

Seasonal changes in antioxidant system enzyme activity and products of lipid peroxidation in blood of different age rabbits spontaneously infested with *Psoroptes cuniculi*

Abstract. It has reliably been discovered, that the highest level of lipid peroxidation products, e.i. malondialdehyde (MDA) and diene conjugates (DK), while sharp decrease in the activity of antioxidant enzymes, e.i. superoxide dismutase (SOD) and catalase (CAT), may be observed in winter. Herewith, a considerable amount of antioxidant system enzymes like SOD and CAT accumulates in blood of rabbits in summer and autumn periods, which for a fact sustains reasonably low level of lipid peroxidation products.

Key words: psoroptoses, rabbits, ear scab, seasons, blood plasma, oxidative stress

Сезонні зміни активності ферментів антиоксидантної системи та продуктів перекисного окислення ліпідів у кролів різного віку, хворих на псороптоз

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Анотація. Встановлено, що вірогідно найвищий рівень продуктів перекисного окиснення ліпідів при одночасному різкому зниженні активності антиоксидантних ферментів спостерігається у зимовий період року. При цьому влітку та восени у крові кролів накопичується значна кількість антиоксидантних ферментів, що підтримує вірогідно невисокий вміст продуктів перекисного окиснення ліпідів.

Ключові слова: псороптоз, кролі, вушна короста, пори року, оксидативний стрес

Сезонные изменения активности ферментов антиоксидантной системы и продуктов перекисного окисления липидов у кроликов разного возраста, спонтанно больных псороптозом.

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Аннотация. Установлено, что наиболее высокий уровень продуктов перекисного окисления липидов при одновременном резком снижении активности антиоксидантных ферментов наблюдается в зимний период года. При этом летом и осенью в крови кроликов накапливается значительное количество антиоксидантных ферментов, поддерживающее достоверно невысокий уровень продуктов перекисного окисления липидов.

Ключевые слова: псороптоз, кролики, ушная короста, времена года, окислительный стресс

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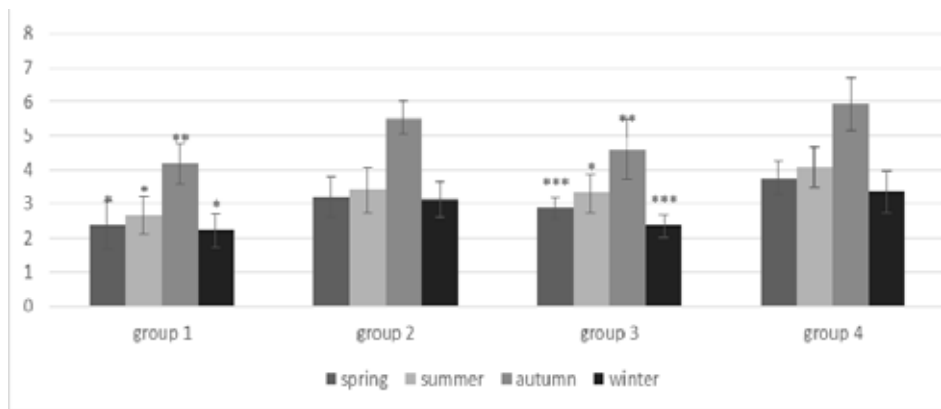
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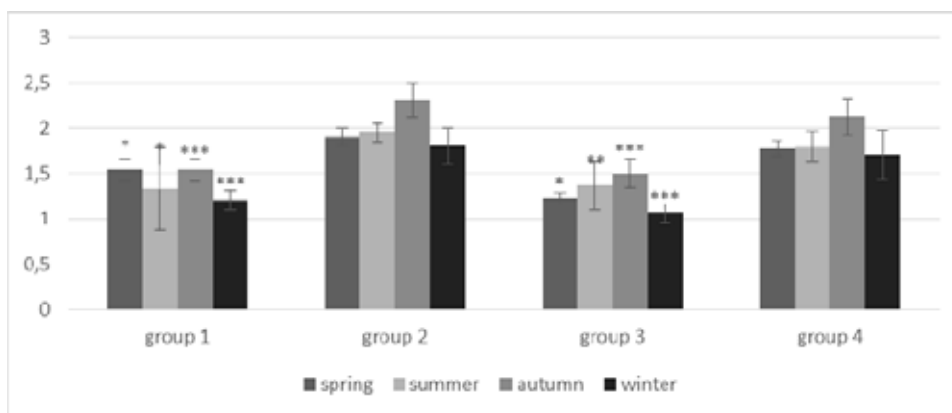
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Previously most of researchers considered ear scab merely being a skin disease but not the disease of animal's organism on the whole. Such a misconception made it impossible to correctly interpret pathogenesis of the disease and the relationship between the parasite and the host. The defining condition for exis-



Pic. 1. Activity of superoxide dismutase in blood of healthy and spontaneously infected with *Psoroptes cuniculi* rabbits of different age during four seasons of the year, U/mg Hb



Pic. 2. Activity of catalase in blood of healthy and spontaneously infected with *Psoroptes cuniculi* rabbits of different age during four seasons of the year, μM/min. x mg Hb

tence of mite infection is the general state of health of the host-animal and their skin [1].

Inflammatory processes in the organism caused by infectious, parasitic, allergic and other factors are based on degradation of cell membranes, which in its turn violates functional state of the lipid layer, leads to dysfunction of cells and determines the nature and course of the disease.

Nowadays, lipid peroxidation is considered to be a universal key link to pathogenesis of various diseases.

The fundamental purpose of the release of large amounts of reactive oxygen species during the inflammatory process is to kill or destroy invading microorganisms and/or to degrade damaged tissue structures. Thus, leukocytes are able to generate superoxide anion and hypochlorite, which are important sources of reactive oxygen species in situ. The excess of reactive oxygen species may be accumulated in the organism under the influence of toxic substances, harmful emissions in the environment, UV-radiation, preservatives and drugs [9].

Blocking of these processes is carried out by means of endogenous antioxidants and protective enzymes. However, when free radicals are produced in the excessive amounts, it results in misbalance between antioxidant system and the processes of lipid peroxidation,

which leads to peroxidation, destruction of cells and the development of oxidative stress [5].

It was established that oxidative stress plays an important role in the pathogenesis of parasitic diseases [4, 5, 9, 11].

Some scientific studies demonstrated that ticks of the Sarcoptidae family can induce oxidative stress in animals [11, 13]. However, only few scientific works are devoted to the subject of oxidative stress induced by *Psoroptes cuniculi* ticks and its elimination in rabbits [10, 12, 13].

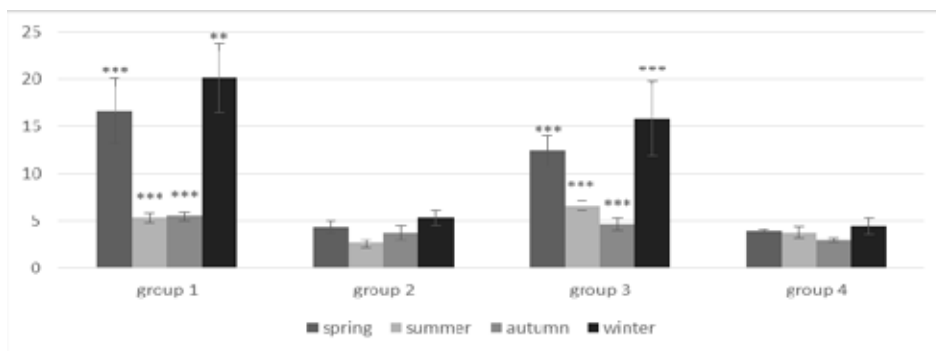
The aim of our study was to investigate during the year the dynamics of state of antioxidant defense system and to observe the results of lipid peroxidation in rabbits, which had been spontaneously infected by *Psoroptes cuniculi* mites.

Materials and methods.

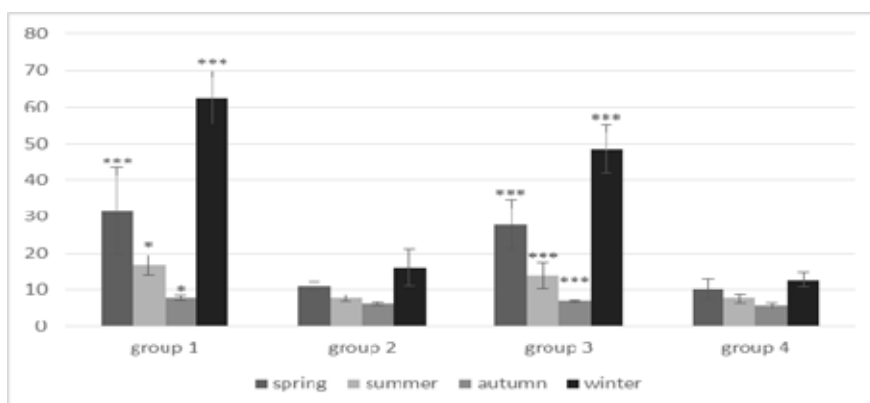
The study was carried out in the vivarium and in the Department of Parasitology and Ichtiopatology of S.Z. Gzhytskiy National Veterinary and Biotech University of Lviv from April 2014 till the end of March 2015. Ninety-two Californian rabbits, healthy and spontaneously infected by *Ps. cuniculi* mites, were used for the purposes of this research. The first group consisted of spontaneously infected rabbits aged 6-9 months. The second group - healthy rabbits aged 6-9 months. The third group - spontaneously infected rabbits aged 12 months and older. The fourth group - healthy rabbits aged 12 months and older. Blood samples were being obtained from rabbits during four yearly seasons and in the following way: blood samples were taken from 6 rabbits in each group in winter, spring and autumn and from 5 rabbits in each group accordingly in summer.

Collection and processing of ticks was carried out in conventional methods [8]. The content of CAT [3] and SOD [7] was tested in whole blood, and the levels of MDA [2] and DK [6] were determined in plasma. The data are processed biometrical. The results of average values were considered as statistically significant when $p < 0,05$ -*, $p < 0,01$ - ** and $p < 0,001$ - ***.

Results and discussions. Pictures 1 and 2 hereunder represent the research data on activity of the antioxidant enzymes such as CAT and SOD in whole blood of healthy



Pic. 3. Values of malondialdehyde in plasma of healthy and spontaneously infected with *Psoroptes cuniculi* rabbits of different age during four seasons of the year, nM/ml



Pic. 4. Values of diene conjugates in plasma of healthy and spontaneously infected with *Psoroptes cuniculi* rabbits of different age during four seasons of the year, nM/ml

and spontaneously infected rabbits aged 6-9 months, 12 months and older during four seasons of the year. It was found out, that the highest activity of CAT and SOD could be observed in summer and their lowest activity was specified in winter, herewith the decrease in activity of the latter one was more evident. At the same time, results of the research showed sharp rise of oxidative stress during winter and spring periods. Thus, winter values of CAT in rabbits aged 6-9 months decreased in 1,57 times ($p < 0.001$), compared to the control group, while values of SOD decreased in 1,42 times ($p < 0.05$). Differences in similar values with respect to infected with psoroptosis rabbits aged 12 months and older were insignificant. Particularly, activity of CAT decreased in 1,60 times ($p < 0.001$), and the activity of SOD decreased in 1,44 times ($p < 0.001$).

The highest concentrations of antioxidant enzymes such as CAT and SOD were measured during summer period. Thus, under *Psoroptes cuniculi* mite infestation of rabbits aged 6-9 months activity of their catalase enzyme statistically decreased in 1,47 times ($p < 0.05$) compared to the control group, and the activity of SOD decreased in 1,28 times ($p < 0.05$). Differences in similar values as regards rabbits aged 12 months and older were lower and decreased in 1,31 times ($p < 0.01$) and 1,23 times ($p < 0.05$) respectively.

The present study has proven that the values of SOD increase altogether with the age of rabbits, whereas the activity of CAT decreases. The values of CAT activity vary within 1,01 – 2,54 $\mu\text{M}/\text{min} \times \text{mg Hb}$ during a year, and the values of SOD vary within 1,6 - 6,9 U/mg Hb, herewith, the overall level of both enzymes in blood is the highest in autumn.

Namely, autumn values of SOD in 6-9 month old rabbits decreased in 1,32 times ($p < 0,01$), the same values of CAT decreased in 1,50 times ($p < 0,001$), compared to the control group, while the same values of enzymes in 12 month old and older rabbits decreased in 1,29 times ($p < 0,01$) and in 1,42 times ($p < 0,001$) respectively. The research data as regards the values of lipid peroxidation products in plasma of healthy and spontaneously infected rabbits aged 6-9 months, 12 months and older during four seasons are presented on Pictures 3 and 4 hereunder. The highest values of MDA and DK were measured during winter period and the lowest values were defined in autumn.

Thus, winter values of MDA in plasma of 6-9 month old rabbits increased in 3,81 times ($p < 0,001$), compared to the control group, while DK increased in 3,90 times ($p < 0,001$) accordingly. Differences in similar values in 12 months old and older spontaneously infected with ticks *Psoroptes cuniculi* rabbits were lower compared to the control group. Particularly, values of MDA in plasma increased in 3,56 times ($p < 0,001$), while values of DK increased in 1,21 times ($p < 0,001$).

During summer period values of lipid peroxidation products sharply decreased. Therefore, summer values of MDA in 6-9 month old rabbits with psoroptosis increased in 2,06 times ($p < 0,05$), compared to the control group, while values of DK increased in 2,14 times ($p < 0,01$) respectively. Summer values of MDA in plasma of 12 month old and older rabbits infected by *Psoroptes cuniculi* mites increased in 1,73 times ($p < 0,05$) compared to the control group, while values of DK increased in 1,80 times ($p < 0,05$) within the same groups respectively.

Autumn values were the lowest in both groups during the year. Values of MDA and DK in 6-9 month old rabbits increased in 1,46 times ($p < 0,01$) and 1,22 times ($p < 0,05$), compared to the control group, while in 12 month old and older rabbits the same values increased in 1,55

times ($p < 0,001$) and 1,21 times ($p < 0,001$) respectively. Obviously, such a low intensity of lipid peroxidation products in summer and autumn depend on the highest activity of antioxidant enzymes in the same seasons.

It's known that general metabolism processes of animals are changing during a year. At the same temperatures in summer it's increased and in winter it decreases to a minimum level. According to this cycling, rabbits' metabolic rates change and probably their tendency to mite infestation changes as well.

Thus, the most marked clinical signs of psoroptosis we could observe in winter and in spring, which were the periods of the lowest enzyme activity of antioxidant system and of the highest content of lipid peroxidation products. Accordingly, the highest concentration of antioxidants and low values of lipid peroxidation products were measured in blood of rabbits in summer and autumn, which matches low susceptibility to infestation by mites *Psoroptes cuniculi* and low clinical signs in spontaneously infected rabbits. Extent, to which the activity of antioxidant enzymes and the content of lipid peroxidation products in blood of rabbits differ, depends on the age of the animals.

Conclusion. It was found, that high level of lipid peroxidation products reducing the activity of antioxidant enzymes is one of the factors that make rabbits susceptible to infestation by mites *Psoroptes cuniculi*.

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