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Comparative effectiveness of eimeriocidal products for treatment of broiler chickens in small scale production

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SUMMARY

There is currently almost no poultry holding where avian eimerioses, both monoinvasions and those associated with cryptosporidioses, salmonelloses and colibacterioses, are not reported. In view of this, the disease control is an urgent challenge that shall be approached in its entirety, using various eimeriostats, antibiotics and probiotics. Searching for new effective products with broad-spectrum antiparasitic action is one of priorities in avian eimeriosis control. Comparative tests of different combinations of eimeriocidal products, namely solicox + chicktonic, maduvet + tylosin and eimeterm + enrofloxacin, for their treatment and protective effectiveness were carried out under production conditions in broiler chickens of a poultry factory located in the Republic of Dagestan. To perform the tests, four groups of broiler chickens (one control group and three test groups, each comprising 50 chickens) were formed based on the principle of analogues. The treatment and prevention scheme adopted in the said poultry holding was used for the control group chickens. Test group 1 chickens were given solicox at a dose of 2 ml per 1 liter of drinking water in combination with chicktonic (a feed supplement) at a dose of 1 ml per 1 liter of water during 4–5 days. Group 2 chickens were given maduvet at a dose of 3–5 mg/kg of body weight with feed twice and tylosin at a dose of 5 g of powder per 10 liters of water once a day during 5 days; where necessary, the procedure was repeated in 14–16 days. Group 3 broiler chickens were given eimeterm 2.5% at a dose of 7 mg/kg of body weight with water during 2 days in combination with enrofloxacin at a dose of 3 ml per 1 liter of drinking water during 5–6 days. It is shown that a decrease in the number of clinically diseased and dead chickens was observed in the test groups after the use of eimeriocidal products that helped to improve zootechnical parameters of reared broiler chicks. Product extenseffectiveness and intens-effectiveness in different groups of chickens were as follows: Group 1 – 89.2 and 96%, Group 2 – 87.6 and 94%, Group 3 –81.4 and 96%, respectively. The clinical signs of eimeriosis were observed in the control group chickens throughout the entire period of studies, invasion extensity and intensity were 87.6 and 42.6%, respectively.

Keywords: eimeriosis, coccidiostat, solicox, chicktonic, maduvet, tylosin, eimeterm, enrofloxacin, effectiveness, droppings, broiler chickens, live weight, treatment effectiveness, oocyst, caeca

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Сравнительная эффективность эймериоцидных препаратов при лечении цыплят-бройлеров в условиях мелкотоварного производства

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РЕЗЮМЕ

В настоящее время практически нет ни одного птицеводческого хозяйства, где бы не регистрировались эймериозы птиц, как моноинвазии, так и в ассоциации с криптоспоридиозами, сальмонеллезами и колибактериозами. С учетом этого факта борьба с данным заболеванием является актуальной задачей, которую необходимо решать комплексно, с применением различных эймериостатиков, антибиотиков и пробиотиков. Изыскание новых эффективных препаратов, обладающих широким спектром антипаразитарного действия, – одно из приоритетных направлений в борьбе с эймериозами птиц. В производственных условиях одной из птицефабрик Республики Дагестан на цыплятах-бройлерах провели сравнительные испытания различных комбинаций эймериоцидных препаратов: соликокс + чиктоник, мадувет + тилозин и эйметерм + энрофлоксацин – с целью выявления их лечебной и профилактической эффективности. Для проведения исследований по принципу аналогов сформировали четыре группы цыплят-бройлеров: одна – контрольная и три – опытные – по 50 голов в каждой. В контрольной группе использовали схему лечебно-профилактических мероприятий, принятую в данном птицеводческом хозяйстве. Цыплята-бройлеры первой опытной группы получали препарат соликокс в дозе 2 мл на 1 л питьевой воды в сочетании с кормовой добавкой чиктоник в дозе 1 мл на 1 л воды в течение 4–5 дней. Цыплятам второй группы с кормом задавали препарат мадувет в дозе 3–5 мг/кг массы тела двукратно и тилозин в дозе 5 г порошка на 10 л воды один раз в сутки в течение 5 дней, при необходимости процедуру повторяли через 14–16 дней. Цыплята-бройлеры третьей группы два дня получали с водой 2,5%-й препарат эйметерм в дозе 7 мг/кг массы тела в комбинации с энрофлоксацином в дозе 3 мл на 1 л питьевой воды в течение 5–6 дней. Показано, что в опытных группах после применения эймериоцидных препаратов наблюдали уменьшение количества клинически больных особей и снижение падежа, что способствовало улучшению зоотехнических показателей при выращивании цыплят-бройлеров. Экстенс- и интенсэффективность препаратов в первой группе цыплят составила 89,2 и 96%, во второй группе – 87,6 и 94%, в третьей – 81,4 и 96% соответственно. У птиц контрольной группы наблюдали клинические признаки эймериоза в течение всего периода исследования, а показатели экстенсивности и интенсивности инвазии составили 87,6 и 42,6% соответственно.

Ключевые слова: эймериоз, кокцидиостатик, соликокс, чиктоник, мадувет, тилозин, эйметерм, энрофлоксацин, эффективность, помет, цыплята-бройлеры, живая масса, лечебная эффективность, ооциста, слепые отростки

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INTRODUCTION

Eimeriosis is one of the most common diseases in poultry husbandry. The disease is caused by protozoans of the genus *Eimeria*, which propagate in the intestine and cause digestion and absorption disorders, bodily dehydration, gastrointestinal wall bleeding, thereby increasing the chances of infection with other agents. At present, eimeriosis still continues to be a problem. Unfortunately, there are almost no poultry farms where this parasite is not present. When veterinary and sanitary rules are not complied with, large amounts of *Eimeria* can accumulate in poultry houses within a short space of time, thus constituting a continuing threat of invasion occurrence and spread, and cause huge damage. Many domestic and foreign scientists have addressed this issue [1–10].

Like many parasitic infections, eimeriosis mainly affects young poultry, since they are still developing their immunity during the postnatal period. According to many researchers, coccidiosis affects chickens aged from 10 days to 3 months [11, 12].

Infection in poultry usually occurs during warm and humid seasons when conditions are favourable for the growth of exogenous phase *Eimeria* and their persistence in the environment. Such seasons are late autumn, winter and early spring in the southern regions of Russia and late spring, summer and early autumn in the north west of the country.

According to the data from a number of researchers, the disease control is complicated by the fact that chickens are affected by 9 *Eimeria* species having different sensitivity to eimeriostats. A certain *Eimeria* species can infest only one poultry species and is absolutely harmless for another species, i.e. the disease agents are monotropic. S. K. Svanbaev [13] studied morphologically similar *Eimeria* isolated from turkeys and chickens and found them to be nonidentical, no cross-infection occurred.

Poultry that have had eimeriosis caused by one *Eimeria* species remain susceptible to infection caused by another species. Due to the short life cycle and high productivity of *Eimeria*, the proportion of mass outbreaks in the poultry

houses is continuing to increase, and eimeriosis is currently considered to be the most costly disease.

Eimerioses often occur in association with cryptosporidioses, salmonelloses and colibacterioses, thus constituting a serious threat for poultry holdings of various forms of property. Even the mild form of eimeriosis in association with cryptosporidia, along with inadequate feeding and in the presence of other unfavourable factors, inflicts significant economic damage on poultry farming. Global economic losses due to eimeriosis are huge and make more than 3 billion US dollars a year [14, 15]. The damage is made up of expenses associated with chicken deaths, growth retardation, reduced meat production, increased feeding and treatment costs [16]. Therefore, the invasion control methods undergo continuous improvement, and new methods are developed [2, 5–7, 14, 16–27].

The long-term application of the same eimeriostats results in the appearance of resistant forms of coccidia. Many domestic and foreign authors address this problem in their papers [4, 22, 24, 28–32].

In view of this, treatment shall involve the alternating use of various products, provided that the product administration doses and schedules are complied with. At present, the control of associative forms of avian eimerioses is an urgent challenge that shall be approached in its entirety, using various eimeriostats, antibiotics and probiotics. Searching for new highly effective eimeriostats with broad-spectrum antiparasitic action is increasingly important.

The study was aimed at the examination of comparative effectiveness of currently available eimeriocidal products for treatment of broiler chickens.

MATERIALS AND METHODS

The studies were carried out at the Laboratory for the Study of Invasive Diseases of Farm Animals and Poultry of the Caspian Regional Research Veterinary Institute – Branch of Dagestan Agriculture Science Center and at the AO "Poultry factory "Makhachkalinskaya" affected with avian eimerioses.

Comparative tests of different combinations of eimeriocidal products, namely solicox + chicktonic, maduvet + tylosin and eimeterm + enrofloxacin, for their treatment and prevention effectiveness were carried out under production conditions.

To perform the tests, 200 fourteen-day-old Ross-308 broiler chickens were selected based on the principle of analogues; four groups (one control group and three test groups, each comprising 50 chickens) were formed.

The treatment and prevention scheme adopted in the mentioned poultry holding was used for the control group chickens.

Test group 1 chickens were given solicox at a dose of 2 ml per 1 L of drinking water and chicktonic at a dose of 1 ml per 1 L of water during 4–5 days.

Group 2 chickens were given maduvet at a dose of 3–5 mg/kg of body weight with feed twice and tylosin at a dose of 5 g of powder per 10 L of water once a day during 5 days; where necessary, the procedure was repeated in 14–16 days.

Group 3 broiler chickens were given eimeterm 2.5% at a dose of 7 mg/kg of body weight with water (this is equivalent to 1 ml of the product per 1 L of drinking water) during 2 days and enrofloxacin at a dose of 3 ml per 1 L of drinking water during 5–6 days.

Table 1
The scheme of the experiment carried out in Ross-308 broiler chickens

Groups	Product	Number of chickens	Product dose and treatment schedule
test group 1	solicox + chicktonic	50	2 ml/1 L of water + 1 ml/1 L of water during 4–5 days
test group 2	maduvet + tylosin	50	3–5 mg/kg of body weight twice + 5 g/10 L of water once a day during 5 days; where necessary, the procedure should be repeated in 14–16 days
test group 3	eimeterm 2.5% + enrofloxacin	50	7 mg/kg of body weight (which is equivalent to 1 ml of the product per 1 L of drinking water) + 3 ml/1 L of water during 5–6 days
control group	–	50	–

The scheme of the experiment is presented in Table 1.

The experiment in animals was carried out in compliance with GOST 33215-2014 adopted by the Interstate Council for Standardization, Metrology and Certification and according to the requirements of the Declaration of Helsinki (2000) and Directive 2010/63/EU of the European Parliament and of the Council of 22 September 2010 on the protection of animals used for scientific purposes.

The following material was used for testing: samples of droppings from litter and feedstuffs, floor and tool swabs, as well as caecum samples from dead poultry.

Coprological examination of the chickens' droppings was carried out before the start of the experiment and on days 20, 26, 36, 46 after the product administration.

The intensity of *Eimeria* infestation in poultry was determined according to Darling's method standardized by N. P. Orlov, droppings were tested using direct smears stained with methylene blue, as well as flotation and centrifugation technique (Nikitin and Breza).

Infestation level, the intensity (II) and extensity (EI) of *Eimeria* invasion in the control and test group chickens were determined by counting oocysts in 1 g of droppings using a McMaster counting chamber or the counting chamber developed by the Scientific Research Institute Parasitology named after K. I. Skryabin (VIGIS) in 20 microscope fields of view.

The intenseffectiveness (IE) of the eimeriocidal products was calculated according to the formula:

$$IE = \frac{C - P}{C} \times 100\%,$$

where C is the geometric mean number of oocysts in the control group chickens;

P is the geometric mean number of oocysts in the test group chickens.

The extenseffectiveness (EE) of the products was determined based on the number of broiler chickens that became completely oocyst free after the treatment.

Table 2
The results of comparative studies of product effectiveness and some zootechnical parameters of reared broilers

Parameter	Group			
	control group	test group 1	test group 2	test group 3
Before treatment				
Number of chickens in the group	50	50	50	50
Age of chickens, days	16	16	16	16
Average weight of one chicken at the beginning of the experiment, g	119	121	119	120
Oocysts in caeca, mean number per FOV	42.6 ± 3.2	35.8 ± 3.5	39.4 ± 3.8	37.6 ± 4.2
Oocysts in 20 dropping samples, mean number per FOV	36.8 ± 2.6	31.4 ± 3.8	33.4 ± 3.2	34.7 ± 3.6
After treatment				
Number of chickens that died during the observation period (46 days)	17	2	3	2
Mortality rate, %	34	4	6	4
Oocysts in caeca, mean number per FOV	47.9 ± 5.3	2.4 ± 1.3	6.1 ± 1.1	3.3 ± 0.96
Oocysts in 20 dropping samples, mean number per FOV	44.8 ± 4.2	1.9 ± 2.3	4.8 ± 1.7	2.1 ± 1.3
Product intenseffectiveness, %	–	95	88	94
Survival rate during the observation period (46 days), %	66	96	94	96
Daily average live weight gain during the observation period (46 days), g	36	47	44	46
Average feed intake per 1 kg of live weight gain during the observation period (46 days), kg	2.46	2.1	2.2	2.15
Live weight at the time of slaughter, g	1,725	2,125	1,980	2,050

Number per FOV – number per microscope field of view.

In order to detect *Eimeria* and morphological lesions in the digestive tract, the chickens were selectively subjected to necropsy.

The therapeutic effectiveness of the products was assessed based on the results of coproscopic examination carried out for detection of *Eimeria* in poultry caeca, droppings and swabs from various surfaces of the production facilities.

The following performance indicators were taken into account: survival rate for each poultry house, body weight gain and feed conversion ratio.

The eimeriostat test results were statistically processed using the Biometrics software.

RESULTS AND DISCUSSION

Intensity and extensity do not always characterize the invasion process comprehensively. To get a clear picture of the disease, one should perform a complete helminthological necropsy, taking into account the status of internal organs and the severity of intestinal lesions in poultry.

Table 2 shows the results of comparative studies of the product effectiveness, as well as some zootechnical parameters of reared broilers during the observation period.

The tests showed that the clinical signs of eimeriosis were reported in the control group chickens throughout the entire observation period, and in the test group chickens – only until the treatment started. During the 46 days of the experiment, 17 chickens of the control group died, the survival rate was 66%.

The necropsy of the fallen chickens revealed that the most pronounced lesions were found in caeca: the caecal cavity was filled with blood clots, the mucosa was thickened, necrotic foci were observed in some places. The walls of the duodenum were thickened, petechiae were observed. Such diagnoses as typhlitis and duodenitis were established.

The test group poultry looked clinically healthy. During the entire observation period (46 days), 2, 3 and 2 chickens died in groups 1, 2, 3, respectively, i.e. the survival rates were 96, 94 and 96%. The necropsy of the fallen chickens did not reveal any lesions characteristic of avian eimeriosis in their internal organs and intestines.

Daily average weight gain during the observation period (46 days) in the control group was 36 g, and in the test groups – 47, 44, 46 g, respectively. Feed intake per 1 kg of live weight gain in the control group was 2.46 kg, and in the test groups – 2.1, 2.2 and 2.15 kg, respectively. At the end of treatment, average live weight of one chicken in the control group was 1,725 g, and in the test groups – 2,125, 1,980 and 2,050 g, respectively, i.e. 114–400 g more than in the control group.

During the rearing period, the control group chickens demonstrated slower growth and development and failed to gain the same live weight as the test group chickens. The control group chicken mortality was 5–6 times higher than that of the test group chickens.

Coprological examination revealed the presence of three *Eimeria* species in the chickens' droppings: *E. tenella*, *E. maxima*, *E. acervulina*; the intensity of invasion in the control group was 42.6 ± 3.2 oocysts in 20 microscope fields of view, and in the test groups – 35.8 ± 3.5; 39.4 ± 3.8; 37.6 ± 4.2.

It was found that, after the tested products had been applied, the test group broiler mortality decreased considerably, the number of oocysts in caeca and in 20 dropping samples reduced to 2–6 oocysts in the microscope field of view. The test results showed that the products have pronounced eimeriocidal effect against *Eimeria* oocysts, as well as high therapeutic effectiveness that was 95, 88 and 94% for test groups 1, 2 and 3, respectively, after the treatment.

Data on the results of studies of the extensity (EI) and intensity (II) of *Eimeria* invasion and the extenseffectiveness (EE) and intenseffectiveness (IE) of the studied eimeriocidal products in dynamics are presented in Table 3.

The test results showed that, after the products had been used, the extensity and intensity of invasion on day 46 of testing in group 1 chickens were 9.3 and 1.1%, in group 2 chickens – 6.7 and 2.1%, in group 3 chickens – 7.3 and 1.5%, respectively.

On day 46 of observation, the product extenseffectiveness and intenseffectiveness in group 1 broiler chickens

Table 3
The results of studies of *Eimeria* invasion extensity and intensity and extenseffectiveness and intenseffectiveness of the studied products at different time points during broiler chicken rearing

Group and products	Number of chickens	Extensity and intensity of invasion (%) during testing				Product extenseffectiveness and intenseffectiveness (%) during testing		
		day 20	day 26	day 36	day 46	day 26	day 36	day 46
		EI/II	EI/II	EI/II	EI/II	EE/IE	EE/IE	EE/IE
Test group 1 solicox + chicktonic	50	15.1/ 2.6	14.4/ 2.2	13.7/ 2.1	9.3/ 1.1	74.3/ 93.1	75.9/ 95.6	89.2/ 96.0
Test group 2 maduvet + tylosin	50	16.2/ 2.8	16.0/ 2.5	10.0/ 2.9	6.7/ 2.1	77.2/ 86.9	77.8/ 91.9	87.6/ 94.0
Test group 3 eimeterm 2.5% + enrofloxacin	50	16.8/ 2.6	15.0/ 2.2	11.2/ 2.0	7.3/ 1.5	75.3/ 92.2	76.9/ 95.1	81.4/ 96.0
Control group	50	48.0/ 35.8	56.9/ 48.4	73.2/ 43.8	87.6/ 42.6	–	–	–

were 89.2 and 96%, in group 2 broiler chickens – 87.6 and 94%, in group 3 broiler chickens – 81.4 and 96%, respectively.

By the end of the experiment, the extensity and intensity of invasion in the control group chickens were 87.6 and 42.6%, respectively.

CONCLUSION

The tests performed showed that the clinical signs of eimeriosis were reported in the control group broiler chickens throughout the entire observation period, and in the test group chickens – only until the treatment started. In the control group, 17 chickens died, the survival rate was 66%. Eimeriosis-associated mortality of the control group chickens was 5–6 times higher than that of the test group chickens.

Solicox at a dose of 2 ml per 1 L of drinking water in combination with chicktonic at a dose of 1 ml per 1 L of water for 4–5 days, as well as eimeterm 2.5% given with water at a dose of 7 mg/kg of the body weight (which is equivalent to 1 ml of the product per 1 L of drinking water) in combination with enrofloxacin at a dose of 3 ml per 1 L of drinking water during 5–6 days demonstrated high therapeutic effectiveness against eimeriosis in broiler chickens.

The effectiveness of maduvet given at a dose of 3–5 mg/kg of body weight twice in combination with tylosin at a dose of 5 g of powder per 10 L of drinking water once a day during 5 days was 94%.

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