



Journal homepage: <https://animalscience.com.ua/en>

Animal Science and Food Technology, 12(2), 101-110

Received: x.xx.20xx Revised: x.xx.20xx Accepted: x.xx.20xx

UDC: [639.3.043.13:636.087.73]:[639.371.52:597-11]

DOI: 10.31548/animal2021.02.011

Characteristics of biochemical parameters of sperm production of carp sire when using hulled oats in feeding during the pre-spawning period

Nataliia Syrovatka^{*1}, Igor Hrytsyniak¹, Denys Syrovatka¹, Iryna Yaremchuk²

¹Institute of Fisheries, National Academy of Agrarian Sciences of Ukraine
03164, 135 Obukhivska St, Kiev-164, Ukraine

²Institute of Animal Biology, National Academy of Agrarian Sciences of Ukraine
79034, 38 V. Stus, St, Lviv, Ukraine

Abstract. The restoration of freshwater aquatic life and the cultivation of highly productive sires is a key stage in the process of restoring a new generation of fish, thus, the task of increasing fertility is always relevant for the fishing industry of Ukraine. The purpose of the study is to conduct an in-depth analysis of the physiological characteristics of ejaculates of respiratory and reproductive capacity, to explore the activity of enzymes of the respiratory chain of mitochondria, to determine the percentage of sperm survival when using pre-cleaned oats, as the main component in the diet of carp during the pre-spawning period. In the study, males of the Nyvka interbreed type of Ukrainian scaly carp breed were used, which were kept during the pre-spawning period in pond conditions of the State Enterprise "State Farm "Nyvka" IRG NAAS. Individuals were divided into 3 groups. The first group (Experiment I) was fed 100% hulled oats, the second (Experiment II) – 30% and the control group of fish (Control) was fed a grain mixture. The quality of male carp sexual products was assessed by determining the effect of adding hulled oats to their diet during the pre-spawning period. Indicators of sperm motility and fertilizing ability, the content of γ -, β - and α -globulins, albumin, prealbumin and physiological characteristics of ejaculates of respiratory and reducing capacity, the activity of enzymes of the respiratory chain of mitochondria (COX and SDH) were explored. Considering the increase in the productivity of fish sperm, in particular, the increase in the number of sperm with rectilinear motion, the decrease in the number of lifeless sperm and changes in the protein formula of germ cells, it was established that it is advisable to add hulled

Suggested Citation:

Syrovatka, N., Hrytsyniak, I., Syrovatka, D., & Yaremchuk, I. (2021). Characteristics of biochemical parameters of sperm production of carp sire when using hulled oats in feeding during the pre-spawning period. *Animal Science and Food Technology*, 12(2), 101-110.

^{*}Corresponding author

oats to the main diet in the amount of 30%. According to the results of the conducted research, it was established that the addition of hulled oats to the fodder during the pre-spawning period has a positive effect on the quantitative and qualitative indicators of male carp sexual products, the results of the research can be useful for both students and workers of the fish processing industry of Ukraine

Keywords: male carp, sperm, rectilinear translational motion, succinate dehydrogenase, cytochrome oxidase, γ -, β - and α -globulins, prealbumin

Introduction

Selection of sires with high-quality sperm production, and fertilising ability of sperm is important in the breeding and breeding business (Ostapiv, 2008), as the main function of the reproductive system in fish is the production of sexual products while preserving the genetic material for the next generation. Thus, one of the main factors that in the future affect the viability and plasticity of fish planting material is the quality of germ cells. Therefore, the best quality sperm is one of the conditions under which the fertilisation process occurs with the subsequent development of the embryo (Yaremchuk *et al.*, 2015). The duration of the period of preservation of sperm motility and fertilising ability is variable in different fish species and depends on the environmental conditions, feeding, keeping technology and individual characteristics of the sires. All this should be considered since some external factors have a significant impact on the body, i.e. they can accelerate, inhibit or completely stop the development (spermatogenesis) of germ cells.

It should be noted that sperm membranes are susceptible to peroxide damage by excess reactive oxygen species (ROS). The efficiency of the enzymatic antioxidant defence system, the key enzymes of which are superoxide dismutase, catalase and glutathione peroxidase, is important for maintaining the structural integrity, sperm survival and preventing the

processes of lipid peroxidation (LPO). Therefore, it is important to explore the activity of succinate dehydrogenase and cytochrome oxidase as the primary link in the oxygen process.

Development and maintenance of carp breeding stock are one of the main and most crucial processes in breeding and breeding work, as the efficiency of the farm in the pre-spawning period is determined by the quality of the breeders and is crucial for obtaining results at the end of the growing season. Feeding carp fry in the pre-spawning period with artificial fodder, which fully provides the physiological requirements of fish at this stage of ontogeny, immediately affects the quality of sexual products and the success of the spawning campaign in general. Since, in the current conditions, the technological aspects of carp reproduction are fully developed, during the work in hatcheries, attention is devoted to the selection of elite sires and determination of the quality of their sexual products (Martínez Páramo *et al.*, 2014), (Yurchak *et al.*, 2018). Approximately, the quality of sperm is determined by a five-point scale of G.M. Persov. When assessing the quality of sperm, in addition to visual features (volume, colour, odour, consistency), the motility, concentration, survival, protein component and oxidative functions of sperm are explored (Makarenko *et al.*, 2022). Notably, motility is one of the most important characteristics associated

with the fertilising ability of sperm, indicating their viability and structural integrity. Thus, motility studies are an integral part of semen analysis (Iaremchuk *et al.*, 2012).

Succinate dehydrogenase (SDH) is one of the important oxidative enzymes of CTA and the first link in the chain of electron transfer through ubiquinone and cytochrome system to oxygen. The features of SDH are its location on the inner surface of mitochondria and the independence of the enzyme activity from the ratio of oxidised and reduced forms of NAD/NADH (Fauvel *et al.*, 2010). Cytochrome oxidase (COX) is an enzyme of the final link of electron and proton transport in the respiratory chain to oxygen (Makarenko *et al.*, 2021). COX, together with SDH, characterises the mitochondrial component of oxygen consumption, providing ROS resynthesis, thus, their activity affects metabolism in sperm (Kalachniuk, 2013). By exploring the biochemical parameters of sperm production, some scientists have established a link between the activity of oxidative enzymes and the fertilising ability of sperm, more pronounced with the activity of succinate dehydrogenase (SDH). A close connection between the activity of many enzymes of dehydrogenases and cytochrome oxidase (COX) of sperm with indicators of its quality and fertilising ability has been identified, which served as the basis for using the activity of these enzymes as an indicator of sperm quality (Kosenko *et al.*, 2007), (Ruiz-Pesini *et al.*, 1998) Studies have proved the connection between the activity of SDH of bulls' sperm and fertility, namely, there was a decrease in the fertility of bulls' sperm with a decrease in the activity of the enzyme in the ejaculate (Barbagallo *et al.*, 2020), (Linkevich *et al.*, 2014).

Thus, the results of a comprehensive assessment of male carp sperm production will

provide a complete description of the reproductive system of male carp and will allow recommend using hulled oats in feeding during the pre-spawning period.

The purpose of the study – to explore the physiological characteristics of ejaculates respiratory and recovery capacity, the activity of enzymes of the mitochondrial respiratory chain (COX and SDH), sperm survival, motility and fertilization capacity, the content of γ -, β - and α -globulins, albumin, pre-albumin for using hulled oats in carp feeding during the pre-spawning period.

Materials and methods

The object of the research was different-aged individuals of Nyvkivsky scaly and small-scaled carp. For the research, sperm was collected during the spawning campaign of 2012 from males of Nyvkivsky scaly and small-scaled carp, which were grown in pond conditions under semi-intensive technology.

The semen was diluted with phosphate-salt buffer (NaCl – 0.8 g, KCl – 0.02 g, Na_2HPO_4 – 0.11 g, KH_2PO_4 – 0.02 g, MgCl_2 – 0.01 g, H_2O up to 100 ml).

Using the SpermVision program, which is installed based on the microscope, the analysis of sperm parameters was performed – their total activity, the percentage of sperm with rectilinear and translational movement and the percentage of lifeless sperm. The kinetic parameters of sperm were determined by using the computer system CASA (Computer Assisted Sperm Analysis) – Sperm Vision with the establishment of sperm movement parameters: velocity of curvilinear motion (VCL); velocity of sperm head advancement along the average trajectory (VAP); velocity of straight-line motion of the sperm head along the straight segment between the starting and ending points of the trajectory (VSL), degree of linearity

($LIN = VSL/VCL$), degree of straightness of sperm motion ($STR = VSL/VAP$) and degree of deviation ($WOB = VAP/VCL$). Determined: sperm survival (h) at 22–24°C until the progressive movement stopped, the activity of succinate dehydrogenase (SDH ; units/h $\times$ 0.1 ml of sperm) and cytochrome oxidase (COX , units/h $\times$ 0.1 ml of sperm), oxygen consumption – polarographically (ng-atom O/min $\times$ 0.1 ml of sperm) at 38.5°C in phosphate-salt buffer (PSB ; NaCl – 0.8 g, KCl – 0.02 g, Na_2HPO_4 – 0.11 g, KH_2PO_4 – 0.02 g, $MgCl_2$ – 0.01 g, H_2O to 100 ml) (Dudchak & Sharan, 2010).

The fractional composition of soluble proteins was explored by vertical electrophoresis in 7.5% polyacrylamide gel (PAAG) plates (Fang *et al*, 2020). Samples for electrophoresis were prepared: in 7.5% PAGE: 0.1 ml of sperm was diluted 1:12 with electrode buffer (pH 8.5), 0.1 ml of the sample was mixed with the same amount of 40% sucrose, 0.02 ml (~150–200 μ g of protein) was added to the wells of the concentrating gel. Marker dye – 0.01% bromphenol blue solution was added to the electrode buffer before sample dilution. After electrophoresis, the gels were fixed and simultaneously stained

in 12.5% trichloroacetic acid with 0.25% aqueous Coomassie R 250 solution.

Digital statistical analysis of the material was performed using the computer program Microsoft EXCEL. The arithmetic mean (M), mean square error (m) and probability of differences (P) between the explored arithmetic means were determined.

Results

According to the methodology, in spring the main herd of breeders was boned and transplanted to the pre-spawning ponds. In the process of boning the following types of measurements were used: fish weight, body length (industrial and total), body height, body girth, and head length.

Based on the data obtained, the statistical indicators and the main indices of body composition were calculated – body fatness index (B_f), relative weight index (W/l), index of high-spine (l/H), and girth index (l/O). All experimental groups of males were clinically healthy, in growth and development corresponded to the “elite” class and were used for spawning. The main characteristics are presented in Table 1.

Table 1. Indicators of exterior of males of Nyvkivsky scaly and small-scaled carp used in the research

Indicators Experiment I (n = 4)		Experimental group		
		Experiment II (n = 4)	Control (n = 4)	Control (n = 4)
Average weight (W), kg	$M \pm m$	5.35 $\pm$ 0.28	5.42 $\pm$ 0.35	5.74 $\pm$ 0.20
	σ	601.12	515.22	288.10
	C_v , %	9.88	10.02	5.02
Total length (L), cm	$M \pm m$	56.32 $\pm$ 4.31	54.45 $\pm$ 2.80	59.22 $\pm$ 0.98
	σ	6.61	7.01	1.99
	C_v , %	10.25	9.89	2.98
Industrial length (l), cm	$M \pm m$	51.78 $\pm$ 3.80	54.06 $\pm$ 3.99	54.80 $\pm$ 1.12
	σ	5.87	4.99	1.64
	C_v , %	11.40	13.52	3.00

Table 1. Continued

Indicators Experiment I (<i>n</i> = 4)		Experimental group		
		Experiment II (<i>n</i> = 4)	Control (<i>n</i> = 4)	Control (<i>n</i> = 4)
Body height (<i>H</i>), cm	<i>M</i> ± <i>m</i>	21.04±0.70	21.04±0.56	21.20±0.64
	<i>σ</i>	1.21	1.18	0.84
	<i>C_v</i> , %	5.30	4.98	3.95
Body girth (<i>O</i>), cm	<i>M</i> ± <i>m</i>	49.03±1.86	48.48±2.65	50.0±1.20
	<i>σ</i>	2.11	2.23	1.58
	<i>C_v</i> , %	4.56	4.88	3.16
Body fatness index (<i>B_f</i>)	<i>M</i> ± <i>m</i>	3.72±0.26	3.90±0.44	3.49±0.16
	<i>σ</i>	0.39	0.77	0.20
	<i>C_v</i> , %	21.80	22.15	5.74
Relative weight index (<i>W/l</i>), g/cm	<i>M</i> ± <i>m</i>	105±2.05	102±1.87	104.72±2.72
	<i>σ</i>	2.26	3.01	3.26
	<i>C_v</i> , %	2.13	2.08	3.12
High-spine index (<i>l/H</i>)	<i>M</i> ± <i>m</i>	2.45±0.25	2.51±0.15	2.59±0.07
	<i>σ</i>	0.18	0.22	0.08
	<i>C_v</i> , %	9.01	8.56	3.23
Girth index (<i>l/O</i>)	<i>M</i> ± <i>m</i>	1.16±0.10	1.18±0.08	1.10±0.02
	<i>σ</i>	0.10	0.12	0.03
	<i>C_v</i> , %	6.98	7.21	2.83
Head index (<i>l/C</i>)	<i>M</i> ± <i>m</i>	3.87±0.23	4.01±0.15	3.98±0.13
	<i>σ</i>	0.18	0.16	0.20
	<i>C_v</i> , %	5.33	5.39	0.20

It was established that all experimental groups of males had high rates of total sperm activity, the average value of which exceeded 92%. Therewith, the highest rate was recorded in the experimental animals of the second group – 94.2%, which is 1.32% higher than that of the control group. Individuals from this experimental group had the highest value of sperm content with rectilinear motion – 74.73% and the lowest value of sperm content with arena motion – 19.41%, but the indicators of this experimental group in terms of arena motion had

the highest amplitude of fluctuations – 23.61% against 11.43% in experiment I and 11.2% – in control. Therewith, in individuals from experimental group I, the lowest value of dead sperm was observed – 5.77%, with the maximum variation – 37.21%. Somewhat higher values – 5.87% had individuals from the second experimental group, but the variability index decreased by 9.65%. The highest number of lifeless sperm – 7.0% was recorded among the indicators of sperm production in individuals from the control group, with a variability of 10.79% (Table 2).

Table 2. Physiological parameters of carp sperm ($n = 4$, $M \pm m$)

Experimental options	Total activity (%)	The content of sperm with rectilinear progressive movement (%)	Percentage of sperm with arena movement (%)	Percentage of lifeless sperm (%)
Experiment I	93.75 ± 0.43 0.83	73.37 ± 2.61 6.16	20.87 ± 1.38 11.43	5.77 ± 1.24 37.21
Experiment II	94.2 ± 0.99 1.81	74.73 ± 2.31 5.37	19.41 ± 2.64 23.61	5.87 ± 0.93 27.56
Control	92.97 ± 0.38 0.72	72.63 ± 1.28 3.06	20.37 ± 1.32 11.20	7.0 ± 0.44 10.79

After dilution of sperm, the survival of sperm at a temperature of 22-24°C on average exceeded 63.0 hours. The highest rate (66.37 h) was recorded in experiment II, and the lowest value and the highest rate of variability for this indicator were sperm samples obtained from individuals from the control group – 63.1 h and 7.87%, respectively. In this experimental group,

the highest was the index of motility of non-diluted sperm, at a temperature of 22-24°C, it was 100.4 h and exceeded the index of experimental group I and control group by 2.63 and 3.31%, but the indicators in this group were the most variable, in particular, the variability index was almost 5% against 3.64 and 3.12 in experimental group I and control, respectively (Table 3).

Table 3. Sperm survival and oxidative enzyme activity of carp sperm, ($n = 4$; $M \pm m$)

Experimental option	Survival of diluted sperm at 22-24°C, h	Preservation of motility of non-diluted sperm at 22-24°C, h	Enzyme activity, units/h $\times$ 0.1 ml of sperm	
			SDH	COX
Experiment I	63.6 ± 0.53 1.45	97.83 ± 2.06 3.64	16.8 ± 0.71 7.31	27.47 ± 2.68 16.88
Experiment II	66.37 ± 1.20 3.14	100.4 ± 2.72 4.70	19.95 ± 2.98 25.87	32.7 ± 2.34 12.39
Control	63.10 ± 2.86 7.84	97.07 ± 1.75 3.12	17.9 ± 1.02 9.88	26.83 ± 1.30 8.39

It is known that the intensity of substrate used by individual links of the respiratory chain is a marker of physiological parameters and characterises the fertilising ability of germ cells [17]. From the analysis of the activity of oxidative enzymes of male carp sex products, it was established that the samples of the experimental groups, compared to the control, had higher values, which indicates the ability of germ cells to use substrates of the environment to provide energy requirements through the resynthesis of ROS in the respiratory chain

of mitochondria by adding hulled oats to the main diet.

This analysis demonstrated a significant variability of redox processes in male carp ejaculates. The highest activity of sperm enzymes was noted in the samples of the II experimental group. Thus, the average value of the SDH was 16.0 units/h $\times$ 0.1 ml of sperm, with a minimum value of 16.8 recorded in the I experimental group, and the maximum value – 19.85 units/h $\times$ 0.1 ml of sperm – in the II experimental group. Despite the highest rate,

the maximum value of variation was recorded in this group – 25.87%, compared to 7.31 and 9.88% in the experimental groups. The activity of the *COX* during the research demonstrated similar dynamics. With lower variability, compared to *SDH*, the maximum values were characterised by the samples of the II experimental group. The index of this group exceeded the index of the control group by 17.9%, and by 15.9% – of the I experimental group (Table 3).

Therewith, the quality of sperm depends both on the activity of enzymes and on the content of proteins and their fractions involved in protein metabolism. The analysis identified that the addition of hulled oats to the diet increases the content of protein fractions in semen. In particular, depending on the share of hulled oats in the main diet, the albumin content varied from 7.07 in the control to 9.80% (experiment with 30% content). A similar

upward trend was recorded among the values of γ -globulins (46.7-50.97%). Among the group of α -globulins, there is a tendency to decrease this indicator, depending on the content of the fodder supplement. Among the results of this group, there were significant differences among the values of the coefficient of variation. Thus, in the control group, it ranged from 1.39 to 4.96%, in experimental I – from 7.14 to 19.89, and in experimental II – from 4.56 to 21.88%. Instead, the trend in the distribution of soluble sperm protein fractions, depending on the feeding of hulled oats, could not be traced among the values of β -globulins and prealbumin. Thus, the maximum value of these indicators was respectively 7.47 and 24.64% in the control, the minimum value for the content of β -globulins (5.33%) – in experiment I, for the content of prealbumin (22.01%) – in experiment II (Table 4).

Table 4. Content of soluble protein fractions of carp sperm, % ($n = 4$, $M \pm m$)

Experimental option	γ -globulins	β -globulins	α_3 -globulins	α_2 -globulins	α_1 -globulins	Albumin	Prealbumins
Experiment I	49.27 ± 1.76 6.19	5.33 ± 0.50 16.38	4.60 ± 0.42 15.68	3.57 ± 0.41 19.89	4.20 ± 0.17 7.14	8.83 ± 0.65 12.72	24.2 ± 1.22 8.77
Experiment II	50.97 ± 1.11 3.77	7.35 ± 0.69 16.35	3.57 ± 0.27 13.25	3.10 ± 0.08 4.56	3.20 ± 0.40 21.88	9.80 ± 0.57 10.10	22.01 ± 1.59 12.44
Control	46.70 ± 1.14 4.24	7.47 ± 0.43 9.87	5.70 ± 0.16 4.96	4.17 ± 0.03 1.39	4.25 ± 0.04 1.66	7.07 ± 0.75 18.47	24.64 ± 0.97 6.81

The obtained data confirm that proteins in the fish body are in a dynamic state, which is provided by the processes of constant synthesis and decay. The latter are genetically determined and depend on the conditions of detention. In contrast to mammals, in fish, the share of amino acids only in the substrate of energy metabolism can be 50-90%.

Conclusions

It was established that additional feeding of hulled oats in the amount of 30% is effective. In particular, the addition of this proportion to the basic diet increases the total sperm activity by 1.32% and the rectilinear motion by 2.9% compared to the control. Thus, considering the increase in sperm productivity, which is

manifested in their higher activity, their ability to fertilise increases accordingly. In addition, there is an increase in the activity of enzymes of the respiratory chain - succinate dehydrogenase and cytochrome oxidase, which indicates an increase in the ability of germ cells to use substrates of the environment to meet energy needs through the resynthesis of ROS in the

respiratory chain of mitochondria. In addition, the lack of a distinct trend in the distribution of the total protein content and their fractional composition in the testes of carp, depending on the proportion of hulled oats in the main diet, can be explained by the action of many environmental factors, and depend on the season, age and physiological state of the body.

References

- [1] Ostapiv, D.D. (2008). Individual features of bull sperm production. *Animal Breeding and Genetics*, 42, 204-210.
- [2] Yaremchuk, I.M., Sharan, M.M., Andrushko, O.B., & Korniat, S.B. (2015). Changes in the dynamics of bulls sperm movement during the equilibrium period with addition of biologically active substances to the diluent. *Biology of Animals*, 17(3), 224.
- [3] Rurangwaa, E., Kime, D., Ollevier, F., & Nash, J. (2004). The measurement of sperm motility and factors affecting sperm quality in cultured fish. *Aquaculture*, 234, 1-28.
- [4] Martínez Páramo, S., Gavaia, P.J., & Riesco, M.F. (2014). Factors enhancing fish sperm quality and emerging tools for sperm analysis. *Aquaculture*, 432, 389-401.
- [5] Iurchak, S.V., Zabytivskyi, Yu.M., Deren, O.V., & Yaremchuk, I.M. (2018). Reproductive functions of male carp after feeding vitamin E and selenium during the pre-spawning period. *Bulletin of Agricultural Science*, 5, 36-40.
- [6] Makarenko, A., Mushtruk, M., Rudyk-Leuska, N., Kononenko, R., Shevchenko, P., Khyzhniak, M., Martseniuk, V., Kotovska, G., Klymkovetskyi, A., & Glebova, J. (2022). Investigation of internal organs and additive tissue of hybrid hypophthalmichthys (*Hypophthalmichthys* spp.) as a promising raw material for the production of dietary nutritional products. *Potravinarstvo Slovak Journal of Food Sciences*, 16, 411-430. doi: 10.5219/1760
- [7] Iaremchuk, I.M., & Sharan, M.M. (2012). Modern possibilities of sperm quality analysis and calculation of sperm doses. *Biology of Animals*, 14(1-2), 697-703.
- [8] Fauvel, C., Suquet, M., & Cosson, J. (2010). Evaluation of fish sperm quality. *Journal of Applied Ichthyology*, 26(5), 636-643.
- [9] Makarenko, A., Mushtruk, M., Rudyk-Leuska, N., Kononenko, I., Shevchenko, P., Khyzhniak, M., Martseniuk, N., Glebova, J., Bazaeva, A., & Khalturin, M. (2021). The study of the variability of morphobiological indicators of different size and weight groups of hybrid silver carp (*Hypophthalmichthys* spp.) as a promising direction of development of the fish processing industry. *Potravinarstvo Slovak Journal of Food Sciences*, 15, 181-191. doi: 10.5219/1537.
- [10] Kalachniuk, L.H. (2013). Activity of regulatory enzymes in the cell in disorders of the digestive system. *Biology of Animals*, 15(3), 31-37.
- [11] Kosenko, M.V., Chukhrii, B.M., & Kotsiumbas, I.I. (2007). *Reproductive function and andrological examination of bulls*. OP:Lviv.

- [12] Ruiz-Pesini, E., Diez, C., Lapeña, A.C., Pérez-Martos, A., Montoya, J., Alvarez, E., Arenas, J., & López-Pérez, M.J. (1998). Correlation of sperm motility with mitochondrial enzymatic activities. *Clinical Chemistry*, 44(8), 1616-1620.
- [13] Barbagallo, F., La Vignera, S., Cannarella, R., Aversa, A., Calogero, A.E., & Condorelli, R.A. (2020). Evaluation of sperm mitochondrial function: A key organelle for sperm motility. *Journal of Clinical Medicine*, 9(2), 363.
- [14] Linkevich, S.A., Linkevich, E.Y., Zubova, T.V., Sheiko, E.Y., & Bohdanovich, D.M. (2014). The quality of semen of boars-producers with the introduction of new norms of energy-protein nutrition. *Scientific Notes UO VGAVM*, 50(2-1), 175-178.
- [15] Dudchak, V.O., & Sharan, M.M. (2010). Relationship between succinate dehydrogenase and cytochrome oxidase activity in the semen of breeding bulls and fertility in donor cows with induced polioovulation. *Scientific Messenger of Lviv National University of Veterinary Medicine and Biotechnologies named after S.Z. Gzhytskyj*, 12, 2(44), 81-85.
- [16] Fang, Y., Zhao, C., Xiang, H., Zhao, X., & Zhong, R. (2020). *Melatonin inhibits formation of mitochondrial permeability transition pores and improves oxidative phosphorylation of frozen-thawed ram sperm*. Retrieved from <https://pubmed.ncbi.nlm.nih.gov/31969863/>.
- [17] Ahmed, H., Jahan, S., Salman, M. M., & Ullah, F. (2019). Stimulating effects of Quercetin (QUE) in tris citric acid extender on post thaw quality and in vivo fertility of buffalo (*Bubalus bubalis*) bull spermatozoa. *Theriogenology*, 134, 18-23.
- [18] Ismail, A.A., Abdel-Khalek, A.K.E., Khalil, W.A., Yousif, A.I., Saadeldin, I.M., Abomughaid, M.M., & El-Harairy, M.A. (2020). Effects of mint, thyme, and curcumin extract nanoformulations on the sperm quality, apoptosis, chromatin decondensation, enzyme activity, and oxidative status of cryopreserved goat semen. *Cryobiology*, 97, 144-152.

Характеристика біохімічних показників спермопродукції плідників коропа за використання в годівлі голозерного вівса впродовж переднерестового періоду

**Наталя Юріївна Сироватка¹, Ігор Іванович Грициняк¹,
Денис Анатолійович Сироватка¹, Ірина Митодіївна Яремчук²**

¹Інститут рибного господарства НААН України
03164, вул. Обухівська, 135, м. Київ-164, Україна

²Інститут біології тварин НААН України
79034, вул. Василя Стуса, 38, м. Львів, Україна

Анотація. Відновлення популяції прісноводних гідробіонтів та вирощування високопродуктивних плідників є ключовим етапом процесу відновлення нового покоління риб, тому задача підвищення рівня запліднюваності завжди актуальна для риболовецької галузі України. Мета дослідження – провести поглиблений аналіз фізіологічних характеристик еякулятів дихальної та репродуктивної здатності, дослідити активності ензимів дихального ланцюга мітохондрій, встановити відсоток виживання сперматозоїдів при застосуванні попередньо очищеного вівса, як основного компонента в раціоні коропа впродовж переднерестового періоду. У дослідженнях використовували самців нивківського внутрішньопородного типу української лускатої породи коропа, яких утримували впродовж переднерестового періоду в ставових умовах «ДП «ДГ Нивка» ІРГ НААН. Особин було поділено на 3 групи. Першій групі (Дослід I) згодовували 100 % голозерного вівса, другій (Дослід II) – 30 %, контрольній групі риб (Контроль) згодовували зернову суміш. Проведено оцінку якості статевих продуктів самців коропа способом визначення впливу додавання до їхнього раціону голозерного вівса впродовж переднерестового періоду. Досліджено показники рухливості та запліднювальної здатності сперми, вміст γ -, β - і α -глобулінів, альбуміну, преальбуміну та фізіологічні характеристики еякулятів дихальної й відновної здатності, активності ензимів дихального ланцюга мітохондрій (ЦХО та СДГ). З огляду на підвищення продуктивності сперміїв риб, зокрема збільшення кількості сперміїв з прямолінійно-поступальним рухом, зниження кількості неживих сперміїв та зміни білкової формули статевих клітин встановлено, що доцільним є додавання голозерного вівса до основного раціону в кількості 30 %. Згідно з результатами проведених досліджень встановлено, що додавання до складу кормів голозерного вівса впродовж переднерестового періоду позитивно впливає на кількісні та якісні показники статевих продуктів самців коропа, результати досліджень можуть бути корисними, як для студентів так і для працівників рибопереробної галузі України

Ключові слова: самці коропа, сперматозоїди, прямолінійно-поступальний рух, сукцинатдегідрогеназа, цитохромоксидаза, γ -, β - і α -глобуліни, преальбумін