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PEROXIDATION INTENSITY IN YAKUTIA RESIDENTS IN ZONES WITH A HIGH RATE OF ONCOLOGICAL MORBIDITY

ABSTRACT

In order to study the peculiarities of free-radical processes in the organism of residents of the Republic of Sakha (Yakutia) living in areas with a high oncological diseases index, some indicators of lipid peroxidation and antioxidant system have been determined. We surveyed 75 rural residents of the Lensky district of the southern zone (high oncological diseases) and 88 rural residents of the Anabarsky district of the Arctic zone (growth of liver cancer) were examined. The intensification of lipid peroxidation in residents of the southern zone, especially in non-indigenous women, has been established. In the non-indigenous population, the intensification of free-radical processes causes the activation of low molecular weight antioxidants, and the indigenous population activates the enzymatic link of the antioxidant system. The reduced activity of antioxidant protection indicators was also noted in non-indigenous women, which puts them at risk of developing oxidative stress, as one of the main factors in the development of pre-pathologies and pathologies, including tumors.

Keywords: lipid peroxidation, antioxidant protection, disadaptation, cancer incidence.

Introduction. The severity of environmental stress can be determined by indicators of the increase in mortality of the working age population in a specific area [3]. According to the Ministry of Health of the Republic of Sakha (Yakutia), in the structure of causes of mortality, neoplasms rank third (15%) after circulatory system diseases and external causes of death. In 2018, the death rate from neoplasms increased by 4.4% and amounted to 143.1 per 100 thousand population (2017 - 137.5) [2]. Under the conditions of increasing anthropogenic and technogenic environmental pollution, the growth of environmentally caused diseases can be considered as a result of a decrease in the adaptive reserves of the body. One of the important factors in the impairment of adaptation and the development of many diseases is the activation of lipid peroxidation processes with impairments in the prooxidant-antioxidant system [5, 6]. Therefore, the assessment of the state of lipid peroxidation and antioxidant protection of the organism of the population living in areas with a high incidence of tumors, is an important task to find the reasons underlying the growth of cancer and the adoption of appropriate preventive measures.

The aim of the study was to identify and compare the features of free-radical processes in the inhabitants of the Southern and Arctic zone of the Republic Sakha (Yakutia) with a high rate of oncological morbidity.

Material and research methods. We carried out the determination of indicators of POL-AOS in a sample of 75 rural residents of the Southern zone RS (Ya), where a high oncological morbidity rate is registered (Lensky district). The average age of the investigated was 46.1 ± 0.25 years. In the Arctic zone, where the number of liver, respiratory organs, lymphatic and hematopoietic tissues cancer is growing, the sample was 88 rural residents (Anabarsky district), the average age was 44.1 ± 0.34 years. The intensity of free radical oxidation of lipids was determined spectrophotometrically by the accumulation of malonic dialdehyde (MDA) [8]. The antioxidant defense indicators of the body were determined by the total content of low molecular weight antioxidants (LMWA) [7], catalase (Kat) [4].

Statistical data processing was performed using the SPSS Statistics 17.0 applied statistical software package. Standard methods of variation statistics were used: calculation of averages, standard errors, medians, 95% confidence interval. The data in the tables are presented as M ± m, where M is the average, m is the average error. The significance of differences between the mean values was assessed using Student's t

test and Kolmogorov-Smirnov test, single-factor analysis of variance (ANOVA). The probability of the validity of the null hypothesis was taken at p <0.05. Correlation analysis was performed by the method of Pearson and Spearman.

Results and discussion. The non-parametric Spearman correlation method revealed the interrelation of indicators of POL - AOS with the area of residence: MDA (-0.364; p <0.01), LMWA (0.629; p <0.01), catalase (0.146; p <0.05). It has been established that the intensity of lipid peroxidation processes is higher among residents of the southern zone. The level of MDA in the examined individuals in the Southern zone was 2 times higher than that of the residents of the Arctic zone (p = 0.000) (Table 1).

Intensification of peroxidation always causes activation of the body's antioxidant defense system. It should be noted that the inhabitants of the southern zone is characterized by the strengthening of the non-enzymatic link of antioxidant protection. Thus, the level of LMWA among the residents of the Arctic (p= 0,000). At the same time, the nature of the interrelationships of the parameters of the two systems was expressed by the following correlation: between MDA and LMWA at the level of r = 0,348; p<0.01, between LMWA and catalase at the level r = -0,251; p<0,01. The inhabitants of the Arctic zone more pronounced enzymatic AOS: catalase activity was 15% higher than in the southern zone (p = 0,024).

The greater contribution to the high MDA value among the residents of the southern zone belongs to woman, since their MDA content was 1.5 times higher than that of men (p<0,05). It should be noted that the intensity of POL in women of the Arctic zone is 2.2 times lower than in women in the southern zone (p<0,05). In men of the Arctic zone, the intensity of POL is at the same level as in women (Fig. 1.).

The compensatory increase in the antioxidant system of the body of women in the Southern zone is less pronounced than in men, as evidenced by significantly lower levels of LMWA in women (0.106 ± 0.024 vs. 0.185 ± 0.049 mg * eq / ml erit) with the same catalase activity (Fig. 2).

Comparison of the level of antioxidants depending on gender and place of residence showed that the men of the southern zone had a level of LMWA that was 2.4 times higher than that of men in the Arctic zone, which indicates a greater intensification of the non-enzymatic antioxidant system in response (p<0.05). In the inhabitants of the Arctic, the antioxidant protection of the body by sex did not have significant differences, but it should be noted that men have higher levels of LMWA and catalase with the same levels of MDA.

The alien population mainly lives in the southern zone and one of the adaptation reactions of the body in cold climates is the acceleration of metabolic processes, including free radical oxidation processes, as evidenced by the slight correlation of MDA with ethnicity (r = 0.232; p <0,01). In non-indigenous men, MDA levels were 2.5 times higher than in indigenous men (p <0.05). Also, for non-indigenous women, the MDA level was slightly higher than for indigenous women (Table 2).

However, a comparison of the MDA level of the indigenous people of the two zones showed that in the Southern zone, the level of MDA among the indigenous people is significantly higher than in the Arctic zone (p <0.05). The balance in the POL-AOS system is better preserved among the indigenous men of the southern zone and among the population of the Arctic zone, this is evidenced by a higher K_{AOS} / POL score (Table 2).

The data obtained that a decrease in the adaptive reserves of the body is more chacarteristic of the inhabitants of the southern zone. It is known that in the Lensky and Anabarsky areas there is an intensive development of natural resources, as a result of which the pressure on the environment increase in the degree of contamination of the OS of the Southern and Arctic zones, the incidence rates of the population of malignant neoplasms significantly increase [10,11]. In the Lensky district, residents consume drinking water with high mineralization

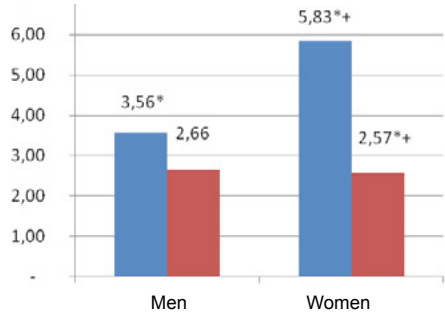

Fig.1 Indicators MDA depending on gender and area of residence.
■ - South Zone ■ - Arctic Zone

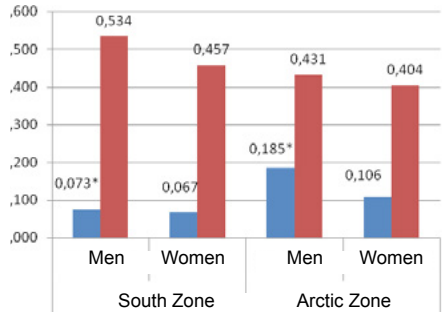

Fig.2. The concentration of antioxidants d epending on gender and area of residence.
■ - LWMA ■ - Catalase

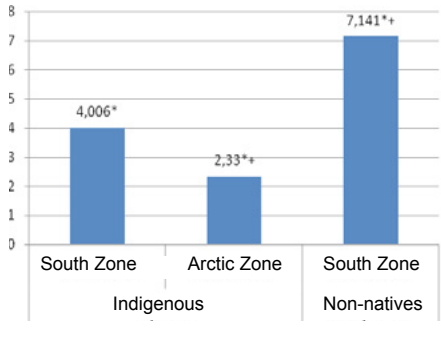

Fig. 3. Concentration MDA in indigenous and non-indigenous people.
■ - MDA

Table 1

The dependence of the concentration of POL - AOS indicators from the area of residence

Statistics	Zone	M±m	St. dev.	Mediana	95% CI	*p*
MDA, µmol/L	South	5.042±0.506	4.112	4.116	4.031 - 6.054	*0.000*
	Arctic	2.593±0.132	1.477	2.349	2.331 - 2.854	
LWMA, mgEq / ml * eryt	South	0.134±0.017	0.145	0.108	0.098 - 0.169	*0.000*
	Arctic	0.068 - 0.002	0.024	0.065	0.064 - 0.074	
Catalase, µCat/L	South	0.413 - 0.031	0.254	0.355	0.35 0 - 0.475	*0.024*
	Arctic	0.479±0.020	0.235	0.459	0.439 - 0.520	
$K_{AO/LP}$	South	0.278– 0.031	0.258	0.202	0.21 4 - 0.341	*0.009*
	Arctic	0.331 - 0.033	0.376	0.275	0.264 - 0.397	

Table 2

POL-AOS Indicators among indigenous and non-indigenous people

South				Arctic	
Men		Women		Men	Women
Indigenous N=18	Non-indigenous N=10	Indigenous N=26	Non-indigenous N=16	Indigenous N=12	Indigenous N=23
MDA, μmol/L					
2.69±0.60*	6.70±0.73*	5.06±0.49	7.28±0.63	3.05±0.76	2.07±0.53
LWMA, mgEq / ml * eryt					
0.205±0.02*	0.116±0.03	0.105±0.02*	0.109±0.02*	0.072±0.03	0.060±0.02
Catalase, μCat / L					
0.448±0.05	0.368±0.06	0.357±0.04	0.495±0.06	0.569±0.06	0.416±0.05
$K_{AOe/LP\ con.un.}$					
0.459±0.09*	0.187±0.02*	0.227±0.02	0.193±0.01	0.311±0.03	0.314±0.03

[7]. And pollution of surface water and soil by production waste can lead to pollutants entering the human body. Heavy metals tend to accumulate and initiate intensification of peroxide processes and the formation of free radicals (SPO) [1]. Oxidative stress becomes one of the leading pathogenetic mechanisms in the development of severe pathologies, including neoplasms [12, 13].

Conclusion. Thus, the intensity of lipid peroxidation is higher in the population of the southern zone, especially, in non-indigenous women, in whom a reduced level of antioxidant protection shows a decrease in the adaptive reserves of the body, and places them at risk of developing oxidative stress as one of the main factors in the development of pre-pathologies and pathologies, including neoplasms. Antioxidant protection is not the indigenous population is characterized by the intensification of low molecular weight antioxidants, and the indigenous population by the intensification of the AOS enzymatic link.

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