

COMPARATIVE ESTIMATION OF TWO METHODOLOGICAL APPROACHES, USED AT THE HYGIENIC REGULATION OF THE CHEMICAL SUBSTANCES OF ATMOSPHERIC POLLUTIONS, TAKING INTO ACCOUNT OF THE COMBINED ACTION

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In this report there have been presented results of experimental researches on study of resorptive effect of binary mixes of formaldehyde and lead acetate by two methods of dependence of "concentration-time-effect" and dependence of "concentration – effect". It was established that at combined presence of formaldehyde and lead acetate in the atmospheric air the character of the combined action at a level of small concentrations meeting in the atmospheric air occurs by type "incomplete summation", coefficient of combined effect (CCE) is equal to 1,36.

The comparative estimation of CCE on the basis of short-term experiments "concentration – time - effect" and on the basis of long 4-month experiments "concentration - effect" has allowed to establish coincide of values of CCE. However the method of dependence of "concentration - time-effect" appeared to be more acceptable in relation to cost of experiment, time of experiment performance, than "concentration-effect" and facilitate more than 2-3 time, more economic.

The method of dependence "concentration – time - effect" allows to receive the functional interconnected wide arsenal of toxicometric parameters that contributed to further development of science in the field of a hygienic regulation of chemical pollution of atmospheric air taking into account of combined complex effect; to establishment of isoeffective concentration (dozes); to estimation of risk factors of health.

Key words: atmospheric air, pollution, hygienic reglamentation, formaldehyde, lead acetate, coefficient of combined effect (CCE), incomplete summation,

Introduction

The estimation of the quality of atmospheric air, water of reservoirs, underground waters, soil, plants, foodstuff in the industrial regions, territorial industrial complexes, and cities and in relation to the risk for health of the population of chemical components is one of the main and primary tasks for today [9]. For the prevention and elimination of negative consequences of pollution of the ambient air of cities and populated areas it is necessary to perform the complex scientific researches directed to study of real pollution of atmospheric air of any concrete district, establishment of the real risk degree, estimation of biological action, development of scientifically confirmed measures. Therefore the accepted improving and preventive measures should ensure the hygienic specifications: State standards, Sanitary norms and rules with criteria for quality of atmospheric air in accordance with the law of the Republic of Uzbekistan " About

atmospheric air, 1992, Law of the Republic of Uzbekistan", "About sanitary well-being of the population, 2015".

The maximum permissible concentrations (MPC) of the pollutants in the atmospheric air is the maximal concentration without rendering of direct and indirect unfavorable effect on the human health during his life and on his subsequent generations, not lowering working activity and not worsening his well-being as well as household sanitary conditions of life.

At the same time the rates of a hygienic regulation of harmful substances in the atmospheric air is greatly behind the practice.

For the accelerated regulation of harmful substances in the atmospheric air it is offered to use a method developed in the Scientific Research Institute of human ecology and environment hygiene after A.N.Cicin based on the dependence of "concentration-time-effect" [2,5,7,8]. However literature data concerning an opportunity of application of "concentration – time-effect" for the resolving of tasks for an estimation of toxicometric parameters of harmful substances and substantiation of their MPC are different [4, 10]. The specified considerations as well as because of insufficient knowledge about dependence of "concentration-time-effect" on the mix of combined substances [3] the realization of special experimental researches for finding out of an opportunity of its use is necessary at the accelerated measurement of maximum allowable concentrations of the complex mixes in the atmospheric air.

The purpose of research was the experimental study of the character of toxic effect of various concentrations of a mix of chemical substances in the atmospheric air (lead acetate, formaldehyde), on the basis of two methodical approaches with the subsequent development of the coefficients of their combined effect.

Materials and methods of research:

The qualitative and quantitative estimations of the character of combined effect of formaldehyde (FA) and lead acetate (LA) on animals were performed with two existing methodical approaches, which in one cases were based on definition of biological equivalence (isoefficacy) of concentrations of FA and LA on the basis of "concentration - time - effect" in short-term experiment [5,7] and in others on the basis of 4-month chronic experiments with a traditional method with use of continuous (daily) inhalation exposure, "concentration - effect"[1].

For establishment of biological isoefficacy of the concentrations of FA and LE there was performed measurements of substances concentrations by the curve obtained at separate action of poisons. It was established, that for 10 hours by summation threshold parameter (STP) for AC there were corresponded concentrations 250 mg/m³, for FA 35 mg/m³, for 50 hours 14,0 and 5,0 mg/m³, for 250 hours - 0,70 and 0,70 mg/m³, for 800 hours 0,075 and 0,18 mg/m³, respectively.

As at study of the combined effect of mixes there were used 2 substances, then the received isoeffective concentrations were divided into half-and-half and 4 mixes of LA and FA were received (mix I - 125,0 mg/m³ of LA and 17,5 mg/m³ of FA; mix II - 7,0 and 2,5 mg/m³; mix III - 0,35 and 0,35 mg/m³; mix IV - 0,035 mg/m³ of LA and 0,09 mg/m³ of FA).

For study of the character of biological effect of the mix LA and FA on the experimental animals by traditional method "concentration-effect" there was carried out 4-month chronic experiment in 4 groups with 15 animals in the every group.

The animals of the 1-st group were exposed to exposure of mix LA and FA, 0,015 and 0,1 mg/m³, respectively; of group 2 - 0,001 and 0,012 mg/m³; of the 3-rd group - 0,0002 and 0,002 mg/m³; the 4-th group was control.

For an estimation of biological action of substances in 4-month chronic experiment there were used the same biochemical, physiological, hematological and gonadotoxic parameters of LA and FA, which were applied at study of the isolated effects..

Measurement of FA and LA in the air was performed with use of colorimetric method [6].

The effect of the mix of LA and FA in the seed chambers at study of a method by dependence "concentration – time - effect" lasted to achievement of deviation of the effects by 25-30 of % from a control parameter at statistic reliability of differences at a level $P < 0,01$ and $0,001$, and at a traditional method within 4 months.

Results and discussion

As the results of experiments of dependence "concentration - time-effect" have shown, the combined action of high concentrations of FA and LA (17,5 mg/m³ and 125 mg/m³) induced anxiety, excitation, trembling, hurried breathing, irritation of mucous membrane of eyes and skin, diarrhea, hypersalivation, discharge of a liquid from a mouth, loss of appetite, which observed at their isolated action. However in case of combined effect the specified changes were more expressed. Thus there was not found death of animals, statistically reliable body mass changes, that, evidently, was connected to short-term influence of exposure to them from 9,5 till 12 hours.

The smaller concentration of a mix FA and LA (0,09 and 0,0375 mg/m³) even at long influence (within 83 days) did not cause suppression of the general health state, behavior and weight of the animals, as well as at the isolated influence of the same concentrations of the substances.

At effect of mix of FA and LA there were observed clear changes both in the integral common toxic parameters (STP, SH group) and in the gonadotoxic parameters (time of

STI	12	17,5	125,0	35,0	250,0	32	210	1,14
	55	2,5	7,0	5,0	14,0	4,5	13,0	1,09
	240	0,35	0,35	0,70	0,70	0,6	0,60	1,16
	1200	0,09	0,0375	0,18	0,075	0,15	0,06	1,22
SH – group in the whole blood	12	17,5	125,0	80,0	300,0	060	400,0	1,04
	50	2,5	7,0	14,0	20,0	14	20,0	1,00
	280	0,35	0,35	2,2	0,70	1,8	0,53	1,30
	900	0,09	0,0375	0,65	0,055	0,6	0,04	1,32
Time of spermatozoid movement	9,5	17,5	125,0	400,0	5000,0	450,0	5000	0,94
	50	2,5	7,0	28,0	240	28,0	250,0	0,980
	280	0,35	0,35	2,02	5,0	2,2	4,2	1,05
	900	0,09	0,0375	0,32	0,35	0,24	0,24	1,395

Table 2

**The summary data of study and estimation of character of resorptive
effect of FA and LA mix under the conditions of 4-month chronic inhalation
exposure to rats**

Table 2

№	Tests and parameters	Groups			
		I	II	III	IV
1.	Weight and behavior of animals	-	-	-	-
2.	Summation-threshold indicator, STI	+	+	-	-
3.	Cholinesterase activity	+	-	-	-
4.	Alanin-transferase content	+	+	-	-
5.	Aspartat-transferase content	+	+	-	-
6.	Blood serum lysozyme activity	+	-	-	-
7.	Sulfhydryl groups contents	+	+	-	-
8.	Morphological blood composition:				
	a) erythrocytes	+	-	-	-
	б) hemoglobins	+	+	-	-
	в) leucocytes	+	-	-	-
9.	Spermatozoid functional state:				

	a) time of mobility	+	-	-	-
	б) osmotic resistance	-	-	-	-
	в) acid resistance	-	-	-	-
10.	Male fertility	+	-	-	-
11.	Pathomorphological changes	+	-	-	-

Notes: (+) – presence of statistical reliable changes; (-) – their absence.

At decrease in concentration of substances in a mix by 1 point (group II) the changes were less expressed, short-term, they occurred only in the end of experiment and were changeable.

Inhalation of the mix in concentrations of studied substances 0,0021-0,00021 mg/m³, respectively in the rats from group III did not cause in them of any deviations in comparison with control animals, and appeared to be inactive.

Further we established the coefficient of the combined action in 4-month chronic experiment by division of the experimentally established inactive concentrations of FA and LA on the corresponding to them MPC in the atmosphere air.

$$CCE = \frac{0,002}{0,003} + \frac{0,00021}{0,0003} = 0,666 + 0,7 = 1,36$$

The comparative analysis and estimation of two methodical approaches for evaluation of the combined effect of FA and LA show, that coefficient of the combined effect at the level of small concentration mainly coincides and is estimated as "incomplete summation", (CCE is equal to 1,32; 1,36; 1,395).

Conclusions:

1. On the basis of study of resorptive effect of binary mixes of vaporous and powdered substances with use of two methods there have been established coefficients of the combined effect of FA and LA in the atmospheric air of the populational places. The character of the combined effect of FA and LA in the level of high concentrations is expressed by type of "summation", and at a level of small concentrations, meeting in the atmospheric air, by type of "incomplete summation".

2. At the combined presence in the atmospheric air of FA and LA the sum of their concentration should not exceed 1,36 at account.

$$\frac{C_1}{\text{ПДК}_1} + \frac{C_2}{\text{ПДК}_2} \leq 1,36,$$

where C_1, C_2 are real concentrations of substances in the atmospheric air,

$\text{MPC}_1, \text{MPC}_2$ are maximum permissible concentrations of any substance in the atmospheric air..

3. At a comparative estimation of the coefficients of combines effect determined on the basis of short-term experiments by definition of biological equivalence (isoefficacy) of substances on a basis of "concentration-time-effect" and on the basis of traditional 4-month chronic experiments "concentration - effect," there have been established coincident values of CCE. Nevertheless methodical scheme of the determination of the biological equivalence of substances has the advantage on time of realization of experiment, opportunity of an establishment of isoeffective concentrations etc. Besides, experience of the establishment of biological equivalence is more acceptable in relation to the cost of experiment, than traditional chronic experiment.

Method of dependence " concentration -time-effect " will allow to reduce terms of the experiment performance in 2-3 times and will reduce financial expenses, improve quality of performed researches directed to the protection of health of the population and maintenance of ecological safety of the country.

REFERENCES

1. Acting methodical guidance on justification of maximum permissible concentrations of pollutants in the air of residential areas. M.1989.P.110.
2. Goncharuk E.I., Sidorenko G.I. Hygienic regulation of the chemical substances in the soil. M. 1986. 196p.
3. Mirzakarimova M.A. Some aspects of dependence of toxic effect of xenobiotic formaldehyde on the concentration and exposition in inhalation administration into the body of experimental animals //Actual problems of hygienic science in Uzbekistan. Proceedings devoted to the 19-year independence of the Republic of Uzbekistan. Tashkent. 2010. P.71-76.
4. Panacyuk E.N., Dacenko I.I., Shtabskiy B.M. Chemical pollutants of the atmospheric air and human working activity. Kiev. 1985. P.32.
5. Pinigin M.A. The tasks of the researches on reglamentation and estimation of the atmospheric pollution // Gigiena I sanitaria. Moscow. 1979. P.3-6.
6. Regulations on the methods of determination of the harmful substances in the atmospheric air. M. 1974.

7. Sidorenko G.I., Pinigin M.A. About ways of the accelerated development of maximum permissible concentrations of the atmospheric pollutants // *Gigiena I Sanitaria*. 1972. N3. P.93-96.
8. Shandala N.G., Pazinich V.M., Podloznyi A.V. To the question about prognosis of maximum permissible concentrations of atmospheric pollution on the basis of short-term experiment // *Gigiena I Sanitaria*. 1977. N 3. P.74-79.
9. Shmandiy V.M., Harlamova E.V. Study of expressions of the ecological danger at the regional level // *Gigiena I sanitaria*. M. 2015. N 7. P. 90-92.
10. Shtabskiy B.M. About conception of differential in relation to time of maximum permissible concentrations of the harmful substances in connection with problem of sanitary protection of the water reservoir // *Gigiena I sanitaria*. 1986. N 11.P.57-60.

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