Dynamics of chemiluminescent characteristics of blood of workers of phosphorous plant depending on individual sensitivity to yellow phosphorous under the influence of liquorice herbal pharmaceutical product

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Abstract: Research has been carried out at occupational pathology department of South-Kazakhstan branch of scientific centre of occupational hygiene and occupational diseases of No.2 clinic of Taraz city. 72 probationary male employees of basic occupations with 5-10 years of employment length from Dzhambyl phosphorous plant and 148 phosphorous intoxicated people have been examined. Chemiluminescent research technique has been applied. Research demonstrated that condition of chemiluminescent parameters of blood hemolysate of phosphorous plant employees depends on individual sensitivity to xenobiotic and reduction of chemiluminescent indicator under the influence of bioslastiline depends on the terms of biologically active additive administration.
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1. Introduction

Modern phosphorous production is the large branch of chemical industry. Production of yellow phosphorous (YP) connected with electrochemical processing of phosphoric ore and release of yellow phosphorous, phosphine, phosphoric anhydride vapours to atmosphere. There is a possibility of significant increase of gas and aerosols concentration at working place, which exceeds permissible exposure limit several times, due to peculiarities of furnaces design and type of technological process (Kozlovskyi, 1985; Atchabarov et al, 1983).

Minimal lethal dose of YP for human is 1 mg/kg; and minimal intoxication dose is 0,3 mg/kg.

Phosphorus is one of the protoplasmatic poisons, which causes involvement of heart, liver, kidneys (Brent et al, 2005).

Acute liver failure, coagulopathy and liver dysfunction have been revealed in some of the patients (Fernandez and Canizares, 1995). In addition, acute tubular necrosis with acute liver failure have been revealed in other patients. There were also changes of central nervous system, such as consciousness confusion, psychosis, hallucinations and coma. Cardiac dysfunctions included hypotension, tachycardia and cardiogenic shock (Talley et al, 1972). N. Ormanov and other researches (Pernebekova et al, 2013) analysed problems of therapy methods in case of heart intoxication by phosphorous compounds and isadrine. In addition, N. Ormanov and D. Adilbekova (Ormanov and Adilbekova, 2011) have analysed oxidative homeostasis and phosphorous pathology.

Occupational pathology within production of YP is chronic intoxication by phosphorous compounds (CIPC) and by its non-organic compounds (Dauletbekova et al, 1991).

N. Ormanov (Ormanov, 1990) suggests analysing indicators of non-specific body resistance for evaluation of intoxication level. M. Zelzer, T. Kostenko (Zelzer et al, 1991) recommend to analyse the content of 17-Ketosteroids in daily urine for early detection of CIPC, substantiating this by hypocorticoidism associated with CIPC.

Meanwhile, it is well known fact, that hypofunction of pituitary-adrenal system is not so rare, if it is connected with other pathologies, and at the same time, it is laborious research.

CIPC is multi-syndrome body disease, which is characterized by polymorphous and dynamic clinical presentation; pathological changes of the body are increasing due to accumulation of phosphorous exposure time. In some cases, the disease tends to progress after interruption of interaction with phosphorous.

It is necessary to pay attention to the fact that during the treatment of CIPC diseased patients, the basic characteristics of treatment means and methods have to be defined by dominating set of involvement symptoms of particular body system. Domination of toxic hepatitis in clinic of chronic phosphorous intoxication creates the necessity of paying attention to the therapy of negatively affected liver within treatment of CIPC diseased patients.

Therefore, the basic occupational pathology within production of YP is the damage of

abovementioned organs and body systems, and particularly liver. Treatment of this pathology is the problem, which is not totally solved. Most of the medicinal products, which have been used, affects only symptoms of disease. Considering the leading role of pro-oxidant – anti-oxidant system damage in pathogenesis of phosphorous intoxication, which leads to imbalance of this system, then the influence of domestic medicinal products on pathobiochemical processes, taking into account sensitivity to xenobiotic, has not been fully studied.

Providing high-efficient and safe medicinal products for reasonable price to the population is the top priority task of medicinal product provision strategy of the country and it is possible due to maximal usage of local natural raw resources. Now more than 40% of contemporary medicinal products, which are used in modern medical practice, are the herbal medicinal products and one of the most widely used among them is liquorice (Glycyrrhiza). Rich natural resources, high content of active ingredients and availability of this unique herb attracted attention of scientists for many years. Further research and searching of new biologically active products of the liquorice, which is very valuable and advanced source for obtaining of medicinal products, is actual approach nowadays (Praliyev et al, 2003). Basic medical properties of liquorice are determined by glycyrrhizic acid and its aglycone – glycyrrhetic acid. These glycosides and its different derivatives have the wide range of bioactivity (Gibson, 1978; Norman et al, 1995).

Glycyrrhizin is the basic bioactive compound of liquorice earthnut (liquorice root), which possesses the wide range of pharmacological properties and used all over the world as the natural sweetener. Biosynthesis process, performed by glycyrrhizin, has considerable importance, because of its economic value (2013).

It is widely used in tobacco, food, confectionary and also in pharmaceutical industry (Baker, 1995).

Chemical composition of liquorice root extract is the following: roots and rootstock of liquorice contain 15% of glycyrrhizic-potassium salt and calcic salt of glycyrrhizic acid. Roots also contain flavonoids (liquiritine, liquiritozide and others), starch, sucrose, glucose, mannitol, slime, gum resin, ascorbic acid.

Medicinal products, based on Urals liquorice and Amur cork tree, have been tested for the first time with the aim of wound healing effect of different animal specimen. (Korotkova, 2003)

Liquorice can be used for wounds healing due to wound healing effect (Seksenbaev et al, 2013)

Bioslastiline is dry refined extract of liquorice root which contains 80% content of glycyrrhizic acid and around 20% of other bioactive substances (components of liquorice root). It is used as biological compound in food and perfume-cosmetic industry. Dry extract of liquorice root (ELR) in amount of 487,5 mg and bioslastiline in amount of 100 mg was dosed to workers once a day during 10-14-20 days in dependence of sensitivity to YP (Ormanov and Adilbekova, 2011).

There is supporting data (Kuanyshbekova et al, 2007) of bioslastiline application as the antioxidant, which increases the resistance of the body that helps to save hemispheric asymmetry of amines content. Obtained data demonstrates positive effect of application of bioactive substances in adverse conditions of external and endogenic origin. Presumably, effect of antioxidant application is determined by reduction of activity of free-radical acidification in neurons, which comes along with lots of pathological and age-related changes in tissues.

Employees of “Institute of chemical sciences named after A. Bekturov” JSC (“ICS” JSC) have developed effective extractive method of sum of native salts of triterpenic acids extraction with optimal chosen composition of solvents, which allowed to increase the extraction rate up to 95-97% of its content in the root and to get the dry extract, i.e. bioslastiline with the content of glycyrrhizic acid of not less than 75-80%. Experimental-industrial procedure of bioslastiline medicinal product was developed and approved on the basis of technology, which was developed at “Chimpharm” JSC (Irismetov et al, 1997).

Original medicinal products based on the liquorice root were created and implemented into medicinal practice: bioslastiline with high content of glycyrrhetinic acid (not less than 80%) (Arystanova, 2001).

According to some data (Zhakipbekova, 1999), bioslastiline has had distinct antiradical impact on free-radical processes within acute phosphorus intoxication.

The goal of research is investigation of chemiluminescent characteristics of blood of workers of phosphorous plant depending on individual sensitivity to yellow phosphorous under the influence of liquorice herbal medicinal product.

2. Material and Methods

In opinion of A. Zhuravlev (Zhuravlev, 1965), the chemiluminescent method is the intrinsic indicator of free-radical oxidative processes flow and activity of bioantioxidative systems of the body. Changing of chemiluminescence (ChL) parameters of biological mediums of the body gives the opportunity of quantitative description of kinetics of free-radical reactions, that is difficult to make with the help of the

other methods. 10-20 minutes is necessary to measure one ChL sample of hemolysate, and this fact has also been considered while choosing the method.

Blood is extracted from patients' finger (under fasting condition of the patients and in the morning) in amount of 0,1 ml and 1 ml in order to carry-out the analysis and then this blood with distilled water has been placed into device for ChL hemolysate.

Fluorescence research has been carried out in "Chemiluminometer ChLMZ - 01" device, which was developed in Radio-technical Institute of Kiev. New PMT-130 photomultiplier ("Quanton" type, England), which has from 300 up to 650 nm sensitivity, has been used as the detector of super-weak fluorescence.

Spontaneous fluorescence of hemolysate has been defined at first stage and then the intensivity of ChL induced by hydrogen dioxide has been defined also. 0,5 ml of 3% hydrogen dioxide solution has been added into the flask through special input for this purpose. After that, the definitive kinetics of fluorescence has been observed. It has been registered with the help of MAR-4 (monitoring automatic-recording) device. Ambient temperature during the experiment has been 37°C. The basic characteristics of researched process of ChL have been the intensity of spontaneous fluorescence and the induced fluorescence. Obtained results have been represented in imp./sec for spontaneous fluorescence and thousands of imp./5 min (total light sum) – for induced one.

Chemiluminescent indicator of intoxication (CLII) has been defined in accordance with the following formula (1) (Adilbekova and Ormanov, 2008):

$$CLII = \frac{\frac{SF_d}{SF_c} + \frac{IndF_d}{IndF_c} + \frac{ASPRF_d}{ASPRF_c}}{3} \quad (1)$$

Being SF – spontaneous fluorescence;

IndFL – induced fluorescence;

ASPRF - average speed of peroxy radicals formation;

d - diseased patients;

c – control.

Individual sensitivity of the body to YP has been defined with the help of chemiluminescence method, developed by N. Ormanov (Adilbekova and Ormanov, 2008).

Identification method: 1% of YP water suspension is prepared preliminary. For this purpose, 1,0 of YP has been placed into 99 ml of distilled water and treated by ultrasound during 10 min at 22 kHz. UZDN-1 (radiant power: 400 watt) device has been used for ultrasound creation.

Blood has been taken from median cubital vein in amount of 1,0-1,2 ml. Then it has been shared in two parts. 0,01 ml 10^{-3} M of YP water suspension has been added to one part, and 0,01 ml of tris-HCL buffer at pH=6,8 has been added to the other part. Then these samples have been placed into thermostat for 30 minutes at T°-37°C. After that both samples have been centrifuged at 1500 rpm adding 0,01 ml of heparine. Then 0,4-0,5 ml of blood plasm has been obtained. Samples have been placed into chemiluminometer ChLMZ-01. Provocation has been performed by 0,5 ml of 3% hydrogen dioxide solution. Sample with phosphorous has been the "check sample" and the other one has been the "control sample". Initiation has been performed by H_2O_2 – luminol system. Total light sum during 5 minutes has been defined.

It was reasonable for the convenience of the comparison to express results as sensitivity coefficient (C_s), which shows the difference of ratio of check sample to the control one according to the following formula (2) (Adilbekova and Ormanov, 2008):

$$C_s = \frac{Light\ sum\ of\ plasma\ with\ phosphorus}{Ligt\ sum\ of\ plasma\ without\ phosphorous},\ relative\ unitet \quad (2)$$

Research has been carried out at occupational pathology department of South-Kazakhstan branch of scientific centre of occupational hygiene and occupational diseases No.2 clinic of Taraz city. 72 probationary male employees of basic occupations with 5-10 years of employment length from Dzhambyl phosphorous plant and 148 CIPC diseased people have been examined. Subdivision of 72 probationary employees and 148 CIPC diseased people is represented in the table in dependence of sensitivity of the body to YP. According to the table 1, the biggest quantity of CIPC diseased patients have been were very sensitive to YP people (59,5%) and the lowest quantity - have been the "very sensitive" (18,2). Sensitivity coefficient of the phosphorous plant workers to YP is different from coefficient of CIPC diseased people, however ChL parameters of "resistant", "sensitive" and "very sensitive" in both groups (workers and diseased) are measured in parallel (table 1).

Table 1 – Subdivision of phosphorous plant workers and CIPC diseased people depending on sensitivity of the body to YP.

	Absol. / value	in %	Sensitivity coefficient	Limit of fluctuation
1 Workers				
1.1 Resistant	24	33,4	0,86±0,22	0,7÷1,10
1.2 Sensitive	24	33,4	1,24±0,06	1,11÷1,30
1.3 Very sensitive	24	33,4	1,48±0,07	1,31÷1,80
Total	72	100	1,19±0,09	0,7÷1,80
2 CIPC diseased				
2.1 Resistant	33	22,3	2,13±0,23	0,83÷3,5
2.2 Sensitive	88	59,5	5,68±0,37	3,51÷7,5
2.3 Very sensitive	27	18,2	13,72±1,09	7,51÷16,7
Total	148	100	6,35±0,51	0,83÷16,7

In order to accomplish determined tasks, after identification of individual sensitivity to YP of 72 observed workers, which were divided into 3 groups, i.e. 24 "resistant" to YP, 24 – "sensitive", 24 – "very sensitive" to YP. 12 people of each group took liquorice root extract (LRE); 12 – bioslastiline (BS), 100 mg once a day. 148 diseased people with CIPC determined diagnosis were examined, including 33 "resistant" to YP, 88 – "sensitive", 27 – "very sensitive" to YP people diseased by CIPC. Length of disease is from 1 up to 5 years.

3. Results and discussion:

In case of using the BS herbal medicinal product made of liquorice root for preventive measures, the literature data regarding hepatoprotective and antioxidant properties of this medicinal product have been considered within influence of different toxic agents in experiment. In accordance with the goal of this research study, we have carried out comparative analysis of chemiluminescence parameters (ChLP) of the workers' blood under the influence of dry LRE and BS depending on sensitivity of the body to xenobiotic.

Activation of lipid peroxidation (LPO) refers to xenobiotic "Resistant" workers. This fact is proved by increased results of spontaneous fluorescence (SF), which are 52% higher in comparison with control group. Also it is proved by 1,66 times increased induced fluorescence (IndFL). The similar dynamics is used while defining the average speed of peroxy radical formation (ASPRF) in blood hemolysate. Chemiluminescent indicator of intoxication (CLII) has been increased in 1,52 times.

ChLP of blood hemolysate of "resistant" workers has been decreased after prophylactic application of LRE in comparison with baseline result, particularly spontaneous ChL decreased by 16,3%, induced super-weak fluorescence decreased by 17.3%. There is the same dynamics for defining of ASPRF. CLII has been decreased by 50,3% in comparison with baseline result.

Workers, who are "sensitive" to xenobiotic, has 2,26 times increased results of spontaneous fluorescence in comparison with control group, and induced fluorescence is higher by 149,1%. CLII is higher by 126% in comparison with control group (table 2).

ChLP of blood hemolysate of "sensitive" workers have been decreased after LRE administration in comparison with baseline result, particularly the spontaneous ChL has been decreased by 19%, induced super-weak fluorescence has been decreased by 17,2%. The same dynamics is traced in case of defining of ASPRF. CLII has been decreased by 16,3%. ChLP of blood hemolysate of "sensitive" workers have been decreased after 10 days of BS administration in comparison with baseline result, particularly, spontaneous ChL has been decreased by 50%, induced super-weak fluorescence – by 51,8%. CLII has been decreased by 50%.

"Very sensitive" to xenobiotic workers have more evident LPO activation. This is proved by increased in 3,56 times spontaneous fluorescence results in comparison with control group, and also increasing of induced fluorescence by 395,3% in comparison with control group.

There is the same dynamics within definition of ASPRF in blood hemolysate. CLII is higher in 4,57 times in comparison with control group.

ChLP of blood hemolysate of "very sensitive" phosphorus plant workers after 10 days of prophylactic application of LRE have decreased in comparison with baseline result, particularly spontaneous ChL decreased by 19%, induced super-weak fluorescence decreased by 9,9%. CLII has decreased by 19,2%. ChLP of blood hemolysate of "very sensitive" workers have decreased in comparison with baseline result after 10 days of bioslastiline administration, particularly spontaneous ChL has decreased by 40,9%, induced super-weak

fluorescence – by 40,2%. CLII has decreased by 41,1% in comparison with baseline result.

ChLP of blood hemolysate of "very sensitive" phosphorous plant workers have been increased by 169,6%, 196,3% and 182% in comparison with the result of "resistant" groups after 10 days of administration of BS medicinal product made of liquorice root.

Obtained data shows that BS shows positive effect at LPO processes in comparison with LRE, and ChL of blood hemolysate parameters decreasing proves this fact. Inhibitive effect is more expressed in administration of BS by workers, who are "resistant" to YP. ChLP of hemolysate of "sensitive" and "very sensitive" workers remain increased more than 1,2 – 2,9 times after 10 days administration of BS.

Table 2 - Changing of chemiluminescence parameters of blood hemolysate of phosphorous plant workers under the influence of LRE and BS.

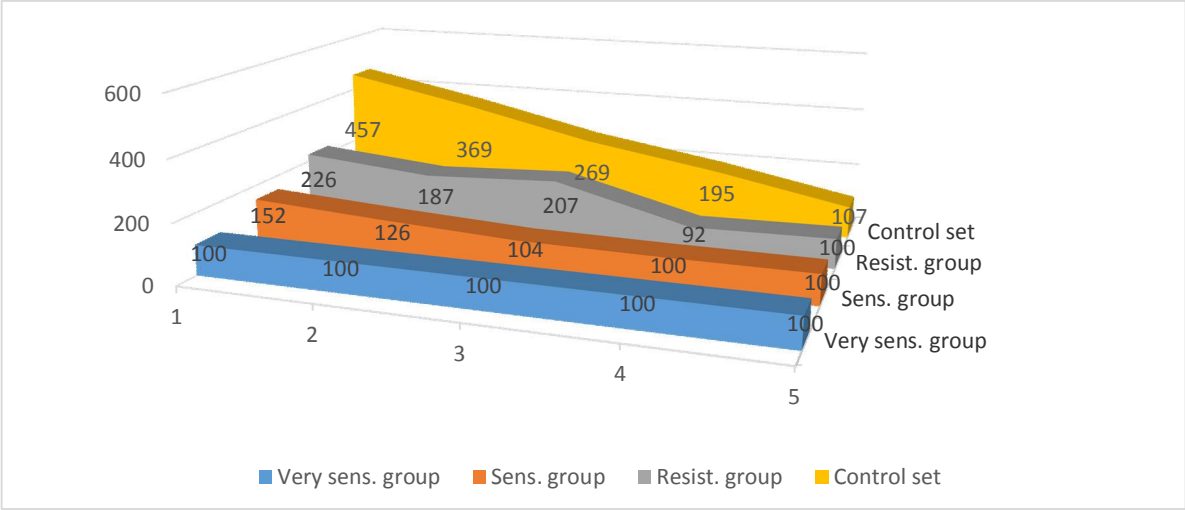
Groups		ChL parameters of blood hemolysate			
		SF (quant/sec)	IndFL (10^3 quant)	ASPRF (quant /sec)	CLII (stand. unit)*
Control group		2,3±0,03	21,2±1,2	70,3±4,2	1,0±0,05
Resistant	1	3,5 ± 0,17*	35,2 ± 1,8*	117 ± 7,0*	1,52 ± 0,05*
	2	2,9 ± 0,04*	29,1 ± 1,4*	97 ± 5,1*	1,26 ± 0,02*
	3	2,4 ± 0,12	21,3 ± 1,2	71 ± 4,7	1,04 ± 0,03
Sensitive	1	5,2 ± 0,26*	52,8 ± 28*	176 ± 9,6*	2,26 ± 0,08*
	2	4,3± 0,31*	44,1 ± 3,1*	147,3 ± 9,3*	1,87 ± 0,09*
	3	2,6 ± 0,13*	25,6 ± 1,4*	86,3 ± 5,1*	1,13 ± 0,07*
	4	2,1 ±0,07	20,8±0,82	69,3±2,7	0,92±0,05
Very sensitive	1	10,5 ± 0,44*	105,0 ± 5,4	350 ± 17,5	4,57 ± 0,21*
	2	8,5 ± 0,78*	94,6 ± 7,8*	315,3 ± 14,9*	3,69 ± 0,13*
	3	6,2 ± 0,37*	62,8 ± 3,6*	207,4± 12,4*	2,83 ± 0,12*
	4	4,2±0,21*	44,3±2,6*	147,6± 7,3 *	1,95± 0,09*
	5	2,4±0,11	23,4±1,6	78,6±4,6	1,07±0,07

Comment
1 – baseline indicator
2 – after administration of LRE
3 – after administration of bioslastiline over a period of 10 days;
4 – after administration of bioslastiline over a period of 14 days;
5 – after administration of bioslastiline over a period of 20 days;
6 - * $p<0,05$ – confidence factor in comparison with control group.

Administration of BS over a period of 14 days for preventive measures decreases ChLP of blood hemolysate of "sensitive" workers by 19,2%, 18,7% and 19,7% in comparison with results of 10 days administration and achieves the result of control group, and for "very sensitive" to YP workers this figures are decreased by 32,2%, 29,4% and 28,8%. However, the results remain increased by 82,6%, 109% and 110% in comparison with results of control group. ChLP of hemolysate of "very sensitive" to xenobiotic workers has been reduced after 20 days of boislastilin administration in comparison with the result of 14 days administration, particularly SF was reduced by 42,8%, induced super-weak fluorescence was decreased by 47,1%. There is such dynamics within ASPRF determination. CLII has been reduced by 45,1% and achieves the result of control group.

ChLP of blood hemolysate of "resistant" workers is lower than of "very sensitive" workers, and under the influence of bioslastiline, i.e. liquorice root medicinal product, "sensitive" to YP workers have significant reduction after 14 days administration and "very sensitive" workers have the same effect after 20 days of bioslastiline administration.

Therefore, this research has demonstrated that condition of ChLP of blood hemolysate of phosphorus plant workers depends on individual sensitivity to xenobiotic and reducing of CLII under the influence of BS depends on terms of biological active supplement administration (see picture below).



Comment: before medicinal products administration; 2 – after 10 days administration of LRE; 3 – after 10 days of BS administration; 4 – after 14 days of BS administration; 5 – after 20 days of bioslastiline administration.

Picture - Dynamics of CLII of blood of phosphorus plant workers depending on sensitivity to xenobiotic under the influence of bioslastiline

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References

1. Kozlovskyi V.A. Workplace hygiene in modern phosphorous industry. Author's abstract Dr.scient.med. M., 1985; 35.
2. Atchabarov B.A., Beloskurskaya G.I., Aitbembetov B.N., Berdykhodzhin M.T. Occupational diseases, caused by exposure of phosphorous and its compounds. Manual for occupational diseases. M.: Medicine, 1983; (1): 290-295.
3. Brent J., Wallace K.L., Burkhart K.K. Phosphorus. In: J. Brent, K. Wallace, K. Burkhart, S. Phillips, J. Donovan, editors. Critical Care Toxicology – Diagnosis and Management of the Critically Poisoned Patient. Elsevier Mosby. Philadelphia, PA. 2005; 851-61.
4. Fernandez O.U., Canizares L.L. Acute hepatotoxicity from ingestion of yellow phosphorus-containing fireworks. J Clin Gastroenterol. 1995; (21): 139-42.
5. Talley R.C., Linhurt J.W., Trevino A.J. Acute elemental phosphorus poisoning in man: Cardiovascular toxicity. Am Heart J. 1972; (84): 139-140.
6. Pernebekova R.K, Ormanov N.Z., Shingisbayeva Z.A., Sikhynbayeva Z.S. Modern problems of methods of therapy in case of heart intoxication by phosphorus and isoproterenol compounds. Material IX Miedzynaradowey Naukowi-Praktyczney Konferencji "Strategiczne Pytania Swiatowej Nauki-2013" Przemysl, 2013; (23): 69-74.
7. Pernebekova R.K, Ormanov N.Z., Sikhynbayeva Z.S., Dzhakipbekova N.O., Shingisbayeva Z.A. Modern problems of methods of therapy in case of heart intoxication by phosphorus and isoproterenol compounds. Searching. 2013; 1(2): 263-267.
8. Ormanov N.Z., Adilbekova D.A. Oxidative homeostasis and phosphorus pathology. Shymkent, 2011; 120.

9. Dauletbekova M.I., Ormanov N.Z., Berdykhodzhin M.T. and others. Chronic intoxication by phosphorus compounds (pathogenesis, clinics, diagnostics and employability expertize issues). Guidelines. Almaty, 1991; 22.
10. Ormanov N.Z. Defining methods of professional suitability of people for operation in conditions of yellow phosphorus activity. Copyright certificate of USSR No. 1628701 dated October 15, 1990.
11. Zelzer M.E., Kostenko T.F., Kulkybayev G.A. Condition of endocrine system in conditions of chronic phosphorus intoxication. In the book: Workplace hygiene and occupational pathology within phosphorus industry and its non-organic compounds. Almaty, 1991; 90-99.
12. Praliyev K.D., Dzhiyembayev B.Z., Irismetov M.P., Baramysova G.T. Development, creation and implementation of new, original, home-produced medicinal products made of synthetic and herbal raw material of Kazakhstan. Chemical magazine of Kazakhstan. 2003; (1): 12-26.
13. Gibson M.R. Glycyrrhiza in old and new perspectives. J at Prod. 1978; (41): 348-354.
14. Norman H.A., Pillai P., Baker M.E. Licorice derived compounds inhibit linoleic acid desaturation in soybean chloroplasts. FEBS Letters. 1995; (368): 135-138.
15. Assessment report on Glycyrrhiza glabra L. and/or Glycyrrhiza inflate Bat. and/or Glycyrrhiza uralensis Fisch., radix. European Medicines Agency. 2013: 1-40.
16. Baker M.E. Endocrine activity of plant derived compounds: an evolutionary perspective. Proc. Soc. Exp Biol. Med. 1995; (208): 131-138.
17. Korotkova I.P. Morphofunctional evaluation of wound healing within application of Urals liquorice and Amur cork tree: Thesis work. PhD of Veterinary Science. Blagoveshchensk: Ussuriysk, 2003; 33.
18. Seksenbaev B., Nurmashev B., Yessirkepov M., Burabaev A., Mukanova U. The Treatment of Wounds by Device Method in the Experiment. Life Science J, 2013; 10 (3): 1135-1137.
19. Kuanyshbekova G.A., Kapysheva U.N., Kolbai I.S. Medical sciences. 2007; (2): 15-20.
20. Irismetov M.P., B. Dzhiyembayev B.Z., Praliyev K.D. Patent right 5463 of Republic of Kazakhstan. Method for the production of dry liquorice extract – bioslastiline. 1997; (5): 9.
21. Arystanova T.P. Standardization of medicinal products of liquorice root. Shymkent, 2001:161.
22. Zhakipbekova G.S. Influence of bioslastiline onto chemiluminiscent properties of bioobjects in case of acute phosphorus intoxication. Bulletin of South-Kazakhstan Medical Academy. 1999; (2): 104-107.
23. Zhuravlev A.I. Bioluminescence problems. Bioluminescence. M.: Science, 1965; (21): 184-192.
24. Adilbekova D.A., Ormanov N.Z. Determination method of individual sensibility of the body to the yellow phosphorus. Provisional patent No. 20447. Astana, 2008; (12): 1-5.

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