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THE PATTERN OF PREVALENCE OF CHICKEN EIMERIASIS IN THE REPUBLIC OF ARMENIA

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The article presents data on epidemiological features of chicken eimeriasis in poultry farms in northern regions of the Republic of Armenia – Gegharkunik, Tavush, Shirak, and Lori. According to research data, chicken eimeriasis is widespread in target areas (extensiveness of the Eimeria infection was equal to 22.55%, 34.1%, 27.27%, and 30.86% respectively), and often occurs as a mixed invasion with ascariasis, capillariasis, and syngamosis. Eimeria necatrix is the most prevalent Eimeria species in all targeted regions. Eimeria acervulina is the least common species in Armenia. The pattern of Eimeria species distribution was the same for all the regions. It does not depend on climatic and natural condition, as well as on poultry breed. Poultry eimeriasis is generally registered among chickens of 10 to 180 days of age, while one of the pronounced and frequently occurring pathomorphological changes is hemorrhagic inflammation of the caeca mucous membranes. The extensiveness of eimeriasis depends both on the climatic and geographical features of the region, and on the conditions of the poultry keeping, which must be taken into account when carrying out a complex of preventive, veterinary and sanitary measures.

Eimeriasis – chicken – oocyst – prevalence – region

Հոդվածում ներկայացված են տվյալներ Հայաստանի Հանրապետության հյուսիսային մարզերի՝ Գեղարքունիքի, Տավուշի, Շիրակի և Լոռու թռչնաբուծարաններում հավերի էյմերիոզի համաճարակաբանական առանձնահատկությունների վերաբերյալ: Ըստ հետազոտության տվյալների՝ հավերի էյմերիոզը տարածված է նշված մարզերում (Էյմերիոզի տարածվածությունը համապատասխանաբար կազմում է 22,55 %, 34,1 %, 27,27 % և 30,86 %) և հաճախ ընթանում է խառը ինվազիայի տեսքով՝ ասկարիդիոզի, կապիլյարիոզի և սինգամոզի հետ համատեղ: Eimeria necatrix-ը էյմերիաների ամենատարածված տեսակն է բոլոր ուսումնասիրված տարածաշրջաններում: Eimeria acervulina-ն ամենից քիչ տարածված տեսակն է Հայաստանում: Էյմերիաների առանձին տեսակների տարածվածությունը գրեթե նույնն է բոլոր տարածաշրջաններում: Այն կախված չէ բնակլիմայական գործոններից, ինչպես նաև թռչնի ցեղից: Թռչնաբուծարաններում էյմերիոզը սովորաբար արձանագրվել է 10-180 օրական հավի ճտերի մոտ: Առավել ցայտուն արտահայտված և հաճախակի հանդիպող ախտաբանաանատոմիական փոփոխությունը կույր աղիքի լորձաթաղանթի հեմոռագիկ բորբոքումն էր: Էյմերիոզ հիվանդության տարածվածությունը կախված է ինչպես տարածաշրջանի կլիմայական և աշխարհագրական առանձնահատկություններից, այնպես էլ թռչնաբուծարանի

սանիտարահիգիենիկ պայմաններից, որոնք պետք է հաշվի առնել կանխարգելիչ անասնաբուժական և սանիտարական միջոցառումներ իրականացնելիս:

Էյմերիոզ – օվոցիստ – հավ – տարածվածություն – տարածաշրջան

В статье представлены данные об эпизоотологических особенностях эймериоза кур в птицеводческих хозяйствах северных регионов Республики Армения – Гегаркунике, Тавуше, Шираке и Лори. По данным исследований, эймериоз кур широко распространен в указанных регионах (распространенность эймериоза составляла 22,55 %, 34,1 %, 27,27 % и 30,86 % соответственно) и часто протекает в виде смешанной инвазии с аскаридиозом, капилляриозом и сингамозом. Eimeria necatrix является наиболее распространенным видом эймерий во всех исследуемых регионах. Наименее распространенным в Армении видом является Eimeria acervulina. Распространность отдельных видов эймерий во всех исследованных регионах одинакова и не зависит от природно-климатических условий и породы птицы. Эймериоз зарегистрирован преимущественно у цыплят в возрасте от 10 до 180 дней, при этом наиболее выраженным и часто встречающимся патоморфологическим изменением являлся геморрагическое воспаление слизистой оболочки слепых кишок. Экстенсивность эймериоза зависит как от природно-климатических особенностей региона, так и от условий содержания птицы, что необходимо учитывать при проведении комплекса профилактических и ветеринарно-санитарных мероприятий.

Эймериоз – ооциста – куры – распространенность – регион

After gaining independence, small farms began to develop intensively in the Republic of Armenia, in which poultry farming occupies a special place. Relatively limited feed consumption, high precocity and unpretentiousness to the conditions of keeping has made poultry a convenient source of additional profit in the conditions of the economic crisis caused by rising inflation and unemployment. In addition to large poultry farms specializing in breeding of broiler and egg-laying chicken breeds, there are a huge number of small poultry farms in Armenia, numbering from several units to several hundreds chickens of local mixed breeds. Such poultry farmsteads, which are available in almost every village dwelling, as well as in houses located on the periphery of cities, effectively supply their owners not only with poultry products, but also with profits received from the sale of chickens, meat and eggs of so-called "home production". Poultry products from small farms are in great demand among the local population due to such qualities as freshness, good taste and safety due to the use of natural feeds that do not contain antibiotics, hormonal agents and other growth stimulants, unlike large poultry farms.

A serious obstacle to the development of small-scale poultry farming is such infectious and invasive diseases of poultry as infectious mycoplasmosis, Newcastle disease, prosthogonimosis, and eimeriasis. Chicken eimeriasis has the highest specific gravity in the nosological profile of infectious diseases of poultry in Armenia. Economic losses from chicken eimeriasis are formed from the death of sick chickens, a decrease in productivity in adults, the cost of treatment, and a complex of veterinary and sanitary measures [4, 6, 7, 12, 13].

Eimeriasis is acute, subacute or chronical protozoal infection disease of chickens aged 10 to 180 days, although adult birds are also susceptible. The disease is manifested in lethargy, loss of appetite, diarrhea, cachexia, anemia, sometimes convulsions [2, 11, 14].

The causative agents of eimeriasis are Protozoa (Type; Apicomplexa, Class: Sporozoa, Order: Eucoccidia, Family: Eimeriidae, Genus: Eimeria). They are unicellular parasites with a complex life cycle. An endogenous stage of development occurs in the body of birds, and ends with the formation of oocysts, and an exogenous one occurs in the environment. Oocysts excreted from the bird organism, are non-invasive, and cannot infect new hosts. In the presence of oxygen, sufficient humidity, and optimal temperature (+18…+29°C), they become invasive in 24 to 96 hours. Invasive oocysts enter the digestive tract of birds with food or water, their shell is destroyed, the released sporozoites are introduced into the intestinal epithelial cells, and begin to multiply intensively. One oocyst in 7-10 days can give rise to 88 thousand to 2 million new oocysts. All bird species are susceptible to eimeriasis, and each bird species has its specific eimerian parasites. Chicken eimeriasis (coccidiosis) are caused by nine species of eimeria, the most common of which are *Eimeria tenella* Tyzzer, 1929; *Eimeria maxima* Tyzzer, 1929; *Eimeria acervulina* Tyzzer, 1929; *Eimeria necatrix* Johnson, 1930 [1, 2, 11]. Morphologically, different species of *Eimeria* differ in the shape and size of the oocysts, the structure of the shell, the presence or absence of micropyle, cap, polar granule, residual and Stied`s bodies in the oocyst and spores, as well as localization in the tissues of their hosts [3,11]. Although chicken eimeriasis is an extremely serious problem of veterinary parasitology, research of this disease in Armenia are fragmentary and insufficient [9]. Numerous aspects of the problem in our country remain unexamined. That is why the relevance of the problem of chicken eimeriasis is obvious.

***Materials and methods*.** The objective of current research was to investigate the prevalence of chicken eimeriasis in four regions (marzes) in the northern part of the Republic of Armenia: Gegharkunik, Tavush, Shirak, and Lori with further development of a set of preventive measures taking into account the geographical and climatic features of these regions.

Selection of the regions was determined by traditional poultry-keeping that is very popular in the mentioned regions (marzes), and thus, the highest risk of the chicken eimeriasis exists there. Besides, climatic conditions in the selected areas are extremely contrast so it will allow to analyze the role of climatic and meteorological factors in pattern of prevalence of the chicken eimeriasis.

The research covered towns and villages in the above-mentioned areas from September 2021 to June 2022. The study of samples of excrements and corpses of birds that fell with signs characteristic of eimeriasis, was carried out in the parasitological laboratory of the Department of Epidemiology and Parasitology of the National Agrarian University of Armenia. In total, 102 samples of chicken excrements, and 10 chicken carcasses from 10 settlements of Gegharkunik Region, 88 samples of chicken excrements and 10 chicken carcasses from 12 settlements of Tavush Region, 77 samples of chicken excrements and 10 chicken carcasses from 10 settlements of Shirak Region, as well as 81 samples of chicken excrements and 10 chicken carcasses from 10 settlements of Lori Region have been examined. Map of the settlements/communities where the samples have been collected, is as follows (fig. 1).

For microscopic detection of *Eimeria* oocysts in the examined excrement samples, zinc sulfate floatation method has been used. The method consists of 2 stages: sedimentation of excrements with water using centrifuge (5 min, 1500 min^{-1}), and floatation with saturated solution of zinc sulfate (density 1.4 g/ml) using centrifuge with the same regimen.

The diagnosis of the chicken eimeriasis was performed on the basis of characteristic clinical signs, a lifetime coprological examination of the excrements for the presence of *Eimeria* oocysts, as well as on pathomorphological pattern if carcasses are available, and on direct microscopy of the smears of small intestine and cecum mucous membrane [5, 8,10].

Excrement samples were taken from clinically healthy chickens from 1 to 24 months of age, and carcasses of birds died from eimeriasis at the age of 10 to 180 days were subjected to a pathomorphological examination.

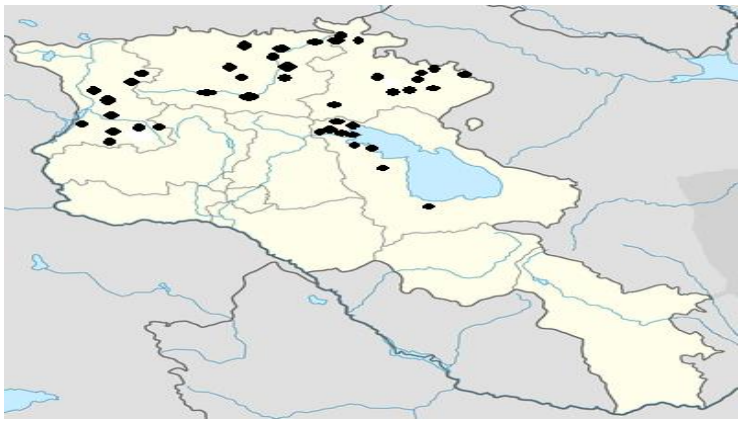

Figure 1. Map of the sampling areas

Results and Discussion. Totally, 102 poultry excrement samples were collected in Gegharkunik Region, 88 samples done in Tavush Region, 77 samples in Shirak Region, and 81 samples in Lori Region. Results of the excrement sample examination are shown in Tab.1.

Table 1. The degree of the eimeriasis infection at poultry farms in the northern regions of the Republic of Armenia

Region	Average altitude, above sea level, m	Number of examined excrement samples	Number of excrement samples containing oocysts	Exten-siveness, %
Gegharkunik	1995	102	23	22.55
Tavush	732	88	30	34.09
Shirak	1750	77	21	27,27
Lori	1200	81	25	30,86
TOTAL	N/A	348	99	28.45

As a result of the performed research, it was revealed that 23 of 102 poultry excrement samples collected in Gegharkunik Region, contain *Eimeria spp.* oocysts (22.55 %).

Eimeria spp. oocysts have been also detected in 30 out of 88 samples of poultry excrements collected in Tavush Region (34.09 %). 21 of 77 examined samples from Shirak Region (27.27 %), and 25 of 81 examined excrement samples from Lori Region (30.86 %) contain *Eimeria sp.* oocysts.

Therefore, the lowest prevalence of chicken eimeriasis has been registered in the settlements of Gegharkunik Region. Infection rate in Shirak Region was a little higher, and the highest indices of chicken *Eimeria* infection have been registered in the settlements of Tavush and Lori Region. However, according to Fisher`s and Chi-square criteria, the difference between these indices is not statistically significant (Chi-square criterion equals to 3.4; $p > 0.05$).

Eimeria spp. oocysts were detected in samples taken from all communities/villages, therefore, there is no evidence of poultry eimeriasis focality in researched regions.

In four samples of excrements collected in Gegharkunik Region, in one sample of excrements collected in Tavush Region, and in two samples collected in Lori Region, in addition to *Eimeria spp.* oocysts, *Ascaridia galli*, *Syngamus trachea*, and *Capillaria obsignata* eggs were found.

The relatively high extensiveness of invasion in Tavush and Lori Regions can be explained by climatic and geographical features of the targeted regions. Thus, Tavush Region, located in the north-east part of Armenia, with an average altitude 732 meters above sea level, is characterized by a subtropical climate: long mild summers (average temperature in July is $+24^0$C) and mild low-snow winters (average temperature in January is 0^0C). In addition, the region is characterized by an abundance of forest cover, and a relatively high average annual humidity (about 73 %).

Lori Region, located in the north part of Armenia, with an average altitude 1200 meters above sea level, is characterized by a temperate warm climate with long mild summers (average temperature in July is $+18^0$C) and long mild-cold winters with abundant snow cover (average temperature in January is -4.8^0C). In addition, the region is characterized by an abundance of forest cover, and a relatively high average annual humidity (about 80%).

Gegharkunik Region located in the east part of Armenia, at an average altitude of 1995 meters above sea level, is characterized by a moderately cold humid climate, characterized by a short mild summer (the average temperature in July is $+16^0$C) and a long cold winter (the average temperature in January is $-8 \ldots -12^0$C), and the average annual humidity is about 67 %.

Shirak Region located in the north-west part of Armenia, at an average altitude of 1750 meters above sea level, is characterized by a moderately cold humid climate, characterized by a short mild summer (the average temperature in July is $+16^0$C) and a long cold winter (the average temperature in January is -9^0C, and the lowest temperature ever registered in Armenia -46^0C), and the average annual humidity is about 50 %.

The climatic features of the regions are reflected in specificity of the poultry keeping conditions in farmsteads. In Tavush and Lori Regions poultry is kept outdoors longer, in a warm, humid climate, and Eimeria oocysts become invasive faster, and that is why the intensity of chicken infection increases sharply. On the contrary, in Gegharkunik and Shirak Regions, due to the long and cold winter, birds are kept in closed makeshift poultry houses for most of the year, which are often cleaned and disinfected by the owners, and low air temperature and low humidity delay the maturation of oocysts, which slows down the process of chicken infection with eimeriasis.

The following species of *Eimeria* have been detected in poultry excrement samples: *Eimeria necatrix*, *Eimeria tenella*, *Eimeria maxima*, and *Eimeria acervulina* (see photos 1 to 4).

Prevalence of various species of *Eimeria* in poultry of different regions is demonstrated in Tab. 2.

Photo 1. *Eimeria necatrix* oocysts in poultry excrements (480x)

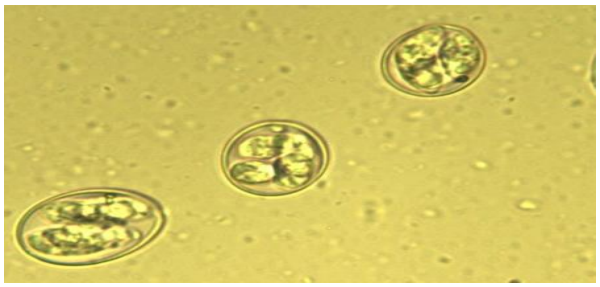

Photo 2. *Eimeria tenella* oocysts in poultry excrements (480x)

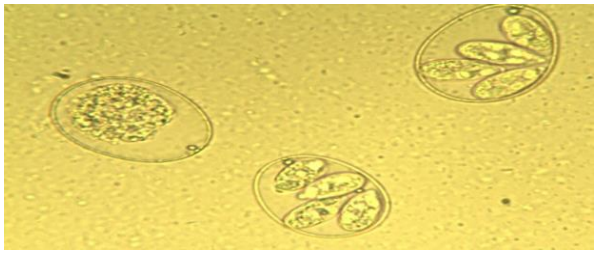

Photo 3. *Eimeria maxima* oocysts in poultry excrements (480x)

Photo 4. *Eimeria acervulina* oocysts in poultry excrements (480x)

Table 2. Prevalence of various species of *Eimeria* in poultry of different regions

Region	Examined samples	Eimeria species							
		Samples with *E. necatrix*	%	Samples with *E. tenella*	%	Samples with *E. maxima*	%	Samples with *E. acervulina*	%
Gegharkunik	102	16	15.69	5	4.9	6	5.88	1	0.98
Tavush	88	22	25	6	6.82	6	6.82	2	2.27
Shirak	77	4	5,19	6	7,79	7	9,09	11	14,2
Lori	81	3	3,7	7	8,64	8	9,88	9	11,1
TOTAL	348	45	12,9	24	6,9	27	7,76	23	6,6

Results of the research show that *Eimeria necatrix* is the most prevalent *Eimeria* species in all targeted regions. *Eimeria acervulina* is the least common species in our country. Prevalence of *E. tenella* and *E. maxima* is intermediate in all regions researched. The pattern of *Eimeria* species distribution was the same for all the regions. It does not depend on climatic and natural condition, as well as on poultry breed. According to Fisher`s and Chi-square criteria, the difference between these indices is statistically significant (Chi-square criterion equals to 11.72; $P < 0.05$).

A pathomorphological study of the corpses of chickens died from eimeriasis has demonstrated changes typical for this disease. Namely, the corpses were exhausted, the feathers in the cloacal area were stained with feces, the earrings, comb and conjunctiva were anemic, the muscle tissue was flabby. The mucous membranes of the large intestine, especially the caeca, were hemorrhagically inflamed, and sometimes covered with blood clots (see photo 5). Granular dystrophy was detected in parenchymal organs.

Photo 5. Cecal hemorrhages in chicken eimeriasis caused by *E. tenella*

Conclusion

Based on the obtained research data, the following conclusions can be made:

1. Eimeriasis of chickens is widespread in all regions of Armenia, while the extensiveness of invasion directly depends on climatic and geographical features and conditions of poultry keeping, so the extensiveness of invasion in Tavush and Lori Region exceeds the same indicator in Gegharkunik and Shirak Region about 1.3 times;

2. Poultry eimeriasis is generally registered among chickens of 10 - 180 days of age, while one of the pronounced and frequently occurring pathomorphological changes is hemorrhagic inflammation of the caeca mucous membranes;

3. Poultry keeping conditions, as well as climatic and geographical features of the region should be taken into consideration during performance of preventive measures against the chicken eimeriasis.

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