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Distribution of *Toxoplasma Gondii* among Cattle in Certain Regions of Ukraine

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Abstract. *Toxoplasma gondii* is the agent of toxoplasmosis, which is common to both humans and cattle. That is why the goal of work was to study the spreading of the agent of toxoplasmosis among cattle in certain regions of Ukraine, which in turn will make it possible to predict the appearance of the disease among people and prevent the development of its clinical signs. Whole blood or serum samples of cattle of different ages and sexes from farms in Kyiv, Zhytomyr, Khmelnytskyi and Lviv regions of Ukraine were sent to the laboratory for research. The presence of total antibodies to *T. gondii* was determined in the serum of the animals. To do this, we used the method of enzyme-linked immunosorbent assay using test kits from different manufacturers in accordance with the guidelines. In general, the prevalence of *T. gondii* among cattle in Kyiv, Zhytomyr, Khmelnytskyi and Lviv regions of Ukraine according to the results of studies was 10.3% (95% confidence interval: 6.7-15.1). At the same time, the study of animals was carried out in two stages, in 2014 and 2018, and the prevalence did not differ significantly. Thus, in 2014, according to the results of research, a positive reaction to the agent of toxoplasmosis was detected in 10 samples or 13.9% (95% confidence interval: 7.3-23.4), while in 2018 this figure was 11 samples or 8.4% (95% confidence interval: 4.5-14.1) of the studied animals. Also, in 2014 and 2018 studies found that the highest level of seroprevalence of the agent of toxoplasmosis in both years of research was registered in cattle from farms of Zhytomyr and Kyiv regions was 11.9% (95% confidence interval: 4.5-24.4) and 11% (95% confidence interval: 5.9-18.3), respectively. During the conducted research, an increase in the prevalence of *T. gondii* with the age of animals was statistically significant. Among animals under six months of age, of the 65 serum samples tested, 3 tested positively to the agent (4.6; 95% confidence interval: 1.2-12.1), while in the group of animals older than three years (49 cows) 10 samples were positively responded (20.4; 95% confidence interval: 10.9-33.4) compared to the previous group of animals, the P-value was 0.0114. So, the data obtained indicate the presence of the agent of toxoplasmosis among cattle in Ukraine, which requires further study and development of approaches to prevent human infection when eating meat and dairy products of positively reacting animals

Keywords: toxoplasmosis, serology, enzyme-linked immunosorbent assay, Kyiv, Zhytomyr, Khmelnytskyi, Lviv regions

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Introduction

Toxoplasmosis is a common protozoan disease of various animal and human species in the world, which is caused by parasitisation of a single-celled *Toxoplasma gondii* [1; 2; 3]. It is recorded both in cattle and among other animal species. Infection with human toxoplasmosis is possible in utero, if invasive oocysts will be swallowed, or when eating insufficiently heat-treated meat and dairy products of productive animals. The definitive hosts of the agent of toxoplasmosis are representatives of the Felidae family, most often – pets, namely cats. Intermediate hosts include vertebrates, as well as humans.

The percentage of people affected by the agent of toxoplasmosis in different countries of the world is considerable. Thus, according to the results of serological studies using the indirect immunofluorescence method for the presence of antibodies against *T. gondii*, the preva- lence rate among pregnant women in Brazil was 26.8% [4]. According to other Brazilian scientists [5], the presence of antibodies against T. gondii with a profile indicating an acute stage of invasion, accounted for 12.3% of positive cases among people. In [5], the authors also conducted a study of possible sources of human infection – grain cheese, water, and vegetables. According to the results of the conducted studies, fragments of the DNA of the agent of toxoplasmosis were found in two of the samples of grain cheese under study (p=0.01).

Infection with *T. gondii* is possible both in utero, and when invasive oocysts of the agent enter the body, or when eating insufficiently heat-treated meat and dairy products. Thus, according to research results in the Netherlands, beef causes 84% of the total number of suspected (probable) toxoplasmosis infestations among the population, followed by pork (12.0%) and lamb (3.7%) [6]. Therefore, it is important to consider meat processing methods to minimise the risk of toxoplasmosis.

Due to the presence of diverse ways of infection of animals and humans with toxoplasmosis researchers are investigating the issue of prevalence of *T. gondii*, which is quite different depending on many factors. For example, in Brazil, out of 2970 cows, the prevalence of *T. gondii* was found, on average, at the level of 8.5% (the 95% confidence interval was 7.48 to 9.49) [7]. In the Cerrado (Brazilian savanna) of Brazil the prevalence of the agent was 8.9% (137/1533) [8]. Other studies [9] from this country show that the overall prevalence was already 30.9% (332/1073) and covered 93.6% of the farms under study (44/47). All subpopulations investigated in Amazonas had herds of cattle and reacted positively to the *T. gondii* in animals, and in some areas, there was a higher level of prevalence [9]. In general, the frequency of detection of antibodies against *T. gondii* in Brazil's cattle range from 1% to 89.1%, depending on the region, based on data from 1978 to 2018 [10]. In 70% of cases, ruminant studies in Brazil were carried out using the indirect fluorescent method [10]. Based on these data, schemes were constructed to minimise the risks of toxoplasmosis infection and awareness trainings were carried out among the population [10; 11].

Currently, there are no effective specific treatments for toxoplasmosis. Thus, to prevent symptoms, including abortion in the case of human toxoplasmosis, it is necessary to develop new drugs and vaccines. A promising new method for molecular characterisation of organisms is mass spectrometric imaging (MSI) with high resolution [12], ezetimibe, which blocks the replication of tachyzoites of *T. gondii*, *Besnoitia besnoiti*, and *Neospora caninum* in primary bovine host endothelial cells, is being tested in hu- man medicine [13], bovine bone marrow-derived macrophages (BMDM), pre-stimulated with interferon gamma (IFN-γ), limiting the growth of intracellular toxoplasmas independently of nitric oxide [14]. Currently, measures to combat *T. gondii* are insufficient [15] due to the lack of an effective vaccine or effective treatment methods. At the same time, according to scientists, successful candidate vaccines should have the ability to induce a cellular immune response and the production of interferon gamma IFN-γ, but their search and development are still ongoing [15].

Data on the spread of the agent of toxoplasmosis on the territory of Ukraine are quite limited. Distribution has not been investigated among all animal species, but only among a few, and there is no official statistical information. Preliminary studies have developed methods [16; 17] and established the seroprevalence among various animal species, namely among horses [18; 19].

The purpose of this study is to investigate the prevalence of the causative agent of toxoplasmosis among cattle in the Kyiv, Zhytomyr, Khmelnytskyi, and Lviv regions of Ukraine.

Literature Review

According to scientists [20; 21] the presence of antibodies against *T. gondii* in women can pose a threat to the foetus, in case of pregnancy, and the prevalence of the agent in different regions of the world is considerable and ranges from 7% to 51%. According to a meta-analysis of the PubMed, WoS, Scopus, Science Direct, Google Scholar, and ISC databases, a quarter of livestock and poultry were infected with *T. gondii* between 2000 and 2019 [22]. However, data on prevalence vary depending on the types of animals, their age, and the country of study. Thus, in Italy, the prevalence of *T. gondii* was recorded at 10.2%, with differences between regions and values from 5.3% in Liguria to 18.6% in the Piedmont region (p=0.0001) [23]. Animals of different age groups and genders responded positively without substantial differences (age and gender: P value <0.05). Lower values of the prevalence of toxoplasmosis agent were recorded in cattle born in Italy (8.7%), compared with animals imported from abroad (13.4%) (p=0.046) [23]. Prevalence of *T. gondii* according to the results of serological studies in Iran, accounted for 13.0% of cattle [24]. 5.4% of animal tissue samples from dairy farms in Iran were found to be positive when tested using molecular methods for the presence of *T. gondii* [25]. The prevalence in Algeria was 29.8% (37/124) for *C. abortus* and *T. gondii* [26].

According to the meta-analysis, the prevalence of *T. gondii* in cattle in China from 2010 to 2019 was 10.1% (4217/39 274). At the same time, it was highest in southwest China (21.6%, 727/3117) and lowest in northern China (4.5%, 185/1966) [27].

The method of immunoenzymatic analysis based on the surface antigen of *T. gondii* (TgSAG2t) for the detection of both specific IgM and IgG revealed 1.9% (IgM) and 3.1% (IgG) of positively reacting animals among cattle in the Menoufiya province of Egypt [28]. Among the studied buffaloes, the prevalence of *T. gondii* was 9.0% (IgM) and

8.2% (IgG). The mixed invasion rate was 1.5% among cattle and 4.9% among buffaloes. No significant differences were found by age or gender. Statistically significant changes in the prevalence of parasites relative to the period of the year were demonstrated [28]. Using the same method, other researchers in Egypt identified 38.9% of positively responding animals [29].

In general, the prevalence of *T. gondii* during the study of cattle carcasses (n = 2912) was 17.4% [30]. Most of the buffaloes that reacted positively to the agent of toxoplasmosis detected by the modified agglutination method had antibodies in low serum dilutions, while the highest dilution rate was 1:768 in females aged 30 months [31].

When studying the consistency of the modified agglutination method and enzyme immunoassay, the prevalence of *T. gondii* was 8.1 and 6.6%, respectively [31]. These two methods are most widely used in the world for monitoring studies among different animal species for toxoplasmosis.

B1 and P30-specific polymerase chain reaction can detect *T. gondii* according to the authors of the study, blood samples are more accurate than enzyme-linked immunosorbent assay [29; 32]. At the same time, the researchers found no correlation between the direct and indirect method of detecting tthe agent of toxoplasmosis. Thus, *T. gondii* was isolated from the tissues of the diaphragm in a 30-month-old male buffalo using real-time quantitative polymerase chain reaction (PCR) and from the tissues of a mesenteric lymph node in a female buffalo. The results of studies of both animals were negative using modified agglutination and enzyme-linked immunosorbent assay methods. At the same time, infection of laboratory animals did not occur, which may indicate the non-viability of the agent [31].

Since toxoplasmosis is the cause of abortions among animals [33; 34; 35], thanks to the use of the PCR method in the territory of north-western Tunisia, 5% of positive samples were found among the uterine tissues tested for the presence of *T. gondii* DNA. At the same time, simultaneous involvement of the last two pathogens was recorded – *T. gondii* and *Neospora caninum* at the level of 2.85% [36].

In the Mazandaran province of northern Iran, *T. gondii* was verified using a specific polymerase chain reaction in 13 (18.6%) animal foetal tissue samples [37]. Another group of researchers found that the prevalence of *T. gondii* DNA in cattle was 56%. The most infected tissue with the agent was the diaphragm (54.4%), followed by the heart (48.8%) and tongue (43.2%). The most common genotype (70%) among *T. gondii* isolates was type II [38]. This is the same type of agent strain that other researchers have discovered. But at the same time, they pointed out the probability of difficulties in isolating parasites from beef [30].

Viable strain of *T. gondii* was isolated from the blood of 1 out of 60 pregnant cows in Brazil, as well as from the tissues of one foetus. At the same time, researchers believe that the role of beef in the epidemiology of *T. gondii* invasion is still not fully understood [39].

During experimental *T. gondii* infection of buffaloes inoculated with *T. gondii* strain GT1, five animals developed moderate anorexia, weakness, and shortness of breath, and one animal died 11 days after inoculation of the agent. The researchers note that the development of an immunological response occurred 21 days after inoculation of the agent, and the antibodies persisted for 63 days, and then fell below the limit value. Using a mouse bioassay, *T. gondii* was isolated from the brain, lungs, liver, kidneys, lymph nodes, and spleen of a calf that died of acute toxoplasmosis [40].

Materials and Methods

The study was carried out based on the Department of Pharmacology, Parasitology, and Tropical Veterinary Medicine of the Faculty of Veterinary Medicine, the Interdepartmental Educational and Scientific Laboratory of Veterinary and Diagnostic Research and the Ukrainian Laboratory of Quality and Safety of Products of the Agro-Industrial Complex of the National University of Life and Environmental Sciences of Ukraine, as well as in the Institute of Veterinary Medicine of the National Academy of Agrarian Sciences of Ukraine (Research Training Centre for Diagnostics of Animal Diseases).

Blood serum samples from 203 cattle animals were examined. Samples for the study were selected in 2014 and 2018. 72 bovine blood serum samples were analysed in 2014. In 2018, serum samples from 131 animals were examined.

For research, samples of blood or blood serum of cattle of different ages and genders selected by veterinary doctors were sent to the laboratory. The animals were from farms in Kyiv, Zhytomyr, Khmelnytskyi, and Lviv regions. All samples were numbered and had accompanying animal information.

If whole blood was sent to the laboratory, serum was prepared from it. For this, blood samples were placed first in a room temperature for 30 minutes, and then in the refrigerator for 12-24 hours, after which the serum was separated using a dispenser and transferred to a clean test tube. If necessary (in the presence of red blood cells), the samples were centrifuged at 3000 rpm for 3 minutes. After that, the blood serum was transferred to a clean test tube. Before the study, the samples were stored in the refrigerator at +2–(+4) °C. The presence of total antibodies to *T. gondii* was determined in the blood serum of animals. For this, the authors of this study used the method of enzyme-linked immunosorbent assay using a test kit to detect total antibodies to *T. gondii* according to the manufacturer's instructions. For this purpose, 100 µL of control positive, negative, and weakly positive samples were introduced in the repeat, as well as 100 µL of blood serum samples that were to be analysed. Incubated for 30 minutes at 37°C. Washed with a washing solution, filling each well with 400 µL, repeated 5 times. 100 µL of conjugate was added to each well. Incubated for 30 minutes at 37 °C. Washed with a washing solution, filling each well with 400 µL, repeated 5 times. 100 µL of tetramethylbenzidine solution was added to each well. Incubated for 25 minutes at 18-25 °C in the dark. 100 µL of stop reagent solution was added to each well. The optical density was measured at 450 nm at a reference wavelength of 620-655 nm. The obtained numerical results were processed statistically using the OpenEpi software [41].

Results and Discussion

For the first time in Ukraine, the authors conducted monitoring studies to detect antibodies to the agent of toxoplasmosis in bovine blood serum samples.

According to the literature data [23; 24; 25] and the instructions of the manufacturer of the test kit used in the studies, the degree of prevalence of the agent of toxoplasmosis among cattle ranged from 4 to 25%. The number of cattle in Ukraine as of 2014 was 4,534 thousand heads. It gradually decreased and, by 2018, amounted to 3530.8 thousand heads according to the published data of the Department of Agriculture and Environment Statistics of the State Statistics Service of Ukraine [42]. Therewith, the sample size ranged from 60 to 289 animals in the 95% confidence interval and up to 124 animals in the 80% con- fidence interval.

Of the 203 animals studied, 21 animals, or 10.3% (95% confidence interval: 6.7-15.1), responded positively to *Toxoplasma gondii* based on the results of research in 2014 and 2018.

Since the study of animals was carried out in two stages, in 2014 and 2018, Figure 1 presents the results of the study of the first 72 samples.

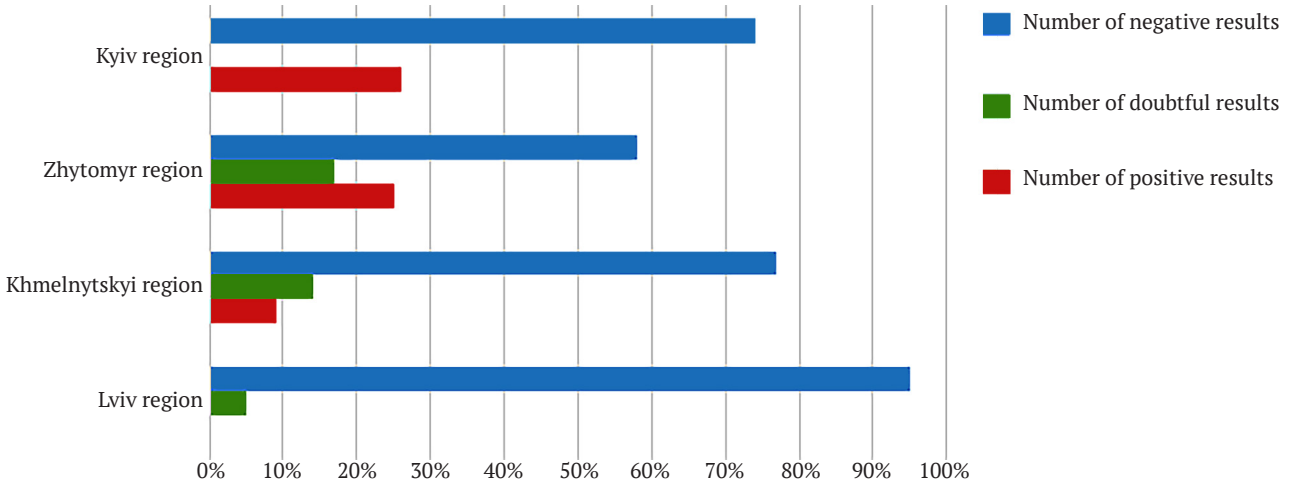

Figure 1. Seroprevalence of the causative agent of toxoplasmosis among cattle in Ukraine according to enzyme-linked immunosorbent assay (2014)

Among them, a positive reaction to the agent of toxoplasmosis was found in 10 samples or 13.9% (95% confidence interval: 7.3-23.4) from among 72 examined. 6 samples were questionable (8.3; 95% confidence interval: 3.4-16.5), and 56 samples were negative (77.8; 95% confidence interval: 67.1-86.3). Among the 61 cow serum samples studied, a positive reaction was observed in 9 samples (14.8; 95% confidence interval: 7.4-25.4), doubtful – in 6 samples (9.8; 95% confidence interval: 4.1-19.3), and negative – in 46 samples (75.4; 95% confidence interval: 63.5-85.0). At the same time, among 11 samples of bovine blood serum, only one sample was positive (9.1; 95% confidence interval: 0.5-37.3), the remaining 10 (90.9; 95% confidence interval: 62.7-99.6) were negative. Thus, no substantial difference was identified between the results of blood serum samples of cows and bulls regarding the detection of antibodies to *T. gondii* in them (P=0.6921). The highest prevalence rate was found among animals from farms in the Kyiv and Zhytomyr regions – 26.3% and 25%, respectively (Fig. 1).

In 2018, 131 samples of animal blood serum were examined. The results were summarised according to the year of the study, regions of Ukraine, age groups of animals and sex, and are presented in Table 1.

Table 1. Seroprevalence of *Toxoplasma gondii* among cattle in some regions of Ukraine according to the year of the study, age groups and sex of animals (using the enzyme immunoassay method, n = 203)

Dependence of *Toxoplasma gondii* prevalence	***N***	***n* of ELISA-positive animals**	**% of ELISA-positive animals**	**95% confidence interval**
By year of research conducted				
2014	72	10	13.9	7.3-23.4
2018	131	11*	8.4	4.5-14.1
By regions where animals were kept (for 2014 and 2018 together)				
Kyiv	100	11	11	5.9-18.3
Zhytomyr	42	5**	11.9	4.5-24.4
Khmelnytskyi	22	2***	9.1	1.6-26.9
Lviv	39	3****	7.7	2.0-9.5

Table 1, Continued

By age group of the studied animals (for 2014 and 2018 together)				
⩽ 6 months	65	3	4.6	1.2-12.1
6-18 months (inclusive)	41	2*****	4.9	0.8-15.2
18 months-3 years	48	6******	12.5	5.2-24.2
⩾ 3 years	49	10*******	20.4	10.9-33.4
By animal gender (for 2014 and 2018 together)				
Cows	184	20	10.9	7.0-16.0
Bulls	19	1********	5.3	0.3-23.3
Total	203	21	10.3	6.7-15.1

Note: **P=0.2341 – animal research results of 2018 in relation to the results of 2014: **P=0.8603 – the ratio of the results in cattle of Kyiv and Zhytomyr regions; ***P=0.8482 – the ratio of the results in cattle of Khmelnytskyi and Kyiv regions; ****P=0.5964 – the ratio of the results in cattle of Lviv and Kyiv regions; *****P=0.9357 – ratio of research results of cattle from 6 to 18 months (inclusive) and animals ⩽ 6 months; ******P=0.1499 – the ratio of research results of cattle from 18 months to 3 years and cattle ⩽ 6 months; *******P=0.0114 – the ratio of the results in cattle ⩾ 3 years and cattle ⩽ 6 months; ********P= 0.5017 – the results of the study of bulls compared to cows*

In general, among the 184 cow serum samples under study, a positive reaction was recorded in 20 (10.9; 95% confidence interval: 7-16), and a negative reaction was recorded in 164 samples (89.1; 95% confidence interval: 84-93). At the same time, out of 19 samples of bovine blood serum, only one was positive (5.3; 95% confidence interval: 0.3-23.3), the remaining 18 (94.7%) were negative.

Based on the results of the research, a probable increase in the seroprevalence of *T. gondii* was established with the age of the cattle. Among the examined 65 samples of a group of animals under the age of 6 months, 3 reacted positively to *T. gondii* (4.6; 95% confidence interval: 1.2-12.1). Therewith, in the group of 49 animals older than 3 years, the prevalence increased by 15.8% (10 positively responding samples) (20.4; 95% confidence interval: 10.9-33.4), compared to the previous group of animals, the P value was 0.0114.

Among farm animals of Kyiv and Zhytomyr regions, the prevalence of *T. gondii* was the highest (11% (95% confidence interval: 5.9-18.3) and 11.9% (95% confidence interval: 4.5-24.4), respectively). Prevalence of *T. gondii* among the animals of farms in Lviv and Khmelnytskyi regions, it was 7.7% and 9.1%, respectively. During the conducted studies, an increase in the prevalence of the agent of toxoplasmosis with the age of animals was statistically probable.

The level of prevalence of the agent in the world, both among different animal species and among humans, varies due to differences in climate, culture, eating habits, behaviour, personal hygiene, and cooking habits. The resulting indicator is higher than the data of Chinese researchers (5.0% (27/535) and 9.4% according to other researchers [43; 44], the average values for metadata processing results (7.0%) [45] and lower than the results of studies conducted in Poland (13.0%) [46], Nigeria (16.3%) [47], conducted by another group of Chinese researchers (19.9%; 144/723) [48], meta-analysis results (20.0%) [49], research results in the Democratic Republic of São Tomé and Príncipe (27.1%) [50], and data from researchers in Brazil (34.27%; 1307/3814 and 60.29%; 369/612) [51; 52]. At the same time, various risk factors were identified, namely the use of raw or poorly heat-treated meat, physical contact with cats or cat toilets, the use of unwashed raw vegetables and fruits, the use of contaminated water and milk [20; 7]. Thus, according to the researchers, the prevalence of *T. gondii* was the highest (11.5±3.1) among cows older than 8 years, which coincides with the results of this paper, and no substantial differences were found regarding the dependence of the spread of the agent of toxoplasmosis on the breed of cows and the area [36]. Similarly, the prevalence was considerably higher in adult buffaloes (12.5%) compared to calves and young animals (1.9%) [31]. This is confirmed by the results of the dependence of animal lesions on age (P<0.0001) with a prevalence of 5.3% for calves (<8 months) and 23.1% for adult animals (> 8 months) [30], as well as the results of studies by scientists in China, where the prevalence was higher among animals aged ⩾ 12 months (9.6%, 1248/12438) than among animals aged <12 months (6.7%, 226/3132). Female cattle had a slightly higher prevalence (12.5%, 793/6670) than males (11.7%, 418/3856). Comparable results were obtained in this study, but they were not statistically significant. The prevalence in summer (11.8%, 517/4744) was the highest of all seasons [27; 29; 53].

Researchers include the number of animals on the farm (OR=4.43) and the presence of domestic cats in the territory where the animals are kept (OR=1.98) [8; 9; 25]. Thus, at the herd level, the risk factors associated with a higher risk of *T. gondii* infection were the drilling of certain wells as sources of drinking water (OR=7.50; 95% confidence interval: 2.11-26.69) [26].

Another risk factor for toxoplasmosis infection is the presence of rodents on farms (P=0.006) [24]. Eating raw or insufficiently heat-treated meat is known to increase the risk of *T. gondii* infection. Freezing meat products can eliminate this risk, but buyers very often prefer unfrozen meat due to its better nutritional quality [54; 55].

Another risk of toxoplasmosis infection is the consumption of unpasteurised milk and certain dairy products [20]. Thus, out of 164 selected raw milk samples from 33 buffalo herds in Iran, 4.3% were recognised as positive by Vero cell culture, and 3.7 and 3.0% were positive by enzyme immunoassay and polymerase chain reaction methods, respectively. The researchers also used bioassays on cats and fed the animals 50 cm^3 buffalo milk for 3 days. All infected cats excreted oocysts with faeces, demonstrating the presence of viable tachyzoites in the animals, which were

in the milk of productive animals and may pose a threat to further infection with toxoplasmosis [40; 56].

Conclusions

According to the results of the research, the prevalence of *T. gondii* among cattle in Kyiv, Zhytomyr, Khmelnytskyi, and Lviv regions of Ukraine is 10.3% (95% confidence interval: 6.7-15.1). Therewith, according to data for 2014 and 2018, it differed slightly. Thus, in 2014, *T. gondii* was found in 13.9% of animals, and in 2018 this figure was 8.4%. The obtained prevalence rates in 2014 in some regions of Ukraine are close to the results of studies conducted in Poland. Moreover, an increase in the prevalence of *T. gondii* was recorded in this species of animal with age. Thus, in the group of 49 animals older than 3 years, the prevalence increased by 15.8% compared to the group of cattle under 6 months of age, which coincides with the results of other researchers. Therefore, eating insufficiently heat-treated meat and unpasteurised milk and certain dairy products can cause human toxoplasmosis infection.

Given the considerable percentage of positively responding animals in some regions of Ukraine, at the next stage of research, it is necessary to analyse the risks of infection with the agent of human toxoplasmosis when eating meat and milk of cattle.

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Поширення *Toxoplasma gondii* серед великої рогатої худоби в окремих регіонах України

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Анотація. *Toxoplasma gondii* як збудник токсоплазмозу, хвороби яка є спільною як для людини, так і для великої рогатої худоби, є надзвичайно поширеним у світі і завдає як економічних збитків так і становить загрозу здоров'ю людини, зокрема при вживанні у їжу продуктів тваринного походження. Саме тому мета роботи полягала у дослідженні поширеності збудника токсоплазмозу у великої рогатої худоби окремих областей України. Для проведення досліджень до лабораторії надсилали зразки цільної крові або сироватки великої рогатої худоби різного віку і статі з господарств Київської, Житомирської, Хмельницької та Львівської областей України. У сироватці крові тварин визначали наявність сумарних антитіл до *Toxoplasma gondii*. Для цього використовували метод імуноферментного аналізу. Загалом поширеність *T. gondii* серед великої рогатої худоби Київської, Житомирської, Хмельницької і Львівської областей України за результатами проведених досліджень становила 10,3 % (95 % довірчий інтервал: 6,7–15,1). Водночас дослідження тварин здійснювалось у два етапи, у 2014 і 2018 роках, а поширеність відрізнялася незначно. Так, у 2014 році за результатами досліджень зареєстровано позитивну реакцію до *T. gondii* в 10 зразках або 13,9 % (95 % довірчий інтервал: 7,3–23,4), у той час, як у 2018 році цей показник становив 11 зразків або 8,4 % (95 % довірчий інтервал: 4,5–14,1) досліджених тварин. Водночас за 2014 і 2018 роки досліджень встановлено, що найвищий рівень поширеності збудника токсоплазмозу відзначався серед тварин господарств Житомирської та Київської областей, відповідно 11,9 % (95 % довірчий інтервал: 4,5–24,4) й 11,0 % (95 % довірчий інтервал: 5,9–18,3). Причому вірогідне підвищення рівня поширеності *T. gondii* відмічали у тварин з віком. Зокрема, серед тварин віком до шести місяців, із 65 досліджених зразків сироватки крові позитивно прореагували до збудника хвороби три (4,6; 95 % довірчий інтервал: 1,2–12,1). У той час, як у групі тварин старших за три роки (49 корів), які позитивно прореагували, виявилися 10 зразків (20,4; 95 % довірчий інтервал: 10,9–33,4), у порівнянні з попередньою групою тварин P-значення становило 0,0114. Отже, отримані дані дають можливість зрозуміти рівень поширеності збудника токсоплазмозу серед великої рогатої худоби на території України, що своєю чергою дозволить попередити захворювання людей при вживанні в їжу м'ясних і молочних продуктів позитивно реагуючих тварин

Ключові слова: токсоплазмоз, серологічні дослідження, імуноферментний аналіз, Київська, Житомирська, Хмельницька, Львівська області