Influence of «Metisevit» on the activity of enzyme and nonenzyme link of antioxidant protection under the bull’s body cadmium loading

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The article contains the research results of the effect of cadmium chloride on the indexes of enzyme and nonenzyme systems of antioxidant defense system in young cattle, such as the activity of catalase, superoxide dismutase, glutathione peroxidase, glutathione levels of vitamins A and E. It is established that feeding calves at a dose of toxicant 0.04 mg/kg decreased glutathione, vitamin A and vitamin E, which is associated with increased activation of lipid peroxidation and the balance between antioxidant system and lipid peroxidation intensity. Given the cadmium load of young cattle it is used a new integrated drug with antioxidant action «Metisevit», which includes metifen, sodium selenite and vitamin E which is founded as stimulating effects on the activity of antioxidant protection. In particular, it is established probable increase in activity of catalase, superoxide dismutase, glutathione peroxidase, glutathione levels, vitamin A and vitamin E in the blood of young cattle, which has performed cadmium stress. These changes occur through comprehensive action components of the drug «Metisevit» that leads to the normalization of metabolic processes and free radical inactivation, as well as the normalization of antioxidant status of chronic cadmium toxicosis.

Key words: pharmacology, toxicology, bull, antioxidant system, the drug «Metisevit» reduced glutathione, vitamin E, vitamin A, catalase, superoxide dismutase, glutathione peroxidase.

Вплив препарату «Метісевіт» на активність ензимної та неензимної ланки антиоксидантного захисту організму бугайців за умов кадмієвого навантаження

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У статті наведено результати досліджень впливу хлориду кадмію на показники ензимної та неензимної систем антиоксидантного захисту у молодняку великої рогатої худоби, а саме на активність каталази, супероксиддисмутази, глутатіонпероксидази, рівень відновленого глутатіну, вітамінів А і Е. Встановлено, що згідно з вищезазначених показників даного токсину у дозі 0,04 мг/кг маси тіла активність каталази, супероксиддисмутази, глутатіонпероксидази, рівень відновленого глутатіну, вітамінів А і Е у крові досліджених тварин упродовж усього досліду знижувався. Найнижчий рівень показників системи антиоксидантного захисту у крові молодняку великої рогатої худоби встановлено на двадцять четверту добу досліду, що пов’язано із посиленням активації процесів ліпопероксидизації та порушенням рівноваги між активністю антиоксидантної системи та інтенсивністю перекисного окиснення ліпідів. За умов кадмієвого навантаження, молодняку великої рогатої худоби вплив препарату «Метісевіт» зумовлює стабілізацію активності антиоксидантних ферментів, а також збільшення вмісту глутатіну, а також вітамінів А і Е.

Citation:
Видно препарат «Метисевит» на активность ферментного и нефермен-
tного звена антиоксидантной защиты организма бычков в условиях кад-
мивой нагрузки

Б.В. Гутый, Ю.Ю. Лавришин, В.Я. Бинкевич, Е.М. Бинкевич, А.Р. Паладийчук, Ю.С. Стронский, И.И. Харив

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В статье приведены результаты исследований влияния хлорида кадмия на показатели ферментной и неферментной системы антиоксидантной защиты у молодняка крупного рогатого скота, а именно на активность каталазы, супероксиддисмутазы, глутатионпероксидазы, уровень восстановленного глутатиона, витамина Е и А. Установлено, что сарак
лизации бычкам данного точка веса в дозе 0,04 мг/кг массы тела активность каталазы, супероксиддисмутазы, глутатионпероксидазы, уровень восстановленного глутатiona, витамина В и Е в крови подопытных жи вотных в течение всего опыта снижался. Самый низкий уровень показателей системы антиоксидантной защиты в крови молодняка крупного рогатого скота установлен в двадцать четвертые сутки опыта, что связано с усилившей активацией процессов липо
оксидации и нарушенным равновесием между активностью антиоксидантной системы и интенсивностью перекисного окисления липидов. В условиях кадмивой нагрузки, молодняк крупного рогатого скота применял новый комплексный препарат с антиоксидантной активностью «Метисевит», в состав которого входит метилен, селен и витамин Е. Выявлено стимулирующее влияние препарата на активность антиоксидантной защиты. В частности, уста
новлено достоверное повышение активности каталазы, супероксиддисмутазы, глутатионпероксидазы, уровня восстановленного глутатиона, витамина А и витамина Е в крови молодняка крупного рогатого скота, которым осуществляли кад
мивую нагрузку. Указанные изменения происходят благодаря комплексному действию составляющих препарата «Метисе
вит», что приводит к нормализации метаболических и свободных радикальных процессов в организме бычков. Полученные результаты исследований указывают о антиоксидантном действии препарата «Метисевит» при применении его молод
няку крупного рогатого скота и обоснованности его введения с целью повышения антиоксидантного статуса организма при хроническом кадмивой нагрузке.

Ключевые слова: фармакология, токсикология, бычки, антиоксидантная система, препарат «Метисевит», восстановленный глутатион, витамина Е, витамина А, каталаза, супероксиддисмутаза, глутатионпероксидаза.

Introduction

Due to the intensive development of science and technology progress over the past decades the number of chemical compounds to which human and animal contact has increased significantly. Especially dangerous is pollution with heavy metals, at a high biological activity, particularly cadmium and its salts (Honskyy et al., 2001; Melnychuk et al., 2004; Gutyj, 2012).

Oxide and reduction reactions occupy an important role in the metabolic changes and their violation play an important and sometimes decisive role in the development of pathological processes. The processes of oxidation in the liver have very important role, where their participation is carried performing its basic body functions, including disposal of endo- and exotoxins. Toxic liver cadmium damages are accompanied by significant flow disturbances oxidative reactions that are characterized by some researches as «oxidative stress» (Honskyy et al., 2001; Gutyj, 2013).

Having established that during cadmium toxicity occurs enhance lipid peroxidation (Gutyj, 2013; Gutyj, 2015), we concluded that the action of cadmium to suppress excessive free radical reactions in animals, it is necessary to use drugs with a strong antioxidant effect that can inhibit processes of peroxide oxidation of lipids. With a large number of antioxidants in cadmium toxicosis bull, we studied the «Metishev» prophylactic effect. This drug blocks the free radicals and prevents the development of oxidation stress in animals.

The purpose of our research was to determine the effect of the drug «Metishev» on the level of enzyme and nonenzyme system of antioxidant defense of the body in conditions of chronic bull cadmium toxicity.

Material and methods

Research were carried on farm in village Ivanivtsi, Zhydachiv district, Lviv region with 10 bulls six months
of age, black and white breed that were formed into 2
groups (5 animals in each):

Group 1 – control (C), calves were fed with food
caesium chloride at a dose of 0.04 mg/kg body weight;

Group 2 – research (R), calves fed with food cadmium
chloride at a dose of 0.04 mg/kg body weight along with
«Metisevit» at a dose of 0.36 g/kg feed.

When conducting research we followed the rules
required when performing experiments on selection
zootechnical and animal analogues in groups, technology
procurement, use and accounting of consumed feed. The
diet of the animals was balanced in nutrients and minerals
that ensure their basic need for batteries.

Antioxidant drug «Metisevit» was developed at the
Department of Pharmacology and Toxicology Lviv
National Stepan Gzhytskyi University of Veterinary
Medicine and Biotechnology which incorporates contains
«Metifen», vitamin E and selenium. These components
enhance each other's action and promote a better balance
in the normalization of complex «System of antioxidant
defense ↔ Peroxidate oxidation of lipids».

The experiment lasted for 30 days. Blood for analysis
were taken from the jugular vein in the 1-, 8-, 16-, 24-,
and 30 th day of the experiment.

The activity of glutation peroxydase is determined by
V.V. Lemeshko and others (Lemeshko et al., 1985); kata-
lase activity (K.F. 1.1.1.6) – after the method of M.A.
Koroljuk (Koroljuk et al., 1988); the activity of
superoxide dismutatase (SOD) (K.F. 1.15.1.1) – after the
method (Chevari et al., 1985), reduced glutathione content
was determined by the method (Butler et al., 1982),
vitamins A and E were determined in blood plasma by
high performance liquid chromatography (Vlizlo et al.,
2012).

Results and discussion

Glutathione peroxidase (GP) – is an enzyme that
protects the body from oxidative damage. It catalyzes the
recovery and restoration of lipid peroxides hydrogen and
peroxide to water. In these reactions the enzyme oxidizes
glutathione. Furthermore, glutathione peroxidase takes
place in redox regulation of various metabolic processes.
Over 70% of GP is localized in the cytosol and 25 – 30% –
in the mitochondrial matrix (Gutyj, 2013).

From the data presented in Table 1 it is shown that
under conditions of chronic cadmium toxicity glutathione
peroxidase activity in blood serum in animal control
group on the first day of the experiment, has increased by
3% compared to the indices of blood taken prior after
feeding with cadmium chloride. The lowest enzyme
activity was on the twenty–fourth day of the experiment
and was 27.7 ± 1.24 nmol NADPH/min. to 1 mg of
protein. Subsequently, the research activity of the enzyme
gradually increased, and on the thirtieth day was 31.1 ±
1.20 nmol NADPH/min. to 1 mg of protein.

After applying metisevit in bulls experimental group
the activity of glutathione peroxidase increased, on the
eighth day, according to 16%. On the sixteenth day of the
experiment, the activity of the enzyme in the experimental
group of calves was 36.1 ± 1.25 nmol NADPH/min. to 1
mg of protein. Later, glutathione peroxidase activity
in blood serum of calves in experimental group continued to
rise, and on the twenty–fourth day of the experiment it
increased by 32%.

Table 1

<table>
<thead>
<tr>
<th>Time of blood tests (day)</th>
<th>Glutathione peroxidase (nmol NADPH / min per 1 mg of protein)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Groups of animals</td>
</tr>
<tr>
<td></td>
<td>control Pilot</td>
</tr>
<tr>
<td>The original size</td>
<td>36.6 ± 1.23</td>
</tr>
<tr>
<td>The first day</td>
<td>37.8 ± 1.21</td>
</tr>
<tr>
<td>The eighth day</td>
<td>31.0 ± 1.13</td>
</tr>
<tr>
<td>The sixteenth day</td>
<td>29.0 ± 1.15</td>
</tr>
<tr>
<td>The twenty–fourth day</td>
<td>27.7 ± 1.24</td>
</tr>
<tr>
<td>The thirtieth day</td>
<td>31.1 ± 1.20</td>
</tr>
</tbody>
</table>

Note: The degree of probability according the control group –p <0.05– *, p> 0.01 – **

Thus, normalization of glutathione peroxidase in
blood of calves after entering metisevit drew the first day,
and the highest enzyme activity is set to the twenty–fourth
and thirty–day of experiment.

Superoxide dysmutatase – is one of the key enzymes of
antiradical protection, which refers to the direct action of
antioxidants. This enzyme rutes superoxideradical to
peroxide, which is less toxic to the previous. Actually so
SOD plays a crucial role in the antioxidant protection of
almost all types of cells that are in contact with oxygen.
SOD is primarily in the mitochondrial matrix, the cytosol
and the cytoplasm (Gutyj, 2013).

For chronic cadmium toxicity in bulls on the first day
of the experiment the activity of superoxide dismutatase in
the serum of animals in the control group increased by
10% compared to the initial values. Later in patients bulls
enzyme activity began to decline according to the eighth
day of the experiment it was 0.52 ± 0.011 cu / Mg protein.
The low activity of the enzyme was on the twenty–fourth
day of the experiment, where a relatively initial value is
decreased by 35% (Table 2).

In the bull, which together with the investigational
toxin were fed drug «Metisevit», superoxide dysmutatase
activity increased throughout the experiment on the
values of the control group animals. On the eighth and
sixteenth day of the experiment enzyme activity in the
experimental group of animals was higher by 17 and 41%
relative values of the control group animals.
### Table 2

**Activity of superoxide dismutase in bulls' blood after feeding them with drug «Metisevit» for chronic cadmium toxicity; (М ± m, n = 5)**

<table>
<thead>
<tr>
<th>Time of blood tests (day)</th>
<th>Superoxide dismutase (u / mg protein)</th>
<th>Groups of animals</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>control group</td>
<td>research group</td>
</tr>
<tr>
<td>The original size</td>
<td>0,62 ± 0,012</td>
<td>0,63 ± 0,011</td>
</tr>
<tr>
<td>The first day</td>
<td>0,68 ± 0,014</td>
<td>0,67 ± 0,012</td>
</tr>
<tr>
<td>The eighth day</td>
<td>0,52 ± 0,011</td>
<td>0,61 ± 0,012**</td>
</tr>
<tr>
<td>The sixteenth day</td>
<td>0,44 ± 0,011</td>
<td>0,62 ± 0,010***</td>
</tr>
<tr>
<td>The twenty–fourth day</td>
<td>0,40 ± 0,010</td>
<td>0,63 ± 0,011**</td>
</tr>
<tr>
<td>The thirtieth day</td>
<td>0,46 ± 0,012</td>
<td>0,64 ± 0,013**</td>
</tr>
</tbody>
</table>

The action of SOD is associated with the action of catalase, if one enzyme increases, the other not, so it contribute to the formation of large amounts of free radicals and increased lipid peroxidation.

Catalase recovers hydrogen peroxide to water. To the active center of the enzyme is trivalent iron protoporphyrin, which interacts with hydrogen peroxide by catalase, or peroxidase mechanism, depending on the concentration of the substrate. The enzyme is found in all tissues at a concentration of 10^-6 M. Generally, the action of catalase is reduced to decrease the concentration of cytotoxic hydroxyl radicals. The highest catalase activity was found in the red blood cells, liver, kidneys. For high intensity formation of hydrogen peroxide in the body, he cleared catalase, and the low – glutatin antioxidant system (Gutyj, 2013).

So, catalase as the mechanism of action of antioxidant system defense refers to direct action. The activity of catalase in bull’s blood serum in conditions of chronic cadmium toxicity and exposure to the drug ”Metisevit” is shown in Table 3.

### Table 3

**The activity of catalase in blood after feeding bulls with drug «Metisevit» for chronic cadmium toxicity; (M±m, n = 5)**

<table>
<thead>
<tr>
<th>Time of blood tests (day)</th>
<th>Catalase (units)</th>
<th>Groups of animals</th>
<th>control group</th>
<th>research group</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>control group</td>
<td>research group</td>
</tr>
<tr>
<td>The original size</td>
<td>6,55 ± 0,12</td>
<td>6,54 ± 0,16</td>
<td></td>
<td></td>
</tr>
<tr>
<td>The first day</td>
<td>6,46 ± 0,13</td>
<td>6,51 ± 0,15</td>
<td></td>
<td></td>
</tr>
<tr>
<td>The eighth day</td>
<td>6,22 ± 0,12</td>
<td>6,52 ± 0,16*</td>
<td></td>
<td></td>
</tr>
<tr>
<td>The sixteenth day</td>
<td>5,75 ± 0,14</td>
<td>6,50 ± 0,15**</td>
<td></td>
<td></td>
</tr>
<tr>
<td>The twenty–fourth day</td>
<td>5,65 ± 0,11</td>
<td>6,51 ± 0,14**</td>
<td></td>
<td></td>
</tr>
<tr>
<td>The thirtieth day</td>
<td>5,93 ± 0,12</td>
<td>6,57 ± 0,12*</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

For chronic cadmium toxicity it was founded reduced activity of catalase in the blood of animals in the control group. The activity of this enzyme was decreased on the eighth day of the experiment to 5%, on the sixteenth day – 13% compared to the initial values.

On the twenty–fourth day of the experiment catalase activity in blood of animals which were fed with food cadmium chloride was low and accordingly was 5,65 ± 0,11 units. On the thirtieth day of experiment, the enzyme activity increased slightly, but remained at a low level.

The use of «Metisevit» contributed to the increase catalase activity in blood of experimental animals. On the eighth day of the experiment enzyme activity increased by 5% for the values of the control group animals. On the sixteenth day of the experiment catalase activity in experimental group amounted to 6,50 ± 0,15 units. On the twenty–fourth day of the experiment indicated in these animals likely increased activity of the enzyme on the values of the control group animals at 15% respectively. On the thirtieth day of the experiment catalase activity in the first experimental group ranged within physiological values.

Thus, the drug «Metisevit» contributed to increasing activity of catalase, superoxide dismutase and that in animals play an important role in lipid peroxidation.

Glutathione is a major component of glutation antioxidant defense system. It consists of three amino acids: glutamic, cysteine and glycine. Glutathione does not only protect cells from toxic compounds and free radicals, but also defines the status of intracellular redox environment. In addition, it increases the resistance of cells to the negative effects of stress factors and is involved in the removal of xenobiotics. Actually so, glutathione is a key element in antioxidant system because it is able to restore other antioxidants (Gutyj, 2013).

Table 4 shows the changes in the level of reduced glutathione in the blood of bulls in cadmium stress. As can be seen from the table data glutathione level at the beginning of the experiment was within the physiological norm values. After feeding with cadmium chloride content of reduced glutathione began to decline. The lowest indicator was on the twenty–fourth day of the experiment, which according to the original values it decreased by 8%.

<table>
<thead>
<tr>
<th>Time of blood tests (day)</th>
<th>Catalase (units)</th>
<th>Groups of animals</th>
<th>control group</th>
<th>research group</th>
</tr>
</thead>
<tbody>
<tr>
<td>The original size</td>
<td></td>
<td></td>
<td>control group</td>
<td>research group</td>
</tr>
<tr>
<td>The first day</td>
<td></td>
<td></td>
<td>control group</td>
<td>research group</td>
</tr>
<tr>
<td>The eighth day</td>
<td></td>
<td></td>
<td>control group</td>
<td>research group</td>
</tr>
<tr>
<td>The sixteenth day</td>
<td></td>
<td></td>
<td>control group</td>
<td>research group</td>
</tr>
<tr>
<td>The twenty–fourth day</td>
<td></td>
<td></td>
<td>control group</td>
<td>research group</td>
</tr>
<tr>
<td>The thirtieth day</td>
<td></td>
<td></td>
<td>control group</td>
<td>research group</td>
</tr>
</tbody>
</table>
The use of animal drug «Metisevit» contributed to raising the level of reduced glutathione in the blood of experimental animals on the eighth day of the experiment by 8%, on the sixteenth day – 12%. The most probable changes in the level of reduced glutathione in the experimental group of animals was founded on the twenty–fourth day of the experiment, in which the figure was 33,33 ± 0,65 mg%, and it was 13% greater than the value of the control group animals.

Equally important in antioxidant system include vitamin E, which protects cell membranes from attack of free radicals and reactive oxygen species. Its content in the blood of animals by chronic cadmium toxicity is shown in Table 5. Feeding toxicant above helped to reduce the content of vitamin E in the blood of animals throughout the experiment. So, on the eighth day of experiment vitamin content was 3,3 ± 0,11 mmol/l, which is lower to 20% compared to the initial values. On the sixteenth day of vitamin E studies continued to decline and relative quantities of blood taken at the beginning of the experiment, that is for feeding bulls with cadmium chloride, decreased to 24%, the twenty–fourth day of the experiment vitamin E decreased to 29%.

### Table 4

<table>
<thead>
<tr>
<th>Time of blood tests (day)</th>
<th>Groups of animals</th>
<th>Control group</th>
<th>Research group</th>
</tr>
</thead>
<tbody>
<tr>
<td>The original size</td>
<td></td>
<td>31,95 ± 0,58</td>
<td>33,14 ± 0,55</td>
</tr>
<tr>
<td>The first day</td>
<td></td>
<td>34,21 ± 0,62</td>
<td>33,38 ± 0,75</td>
</tr>
<tr>
<td>The eighth day</td>
<td></td>
<td>30,99 ± 0,60</td>
<td>33,55 ± 0,76*</td>
</tr>
<tr>
<td>The sixteenth day</td>
<td></td>
<td>29,95 ± 0,65</td>
<td>33,61 ± 0,55*</td>
</tr>
<tr>
<td>The twenty–fourth day</td>
<td></td>
<td>29,49 ± 0,65</td>
<td>33,33 ± 0,65**</td>
</tr>
<tr>
<td>The thirtieth day</td>
<td></td>
<td>30,25 ± 0,65</td>
<td>33,30 ± 0,50*</td>
</tr>
</tbody>
</table>

The applying of the drug «Metisevit» made the rising of vitamins, that were investigated in the blood of experimental animals feeding with toxicants. On the eighth day of the experiment it was founded increased content of vitamin E relative values of the control group of animals in research of blood by 45% respectively. Most likely increase vitamin was founded on the twenty–fourth day of the experiment.

We demonstrated that after the development of chronic cadmium toxicity in young cattle, vitamin A in their blood decreases. As can be seen from the data in Table 6, vitamin A after feeding with cadmium chloride began to fall on the first day to 4%, on the eighth day – 12%, on the sixteenth day – 16%, on the twenty–fourth day of the experiment – 27% relative initial values.

The use of experimental animals the drug of «Metisevit» boosted vitamin A in the blood of bulls under conditions of cadmium loading. Since the first day of the experiment we founded a gradual increase in the content of vitamin A in the blood of experimental animals Ratios control group of animals. On the sixteenth and twenty–fourth day of the experiment vitamin A increased by 28 and 40% compared to the control group of animals.

### Table 5

<table>
<thead>
<tr>
<th>Time of blood tests (day)</th>
<th>Groups of animals</th>
<th>control group</th>
<th>research group</th>
</tr>
</thead>
<tbody>
<tr>
<td>The original size</td>
<td></td>
<td>4,1 ± 0,11</td>
<td>4,1 ± 0,12</td>
</tr>
<tr>
<td>The first day</td>
<td></td>
<td>3,8 ± 0,14</td>
<td>4,7 ± 0,10**</td>
</tr>
<tr>
<td>The eighth day</td>
<td></td>
<td>3,3 ± 0,11</td>
<td>4,8 ± 0,15**</td>
</tr>
<tr>
<td>The sixteenth day</td>
<td></td>
<td>3,1 ± 0,11</td>
<td>4,9 ± 0,12**</td>
</tr>
<tr>
<td>The twenty–fourth day</td>
<td></td>
<td>2,9 ± 0,12</td>
<td>4,8 ± 0,13**</td>
</tr>
<tr>
<td>The thirtieth day</td>
<td></td>
<td>3,1 ± 0,13</td>
<td>4,5 ± 0,12**</td>
</tr>
</tbody>
</table>

### Table 6

<table>
<thead>
<tr>
<th>Time of blood tests (day)</th>
<th>Groups of animals</th>
<th>control group</th>
<th>research group</th>
</tr>
</thead>
<tbody>
<tr>
<td>Start value</td>
<td></td>
<td>0,81 ± 0,030</td>
<td>0,82 ± 0,031</td>
</tr>
<tr>
<td>The first day</td>
<td></td>
<td>0,78 ± 0,018</td>
<td>0,82 ± 0,035*</td>
</tr>
<tr>
<td>The eighth day</td>
<td></td>
<td>0,71 ± 0,018</td>
<td>0,84 ± 0,035**</td>
</tr>
<tr>
<td>The sixteenth day</td>
<td></td>
<td>0,67 ± 0,014</td>
<td>0,86 ± 0,029**</td>
</tr>
<tr>
<td>The twenty–fourth day</td>
<td></td>
<td>0,59 ± 0,014</td>
<td>0,85 ± 0,030**</td>
</tr>
<tr>
<td>The thirtieth day</td>
<td></td>
<td>0,65 ± 0,018</td>
<td>0,84 ± 0,025**</td>
</tr>
</tbody>
</table>
Thus, the applying of drug «Metisevit» for bulls who were under cadmium stress were contributed to the increase of antioxidants in nonenzyme system of antioxidation defense, such as vitamin A and vitamin E.

Overall, we received the research results indicating that feeding of bulls with drug «Metisevit» positively influences the antioxidant defense system in their body.

Conclusions

1. When feeding bulls with cadmium chloride at a dose of 0.04 mg/kg body weight and level indicators of nonenzyme and enzyme systems of antioxidant defense in the blood of experimental bulls decreased throughout the experiment. The lowest level of indexes in antioxidant system installed on the twenty fourth day of the experiment, which deals with enhanced activation of lipid peroxidation and the imbalance between the activity of antioxidant system and lipid peroxidation intensity.

2. The drug «Metisevit» in cadmium stress activates the enzyme and nonenzyme system of antioxidant defense system in bull's body, as it is indicated by increased activity of glutathione peroxidase, catalase, superoxide dismutase and glutathione increase of vitamins A and E in the blood of animals. Addition of «Metisevit» in feeding prevents the oxidation stress, that cause peroxide damages in cell membranes and the intracellular biopolymers.

Prospects for further researches. The results of research will be applied in subsequently studies of antioxidant defense and processes of lipid peroxidation in the blood of the bull to develop antidote drug for the treatment of animals in cadmium toxicosis.

References


Methods of determining the level of glutathione in repairing the red blood cells: guidelines for the differential diagnosis of various forms of ischemic heart disease using the definition of the components of glutathione, protivoperekisnoy catalyzed system eritrotsitah blood. Odessa, 16–20 (in Russian).


