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**INDO AMERICAN JOURNAL OF  
PHARMACEUTICAL SCIENCES**<http://doi.org/10.5281/zenodo.3347001>Available online at: <http://www.iajps.com>**Research Article****PHYTOADAPTOGEN EFFECT BASED ON LICORICE ON ADOLESCENT  
BODY ADAPTATION CAPABILITIES LIVING UNDER CONDITIONS OF  
ENVIRONMENT CHEMICAL POLLUTION****E.A. Milashechkina<sup>1</sup>, I.N. Gernet<sup>2</sup>, O.V. Rezenkova<sup>3</sup>, E.A. Kunitsina<sup>4</sup>, N.V. Logachev<sup>5</sup>,  
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**Abstract:**

*The study presents the data on the correction of deviations concerning the adaptation system activity of 13-14-year-old adolescent bodies, exposed to chemical pollution of the environment by the means of a phytoadaptogen based on licorice. According to the obtained data, they established the reduction of chemical environmental pollution factor negative effect on the adolescent's body: normalization of rhythm, blood pressure, heart rate, maximum oxygen consumption, and the adaptive potential of the circulatory system.*

**Key words:** adolescents, adaptation opportunities, chemical pollution of the environment, phytoadaptogens, phytocorrection, licorice.

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**INTRODUCTION:**

According to various sources, 15–20% of the world territories, are the zones of ecological disaster, about 50% of the population live in environmentally unfriendly regions.

In recent decades, a large amount of scientific information has appeared about the influence of an unfriendly environment on the physical development and functional state of a child's body [1, 3, 7, 8, 13, 15]. The most acute issue is the need for effective measures aimed at body resistance increase in adverse environmental conditions. For many centuries, various medicinal substances have been used by medicine for the treatment and rehabilitation of humans. In recent years, some low-toxic biologically active herbal remedies are purposefully used in sports practice to accelerate recovery, actively replenish spent plastic and energy resources, and selectively control the most important functional systems of the body during heavy physical exercise [5, 10, 11, 13]. Adaptogens are important among them. Adaptogens are the substances that have a general tonic effect on the body and increase its resistance during heavy physical exertion, under hypoxic conditions, and during drastic bioclimatic changes [6]. Plant adaptogens can stimulate the nervous system and metabolic processes in the body moderately, which has a beneficial effect on the adaptation to physical exertion. Currently, herbal preparations based on licorice root are in the field of study by modern scientists [5, 10, 13, 14]. A number of authors indicate the presence of anti-toxic [2, 12] and immunomodulating [16, 17] properties of licorice root.

Therefore, the goal of our study is to evaluate the effect of the drug on the basis of licorice on the leading adaptation systems of adolescent body living in conditions of chemical environmental pollution.

N.G. Belyaev [5], O.V. Rezenkova [14], E.A. Milashechkina [13] studied the effect of licorice extract on the processes of the organism adaptation. The authors found that the licorice root has obvious adaptogenic effect, which is reflected in the harmonization of the hormonal balance and, thus, the stimulation of adaptive responses to environmental factors. The confirmation is the increase of physical performance, the resistance to hypoxia and better results in the development of physical qualities -

general physical endurance. Also, the licorice extract implements its adaptogenic properties by optimizing the functional state of the central nervous system, helping to balance excitatory and inhibitory processes, and to improve its quantitative and qualitative characteristics. These data gave rise to the use of licorice root extract as a stress-limiting agent among group of 14-year-old teenagers, in which most of the indicators revealed the most significant negative changes.

**Study organization and methods.** The influence of chemical environmental factors on the body of adolescents was studied in natural experiment conditions. The participants of the study were 13-14-year-old adolescents, who were divided into the following groups: 1 - control (n = 82) - 42 boys and 40 girls living in the area without anthropogenic pressure; 2 - test (n = 102) – 61 boys and 41 girls living in the conditions of environment chemical pollution; 3 - correctional (n = 37), with the use of licorice root extract - it consisted of 17 boys and 20 girls living in the conditions of environment chemical pollution.

A phytoadaptogen, based on licorice extract, was given in the morning from 7.30 to 8.30 at the dose of 0.05 mg per kilogram of body weight (Milashechkina, 2005).

To determine the adaptive capacity of adolescent body, we used the indicators characterizing the state of regulatory mechanisms. The state of the respiratory system was determined by relative and absolute lung capacity (LC), chest excursion and maximal oxygen consumption (MOC) test, the state of the circulatory system and its regulatory mechanisms — by cardiointervalography indices – HRV (heart rate variability), arterial pressure (AP), the adaptive capacity of the circulatory system (AP) and an individual minute duration.

The stress test recognized by the World Health Organization as an objective and informative indicator of the functional status of the cardiorespiratory system and the functionality of a person - the maximum oxygen consumption (MOC). According to the researchers, the indirect method for the determination of MOC was proposed by A.A. Guminsky [9]. The evaluation of the test results was carried out according to the data presented in table 1.

**Table 1: Child physical performance assessment in terms of MOC/kg** (A.A. Guminsky et al., 1990)

Age, years	MOC, ml/min·kg		Evaluation
	Girls	Boys	
13	41,0	37,5	low
	43,0	39,5	satisfactory
	45,0	41,5	high
14	43,6	35,5	low
	45,5	37,5	satisfactory
	47,5	39,5	high

The adaptive potential of the circulatory system (CS) was determined by R.M. Baevsky's method [4], adapted for the use on the child organism by P.A. Filesly [13], the assessment was made in accordance with the data given in Table 2.

**Table 2: Evaluation of organism functional capabilities according to the values of the circulatory system adaptive potential**

AP (in cond. score)	Assessment of adaptation degree	Functionality level	Recommendations and activities
<1,60	Satisfactory	Optimal	Therapeutic
1,60-2,09	Incomplete or partial	Sufficient	Therapeutic
2,10-2,59	Unstable	There is a risk of decline	Improving and preventive
2,60-3,09	Stress adaptation mechanisms	Reduction	Preventive and curative
>3,10	Unsatisfactory, overstrain of adaptation mechanisms	A sharp decline	Medicinal

The vital capacity of the lungs (VCL), expressed in liters, was measured using a spiograph. The subject drew the maximum inhale and then gradually exhaled the air through the mouthpiece into the spiograph.

Cardiointervals were recorded and analyzed using the Varicard automated computer instrument. Statistical characteristics of the dynamic range of cardiointervals included: expectation (M), heart rate (HR) and standard deviation ( $\sigma$ ), expectation (M). The numerical characteristics of variational pulsograms along with indicators of statistical estimates were mode (Mo), variational span ( $\Delta x$ ) and mode amplitude (AMo).

Individual minute (IM) was determined by F. Halberg's method [18]. According to the author method, the value of IM is a fairly informative test. The magnitude of myocardial infarction is a relatively stable indicator among healthy people.

Mathematical-statistical processing of the survey results was carried out using Microsoft Excel software. The level of difference significance for the studied parameters was determined using Student's criterion. The results were considered statistically significant at  $p \leq 0.05$ .

### DISCUSSION OF STUDY RESULTS:

According to the data we obtained (Table 3), when you use a phytoadaptogen based on licorice VCL tends to increase among boys and girls, and SP has decreased significantly among boys ( $P < 0,05$ ), girls show the tendency of its decrease. This can be explained by the fact that the boys had more pronounced changes in blood pressure indicators as compared with girls, so they were also more sensitive to the effects of phytoadaptogen.

**Table 3: The state of the cardiorespiratory system among 14-year-old adolescents living in a chemically contaminated area after phytocorrection**

Indicators	Control	Test	P <sub>1</sub>	Correctional group	P <sub>2</sub>	P <sub>3</sub>
Girls						
VCL, l	2,38±0,05	2,27±0,08	>0,05	2,32±0,12	>0,05	>0,05
SP, mm.m.col.	99,29±1,70	109,70±1,70	<0,01	109,29±4,90	<0,05	>0,05
DP, mm.m.col.	59,29±0,29	63,77±1,52	<0,05	67,57±3,16	<0,01	<0,01
HR, b/min	81,77±3,01	92,2±3,63	<0,05	85,81±4,36	>0,05	>0,05
Boys						
VCL, l	3,34±0,05	2,29±0,15	<0,001	2,32±0,16	<0,001	<0,001
SP, mm.m.col.	99,17±1,52	121,26±2,59	<0,001	107,33±1,75	<0,001	<0,01
DP, mm.m.col.	57,92±0,52	76,6±1,34	<0,001	66,33±5,50	>0,05	>0,05
HR, b/min	81,45±3,52	86,78±2,00	>0,05	88,00±1,39	>0,05	>0,05

Note: P<sub>1</sub> - the reliability of differences in average values between the experimental and control groups; P<sub>2</sub> - the reliability of differences in average values between the experimental and correction groups; P<sub>3</sub> - the reliability of differences in average values between the control and correction groups.

The intake of licorice root extract contributed to the normalization of the cardiovascular system functional capabilities (Table 4). The indicators of the expectation and heart rate variation decreased significantly among girls and boys, approaching the control group, as compared with the original (P>0.05).

**Table 4: Heart rate variability among 14-year-old adolescents living in a chemically contaminated area, after phytocorrection**

Indicators	Control group	Test group	P <sub>1</sub>	Correction group	P <sub>2</sub>	P <sub>3</sub>
Girls						
M, ms	743±27,90	673,45±17,34	<0,05	715,45±46,79	>0,05	>0,05
MSD, ms	58,33±5,89	76,82±4,66	<0,05	66,45±9,50	>0,05	>0,05
ΔX, ms	331,33±30,23	649,70±61,54	<0,001	372,00±47,77	<0,001	>0,05
Mo, ms	716,67±33,22	647,73±18,84	>0,05	704,55±58,74	>0,05	>0,05
AMo, %	36,83±3,40	36,25±2,19	>0,05	34,00±2,84	>0,05	>0,05
Boys						
M, ms	747±33,19	707,67±20,46	>0,05	683,56±10,64	>0,05	>0,05
MSD, ms	64,82±12,56	68,99±3,40	>0,05	66,44±10,53	>0,05	>0,05
ΔX, ms	362,91±51,36	563,90±31,65	<0,01	421,00±64,56	<0,01	>0,05
Mo, ms	731,81±42,80	673,91±19,05	>0,05	683,33±17,54	>0,05	>0,05
AMo, %	35,36±4,19	36,10±1,62	>0,05	35,44±2,92	>0,05	>0,05

Note: P<sub>1</sub> is the reliability of differences in average values between the experimental and control groups; P<sub>2</sub> is the reliability of differences in average values between the experimental and correction groups; P<sub>3</sub> is the reliability of differences in average values between the control and correction groups.

Analyzing the indicators of IN before and after licorice extract application (Fig. 1), they revealed the increase of adolescent number with a state of vegetative balance, both among boys (66.77%) and among girls (45.45%), which indicates the "smoothing" of chemical pollution negative impact after the use of phytoadaptogen based on licorice root. Moreover, 20.3% of adolescents from the correctional group, had the value of IN even lower than in the control

group, which, together with the change of expectation and variation scope indicators, indicates a high sensitivity of the vegetative nervous system to this phytoadaptogen.

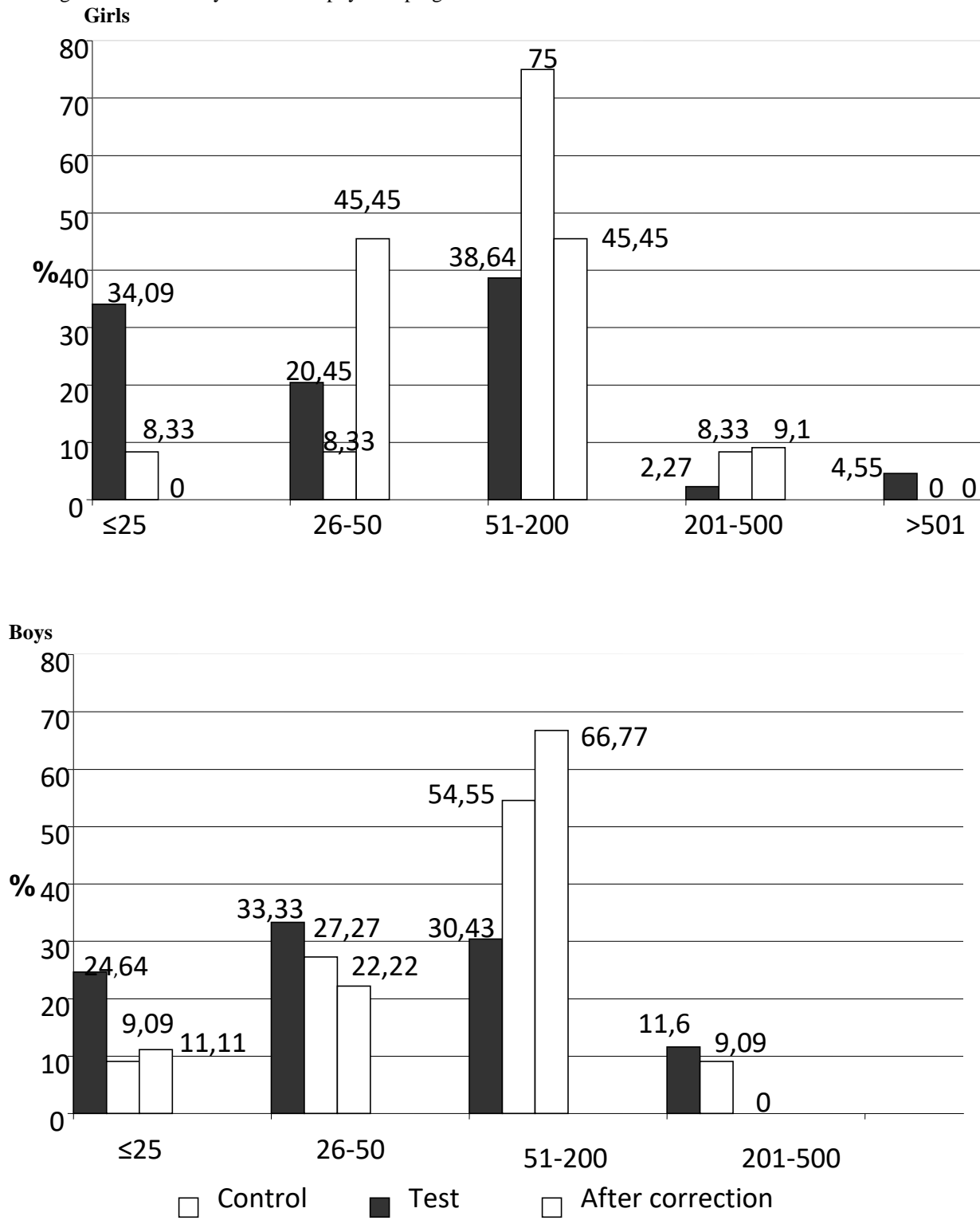


Fig. 1. IN in st. units among 14-year-old girls and boys, living in a chemically polluted area, after phytocorrection with licorice root extract

They revealed the positive effect of licorice extract on the level of adolescent body adaptive abilities (Table 5). Thus, the relative magnitude of MOC/kg improved by 1.26 times among girls, and by 1.32 times among boys and approached that in the control group. The same can be said about the indicators of the circulatory system adaptive potential and the duration of an individual minute (Table 5). After correction, the average values of AP decreased and varied within the limits of a sufficient level of organism functional capacity of the organism (AP = 1.61-2.09) both among girls and boys, averaging  $1.93 \pm 0.26$ . There has been increase of individual minute duration.

### SUMMARY:

In this study, the use of licorice root extract as an adaptogene contributed to the normalization of blood pressure, heart rate, and variation range among 14-year old adolescents living in conditions of environment chemical pollution. Moreover, more pronounced changes towards the normalization of the functional state of the cardiorespiratory system were found among boys, which is probably explained by their more pronounced changes before correction. Among the adolescents of the correctional group, the level of adaptive capacity has increased, as was indicated by AP and MOC indicators. The indicators of IM approached those of the control group, which indicates the stabilization of rhythmstasis.

**Table 5: Adaptive abilities of 14-year old schoolchild body, living in a chemically contaminated area, after phytocorrection**

Indicators	Control group	Test group	P <sub>1</sub>	Correction group	P <sub>2</sub>	P <sub>3</sub>
Girls						
MOC/kg, ml./min./kg.	45,84±0,40	36,17±0,62	<0,001	45,45±1,29	<0,001	>0,05
AP, st.un.	1,75±0,03	2,27±0,08	<0,001	2,05±0,09	>0,05	<0,05
IM, s	45,56±0,02	56,91±0,99	<0,001	49,55±3,52	<0,05	>0,05
Boys						
MOC/kg, ml./min./kg.	47,79±0,42	45,17±0,51	<0,001	46,83±1,09	>0,05	>0,1
AP, st.un.	1,76 ±0,03	2,22±0,05	<0,001	1,99±0,07	<0,001	<0,05
IM, s	54,68±0,11	45,90±0,53	<0,001	49,50±2,62	<0,05	>0,05

Note: P<sub>1</sub> is the reliability of differences in average values between the experimental and control groups; P<sub>2</sub> is the reliability of differences in average values between the experimental and correction groups; P<sub>3</sub> is the reliability of differences in average values between the control and correction groups.

### CONCLUSION:

The study found that licorice root extract is an effective natural adaptogen because it reduces the negative effect of chemical pollution factors on the adolescent body: it leads to a relative normalization of blood pressure, heart rate indicators, individual minute and maximum oxygen consumption. This provides a scientific basis for the development and the use of herbal remedies based on licorice as adaptogens, in order to level the negative effects of environment chemical pollution.

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