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CHANGES IN THE ACTIVITY OF PHOSPHATASES, CALCIUM AND PHOSPHORUS IN RATS WITH THE DIFFERENT COURSES OF GINGIVITIS UNDER CORRECTION BY ANTI-INFLAMMATORY GEL

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The aim of the study was to evaluate changes in the activity of acid and alkaline phosphatases, calcium and phosphorus levels in rats with different courses of experimental gingivitis upon treatment with anti-inflammatory gel with Neovitin and peptide complexes. The experiment was conducted on 100 white nonlinear male rats aged 5-6 months divided into 10 groups: 1 control and 9 - with different coursei of gingivitis. The activity of alkaline and acid phosphatase (ALP, ACP), the levels of calcium (Ca) and phosphorus (P) in rat blood serum and gingiva supernatant were determined. It was found that upon gingivitis, the activity of ALP in blood serum decreased and in gingiva supernatant increased in all groups of animals compared to the control group. The activity of ACP in the serum decreased in hypoergic and hyperergic animal groups and increased in normergia, and in gingiva supernatant increased in all groups: by 2 times in normoergic and hypoergic animals and by 1.4 times in hyperergic. The treatment with anti-inflammatory gel normalized the activity of ALP in both serum and supernatant and decreased the ACP activity in the serum of animals in hypo- and hyperergic groups. The content of serum Ca increased in all groups, and in the supernatant of the gingiva even exceeded the control value. The content of phosphorus in the supernatant of periodontal tissues decreased. The development of the inflammatory process in the periodontium of rats with gingivitis was accompanied by changes in the activity of ACP, ALP, the content of Ca and P in the blood serum and gingival supernatant. The treatment with gel containing neovitin and peptide complexes had a more pronounced therapeutic effect in rats with unchanged reactivity of the organism.

K e y w o r d s: gingivitis, alkaline phosphatase, acid phosphatase, calcium and phosphorus levels, anti-inflammatory gel.

According to the World Health Organization, the prevalence of periodontal tissue disease is over 80% and ranges from 64 to 93% in different countries. In young people, periodontal disease is second only to dental caries, and in adulthood comes to the fore [1, 2]. In Ukraine, the prevalence of periodontal disease among children is about 68%, increasing at a young age to 92% and reaching 100% in adults [3, 4]. The causes of the pathological process in periodontal tissues can be from various factors of both endogenous [5] and exogenous origin [6, 7]. The state of physiological protective mechanisms of periodontal tissues and the body as a whole determines the presence, prevalence and intensity of

inflammatory or inflammatory-dystrophic processes [8-10]. In addition to local etiological factors of inflammation in periodontal tissues (dental plaque, microflora, crowded teeth, etc.), the course of the inflammatory process is closely related to the reactivity of the body [11-14].

To date, there is a large number of therapeutic and prophylactic agents that are recommended for use in periodontal diseases [15, 16], in particular, containing active peptide complexes [17]. Today, one of the current areas for therapeutic and prophylactic effects on periodontal tissues is the study of the mechanism of action of peptide bioregulators of multicellular systems, in particular, short low molecular weight synthesized peptides of selective action. The unique sequence of amino acids in peptides is a certain information stimulus-carrier for the damaged cell, which regulates metabolic processes, enhances protein synthesis in the periodontium, increases antioxidant activity, improves blood microcirculation and accelerates the recovery of periodontal tissues and its functions [18, 19].

Therefore, is relevant to study biochemical processes in experimental gingivitis with altered course of the inflammatory reaction and its correction by nanotechnological drugs to reveal the unstudied links of pathogenesis and assess the effectiveness of treatment this disease.

The aim of the study was to evaluate the effectiveness of the correction of experimental gingivitis in rats using anti-inflammatory gel with bioantioxidant Neovitin and peptide complexes (hereinafter gel with Neovitin) on the biochemical parameters of serum and gingiva supernatant.

Materials and Methods

The experiments were performed on 100 white nonlinear male rats aged 5–6 months, which were divided into 10 groups (10 rats each): Group 1 – intact rats; Group 2 – rats with experimental gingivitis without changes in the reactivity of the organism on the seventh day of pathology modelling; Group 3 – rats with experimental gingivitis with a background of hypoergia of the body on the seventh day of modelling; Group 4 – rats with experimental gingivitis on the background of hyperergy of the organism on the seventh day of modelling the pathology; Group 5 – rats with experimental gingivitis without changes in the reactivity of the organism without correction on day 14 of the experiment; Group 6 – rats with experimental gingivitis on the background of hypoergia without correction on day 14 of the experiment; Group 7 – rats with experimental gingivitis on the background of hyperergy without correction on day 14 of the experiment; Group 8 – rats with experimental gingivitis without changes in the reactivity of the organism, which was corrected by anti-inflammatory gel with Neovitin on day 14 of the experiment; Group 9 – rats with experimental gingivitis on the background of hypoergia of the body, which was corrected by anti-inflammatory gel with Neovitin on day 14 of the experiment; Group 10 – rats with experimental gingivitis on the background of hyperergy of the body, which was corrected by anti-inflammatory gel with Neovitin on day 14 of the experiment.

Modelling of gingivitis without changing the reactivity of the organism was performed as follows. After preliminary anaesthesia (sodium thiopental, 25 mg/kg), the working head of the ultrasonic generator emitter was brought to the gingival area of the lower incisor and performed a single directional exposure to ultrasonic frequency oscillations at the following exposure parameters: oscillation frequency 50 kHz, radiation power in the range from 0.8 to 1.2 W/cm^2 inclusive at an exposure of 45 sec. The conclusion about the reproduced pathological process was made on the fifth day according to the indicators of objective examination (examination) [20]. Modelling of gingivitis on the background of hypoergia of the organism was performed as follows. Rats were injected intramuscularly with cyclophosphamide (Endoxan Baxter) at 10 mg/kg body weight once daily for one week. On the third day of cyclophosphamide administration, after previous performed general anaesthesia (sodium thiopental, 25 mg/kg), the experimental animal was fixed in the machine, then the working head of the ultrasonic scaler was brought into the gingival area of lower incisor and performed one-time directing ultrasound damage with a frequency of 50 kHz, radiation power from 1.0 up to 1.2 W/cm^2 at an exposure of 45 sec [21]. Modelling of gingivitis on the background of hyperemia of the body was performed as follows. The rat was injected intramuscularly with a solution of pyrogenal (FSBI “NDIEM named after MF Gamalei”) at a rate of 10 mg/kg body weight once a day for a week. On the third day of study, after performing general anaesthesia (sodium thiopental, 25 mg/kg) a one-time directed ultrasound damage was made according to the above method [22].

The conclusion about the reproduced pathological process with altered reactivity of the organism was made on the seventh day from the beginning of the experiment according to the indicators of objective examination (review). In the observation groups, there were significant changes in the gingiva, which were characterized by redness, swelling, bleeding and increased height of the gingival papilla without damaging the circular ligament and exposing the root of the tooth, which was determined using a dental probe. From the eighth day of experimental gingivitis, rats of Groups 8, 9 and 10 were treated with anti-inflammatory gel with Neovitin and peptide complexes twice a day for seven days.

Euthanasia of animals and collection of blood and soft tissues of the periodontium were performed under thiopental anaesthesia seven days after the start of the experiment in the group with simulated gingivitis, in groups without correction and with correction, after 14 days.

Biochemical research methods were used to determine the activity of alkaline phosphatase (ALP) and acid phosphatase (ACP), the level of calcium and phosphorus in the serum and gingival supernatant of experimental animals. Determination of the activity of acidic and alkaline phosphatases was performed by grinding in a porcelain mortar with crushed glass of periodontal tissues and producing a homogenate on Tris-HCl buffer (pH 8.0) at the rate of 100 mg of tissue/ml at a temperature of 2 to 8°C. After centrifugation, the homogenate supernatant and blood serum were examined. Determination of alkaline phosphatase activity (pH 10.5) was performed according to the method using the substrate p-nitrophenyl phosphate sodium, which under the action of the enzyme is hydrolysed to p-nitrophenol, which turns yellow, the intensity of which is proportional to the activity of enzymes. The activity of acid phosphatase (pH 4.8) present in the sample was determined by substrate alpha-naphthyl phosphate [23]. Enzyme activity was measured using a Master T semi-automatic biochemistry analyser and expressed in units/l [24]. The content of Ca and P (mmol/l) in blood serum, homogenate and oral fluid was determined using a Master T biochemistry analyzer, o-Cresolphthalein complexone and colorimetric method according to standard methods [24].

During the work, the principles of the European Convention for the Protection of Vertebrate Animals Used for Research and Other Scientific Purposes (Strasbourg, 1986) and norms of biomedical ethics and relevant Laws of Ukraine were observed. Laboratory research was performed in the central research laboratory in compliance with bioethical requirements [25], as evidenced by the conclusion of the Commission on Bioethics of I. Horbachevsky Ternopil National Medical University (Protocol № 62 of January 11, 2021).

Statistical analysis of the research results was performed using computer programs Excel and STATISTICA for Windows version 8. Descriptive statistics provided the calculation of relative and average values. Categorical signs are presented in the form of relative indicators (percentage of patients with the presence of a sign in the group). Quantitative indicators were presented as M ± m, where M is the arithmetic mean, m is the mean error of the mean. Student's criteria and the χ^2-test (Chi-square test) were used to test the significance of the difference between groups of categorical (qualitative) traits [26]. Student's *t*-test was used to test the significance of the difference between the mean values. Differences were considered significant at $P < 0.05$, which is generally accepted for biomedical research.

Results and Discussion

Alkaline phosphatase (ALP) and acid phosphatase (ACP) activity are important indicators of remineralizing and demineralizing functions of oral fluid, osteoblastic and osteoclastic activities [27]. Given that in the experiment were modelling changes in the course of the inflammatory reaction in the gingiva of animals, it was of interest to investigate the activity of phosphatases in rats with hypoergic, hyperergic and normoergic gingivitis.

In our studies, we found that in experimental gingivitis, the activity of ALP in the serum of animals decreased by 8.7, 37.9 and 25.1% in normoergic, hypoergic and hyperergic rats, respectively, compared with similar indicators of animals of the control group ($P < 0.05$) (Table 1). Moreover, in normoergic and hypoergic rats, which were performed correction, the indicator did not differ from that of rats in the control group ($P > 0.05$). Correction by anti-inflammatory gel with Neovitin and peptide complexes showed a significant increase in ALP activity in the blood serum of hypoergic animals by 1.2 times ($P < 0.05$) and a decrease in hyperergic animals by 1.3 times ($P < 0.05$) and in normoergic animals by 6.9% ($P > 0.05$) compared with the group of animals that were not performed correction.

Regarding the change in ALP activity in the gingival supernatant, it increased 1.7, 1.6 and 1.9

Table 1. The activity of alkaline phosphatases in the blood serum of animals of experimental groups, units/l (M ± m, n = 10)

Groups of animals	Normoergic reaction	Hypoergic reaction	Hyperergic reaction	Intact control
Pathology model	320.7 ± 11.1* (Group 2)	235.7 ± 6.8* (Group 3)	263.0 ± 14.1* (Group 4)	351.2 ± 6.9 (Group 1)
Pathology without correction	396.2 ± 10.7* (Group 5)	282.3 ± 16.8* (Group 6)	300.9 ± 16.5* (Group 7)	
Pathology with correction	369.0 ± 10.6 (Group 8)	337.9 ± 12.2** (Group 9)	233.5 ± 15.0*,** (Group 10)	

*The difference is significant from the control group, $P < 0.05$; **the difference is significant from the group without correction, $P < 0.05$

times in normoergic, hypoergic and hyperergic rats, respectively ($P < 0.05$), compared with similar parameter animals in the control group (Table 2). In the correction of gingivitis, the activity of ALP was as follows: an increase in ALP activity was observed in normoergic and hypoergic rats 1.2 times ($P < 0.05$) and 5.2% ($P > 0.05$), respectively. At the same time, in the hyperergic group of animals there was a decrease in ALP activity by 1.45 times ($P < 0.05$) compared with the corresponding indicators of rats, which were not performed correction.

It should be noted that in all groups of rats that underwent correction, the activity of ALP in gingival supernatant was higher than the control: 1.2, 2.7 and 1.7 times in normoergic, hypoergic and hyperergic animals, respectively ($P < 0.05$). Therefore, in the supernatant of periodontal tissues of rats of all experimental groups of animals, there was an increase in ALP activity. Performed correction by anti-inflammatory gel, containing Neovitin and peptide complexes in experimental gingivitis leads to normalization of ALP activity in the blood serum of normoergic and hypoergic animals. Regarding the activity of ALP in the supernatant of the gingiva of hyperergic animals, which were performed correction, it was closer to the control value.

Studies of the activity of ACP in the blood serum of animals showed an increase in its activity in normoergic rats in the modelling of gingivitis by 1.4 times ($P < 0.05$) (Table 3). For animals of hypoergic and hyperergic groups, there was a decrease in ACP activity by 1.4 times ($P < 0.05$) and 3.7% ($P > 0.05$), respectively. Using of anti-inflammatory gel with Neovitin and peptide complexes led to an increase in ACP activity by 5% ($P > 0.05$) in normoergic and 1.25 times ($P < 0.05$) in hypoergic animals. Regarding the hyperergic group of animals, there was a decrease in the activity of ACP by 1.74 times ($P < 0.05$) compared to the same indicator of animals that were not performed correction. Thus, with the development of experimental gingivitis, the activity of ACP in the blood serum of animals decreased with altered reactivity of the organism and increased with normoergic reaction.

Table 2. The activity of alkaline phosphatases in the supernatant of periodontal tissues of animals of experimental groups, units/l (M ± m, n = 10)

Groups of animals	Normoergic reaction	Hypoergic reaction	Hyperergic reaction	Intact control
Pathology model	231.5 ± 6.6* (Group 2)	215.9 ± 11.2* (Group 3)	267.0 ± 12.2* (Group 4)	137.7 ± 4.2 (Group 1)
Pathology without correction	137.5 ± 7.1 (Group 5)	346.9 ± 11.0* (Group 6)	341.2 ± 8.1* (Group 7)	
Pathology with correction	162.0 ± 4.2*,** (Group 8)	365.0 ± 9.3* (Group 9)	234.9 ± 7.9*,** (Group 10)	

*The difference is significant from the control group, $P < 0.05$; **the difference is significant from the group without correction, $P < 0.05$

Table 3. The activity of acid phosphatases in the blood serum of animals of experimental groups, units/l (M ± m, n = 10)

Groups of animals	Normoergic reaction	Hypoergic reaction	Hyperergic reaction	Intact control
Pathology model	4.53 ± 0.09* (Group 2)	2.40 ± 0.06* (Group 3)	3.14 ± 0.06 (Group 4)	3.26 ± 0.15 (Group 1)
Pathology without correction	3.79 ± 0.13* (Group 5)	2.60 ± 0.14* (Group 6)	4.26 ± 0.17* (Group 7)	
Pathology with correction	3.98 ± 0.15* (Group 8)	3.24 ± 0.13** (Group 9)	2.45 ± 0.08*,** (Group 10)	

*The difference is significant from the control group, $P < 0.05$; **the difference is significant from the group without correction, $P < 0.05$

Studies of ACP activity in gingival supernatant in gingivitis modelling showed its increase in all experimental groups: 2 times in normoergic and hypoergic animals ($P < 0.05$) and 1.4 times in hyperergic ($P < 0.05$). Changes in the activity of acid phosphatase, apparently indicate an adaptive response of the body and gingiva, in particular, to the development of the inflammatory process in the periodontium. Performed correction with anti-inflammatory gel with Neovitin and peptide complexes reduced the activity of ACP in gingival supernatant in all experimental animals: 1.5, 1.2 and 1.7 times in the normoergic, hypoergic and hyperergic groups, respectively, compared with the corresponding parameters in animals that were not performed correction ($P < 0.05$). Thus, performed correction by the anti-inflammatory gel with Neovitin and peptide complexes significantly reduced the activity in blood serum ACP of experimental animals, moreover in the hyperergic group even below value in the intact control ($P < 0.05$).

In the gingival supernatant, the corrective effect was manifested by a tendency to reduce the activity of ACP in rats of all experimental groups (Table 4). Thus, in the hypoergic reaction the activity of ACP was 2.65 ± 0.08 units/l, in the hyperergic 2.68 ± 0.06 units/l. The most pronounced corrective effect of the therapeutic complex had in normoergic reaction of animals, the activity of ACP in the supernatant of the gingiva was 1.62 ± 0.07 units/l, approaching a similar indicator of the intact control group.

Thus, according to the indicators of changes in the activity of alkaline and acid phosphatases in the blood serum and gingival supernatant of experimental animals, it can be stated that local application of anti-inflammatory gel with Neovitin and peptide complexes had a pronounced effect on periodontal tissues that coincides with our previous studies [28].

Calcium has a high biological activity, performing various functions in the body, including the formation of bone tissue, mineralization of bones and teeth. The next step in our study was to deter-

Table 4. The activity of acid phosphatases in the supernatant of periodontal tissues of animals of experimental groups, units/l (M ± m, n = 10)

Groups of animals	Normoergic reaction	Hypoergic reaction	Hyperergic reaction	Intact control
Pathology model	2.81 ± 0.07* (Group 2)	2.83 ± 0.16* (Group 3)	1.9 ± 0.05* (Group 4)	1.38 ± 0.06 (Group 1)
Pathology without correction	2.38 ± 0.19* (Group 5)	3.18 ± 0.04* (Group 6)	4.57 ± 0.07* (Group 7)	
Pathology with correction	1.62 ± 0.07*,** (Group 8)	2.65 ± 0.08*,** (Group 9)	2.68 ± 0.06*,** (Group 10)	

*The difference is significant from the control group, $P < 0.05$; **the difference is significant from the group without correction, $P < 0.05$

mine the level of Ca and P in the blood serum and gingival supernatant of experimental animals with altered reactivity of the organism. As you can see (Table 5) the concentration of Ca in the blood serum of rats decreased compared with the control indicator (3.25 mmol/l) in animals with normoergic and hypoergic gingivitis – by 1.54% ($P > 0.05$) and 18.46% ($P < 0.05$), respectively. As for the animals with modelled hyperergic gingivitis, in this group there was an increase in calcium levels by 1.54% compared to controls ($P > 0.05$).

In the group of rats with simulated pathology, which was not performed correction, the content of Ca in the blood serum was lower by 10.15, 23.38 and 12.31% ($P < 0.05$) in the normoergic, hypoergic and hyperergic groups, respectively. In the groups of animals, which were performed correction by anti-inflammatory gel with Neovitin and peptide complexes, there was an increase in the content of Ca, but it did not reach the control indicator and was lower by 3.08% ($P > 0.05$), 12.92% ($P > 0.05$) and 5.85% ($P > 0.05$) in the normoergic, hypoergic and hyperergic groups, respectively.

The content of Ca in the supernatant of periodontal tissues did not differ significantly ($P > 0.05$) from the control value (2.89 mmol/l) in all groups of animals and had a various nature (Table 6). Thus, in the groups with modelled normoergic and hyperergic gingivitis there was an increase in calcium content by 8.30 and 4.50%, respectively, and in hypoergic gingivitis a decrease of 7.96%. In the groups of rats, which were not performed correction, the decrease in calcium content in the supernatant of periodontal tissues was 1.73, 10.38 and 1.04% in the normoergic, hypoergic and hyperergic groups, respectively. As for the groups of animals, which were performed correction, there was an increase in the content of Ca, which exceeded the control indicator by 3.46 and 1.73% in the hypoergic and hyperergic groups, respectively. In animals of the normoergic group, the calcium content in the supernatant of periodontal tissues was 1.04% lower than the control indicator.

Insoluble (calcium) salts of phosphoric acid are the mineral basis of bone and tooth tissue. Soluble salts of phosphoric acid form a phosphate buffer system responsible for the stability of the acid-base balance of the intracellular fluid. Phosphorus is in the biological environment in the form of a phosphate ion, which is part of inorganic components and organic biomolecules.

Determination of phosphorus content in the blood serum of animals showed that in animals of all groups its content decreased by 19.54, 39.34 and 30.46% ($P < 0.05$), respectively, in normoergic, hypoergic and hyperergic gingivitis, compared with parameters in control group (3.94 mmol/l) (Table 7). In the group of rats that were not performed correction, the decrease in blood serum phosphorus was 32.74, 44.42 and 33.50% ($P < 0.05$) in the normoergic, hypoergic and hyperergic groups, respectively. For group of rats that were performed correction by anti-inflammatory gel with Neovitin, there was an increase in the content of P, however, it did not reach the control indicator and was lower by 21.57, 34.26 and 32.23% ($P < 0.05$) in normoergic, hypoergic and hyperergic groups, respectively (Table 8).

There was a significant decrease in the content of phosphorus in the supernatant of periodontal tissues compared to the control indicator (4.85 mmol/l) by 1.6, 2.3 and 1.8 times in the normoergic, hypoergic and hyperergic groups, respectively (Table 8).

In rats of the experimental groups, which were not performed correction, the decrease in phosphorus content was 1.7, 1.9 and 2.1 times; in rats which

Table 5. The level of calcium in the blood serum of animals with experimental gingivitis, mmol/l (M ± m, n = 10

Groups of animals	Normoergic reaction	Hypoergic reaction	Hyperergic reaction	Intact control
Pathology model	3.20 ± 0.05 (Group 2)	2.65 ± 0.12* (Group 3)	3.30 ± 0.09 (Group 4)	3.25 ± 0.06 (Group 1)
Pathology without correction	2.92 ± 0.09* (Group 5)	2.49 ± 0.09* (Group 6)	2.85 ± 0.09* (Group 7)	
Pathology with correction	3.15 ± 0.06 (Group 8)	2.83 ± 0.10* (Group 9)	3.06 ± 0.14 (Group 10)	

*The difference is significant from the control group, $P < 0.05$; **the difference is significant from the group without correction, $P < 0.05$

Table 6. The level of calcium in the periodontal tissues of animals with experimental gingivitis, mmol/l (M ± m, n = 10)

Groups of animals	Normoergic reaction	Hypoergic reaction	Hyperergic reaction	Intact control
Pathology model	3.13 ± 0.09 (Group 2)	2.66 ± 0.12 (Group 3)	3.02 ± 0.08 (Group 4)	2.89 ± 0.11 (Group 1)
Pathology without correction	2.84 ± 0.11 (Group 5)	2.59 ± 0.13 (Group 6)	2.86 ± 0.09 (Group 7)	
Pathology with correction	2.86 ± 0.11 (Group 8)	2.99 ± 0.11** (Group 9)	2.94 ± 0.14 (Group 10)	

*The difference is significant from the control group, $P < 0.05$; **the difference is significant from the group without correction, $P < 0.05$

Table 7. The level of phosphorus in the serum of animals with experimental gingivitis, mmol/l (M ± m, n = 10)

Groups of animals	Normoergic reaction	Hypoergic reaction	Hyperergic reaction	Intact control
Pathology model	3.17 ± 0.12* (Group 2)	2.39 ± 0.10* (Group 3)	2.74 ± 0.04* (Group 4)	3.94 ± 0.14 (Group 1)
Pathology without correction	2.69 ± 0.13* (Group 5)	2.19 ± 0.06* (Group 6)	2.62 ± 0.11* (Group 7)	
Pathology with correction	3.09 ± 0.12*,** (Group 8)	2.59 ± 0.16*,** (Group 9)	2.67 ± 0.10* (Group 10)	

*The difference is significant from the control group, $P < 0.05$; **the difference is significant from the group without correction, $P < 0.05$

Table 8. Phosphorus level in the supernatant of periodontal tissues of animals with experimental gingivitis, mmol/l (M ± m, n = 10)

Groups of animals	Normoergic reaction	Hypoergic reaction	Hyperergic reaction	Intact control
Pathology model	3.02 ± 0.06* (Group 2)	2.12 ± 0.09* (Group 3)	2.78 ± 0.12* (Group 4)	4.85 ± 0.10 (Group 1)
Pathology without correction	2.80 ± 0.11* (Group 5)	2.46 ± 0.13* (Group 6)	2.30 ± 0.09* (Group 7)	
Pathology with correction	3.81 ± 0.12*,** (Group 8)	2.99 ± 0.11*,** (Group 9)	2.59 ± 0.11*,** (Group 10)	

*The difference is significant from the control group, $P < 0.05$; **the difference is significant from the group without correction, $P < 0.05$

were performed correction, decrease in phosphorus content was 1.3, 1.6 and 1.9 times in the normoergic, hypoergic and hyperergic groups, respectively, compared with the control indicator.

The developed experimental model of gingivitis on biochemical parameters and morphological changes completely reproduced the inflammatory process in the gingiva at the different (normoergia, hypoergia and hyperergia) its course, which gave grounds to evaluate the effectiveness of local use of anti-inflammatory gel with peptide complexes. To assess changes in the gingiva and in the organism of experimental animals, laboratory studies of supernatant of gingiva and blood serum were used. Moreover, changes in indicators were more significant in periodontal tissues, in particular, the activity

of alkaline and acid phosphatase. The effectiveness of the corrective action of anti-inflammatory gel with active peptide complexes in the experiment was confirmed by a decrease in acid phosphatase activity ($P < 0.05$) in periodontal tissues and an increase in alkaline phosphatase activity ($P < 0.05$) compared with animals without drug correction.

Thus, due to the development of the inflammatory process in the periodontium in the experimental modelling of the pathology, there were changes in the content of Ca and P in the blood serum and gingival supernatant of the animals, which indicated the adaptive response of the body and periodontal tissues, in particular. Correction using anti-inflammatory gel with Neovitin and peptide complexes influenced changes in the activity of ACP, ALP, calcium and phosphorus in blood serum and gingival supernatant of animals and had a more pronounced corrective effect in white rats with unchanged reactivity.

Conclusions. The development of the inflammatory process in the periodontium in the experimental modelling of pathology was accompanied by changes in the activity of alkaline and acid phosphatases, calcium, phosphorus in serum and gingival supernatant of experimental animals. Anti-inflammatory gel with Neovitin and peptide complexes had a corrective effect on the activity of alkaline and acid phosphatases, the content of macronutrients calcium and phosphorus in blood serum and gingival tissue supernatant. Corrective effect observed, as in the development of the inflammatory process at non-altered and at the altered reactivity of the organism of experimental animals. Performed correction using anti-inflammatory gel with Neovitin and peptide complexes with non-altered reactivity of white rats had a more pronounced corrective effect than in animals with modelled changes in the course of inflammatory reaction in periodontal tissues.

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ЗМІНИ АКТИВНОСТІ ФОСФАТАЗ, КАЛЬЦІЮ ТА ФОСФОРУ У ЩУРІВ ІЗ ГІНГІВІТОМ РІЗНОГО ПЕРЕБІГУ ЗА КОРЕКЦІЇ ПРОТИЗАПАЛЬНИМ ГЕЛЕМ

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Метою дослідження було оцінити активність кислої та лужної фосфатаз, рівнів кальцію та фосфору у щурів з експериментальним гінгівітом різного перебігу у разі застосування протизапального гелю з неовітаном та пептидним комплексом. Дослідження проводили на 100 білих нелінійних щурах-самцях віком 5-6 місяців, яких було розділено на 10 груп: 1 – контрольна і 9 – з різним перебігом гінгівіту. У ході дослідження визначали активність лужної та кислої фосфатази (ЛФ, КФ), рівень кальцію (Са) та фосфору (Р) в сироватці крові та супернатанті ясен щурів. Встановлено, що за гінгівіту активність ЛФ у сироватці крові знижувалася, а в супернатанті ясен підвищувалася в усіх групах тварин порівняно з контрольною групою. Активність КФ у сироватці крові знижувалася в гіпо- та гіперергічних групах тварин і підвищувалася в нормергічній, а в супернатанті ясен підвищувалася у всіх гру-

пах: у 2 рази у нормо- та гіпоергічних тварин і в 1,4 раза у гіперергічних. Застосування протизапального гелю нормалізувало активність ЛФ, як у сироватці крові, так і в супернатанті, та знижувало активність КФ у сироватці крові тварин у гіпо- та гіперергічних групах. Вміст Са в сироватці крові збільшувався в усіх групах, а в супернатанті ясен навіть перевищував контрольне значення, у той час, вміст фосфору в супернатанті тканин пародонту зменшувався. Отже, розвиток запального процесу в пародонті щурів із гінгівітом супроводжувався зміною активності КФ, ЛФ, вмісту Са та Р у сироватці крові та супернатанті ясен. Застосування гелю з неовітіном та пептидними комплексами мало більш виражений коригувальний ефект у щурів із незміненою реактивністю організму.

Ключові слова: гінгівіт, лужна фосфатаза, кисла фосфатаза, рівень кальцію та фосфору, протизапальний гель.

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