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Influence of *Ctenocephalides felis* on biochemical indicators of blood serum of infested cats

B. Havryk[1] | V. Melnychuk[1, 2]

Article info

Correspondence Author
V. Melnychuk
E-mail:
vitaliy.melnichuk@pdau.edu.ua

[1] Poltava State Agrarian University,
Skovorody Str., 1/3,
Poltava, 36003, Ukraine

[2] Institute of Veterinary Medicine of the National Academy of Agrarian Sciences of Ukraine,
Donetska Str., 30, Kyiv,
03151, Ukraine

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Fleas represent one of the most important groups of blood-sucking parasitic insects. An important aspect of the medical and veterinary importance of fleas, which has not lost its relevance even today, is their role in maintaining natural foci of zooanthroponotic and zoonotic infections. With constant flea attacks on an animal, clinical signs develop, characterized by itching, anxiety, and dermatopathologies, which are due to certain parasite-host relationships, which are based on the interaction of the pathogenic effect of the parasite and the host's defense mechanism. The aim of the research was to determine changes in the biochemical parameters of blood serum of infested cats at different levels of ctenocephalic invasion intensity. The conducted studies have established that flea parasitism on the body of cats led to a negative impact of ectoparasites on the biochemical parameters of the blood serum of infested cats. With increasing intensity of flea infestation of cats, the severity of changes in the biochemical parameters of their blood serum increased. Thus, at low levels of ctenocephalic invasion intensity (up to 19 specimens/head), a decrease in albumin content by 3.99 % ($p<0.05$) was detected in the blood serum of infected cats compared to the levels in clinically healthy cats. All other indicators were within physiological fluctuations. At higher rates of intensity of ctenocephalic invasion (from 20 to 42 specimens/head) in the blood serum of infected cats, a decrease in albumin content by 15.39 % ($p<0.01$), glucose by 35.99 % ($p<0.05$), an increase in total bilirubin content by 33.54 % ($p<0.05$), urea by 36.24 % ($p<0.05$), creatinine by 16.18 % ($p<0.05$), as well as an increase in the activity of enzymes alanine aminotransferase by 22.42 % ($p<0.05$), aspartate aminotransferase by 38.56 % ($p<0.05$), alkaline phosphatase by 2.4 times ($p<0.05$), α-Amylase by 51.44 % ($p<0.05$), gamma-glutamyl transpeptidase by 31.22 % ($p<0.05$) compared to the indicators in clinically healthy cats. The results obtained expand existing data on the impact of fleas on the body of infested cats, and also allow us to take into account indicators of infestation intensity in increasing the effectiveness of treatment measures.

Keywords: parasitology, ctenocephalosis, cats, intensity of invasion, biochemical parameters, blood serum.

Вплив Ctenocephalides felis на біохімічні показники сироватки крові інвазованих котів

Б. А. Гаврик[1] | В. В. Мельничук[1, 2]

[1] Полтавський державний аграрний університет,
м. Полтава, Україна

[2] Інститут ветеринарної медицини Національної академії аграрних наук України,
м. Київ, Україна

Блохи представляють одну з найбільш важливих груп кровосисних паразитичних комах. Важливим аспектом медичного та ветеринарного значення бліх, які не втратили актуальності і в даний час, є їх роль у підтримці природних вогнищ зооантропонозних та зоонозних інфекцій. При постійному нападі бліх на тварину розвиваються клінічні ознаки, які характеризуються свербежем, занепокоєнням та дерматопатологіями, що обумовлено певними паразито-хазяїнними відносинами, в основі яких лежить взаємодія патогенного впливу паразита і механізму захисту організму хазяїна. Метою досліджень було встановити зміни в біохімічних показниках сироватки крові інвазованих котів за різних показників інтенсивності ктеноцефальозної інвазії. Проведеними дослідженнями встановлено, що паразитування бліх на тілі котів призводило до негативного впливу ектопаразитів на біохімічні показники сироватки крові інвазованих котів. При зростанні інтенсивності зараження котів блохами тяжкість змін у біохімічних показниках їх сироватки крові зростала. Так, за невисоких показників інтенсивності ктеноцефальозної інвазії (до 19 екз/гол.) у сироватці крові заражених котів виявляли зниження вмісту альбумінів на 3,99 % ($p<0,05$) порівняно з показниками у клінічно здорових котів. Всі інші показники знаходилися в межах фізіологічних коливань. За більш високих показників інтенсивності ктеноцефальозної інвазії (від 20 до 42 екз/гол.) у сироватці крові заражених котів встановлювали зниження вмісту альбумінів на 15,39 % ($p<0,01$), глюкози на 35,99 % ($p<0,05$), зростання вмісту загального білірубіну на 33,54 % ($p<0,05$), сечовини на 36,24 % ($p<0,05$), креатиніну на 16,18 % ($p<0,05$), а також зростання активності ферментів аланінамінотрансферази на 22,42 % ($p<0,05$), аспартатамінотрансферази на 38,56 % ($p<0,05$), лужної фосфатази у 2,4 раза ($p<0,05$), α-Амілази на 51,44 % ($p<0,05$), гамма-глутамілтранспептидази на 31,22 % ($p<0,05$) порівняно з показниками у клінічно здорових котів. Отримані результати розширюють вже існуючі дані щодо впливу бліх на організм інвазованих котів, а також дозволяють враховувати показники інтенсивності інвазії у підвищенні ефективності лікувальних заходів.

Ключові слова: паразитологія, ктеноцефальоз, коти, інтенсивність інвазії, біохімічні показники, сироватка крові.

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Introduction

Fleas of the genus Ctenocephalides are widespread ectoparasites of cats in most countries of the world, including Ukraine [1–6]. These parasitic insects can also transmit numerous pathogenic bacteria to both humans and animals, as well as the cestode pathogen Dipylidium caninum to dogs and cats [7–9].

As a result of flea parasitism, the transmission of pathogens, the release of toxins, the development of allergic reactions in the host's body, as well as a severe course of the disease with a fatal outcome can occur [10–12]. Ectoparasites can affect the physiological processes of the host, which is reflected in the immune defense and condition of the organism, as well as in the morphological and biochemical parameters of its blood. In particular, researchers found that flea-infested animals had decreased hematocrit, red blood cell count, hemoglobin, and lymphocyte count, which the authors believe is due to the ectoparasites feeding on blood. At the same time, the number of eosinophils, neutrophils, and basophils in the blood of flea-infested animals increased, indicating an immune response by the host [13].

Other researchers have established the negative impact of fleas on the body of sick animals, where a significant decrease in the number of erythrocytes ($p<0.05$), hemoglobin content ($p<0.01$) and hematocrit was recorded in their blood. At the same time, the number of leukocytes increased in the blood of sick cats and dogs ($p<0.01$). Changes in the biochemical parameters of the blood serum of sick animals were characterized by an increase in the content of total protein, urea, creatinine, AST, ALT and alkaline phosphatase activity ($p<0.01$) [14].

Scientists note that parasitism by ectoparasites of the genus Ctenocephalides leads to changes in hematological parameters of infested dogs, the severity of which depends on the intensity of the invasion. Leukocytosis and eosinophilia were detected in the blood of animals that were parasitized by up to 15 ex. fleas. At the same time, in the case of an invasion intensity of 16 to 47 ex. fleas, signs of anemia, inflammatory and allergic phenomena were recorded on the animal's body, as evidenced by a decrease in the number of erythrocytes, hemoglobin content, an increase in the number of leukocytes, eosinophils and rod-shaped neutrophils [15].

There are reports where, with a heavy infestation of *Ctenocephalides felis*, dairy calves were found to be lethargic, lose weight, and also have pale mucous membranes and dehydration. Hematological analysis revealed anemia with a significant decrease in the number of red blood cells [16].

The aim of the study

The aim of the studies was to determine changes in the biochemical parameters of blood serum of infested cats at different rates of intensity of ctenocephalic infestation.

Materials and methods

The research was carried out during 2024 in the conditions of the private veterinary clinic "Yashma" (Kremenchuk) and the Laboratory of the Department of Parasitology and Veterinary and Sanitary Examination of the Poltava State Agrarian University (Poltava).

To determine the biochemical parameters of the blood serum of animals, the experiment used 18 cats belonging to residents of Kremenchuk. Three groups of animals of 6 animals each were formed from them: one control (clinically healthy cats) and two experimental (spontaneously infested with fleas at different II: up to 19 specimen/head and 20–42 specimen/head). Biochemical parameters of blood serum were studied using a semi-automatic analyzer "Stat Fax 1904 Plus" (USA). Sample preparation and determination of specific parameters were carried out according to the instructions for the device and reagents. In blood serum, the following were determined: the content of total protein, albumin, total bilirubin, creatinine, urea, glucose, phosphorus, potassium, calcium, magnesium, activity of alanine aminotransferase, aspartate aminotransferase, alkaline phosphatase, gamma-glutamyl transpeptidase, α-Amylase.

Mathematical analysis of the obtained data was performed using the Microsoft EXCEL application package by determining the arithmetic mean (M), standard deviation (SD) and probability level (p) using the one-way analysis of variance technique using Fisher's exact test.

Results and discussion

The conducted studies have established that flea parasitism on the body of cats led to a negative impact on the biochemical parameters of the blood serum of infested cats. With increasing intensity of flea infestation of cats, the severity of changes in the biochemical parameters of their blood serum increased. Thus, with low intensity of ctenocephalic invasion (up to 19 specimen/head) in the blood serum of infected cats, a decrease in albumin content by 3.99 % (27.20±2.70 g/l, $p<0.05$) was detected compared to the indicators in clinically healthy cats (28.33±3.01 g/l) (***Fig. 1***).

At higher rates of ctenocephalic invasion intensity (from 20 to 42 specimen/head) in the blood serum of infected cats, an even greater decrease in albumin content by 15.39 % (23.97±1.10 g/l, $p<0.01$, relative to clinically healthy animals – 28.33±3.01 g/l), a decrease in glucose content by 35.99 % (4.18±1.03 mmol/l, $p<0.05$, relative to clinically healthy animals – 6.53±0.83 mmol/l), an increase in total bilirubin content by 33.54 % (6.45±0.82 mmol/l, $p<0.05$, relative to clinically healthy animals – 4.83±1.53 mmol/l), urea by 36.24 % (8.27±2.23 mmol/l, $p<0.05$, relative to clinically healthy animals – 6.07±0.29

mmol/l), creatinine by 16.18 % (108.42±12.85 mmol/l, p<0.05, relative to clinically healthy animals – 93.32±10.42 mmol/l).

Also, with low intensity of ctenocephalic invasion (up to 19 specimens/head), enzyme activity levels in the blood serum of infected cats did not differ from those in clinically healthy cats and were within physiological fluctuations (***Fig. 2***).

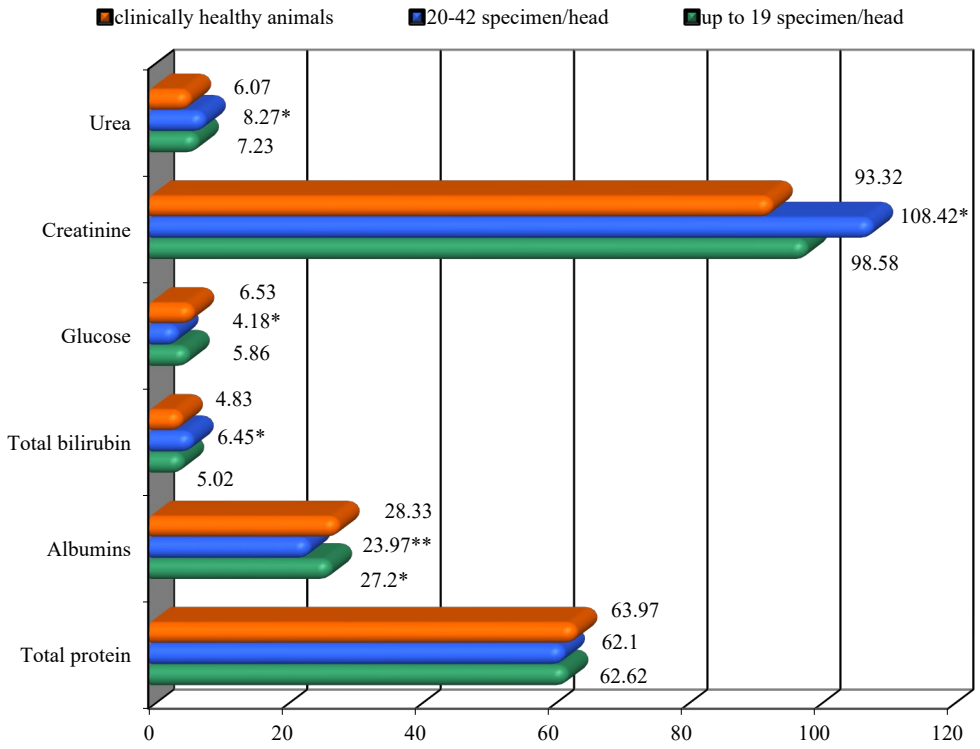

Fig. 1. The effect of ctenocephalic invasion on biochemical parameters of blood serum of infected cats depending on the intensity of the invasion
* – p<0.05; ** – p<0.01 – relative to the parameters of clinically healthy animals

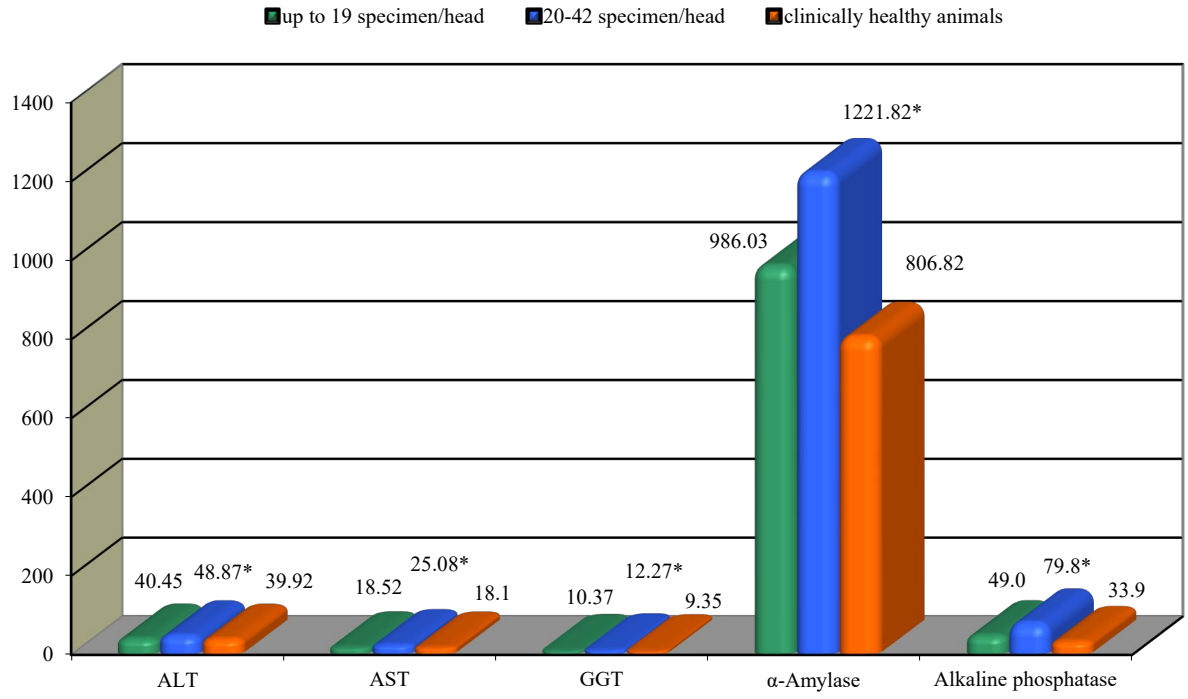

Fig. 2. The effect of ctenocephalic invasion on the activity of serum enzymes of infected cats depending on the intensity of the invasion
* – p<0.05 – relative to the indicators of clinically healthy animals

With indicators of intensity of ctenocephalosis invasion from 20 to 42 specimen/head. In the blood serum of infected cats, an increase in the activity of alanine aminotransferase enzymes by 22.42 % (48.87±5.09 U/l, $p<0.05$, relative to clinically healthy animals – 39.92±7.16 U/l), aspartate aminotransferase by 38.56 % (25.08±5.16 U/l, $p<0.05$, relative to clinically healthy animals – 18.10±4.44 U/l), alkaline phosphatase by 2.4 times (79.8±82.4 U/l, $p<0.05$, relative to clinically healthy animals – 33.9±61.2 U/l), α-Amylase by 51.44 % (1221.82±397.92 U/l, $p<0.05$, relative to clinically healthy animals – 806.82±221.59 U/l), gamma-glutamyl transpeptidase by 31.22 % (12.27±2.42 U/l, $p<0.05$, relative to clinically healthy animals – 9.35±2.07 U/l).

Regardless of the intensity of ctenocephalic invasion, the content of trace elements such as K, P, Ca2+ and Mg in their blood serum did not significantly differ from similar indicators in clinically healthy animals and were within physiological fluctuations (***Fig. 3***).

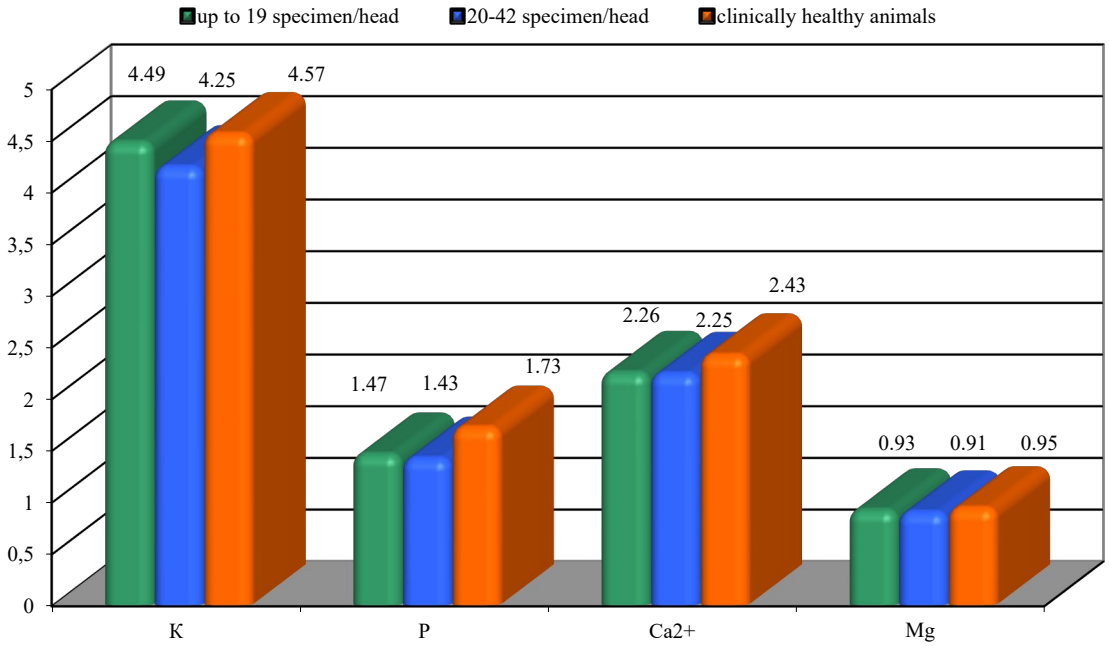

Fig. 3. The effect of ctenocephalosic invasion on the content of trace elements in the blood serum of infected cats depending on the intensity of the invasion

In nature, there are various biological relationships between living organisms. One of these relationships is parasitism. A parasite is an organism that settles in the body of an animal and a human and uses it as a habitat and food source, leading to various pathological processes that can be detected by changes in blood parameters of infected animals [17–19]. Therefore, the aim of our research was to establish changes in biochemical parameters in the blood serum of infested cats at different levels of ctenocephalic invasion intensity. It was found that with increasing intensity of flea infestation in cats, the severity of changes in biochemical parameters of their blood serum increased. Thus, with low intensity of ctenocephalic invasion (up to 19 specimen/head), a decrease in albumin content by 3.99 % ($p<0.05$) was detected in the blood serum of infected cats. At higher rates of intensity of ctenocephalic invasion (from 20 to 42 specimens/head) in the blood serum of infected cats, a decrease in albumin content by 15.39 % ($p<0.01$), glucose by 35.99 % ($p<0.05$), an increase in total bilirubin content by 33.54 % ($p<0.05$), urea by 36.24 % ($p<0.05$), creatinine by 16.18% ($p<0.05$), as well as an increase in the activity of enzymes alanine aminotransferase by 22.42 % ($p<0.05$), aspartate aminotransferase by 38.56 % ($p<0.05$), alkaline phosphatase by 2.4 times ($p<0.05$), α-Amylase by 51.44 % ($p<0.05$), gamma-glutamyl transpeptidase by 31.22 % ($p<0.05$).

Similar data were obtained when studying the effect of flea parasitism on blood serum parameters of infected dogs. In particular, depending on the intensity of the invasion, an increase in the content of total bilirubin (by 15.73 %, $p<0.05$), a decrease in the content of albumins (by 22.37–29.28%, $p<0.05…0.01$), glucose (by 25.29 %, $p<0.05$), an increase in the activity of aspartate aminotransferase and alanine aminotransferase (by 1.4 times, $p<0.05$), alkaline phosphatase (by 2 times, $p<0.05$) were found. Such changes, according to the author, indicate pathological changes in the liver that occur as a result of intoxication of the body from flea parasitism, as well as a decrease in food consumption due to severe itching [20].

The results obtained expand existing data on the impact of fleas on the body of infested cats, and also allow us to take into account indicators of infestation intensity in increasing the effectiveness of treatment measures.

Conclusions

With ctenocephalosis of cats, changes were found in the indicators of their blood serum, where the severity of the changes depended on the indicators of the intensity of the invasion. With indicators of the intensity of ctenocephalosis invasion up to 19 specimens/head. in the blood serum of infected cats, only albuminemia was detected (by 3.99 %, $p<0.05$). With indicators of the

intensity of ctenocephalosis invasion from 20 to 42 specimens/head. In the blood serum, albuminemia (by 15.39 %, $p<0.01$), hypoglycemia (by 35.99 %, $p<0.05$), as well as an increase in the content of total bilirubin (by 33.54 %, $p<0.05$), urea (by 36.24 %, $p<0.05$), creatinine (by 16.18 %, $p<0.05$), ALT activity (by 22.42 %, $p<0.05$), AST (by 38.56 %, $p<0.05$), alkaline phosphatase (by 2.4 times, $p<0.05$), α-Amylase (by 51.44 %, $p<0.05$), GGT (by 31.22 %, $p<0.05$).

Conflict of interest

The authors state that there is no conflict of interest.

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ORCID

B. Havryk https://orcid.org/0009-0003-9723-7388
V. Melnychuk https://orcid.org/0000-0003-1927-1065