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FACTORS OF GLOBAL WARMING IN KHERSON REGION AND FEATURES OF EUKARYOTES' METABOLISM UNDER THESE CONDITIONS

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Here are the results of studies of environmental change under global warming conditions. With the help of indices they show a stable trend of rising temperatures and their negative impact on the ontogeny of eukaryotes. The possibilities of stabilizing the metabolism of living organisms through their own genetic resources (enzymes, RNA thermometers) and the possibility of their use in biotechnology, obtainment of biologically active substances that increase the resistance of organisms to stressful temperatures are described in the article.

***Keywords:** climate, global warming, thermometers RNA, enzymes, living organisms.*

Formulation of the problem. Global warming, which started in 70's of the last century, in the near future will certainly affect all sectors of agriculture. Therefore, the relevance of this problem over the years probably will increase. Unfortunately we can not influence the process of climate change, but we are able to analyze how these changes affect the environment, including living organisms and suggest ways to reduce the negative impact of these changes.

The purpose of the research is to establish the impact of global warming on climate change performance and comfort of living organisms in the implementation of their genetic potential under stress.

Materials and methods of research. The material for the research were perennial climatic data of meteorological observations of agrometeorological station in Kherson [1,2]. With the help of Humidex-based Heat Stress Calculator [3,4] we calculated indices of temperature stress and determined comfort level of living organisms.

Presentation of the main material. We have done considerable work on the study of changes in the temperature

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regime of Kherson region during the last 30 years according to the data of agrometeorological station in Kherson.

A striking example characterizing climate change is the increasing amounts of the average temperature (Fig. 1,2).

In our work we consider the amount of average temperatures above 0 ° C and above + 15 ° C. Whereas, in the southern desert maximum temperatures ranged + 30-37 ° C the division of the temperature mode into two components allows to view it's changes in great detail.

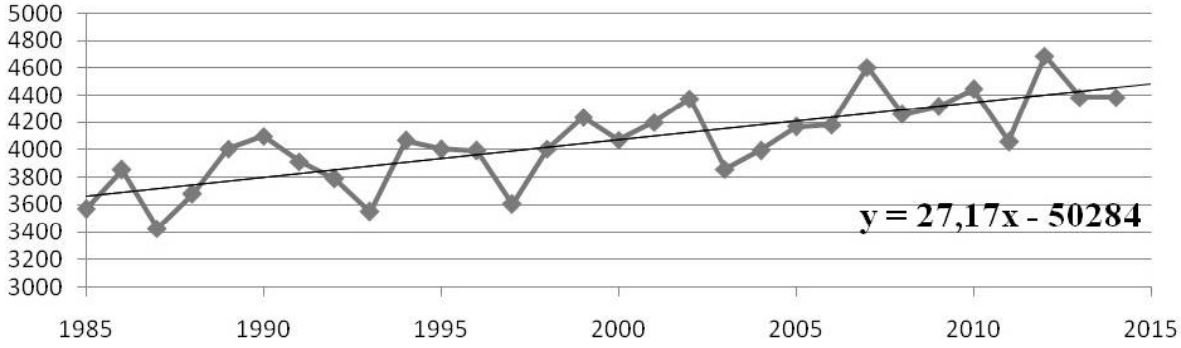

Fig. 1. The amount of changes in sum of temperatures above 0 ° C according to agrometeorological station in Kherson (1985-2014)

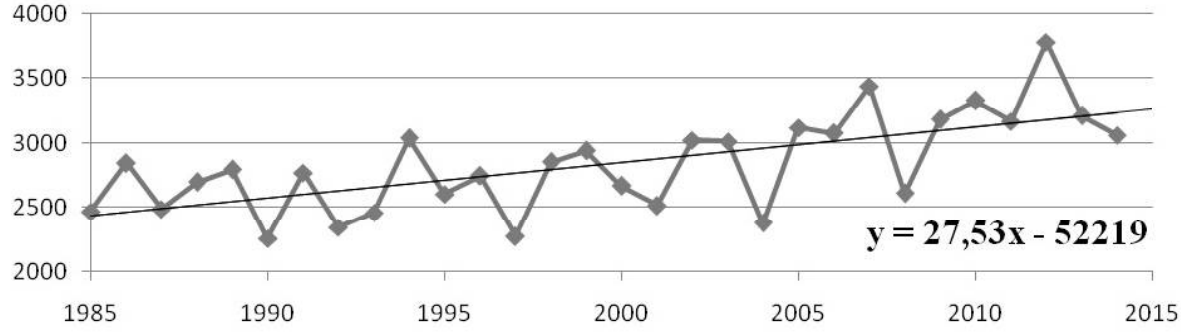

Fig. 2. The amount of changes in sum of temperatures above +15°C according to agrometeorological station in Kherson (1985-2014)

As we can see, the sums of temperature from 1985 to 2014 are steadily increasing. It should be noted that the highest tendency to increase have temperatures above +15°C, according to many years of data. Given that the maximum amounts of the mentioned temperatures occur in 2010-2014, to assess the magnitude of these changes, we have implemented a mathematical calculation for the amounts of active and effective temperatures for the last 5 years (2010-2014) according to the agrometeorological station in Kherson. Comparing them with the average long-term data, we found that

during the said period, the amount of active temperatures relative to annual-average temperature increased from an average of 12% (active above 0°C) to 40% (effective above + 15°C) (Table . 1).

The above information shows a significant increase in the thermal load on the environment of our region.

Increased ambient temperature affects the livelihoods of all living organisms. But not always, this effect has a negative impact. Different set of factors such as temperature and humidity have different effects on organisms.

In order to determine the impact of these changes of temperature mode on the livelihoods of living organisms, we decided to use temperature stress index "Humidex" to research how comfortable feels the leading representative of the natural world -human, with different ratio of mentioned above meteorological factors.

In recent years the maximum temperature occurred in 2007, 2012 and 2013, and the minimum in 2003, 2006. So to compare indices of the temperature stress we decided to analyze the past 16 years from 2000 to 2015.

Table 1

The annual amount of active and effective temperatures for the 2010-2014 years according to the agrometeorological station in Kherson.

Year	The annual amount of active temperatures				The annual amount of effective temperatures		
	Higher than 0°	Higher than +5°	Higher than +10°	Higher than +15°	Higher than +5°	Higher than +10°	Higher than +15°
2010	4443	4338	4066	3330	3142	1892	1042
2011	4060	3795	3534	3169	2720	1748	934
2012	4688	4654	4293	3780	3388	2219	1246
2013	4385	4120	3466	3211	2932	1788	1009
2014	4386	4228	3792	3030	2970	1859	1005
Middle	4392	4227	3830	3304	3030	1901	1047
Long term average	3926	3705	3357	2648	2604	1553	746
Deviation	466	522	473	656	426	348	301
Deviation %	+12%	+14%	+14%	+24%	+16%	+22%	+40%

Analysis was conducted based on the two key parameters, namely: maximum temperature for the day and relative humidity at this time. Whereas the basic temperature peaks occur in the

summer months were included in the calculation of the data for June, July and August.

Humidex index describes how comfortable we feel at different values of meteorological variables such as temperature and humidity.

The presence of other meteorological factors such as wind or staying in direct sunlight may slightly change the specified index.

Considering local climatic characteristics we have decided on the following distribution of indices for their negative impact.

Table 2

Allocation of the temperature stress indices according to their level of impact.

Humidex range	Level of comfort
Up to 29	Comfortable conditions
From 30 to 38	Minor discomfort
From 39 to 45	Significant discomfort
More than 45	Hazardous conditions

Given the significant impact on the living organism, specifically air temperature, we've separated the days, when the air temperature was increased to + 30 ° C and higher.

The results of the calculations are shown in Table 3.

As we can see from results, only 30 days from 92 summer days were comfortable for our functionality, which is only 32%. At the same time, there were 52 days with minor discomfort, which is 57%. Separately we should days with significant discomfort, on average there was 11, which is 11%, while this value ranges from 0 days in 2003 to 25 days in 2010. We also see that there were no hazardous days

As for days with air temperature + 30 ° C and above, their average was 62, which is 67%, while this value ranges from 59 in the same 2003 to 88 in 2010.

Analyzing this data over time (Figure 3), we see that such parameter as the number of days with little discomfort tends to increase and given that the one thing that tends to reduce is the number of comfortable days, we can conclude that number of days with little discomfort increases by reducing comfort days.

At the same graph shows that the number of days with significant discomfort varies greatly, but the overall trend are stable.

Table 3

The number of days with different temperature stress index and the number of days with air temperature + 30°C and higher, according to agrometeorological station in Kherson.

Year	Number of studied days	Comfortable days	%	Minor discomfort days	%	Significant discomfort days	%	Hazardous days	%	Days with temp. higher than 30°	%	Notes
2000	92	38	41	50	54	4	4	0	0	54	59	
2001	92	30	32	45	49	17	18	0	0	62	67	
2002	92	37	40	35	38	20	22	0	0	55	60	
2003	92	38	41	54	58	0	0	0	0	54	59	
2004	92	38	41	50	54	4	4	0	0	54	59	
2005	92	35	38	44	48	13	14	0	0	57	62	
2006	92	30	33	52	57	10	11	0	0	62	67	
2007	92	14	15	62	67	16	17	0	0	62	67	
2008	92	28	30	53	58	11	12	0	0	64	70	
2009	92	31	34	55	60	6	7	0	0	61	66	
2010	92	29	31	56	61	25	27	0	0	81	88	
2011	92	26	28	55	58	11	12	0	0	66	72	
2012	92	23	25	48	52	21	23	0	0	69	75	
2013	92	24	26	62	67	6	7	0	0	68	74	
2014	92	29	31	58	63	5	5	0	0	63	68	
2015	92	31	34	56	61	5	5	0	0	61	66	
Average value	92	30	32	52	57	11	11	0	0	62	67	

The number of days with a temperature of + 30 ° and higher also tends to increase and given that 2015, according to meteorological observations can be recognized as the warmest year for the entire observation period, the trend of growth will continue to be observed. It should be noted that for all the years of observation, days with hazardous criteria were not detected.

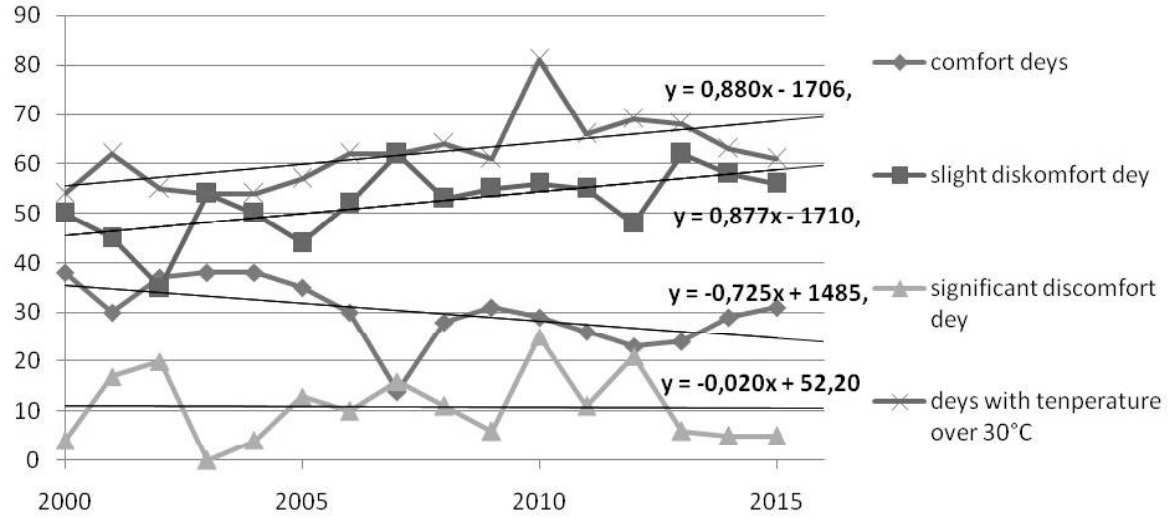

Fig. 3. The number of days with different indices of temperature stress and temperature over 30°C between 2000 and 2015

Such distribution of temperature stress indices was made possible by the fact that Ukraine steppe zone of the South, to which the Kherson region is arid is a zone with a deficit of moisture, so with a significant temperature increasing there is a reduction in humidity and temperature stress index is also reduced.

Climatic conditions caused by global warming have a negative impact not only on the human body but also to other genetically close to us organisms, such as pigs [5].

For example, in the works of M.G. Tishchenko, I.Yu Gorbatenko [6,7] et al. were presented materials on the impact of high temperature on the ontogeny of domestic animals.

The work of I.Yu. Gorbatenko [8] shown the possibility for the increasing of resistance of animal organism, namely the existence of sequence (RNA - thermometers), which determine resistance to high temperatures and act as protectors in their ontogeny. Using molecular biology techniques makes it possible to modify the genome of animals, by methods such as insertion sequences or cultivation of microorganisms - symbionts that can be used in biotechnology by creating biologically active compounds which, at elevated temperatures of the environment, reduce the negative impact of high temperatures on living organisms.

M.G. Tishchenko [9] proposed an installation, which reduces the negative impact of temperature and improves animal breeding conditions.

All animals receive heat from two sources - directly from environment and from the splitting of chemical substrates in cells. The extent to which animals are able to generate and store heat depends on the physiological mechanisms inherent in a particular phylogenetic group.

Like other chemical reactions, reactions of metabolism requires a certain amount of power in order for them to occur. The energy increases the heat in which the molecules are moving, and the frequency of molecular collisions. These collisions increase interaction among electrons in molecules and create new chemical bonds. Temperature regimes that exist spontaneously in cells, are usually moderate to undergo chemical reactions that provide life support and it is because the cells contain enzymes.

Enzymes - are globular proteins that carry out specific chemical reactions in the middle of the cell and need a tiny amount of energy (activation energy) required to initiate the reaction.

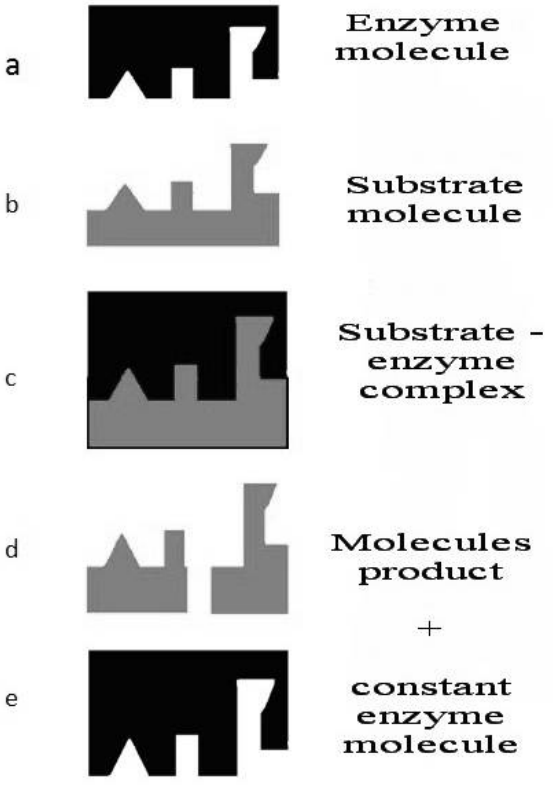

Fig. 5. The interaction of enzyme molecule with a substrate molecule

Fig. 5 shows the configuration of enzyme molecules (a) corresponding to the form of substrate molecules (b). When substrate molecule connects to the enzyme (c), a chemical

reaction occurs. The result of the reaction (d) is the molecules product (e) and the unchanged enzyme.

Enzymes are needed in small quantities, because their function is reduced to a constant energy (heat). The metabolism cells include hundreds of different chemical reactions that are controlled by specific type of enzymes. Each enzyme polypeptide chain forms a unique shape and provides specific structure of substrate molecules, and therefore is the key to a substrate to perform chemical reactions.

Table 4

Shows the main characteristics of the life cycle (ontogeny) of the pig.

Process	Examples	Process	Examples
Movement	Changing the position of the body, or body parts, internal organs motion.	Digestion	The release of substances from food in simple forms.
Conformity	Reaction to the change that takes place inside or outside of the body.	Absorption	Transportation of digestion products through membranes in the body fluid.
Growth	Increasing the size of body without changing of the shape.	Circulation	The movement of materials from one place to another in the body flows.
Reproduction	Production of of new organisms.	Assimilation	Change of adsorbed substances to chemically various forms.
Breathing	Oxygen receiving, use of oxygen to release energy from food and transportation of dioxin emissions outside.	Excretion	Moving the excretions, that were obtained through metabolic reactions.

Presented material enables a deeper analysis of the temperature factor that affects the passage of metabolic processes of the animal organism. Installed at the molecular level sequences (RNA - thermometers) that affect temperature regulation of homeostasis, namely enzymes.

RNA - thermometers play a significant role in the growth and development of the organism not only at optimal environmental conditions, but also under extreme conditions (of global warming). Their detailed study in conjunction with possible further climate change will enable professionals of biology and breeding programs to create metabolic adaptation to higher temperatures impact.

Conclusion. Calculations using Humidex-based Heat Stress indices indicate that the climate in the southern steppes of Ukraine has a steady tendency upward changes in temperature parameters,

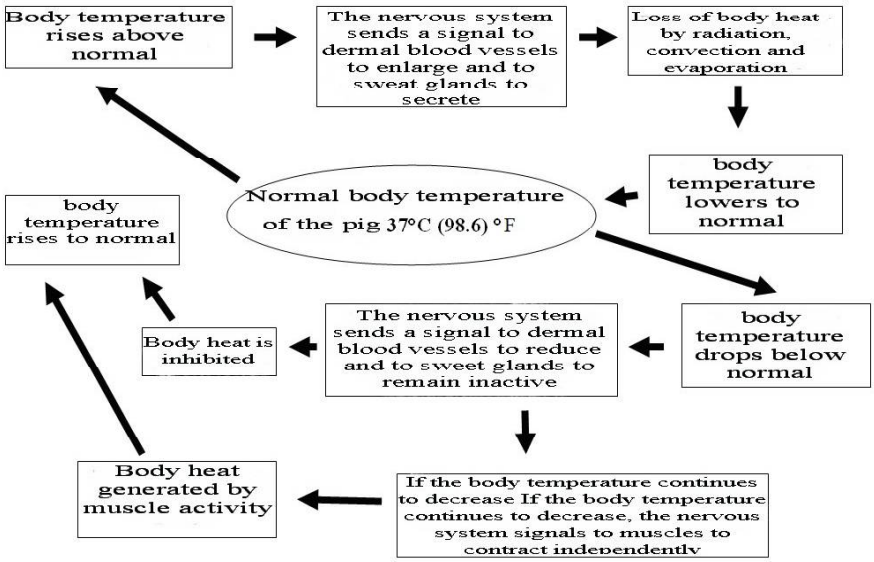

Fig. 7. Presents are some of the factors that affect pig's body during the process of temperature regulation.

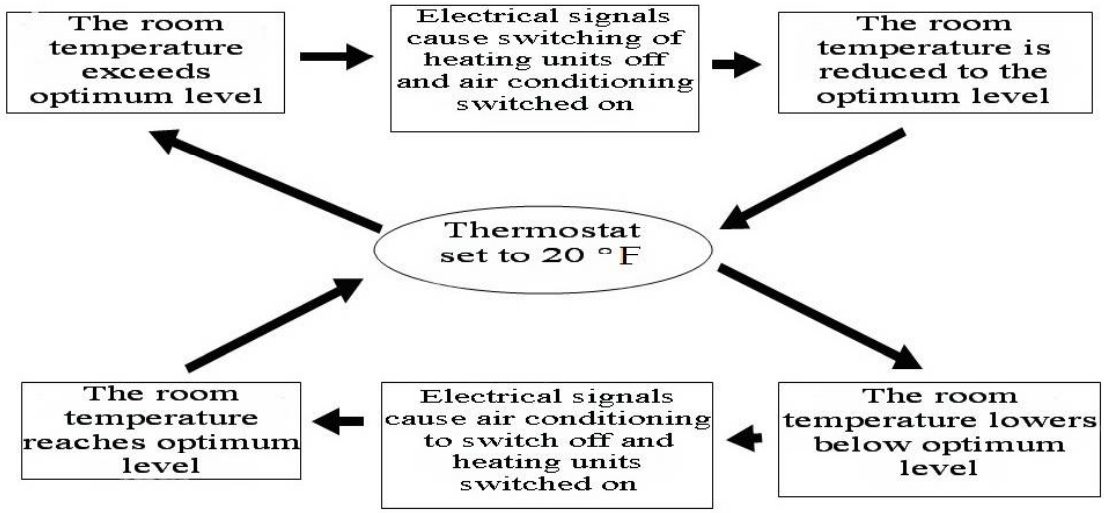

Fig. 8. Shows the work process of thermal unit, which maintains optimal conditions and optimal temperature in animal areas. This system is a homeostatic mechanism.

creating uncomfortable conditions for passing the eukaryotes ontogenesis. From 2010 up to 2014 temperature parameters exceeded long-term data up to 12%, and in the most hot 2012 – up to 19%. In this research we also show the role of enzymes under stressful conditions on the ontogeny of animal organism at the metabolic level, and the presence of nucleotide sequences (RNA

- thermometers), which can stabilize the animal organism under stressful environmental conditions.

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Ю. П. Кирияк, М. Г. Тищенко, И. Ю. Горбатенко. ***Факторы глобального потепления в Херсонском регионе и особенности метаболизма эукариот в этих условиях.***

Представлены результаты исследований изменения окружающей среды в условиях глобального потепления. С помощью индексов показана стабильная тенденция повышения температур и их негативное влияние на онтогенез эукариот. Указаны возможности стабилизации метаболизма живых организмов с помощью собственных генетических ресурсов (ферменты, РНК - термометры) и возможность их использования в биотехнологиях, получение биологически-активных веществ, увеличивающих резистентность организмов к стрессовым температурам.

Ключевые слова: *климат, глобальное потепление, эукариоты, метаболизм, живые организмы.*

Ю. П. Кіріяк, М. Г. Тищенко, І. Ю. Горбатенко. ***Фактори глобального потепління в Херсонському регіоні та особливості метаболізму еукаріот в зазначених умовах.***

Представлені результати досліджень зміни довкілля в умовах глобального потепління. За допомогою індексів показані стабільні тенденції підвищення температур та їх негативний вплив на онтогенез еукаріот. Показані можливості стабілізації метаболізму живих організмів за допомогою власних генетичних ресурсів (ферменти, РНК- термометри) та можливість їх використання в біотехнологіях, отримання біологічно-активних речовин, які підвищують резистентність організмів на стресові температури.

Ключові слова: *клімат, глобальне потепління, еукаріоти, метаболізм, живі організми.*