molecules within their pores [8]. For example, the porosity, particle and crystal size of the zeolitic material and its degree of aggregation determine the rate of access of ingesta fluids during passage through the gastro intestinal tract (GIT) [6]. Average daily live body weight gain and feed conversions in laying hens have been improved with dietary inclusion of zeolites. Zeolite feed amendment has also been reported to increase egg production and have positive effects on egg weight and internal egg quality. Papaioannou et al. reported zeolite feed amendment to be associated with a reduction in the rate of passage of feed through the digestive system, and an associated reduction in feed intake resulting in better FCR. However, factors including the type of zeolite, its purity, physiochemical properties, and the supplementation level used in the diets may impact the performance effect [9-12].

Chemically modified natural zeolites have been associated with bactericidal effects on pathogenic organisms in the guts of birds. A reduction in mortality of chickens and reduced viable counts of Salmonella enteritidis and Escherichia coli in the proximal and distal gut were associated with inclusion of zeolite in feed [13]. Zeolite can be modified chemically with organic cations resulting in increased hydrophobicity of the mineral surface, increasing its adsorptive capacity to certain molecules, and resulting in increased bactericidal effects against Escherichia coli and its toxins [14,15].

Zeolite, one of the non-metallic mineral clays, has been incorporated in animal diets as an enhancer of nutrient digestibility and growth performance in animals. In vitro studies showed that clinoptilolite could adsorb Escherichia coli [16].

Materials and methods

The experimental work was carried out in 2016 at the vivarium of the Kazakh National Agrarian University and at the Laboratory of Microbiological Safety of the Kazakhstan-Japan innovation center. The objects of study were 40 laying hens of “Haysex white” cross from “Sary-Bulak” poultry farm’s hatchery. The birds were housed in cages. The housing conditions were compatible with the existing technological requirements. To conduct the study two groups of chickens - experimental and control - were formed (20 birds in each) on the principle of analogues. Feeding chickens included three - the start (1-30 days), growth (31-60 days) and finishing (from 61 to 90 per day) - periods according instructions of the industrial poultry farm scheme “Sary-Bulak” with commercial basic diet (BD). The chickens were allowed to have free access to feed and water. Chickens in the control group received the BD. Into BD of the experimental group was daily adding 5% of the functional feed additive based on zeolite from the first feeding day. The study scheme is presented below (Table 1).

Table 1. Study scheme

Indicators	Starter	Growth	Finish
Control group (BD)	400 g	700 g	1000 g
Experimental group (BD + 5% feed additive)	380 g + 20 g	665 g + 35 g	950 g + 50 g

Before feeding zeolite was grinded to particles size 0.5-3.0 mm. Experiment’s scheme depended on the purpose of the experiment and subsequently will be reflected in the description of the relevant research results.

Microbiological tests were taken from the contents of small and large intestines of the randomly selected and killed five chickens in the each group at the first, 30th, 60th and 90th days.

Study of the intestinal microbiota was performed by quantitative group analysis.

The intestinal tract was separated immediately after slaughter. The samples of intestine contents (1g) were transferred under aseptic conditions and diluted with saline solution (1:10) for determination of specific quantitative microflora composition [17]. After dilution, 100 μl of each sample was planted onto the following media: Endo-agar for E.coli, Sabouraud-agar for fungi, MPA-agar for Streptococcus, Yolk-salt-agar for Staphylococcus, Vismut sulfite agar and Ploskirev agar for Salmonella and Shigella spp., Blaurokk-media for bifidobacteria and Lactobacillus spp. They were incubated at 37°C for 24–72 h. After the incubation the colonies on the culture media were counted and the numbers of viable colony forming units (CFU) per g were calculated. The identification was conducted according to Bergey's Manual of Determinative Bacteriology by morphological, cultural, physiological and biochemical properties of microorganisms. The significance of difference among the groups was determined by one-way analysis of variance (ANOVA) and t-test. Differences were considered significant at p<0.01. The study was approved by the Local Ethical Committee of the Kazakh National Agrarian University, in accordance with the ethical standards of Principles of Animal Care.

Results and discussion

The results of the experiment showed that dynamics of formation of the whole microbiocenosis had some differences at chickens of the control and experimental groups. So, significant differences were revealed in the intensity of colonization of the intestinal biocenosis that was depending from the laying hens' age of the both groups (Figures 1, 2).

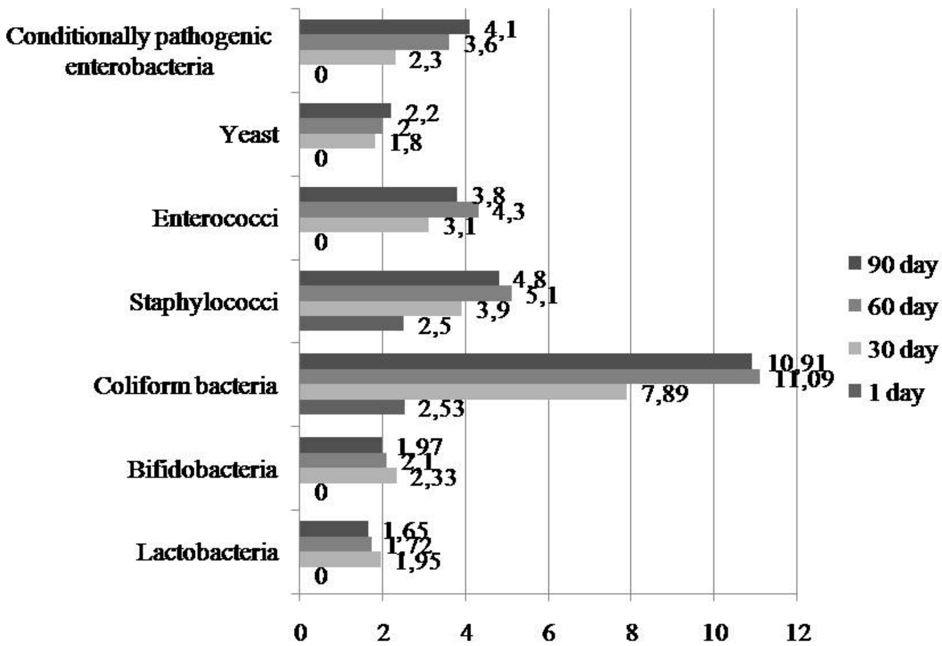

Figure 1. Status of intestinal microbiota of control group laying hens at different ages, log 10 CFU/g

In day-old chicks microflora consists mainly of Escherichia coli. Nevertheless, at the samples of seven days old chickens we observed the population of the intestinal bacteria included E.coli, lactic acid bacteria and bifidobacteria.

The number of bifidobacteria in experimental group decreased with respect to the data of 30-day-old on 3.13 log 10 CFU/g (p<0.05) greater than that of the control counter parts.

60 days-old chicks of the control group had significant decrease of the of lactobacilli number with 1.72 log 10 CFU/g (p<0.01) to 2.19 log 10 CFU/g (p<0.05) than in experimental group of chickens. So chickens of this age in the experimental group had active colonization of intestine by bifidobacteria and lactobacilli. It could be suggested that their growth suppressed E.coli, the amount of which was at the level 11.09 log 10 CFU/g (p<0.01). On the other hand it can be attributed the fact that the contents of the intestine there was an increase in the number of staphylococci in control group (5.1 log 10 CFU/g) than in the experimental group. The number of conditionally pathogenic enterobacteria in the control group was the first day 2.3 log 10 CFU/g (p<0.01) and in the experimental group it was 1.6 log 10 CFU/g (p<0.01). Yeast also

goes to the down turn in samples from the experimental group compared to controls in all periods of growth of chickens.

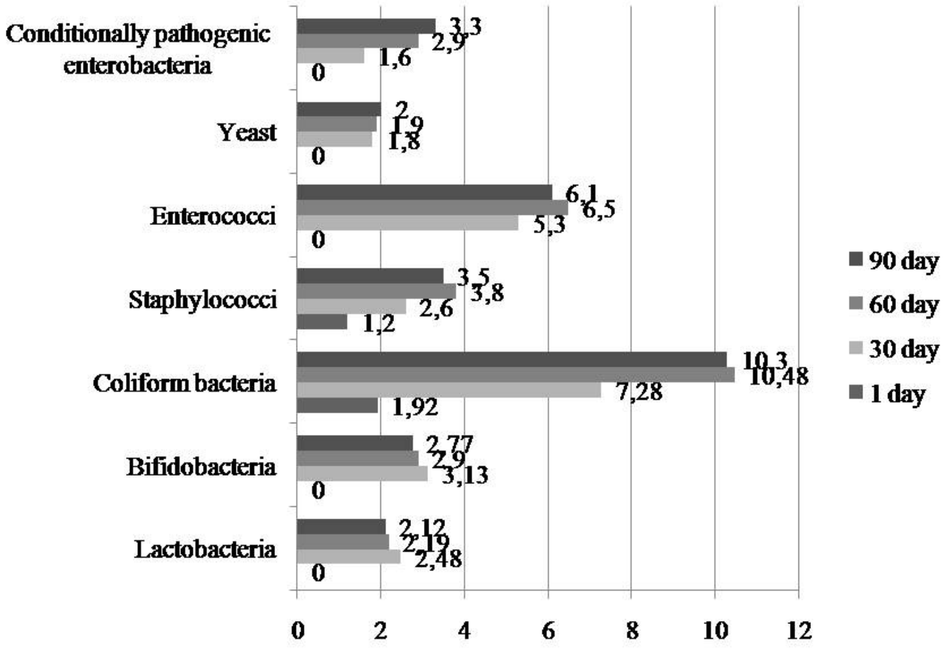

Figure 2. Status of intestinal microbiota of laying hens of the experimental group at different ages, log 10 CFU/g

At the moment of hatching the intestine of chickens is sterile and after hatching it is being populated by environmental microorganisms. Therefore, the providing for the rapid and valuable formation of microflora composition of the intestinal tract in nestlings is a main problem of healthy poultry production.

Every microorganism group in the intestinal tract performs its function. Bifidobacterium generate organic acids and create unfavourable conditions for reproduction of pathogens.

Escherichia coli, being strict anaerobes, use oxygen and create favourable conditions for other bacteria, and secrete colicins, which inhibit the growth of pathogenic microorganisms.

The composition of forage influences birds' health and their resistance to pathogenic microflora. The intestinal microbial associations are substrate-specific and therefore they depend on nutrient presence in the occupation zone. It is known that the basic microorganisms for animals or birds are facultative and strict anaerobe bifidobacteria, Lactobacillus and lactate-fermentation bacteria, and Bacteroides.

In poor hygienic conditions birds that were fed the poor quality food and had unbalanced feeding tend to have unbalanced intestinal microflora: the active propagation of pathogenic bacteria and repression of representatives of the "normal" microflora with all the following negative consequences.

Under natural conditions, the establishment of microflora in the digestive tract of warm-blooded animals soon after birth is an inevitable process. However, despite the crucial role of the microflora in the life of the microorganism, today there is no uniform classification of it. Many researchers use the intestine fundamental criteria for the quantitative aspects of the microflora, dividing them into the main, and the concomitant residual. Therefore, the primary objective is further to ensure and maintain the gut microflora of poultry at its normal level [18].

Results of this research have found that the functional feed additive based on Chankanay deposit zeolite has a positive effect on the laying hens' intestinal microbiocenosis, reducing the content of yeast and staphylococci. The process of suppressing the pathogenic bacteria occurs apparently due to the fact that this feed additive possesses antibacterial properties. At the same time reducing background of pathogenic bacteria increased content of bifidobacteria and lactobacilli. Probably, this is due to the selective effect of the zeolite which has a special microstructure that can restrain pathogenic bacteria.

The impact of phasing out animal growth promoters could be minimized provided that adequate attention is given to the implementation of alternative disease-prevention strategies and management factors, such as alternative husbandry practices in food animal production.

Conclusion

From these above results, it can be concluded that Chankanay deposit's zeolite dietary treatment of 5% by weight of the feed showed significant reduction in intestinal counts of E.coli and elevation in intestine Lactobacillus spp. and bifidobacteria counts of chickens compared to control group ($p<0.05$). So the feed additive will increase the amount of useful intestinal bacteria, and suppress the growth of the pathogenic microflora.

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ҚҰС ШАРУАШЫЛЫҒЫНДА АНТИБИОТИКТЕР ОРНЫНА ӨСУ СТИМУЛЯТОРЫ РЕТІНДЕ ЦЕОЛИТТЕРДІ ПАЙДАЛАНУ

Аңдатпа

Зерттеудің қорытындысы бойынша салмақ үлесі бойынша құрамында 5% цеолит диетасы негізінде жұмыртқалағыш тауықтардың ішектерінде *E. coli* мөлшерінің айтарлықтай төмендеуі және тәжірибиелік топтағы *Lactobacillus spp.* және *Bifidobacteria* бақылау тобымен салыстырғанда (p <0,05) жоғарылауы анық байқалынды.

Кілт сөздер: антибиотик, цеолит, өсу стимуляторлары, азықтық қоспа, жұмыртқалағыш тауықтар, микрофлора.

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ЦЕОЛИТЫ КАК АЛЬТЕРНАТИВЫ АНТИБИОТИКАМ В КАЧЕСТВЕ РОСТА СТИМУЛЯТОРА ПРИ ИСПОЛЬЗОВАНИИ В ПТИЦЕВОДСТВЕ

Аннотация

По результатам данного исследования можно сделать вывод о том, что диета на основе цеолита, содержащая 5% по весу корма, показала значительное снижение количества *E.coli* и повышение в кишечнике *Lactobacillus spp.* и *Bifidobacteria* у кур-несушек экспериментальной группы по сравнению с контрольной группой (p <0,05).

Ключевые слова: антибиотик, цеолит, стимуляторы роста, кормовая добавка, куры несушки, микрофлора.

УДК 616.98:637.4.64

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ОЦЕНКА ПИШЕВОЙ ЦЕННОСТИ МЯСО СВИНЕЙ ПРИ ЦИРКОВИРУСНОЙ ИНФЕКЦИИ

Аннотация

Как показывают результаты исследования, по химическому составу в мясе свиней контрольной группы жира бльше, чем в опытной группе, а по калорийности также на 1 ккал выше, чем в опытной группе, а остальные показатели почти одинаковые.

Незаменимые аминокислоты в мясе свиней опытной группы 7180мг/100г, а в контрольной группе 99269,9мг/100г. Заменимые аминокислоты в опытной группе 11106мг/100г, в контрольной группе 11162 мг/100г.

Ключевые слова: аминокислоты, оценка, мясо свиней, пищевая ценность.

Введение

Основным фактором биологической полноценности белковых продуктов считается их аминокислотный состав. Питательность мяса, среди других факторов, обусловленная соотношениям в нем полноценных и неполноценных белков. Считается, что в качестве показателя биологической полноценности белков мяса можно использовать соотношение количества триптофана к оксипролину, поскольку триптофан содержится лишь в полноценных белках и отсутствует в белках соединительной ткани. Оксипролин является составной частью соединительнотканного белка коллагена, высокое содержимое которого снижает общую питательность мяса, придает жесткости и отрицательно сказывается на вкусовых качествах.

Аминокислоты, происходящие во всех организмах азотные вещества

- считаются основными, начальными соединениями гормонов, витаминов, медиаторов, в основах пурина и пиримина, алколоидах, др. веществах, и участвуют в процессе обмена веществ, выполняют функцию мономеров всех белков организмов животных и растений. Место аминокислот в белках при биосинтезе протеинов в клетках определяет генетический код.

Наша цель научно-исследовательских работ определить количество аминокислот в мясе свиньей при цирковирусной инфекции. [2,6]

Материалы и методы

Исследования проводили в лаборатории РГП «Научно-исследовательский институт проблем биологической безопасности». Исследования были проведены на свиньях, а именно: больное животное цирковирусный инфекции (I группа - контрольная), здоровое животное (II группа - опытая). Как исследовательский материал взяты пробы с бедренных мускул свиней в опытную группу (10 голов) и контрольную группу(10 голов). Во время исследований определены вышесказанные показатели жирность мяса, выход мяса, а также состав аминокислот в мясе свиней.

Аминокислоты определяли Автоматическим Анализатором Аминокислот ААА-834.

Содержание аминокислот в мясе свиней ААА 881- проводилось с помощью автоматизированного аминокислотного анализатора. [1,5]