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AGE DYNAMICS OF DISTRIBUTION OF *Eimeria* SPECIES PARASITIZING DOMESTIC CHICKENS IN THE SHAKHBUZ REGION

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ВОЗРАСТНАЯ ДИНАМИКА РАСПРЕДЕЛЕНИЯ ВИДОВ *Eimeria*, ПАРАЗИТИРУЮЩИХ У ДОМАШНИХ КУР В ШАХБУЗСКОМ РАЙОНЕ

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Abstract. In this study, the prevalence of *Eimeria* species among domestic chickens in Shahbuz district of Nakhchivan Autonomous Republic during 2021-2024 was analyzed according to age characteristics. For this purpose, 533 chicken feces of different age groups were collected from the mountainous and foothill areas of the region and *Eimeria* species were found in 372 (IE-69.7%) samples. As a result of morphological analysis, *E. tenella*, *E. maxima*, *E. acervulina*, *E. praecox*, *E. mitis*, *E. necatrix* and *E. brunetti* species were detected and differences were observed in their distribution according to age groups. The infection level was found to be higher in 0-3 and 4-7 months old chickens, especially in the skirt sections. The results obtained in the study indicate that the age of the chickens plays an important role in the distribution of species of the genus *Eimeria*. These results are of great importance for establishing effective control and prevention strategies in the region.

Аннотация. Проведен анализ распространенности видов *Eimeria* среди домашних кур в Шахбузском районе Нахчыванской Автономной Республики в период 2021-2024 гг. в зависимости от возрастных особенностей. Для этого из горных и предгорных частях района было собрано 533 пробы фекалий кур разных возрастных групп и в 372 пробах (ИЭ-69,7%) были обнаружены виды *Eimeria*. В результате морфологического анализа были выявлены виды *E. tenella, E. maxima, E. acervulina, E. praecox, E. mitis, E. necatrix и E. brunetti*, причем наблюдались различия в их распределении по возрастным группам. Уровень инфицированности был выше у цыплят в возрасте 0-3 и 4-7 месяцев, особенно в юбочных отделах. Полученные в ходе исследования результаты свидетельствуют о том, что возраст цыплят играет важную роль в распределении видов рода *Eimeria*. Эти результаты имеют большое значение для разработки эффективных стратегий контроля и профилактики в регионе.

Keywords: Nakhchivan Autonomous Republic, Shahbuz region, poultry, domestic chickens, invasive diseases, *Eimeria*

Ключевые слова: Нахчыванская Автономная Республика, Шахбузский район, домашняя птица, домашние куры, инвазионные болезни, *эймерия*

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Parasitic diseases are one of the main factors limiting productivity in poultry farms. One of these diseases commonly seen in domestic chickens is eimeria, an infestation caused by protozoa belonging to the genus *Eimeria* (*Coccidia, Apicomplexa*). *Eimeria* is one of the most common invasive diseases in domestic chickens, causing serious economic losses. These species belonging to the genus *Eimeria* damage the epithelial layer of the intestine, causing pathological processes in the bird's body, leading to weakness, weight loss, bloody diarrhea and high mortality rates [1, 2].

This disease can occur in both clinical and subclinical forms. In subclinical cases, decreased yield, feed refusal and weakened immunity are observed [3].

In order to implement effective control measures against *Eimeria* infections, it is important to study their distribution dynamics. The activity and widespread distribution of *Eimeria* species are known to be closely related to a variety of environmental factors, particularly season and age of birds [4, 5].

Since the developmental stage of the parasite and the ability of oocysts to survive in the environment are sensitive to air temperature and humidity, infection rates vary between seasons. Since warm and humid conditions are favorable for oocyst sporulation, infestation density may be higher in spring and fall [6].

At the same time, infestation can be more severe in 0-6 month old chickens whose immunity is not yet fully formed [7].

Shahbuz district of Nakhchivan Autonomous Republic is characterized by its orographic and climatic diversity. The district has different regions in terms of climate and relief and covers foothills (Shahbuz district center, Kolani, Selesuz, Ayrinc, Shahbuzkend) and mountainous areas (Bichenak, Kuku, Kulus, Kechili), which can directly affect the spread of parasites. Samples were collected mainly from subsidiary and small poultry farms in the region. Poor control of hygienic conditions on these farms, irregular feeding and free grazing system further facilitate the spread of infestations [8].

The aim of this study was to analyze the dynamics of the spread of *Eimeria* species in domestic chickens in the Shahbuz region according to age groups. The results of the study are of practical importance for optimizing measures to combat infestations and designing regionally appropriate anticoccidial programs.

Material and methods

The study was conducted in Shahbuz district of Nakhchivan Autonomous Republic between 2021 and 2024. The study covered both foothill areas (Shahbuz district center, Kolani, Selesuz, Ayrinc, Shahbuzkend) and mountainous areas (Bichenak, Kuku, Kulus, Kechili). Samples were mainly from domestic chickens kept in family and private subsidiary farms. Farm conditions, age groups and seasons were taken into account in the selection of samples. During the study period, fecal samples from a total of 533 chickens were collected in sample containers immediately after defecation, water and 2% $K_2Cr_2O_7$ were added and transported to the laboratory. The samples were kept open-mouthed in the laboratory for 48-96 hours with frequent stirring. After the oocysts in the samples were sporulated, they were stored in the refrigerator at $+4^0$C until morphological analyses were performed.

Classical flotation method was used to identify parasites in fecal samples and to determine the species belonging to the genus *Eimeria*. For this purpose, fecal samples were centrifuged in NaCl solution at 1500 rpm for 2 minutes, a drop was taken from the upper surface of the liquid using a circular copper hook, placed on a glass slide, covered with a coverslip and examined on a

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SMART 3 T2/L microscope with x10, x20, x40 objectives. *Eimeria* species were identified according to the morphological characteristics (shape, size, micropyle, residual body) of the oocysts [4, 5].

Samples were divided into three age groups (0-3 months, 4-7 months, older) and systematized. The degree of infection was assessed by two indicators (extensive invasion — IE, intensity of invasion — II).

Result and discussion

According to the results of the studies, it was determined that *Eimeria* genus parasites were common in poultry farms in Shahbuz district of Nakhchivan Autonomous Republic. A total of 533 fecal samples were collected, of which 372 (IE-69.7%) contained oocysts of species of the genus Eimeria. The table below shows the distribution of the species we detected in the fecal samples based on morphological analysis according to the age of the chickens. As can be seen from the table, a total of 533 fecal samples were collected from 0-3 months old chickens (180 from 0-3 months old chickens, 179 from 4-7 months old chickens and 174 from old chickens) during the studies covering various parts of Shahbuz district (Table).

Table

AGE-RELATED PREVALENCE DYNAMICS OF SPECIES OF THE GENUS EIMERIA IN DOMESTIC CHICKENS IN SHAHBUZ REGION DURING 2021-2024

	Age groups	*Number of stool samples examined*	*Number of infected samples*	*Prevalence of infestation(%)*	*Intensity of infestation*
		Mountain foothills			
Eimeria tenella	0-3	96	57	59,3	1-56
E. maxima			51	53,1	2-60
E. acervulina			56	58,3	2-69
E. praecox			40	41,6	1-32
E. mitis			39	40,6	1-30
E. necatrix			24	25,0	1-14
E. brunetti			16	16,6	1-7
E. tenella	4-7	102	56	54,9	1-40
E. maxima			62	60,7	4-78
E. acervulina			58	56,8	1-58
E. praecox			39	38,2	1-30
E. mitis			35	34,3	1-24
E. necatrix			32	31,3	1-11
E. brunetti			29	28,4	1-11
E. tenella	Adult	84	27	32,4	1-12
E. maxima			34	40,4	1-18
E. acervulina			35	41,6	1-21
E. praecox			26	30,9	1-10
E. mitis			25	29,7	1-12
E. necatrix			18	21,4	1-6
E. brunetti			12	14,2	1-5
E. tenella	Total	282	140	49,6	1-56
E. maxima			147	52,1	1-78
E. acervulina			149	52,8	1-69
E. praecox			105	37,2	1-32

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	Age groups	*Number of stool samples examined*	*Number of infected samples*	*Prevalence of infestation(%)*	*Intensity of infestation*
E. mitis			99	35,1	1-30
E. necatrix			74	26,2	1-14
E. brunetti			57	20,2	1-11
		Mountainous			
E. tenella	0-3	84	35	41,6	1-38
E. maxima			34	40,4	1-26
E. acervulina			33	39,2	1-38
E. praecox			34	40,4	1-21
E. mitis			32	38,0	1-22
E. necatrix			26	30,9	1-10
E. brunetti			14	16,6	1-4
E. tenella	4-7	77	27	35,0	1-22
E. maxima			38	49,3	2-57
E. acervulina			36	46,7	1-49
E. praecox			29	37,6	1-17
E. mitis			24	31,1	1-18
E. necatrix			15	19,4	1-8
E. brunetti			21	27,7	1-7
E. tenella	Adult	90	28	31,1	1-14
E. maxima			26	28,8	1-10
E. acervulina			28	31,1	1-14
E. praecox			18	20	1-13
E. mitis			18	20,0	1-7
E. necatrix			9	10	1-5
E. brunetti			10	11,1	1-2
E. tenella	Total	251	90	35,8	1-38
E. maxima			98	39,0	1-57
E. acervulina			97	38,6	1-49
E. praecox			81	32,2	1-21
E. mitis			74	29,4	1-22
E. necatrix			50	19,9	1-10
E. brunetti			45	17,9	1-7

A total of 282 fecal samples were collected from chickens kept in auxiliary and small poultry farms on the outskirts of Shahbuz district. According to the distribution of the samples according to age groups, 96 fecal samples were collected from 0-3 month old chickens, 102 from 4-7 month old chickens and 84 from old chickens.

A total of 251 fecal samples were collected from chickens kept in auxiliary and small poultry farms in the mountainous areas of Shahbuz district. According to the distribution of the samples according to age groups, 84 fecal samples were collected from 0-3 month old chickens, 77 from 4-7 month old chickens and 90 from old chickens.

As a result of morphological analysis of 282 fecal samples collected from villages in the foothills, *Eimeria tenella* was detected in 140 (IE-49.6%) samples. Of these, 57 were found in 0-3 months old chickens (IE-59.3%; CI: 1-56), 56 in 4-7 months old chickens (IE-54.9%; CI: 1-40) and 27 in older chickens (IE-32.4%; CI: 1-12). Overall, the infestation density in samples where *E. tenella* was found ranged from 1-56.

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E. maxima was detected in a total of 147 (IE 52.1%) fecal samples. Of these, 51 samples were recorded in 0-3 months old chickens (IE-53.1%; CI: 2-60), 62 in 4-7 months old chickens (IE-60.7%; CI: 4-78) and 34 in older chickens (IE-40.4%, CI: 1-18). The overall infestation density for this species was in the range 1-78. *E. acervulina* was detected in a total of 149 (IE-52.8%) samples. Of these, 56 (IE-58.3%; CI: 2-69) were detected in 0-3 months old chickens, 58 (IE-56.8%; CI: 1-58) in 4-7 months old chickens and 35 (IE-41.6%; CI: 1-21) in older chickens. The infestation density of this species ranged from 1-69.

E. praecox was detected in 105 (IE-37.2%) fecal samples. Of these, 40 samples were found in 0-3 months old chickens (IE-41.6%; CI: 1-32), 39 samples in 4-7 months old chickens (IE-38.2%; CI: 1-30) and 26 samples in older chickens (IE-30.9%; CI: 1-10). The infestation density of this species is in the range of 1-32.

A total of 99 (IE-35.1%) fecal samples were infected with *E. mitis*. Of these, 39 samples were found in 0-3 month old chickens (IE-40.6%; CI 1-30), 35 samples in 4-7 month old chickens (IE-34.3%; CI: 1-24) and 25 samples in older chickens (IE-29.7%; CI 1-12). The CI for this species ranged from 1-30.

A total of 74 (IE-26.2%) fecal samples were infected with *E. necatrix*. Of these, 24 samples were found in 0-3 months old chickens (IE-25.0%; CI: 1-14), 32 samples in 4-7 months old chickens (IE-31.3%; CI: 1-11) and 18 samples in older chickens (IE-21.4%; CI: 1-6). Infestation density for this species was recorded between 1-14.

E. brunetti was found in 57 (IE-20.2%) fecal samples. Of these, 16 samples were found in 0-3 months old chickens (IE-16.6%; CI: 1-7), 29 samples in 4-7 months old chickens (IE-28.4%; CI: 1-11) and 12 samples in older chickens (IE-14.2%; CI: 1-5). The infestation density for this species ranged from 1-11.

The results of morphological analysis showed a common trend of *Eimeria* species in fecal samples collected from villages in the foothills of the Shahbuz region. Overall, the prevalence of infection cases (%IE) ranged from 20.2% to 52.8%.

The highest infection was recorded in the *E. acervulina* species (149 samples, IE-52.8%), which was predominantly found in chickens aged 0-3 months (IE-58.3%). It was followed by *E. maxima* (IE-52.1%) and *E. tenella* (IE-49.6%) with high prevalence.

When compared by age group, the incidence of infection was higher in 0-3 months old chickens. In this age group, the prevalence of *E. tenella*, *E. acervulina* and *E. praecox* species was particularly high. The intensity of infestation varied over a wider range in E. tenella (II: 1-56), E. maxima (II: 4-78) and E. acervulina (II: 2-69), indicating that these species have a higher parasite burden.

As a result of morphological analysis of 251 fecal samples collected from the villages in the mountainous parts of the region, *E. tenella* species were found in 90 (IE-35.8%) samples. Of these samples, 35 were found in 0-3 month old chickens (IE 41.6%; CI: 1-38), 27 in 4-7 month old chickens (IE 35.0%; CI: 1-22) and 28 in older chickens (IE 31.1%; CI: 1-14). The infestation density of *E. tenella* species ranged from 1-38.

E. maxima was detected in 98 (IE 39.0%) fecal samples. Of these, 34 samples were found in 0-3 months old chickens (IE-40.4%; CI: 1-26), 38 in 4-7 months old chickens (IE-49.3%; CI: 2-57) and 26 in older chickens (IE-28.8%; CI: 1-10). The CI index for this species ranged from 1-57.

E. acervulina was detected in a total of 97 (IE-38.6%) samples. Of these, 33 were found in 0-3 months old chickens (IE-39.2%; range: 1-38), 36 in 4-7 months old chickens (IE-46.7%; range: 1-49) and 28 in older chickens (IE-31.1%; range: 1-14). The infestation density of this species ranged from 1-49.

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E. praecox was detected in 81 (IE-32.2%) fecal samples. Of these, 34 samples (IE-40.4%; CI: 1-21) were found in 0-3 months old chickens, 29 samples (IE-37.6%; CI: 1-17) in 4-7 months old chickens and 18 samples (IE-20%; CI: 1-13) in older chickens. The infestation density of this species was recorded in the range of 1-21.

E. mitis was found in 74 (IE-29.4%) fecal samples. Of these, 32 samples (IE-38.0%; CI: 1-22) were found in 0-3 months old chickens, 24 samples (IE-31.1%; CI: 1-18) in 4-7 months old chickens and 18 samples (IE-20%; CI: 1-17) in older chickens. The CI index of this species ranged between 1-22.

E. necatrix infection was recorded in 50 (IE-19.9%) samples. Of these, 26 samples were detected in 0-3 months old chickens (IE-30.9%; CI: 1-10), 15 samples in 4-7 months old chickens (IE-19.4%; CI: 1-8) and 9 samples in older chickens (IE-10%; CI: 1-5). The infestation density of this species ranged from 1-10.

E. brunetti was detected in 45 (IE-18.7%) fecal samples. Of these, 14 samples were found in 0-3 months old chickens (IE-16.6%; IE: 1-4), 21 samples in 4-7 months old chickens (IE-27.7%; IE: 1-7) and 10 samples in older chickens (IE-11.1%; IE: 1-2). The severity of infestation of this species varies between 1-7.

In the study conducted in Shahbuz district in 2021-2024, 7 parasite species belonging to the genus *Eimeria* (*E. tenella*, *E. maxima*, *E. acervulina*, *E. praecox*, *E. mitis*, *E. necatrix*, *E. brunetti*) were detected as a result of the analysis of 533 fecal samples taken from domestic chickens. According to the results obtained, the prevalence of *Eimeria* species varied significantly depending on the age of the chickens. In general, the prevalence of infection cases (%IE) in the highlands and foothills ranged from 17.9% to 52.8%, indicating the intensive spread of the infestation in the region. The highest prevalence was recorded for *E. maxima* (98 specimens, IE-39.0%). This species was mainly common in the 4-7 month age group (IE-49.3%), with infestation density ranging from 2-57. It was followed by *E. acervulina* (IE-38.6%) and E. tenella (IE-35.8%) in high proportions. Both species were more common in early and middle-aged chickens.

Moderate prevalence was observed for *E. praecox* (IE-32.2%) and *E. mitis* (IE-29.4%) and infection with these species was more common in the 0-3 months age group.

The least common species were *E. necatrix* (IE-19.9%) and *E. brunetti* (IE-17.9%). Infection with these species was more common in 4-7 month old chickens. The relatively low infestation density of *E. brunetti* in particular (II-max 7) suggests that this species has a weaker potential to spread in mountainous areas.

In addition, the more intense conditions in the foothills and the lack of full compliance with hygiene and sanitation rules on individual farms can also lead to widespread infestation. In the mountainous region, harsher and more variable climatic conditions reduced the likelihood of oocyst sporulation and thus relatively limited the incidence of infection [10].

The results of the study show that among *Eimeria* species, *E. tenella*, *E. maxima* and *E. acervulina* species are the main indicators of infection regardless of age. However, the prevalence of these species was particularly high in chickens aged 0-3 months and 4-7 months. This may be due to the fact that the immune system of chickens at that age is not yet fully developed and they are more exposed to sporulated oocytes [2, 3].

The obtained indicators are consistent with the literature data. Indeed, it has been reported in many studies that *E. tenella* and *E. maxima* species cause more severe pathological processes in chickens and the infection is more intense at an early age[1, 2].

Subclinical *E. mitis* and *E. praecox* species were generally observed with low prevalence, mostly in young chickens [9].

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As chickens age, there is a tendency for the spread of infestations to decrease as specific immunity is built up [11].

This suggests that improved immunity and resistance to recurrent infections may partially prevent infestation in the body. The results of the study showed that since 0-3 and 4-7 months old chickens are more susceptible to *Eimeria* species, it is more appropriate to direct preventive and therapeutic measures to these age groups. In addition, the use of anticoccidial drugs at this age is of practical importance[12].

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