O‘ZBEKISTON RESPUBLIKASI

OLIY TA’LIM, FAN VA INNOVATSIYALAR VAZIRLIGI

FARG‘ONA DAVLAT UNIVERSITETI

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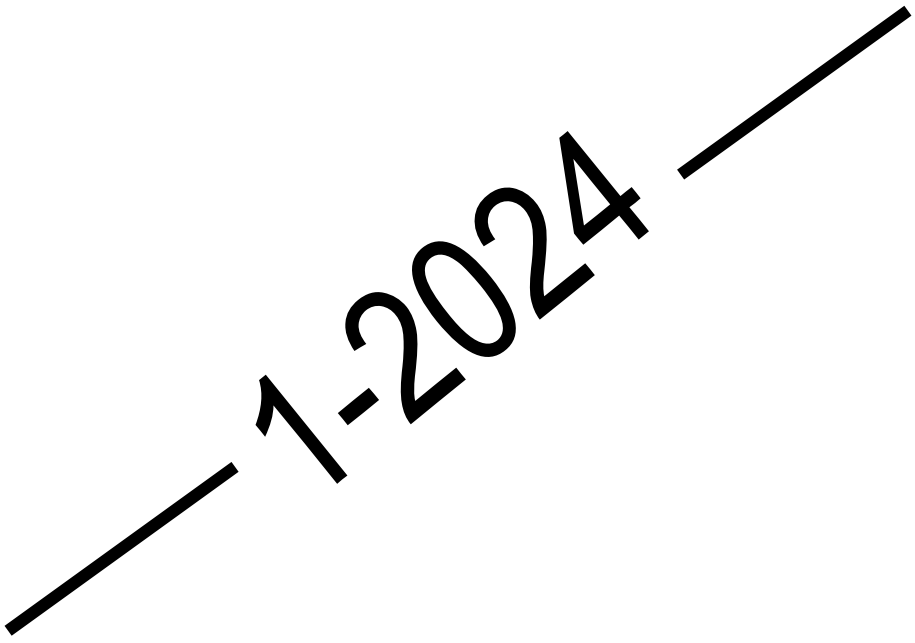

НАУЧНЫЙ ВЕСТНИК. ФерГУ

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concentration of the biologically active complex. Determination of the odor threshold was carried out in water at different initial concentrations of the drug (0.3-3.5 mg/l). According to the results of most odorators, the odor threshold is usually 1.5 mg/l. As a result of the statistical processing of the results, the sense of smell is determined to be 1.6 mg/l. The graphical method of determining the limit concentration allowed to set the limit concentration at the level of 1.5 mg/l, and the practical limit was set at 3.2 mg/l. In the studied concentrations, the drug did not affect the sanitary regime of water bodies. Analyzing the data obtained on the study of the effect of the drug on the organoleptic properties of water and the sanitary regime of water reservoirs, it was determined that the limiting sign of harmful effects is the organoleptic (odor) limit at the level of 1.5 mg/l. Taking into account the results of the sanitary-toxicological experiment, the (fixed coefficient) in water bodies is recommended at the level of 1.5 mg/l.

The following are recommended for standardization of harmful substances in the air that are widely used in practice, taking into account the parameters of toxicometry and physico-chemical properties of the drug, according to calculations and scientific bases: 0.05 mg/m^3 in atmospheric air, 2.5 mg/m^3 in the working air space.

According to the maximum permissible amount for food products, the approximate acceptable concentration in the soil - according to the standards approved for food, this drug is "not allowed" in cottonseed oil. The recommended standard in soil is 1.15 mg/kg.

Summarizing the obtained results, the hygienic standards and rules for the use of this complex in agriculture are presented in table 1.

Table 1

Hygienic standards and rules for the use of the complex in agriculture

№	Indicators	Value
1	Permissible coefficient in water bodies, mg/l	0,3
2	Permissible coefficient in the air of the working zone, mg/m^3	5
3	Permissible coefficient in atmospheric air, mg/m^3	0,05
4	Permissible value in soil, mg/kg	1,15
5	Maximum permissible amount in food products, mg/kg	«not allowed»
6	Sanitary-protection zone , m	100
7	Return to work period, day	7

CONCLUSION

Based on the received data, it was determined that the this biologically active complex belongs to substances of the III hazard class in terms of acute toxicity - low-risk compounds. This drug has a slow functional cumulative effect, has a weak irritating effect on the mucous membrane of the eye, and does not have a negative effect on the skin. All the identified indicators show that this biologically active drug can be widely used in agriculture.

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DITERPENE ALKALOID FROM *DELPHINIUM OREOPHILUM* AND ANTIOXIDANT ACTIVITY

DELPHINIUM OREOPHILUM O‘SIMLIGIDAN ANIQLANGAN DITERPEN ALKALOID VA ANTIOKSIDANT FAOLLIGI

ДИТЕРПЕНОВЫЙ АЛКАЛОИД ИЗ *DELPHINIUM OREOPHILUM* И АНТИОКСИДАНТНАЯ АКТИВНОСТЬ

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Annotatsiya

Delphinium oreophilum o‘simligining yer ustki qismi Zomin va Yangiqo‘rg‘on tumani tog‘ yonbag‘irlaridan yig‘ib olindi. O‘simlik tarkibidagi alkaloidlarni o‘rganish maqsadida o‘simlik salqin joyda quritildi, maydalandi va 70% li etil spirit bilan ekstraksiya qilindi. O‘simlikning spirtli ekstrakti etil atsetatli va xloroformli fraksiyalarga ajratildi. Xloraformli fraksiyadan diterpen alkaloidlar yig‘indisi ajratib olindi. Olingan birikmalar MS, 1D, 2D YaMR spektrlari yorgamida analiz qilindi. Antioksidant faollik DPPH tahlili bilan amalga oshirildi. Olingan analiz natijalari tahlil qilindi va birikmalardan biri Lycoctonine ekanligi aniqlandi. Moddaning turli konsentratsiyalarda antioksidant faolligi o‘rganildi.

Аннотация

Надземную часть растения Delphinium oreophilum заготовили со склонов гор Зоминского и Янгикурганского районов. Для изучения содержащихся в растении алкалоидов растение высушивали в прохладном месте, измельчали и экстрагировали 70%-ным этиловым спиртом. Спиртовой экстракт растения разделили на этилацетатную и хлороформовую фракции. Из хлороформной фракции выделена сумма дитерпеновых алкалоидов. Полученные соединения анализировали по спектрам МС, 1D, 2D ЯМР. Антиоксидантную активность определяли с помощью анализа DPPH. Результаты анализа были проанализированы и одним из соединений оказался Ликоктонин. Изучена антиоксидантная активность вещества в различных концентрациях.

Abstract

The aerial parts of the Delphinium oreophilum plant was harvested from the mountain slopes of Zomin and Yangikurgan districts. In order to study the alkaloids contained in the plant, the plant was dried in a cool place, crushed and extracted with 70% ethyl alcohol. The alcoholic extract of the plant was divided into ethyl acetate and chloroform fractions. A sum of diterpene alkaloids was isolated from the chloroform fraction. The obtained compounds were analyzed by 1H and 13C NMR spectra. Antioxidant activity was performed by DPPH assay. The results of the analysis were analyzed and one of the compounds was found to be Lycoctonine. The antioxidant activity of the compound in different concentrations was studied.

Kalit so‘zlar: *Delphinium oreophilum, Ranunculaceae, diterpene alkaloidlar, Lycoctonine, ^{1}H va ^{13}C YaMR spektrlari, antioksidant faolligi.*

Ключевые слова: *Delphinium oreophilum, Ranunculaceae, дитерпеновые алкалоиды, Ликоктонин, ^{1}H и ^{13}C ЯМР-спектры, антиоксидантная активность.*

Key words: *Delphinium oreophilum, Ranunculaceae; diterpene alkaloids; Lycoctonine, ^{1}H and ^{13}C NMR spectra, antioxidant activity*

1. INTRODUCTION

Delphinium L. is a large plant belonging to the *Ranunculaceae* family. This species includes about 350 species, which of 22 species have been identified in Uzbekistan [1]. Most of the alkaloids contained in the *Delphinium* L. plant correspond to the flowering period of the plant. The amount of alkaloids was determined mainly from the above-ground part of the plant.

Delphinium oreophilum Huth is a perennial plant with a height of 30-60 cm and grows in the middle and upper mountain ranges of Jizzakh and Yangikurgan [1]. At first, the alkaloid content of this species was little studied [2,3]. For this reason, we started to study the above-ground part of *D. oreophilum* collected from Jizzakh mountain ranges during the flowering period. Essential oils, macro and microelements [4,5] and alkaloids contained in the alcoholic extract of the plant were studied during our work [6,7]. One of them is Lycoctonine, which belongs to the type of lycoctonine, which is a C19-diterpene alkaloid [8,9]. The structure of the isolated compound was determined using 1D, 2D NMR spectroscopy, mass spectrometry (MS).

C_{18}, C_{19}, C_{20}-diterpene alkaloids were mainly isolated from *Delphinium L.* plant species. Lycoctonine-type alkaloids belong to the group of C19-diterpene alkaloids. Alkaloids of this type are considered important for medicine and folk medicine, in particular, they have been used for a long time in folk medicine for the treatment of rheumatism and neuralgia. Diterpenoid alkaloids and their derivatives identified in this plant are cytotoxic against lung (A549), vincristine-resistant nasopharyngeal (KB-VIN), prostate (DU145) and triple negative breast cancer (MDA-MB-231) cancer cell lines. showed activity.

2. EXPERIMENTAL

2.1. General experimental procedures

Mass spectra were measured in an LC/MS-IT-TOF mass spectrometer (Shimadzu, Kyoto, Japan). 1D and 2D NMR spectra were taken with TMS internal standard on Avance III-500 or Avance III-600 spectrometers (Bruker, Bremerhaven, Germany). TLC monitoring used GF254 silica gel plates (Yantai Jiangyou Silicon Development Co., Yantai, China). Column chromatography (CC) used silica gel (200–300 mesh, Linyi Haixiang Co., Ltd., Linyi, China) and Sephadex LH-20 (Amersham Bioscience, Sweden).

2.2. Plant materials

D. oreophilum was collected in July 2018 in the Zomin and Yangikurgan mountains at an altitude of 800-1000 m. The plant passport is defined in the national herbarium fund of the Institute of Botany of the Academy of Sciences of Uzbekistan under the number DM0371.

2.3. Extraction and separation

The aboveground part of the air-dried plant *D. oreophilum* (2.8 kg) was extracted three times with 70% ethanol. The extracts were filtered and distilled under vacuum. The residue was dissolved in 1 liter of water and extracted with ethyl acetate. The mother cell was brought to pH = 9~10 by adding a dilute NaOH solution and extracted three times with chloroform. After solvent distillation, the resulting residue (22 g) was chromatographed over a column of silica gel with elution by CHCl3-MeOH (19:1, 9:1, 7:1, 4:1) (Frac. A-F). Fraction F (2.63 g) was rechromatographed over a column of silica gel with elution by $CHCl_3$-MeOH-Et_2NH (49:1:0.5-18:2:0.2) (Frac. F 1-4) The resulting fraction F-4 (447 mg) was again rechromatographed over a column of silica gel with elution by CHCl3-MeOH (19:1-4:1). As a result, compound (105 mg) was obtained

2.4. DPPH (1,1-diphenyl-2-picrylhydrazyl) free radical scavenging activity assay

Radical scavenging activity of the alkaloid was determined using DPPH as a reagent [10]. The reaction mixture containing test sample (1 mL) in different concentrations and DPPH (3 mL) (Sigma, 100 μM) in ethanol was taken and incubated in the dark for 30 min. Scavenging capacity was read spectrophotometrically by monitoring the decrease in absorbance at 517 nm. A lower absorbance of the reaction mixture indicated higher free radical scavenging activity. Ascorbic acid was used as positive control. All the chemicals used were of analytical grade (Sigma, USA). The percent DPPH scavenging effect was calculated using the following equation:

DPPH scavenging effect (%) = $[(A_{control} - A_{sample}) / A_{control}] \times 100\%$

where $A_{control}$ is the absorbance of the control, and A_{sample} is the absorbance of the sample.

3. RESULTS AND DISCUSSION

Lycoctonine (Delsine; Royline) colorless needle-shaped crystals with m.p. 136-140 °C (EtOH) [8]. MS *m/z* 468.2977 $[M + H]^+$(calcd for $C_{25}H_{41}NO_7$ 467.6) [11]. IUPAC name: 11-ethyl-13-(hydroxymethyl) -4,6,16,18-tetramethoxy-11-azahexacyclo (7.7.2.12, 5.01,10.03, 8.013, 17) nonadecane-8,9-diol (Fig. 1)

^{1}H NMR spectrum (600 MHz, $CDCl_3$, δ, ppm, J/Hz): 1.05 (3H, t, N-CH_2 CH_3), 1.52 (1H, ddd, J=13.18, 4.80, H-15a), 1.65 (2H, m, H-3), 1.69 (1H, br. s, H-5), 1.87 (1H, ddd, H-12a), 1.91 (1H, m, H-10), 2.06 (1H, m, H- 2a), 2.14 (1H, m, H-2b), 2.40 (1H, dd, J=14.55, 5.11, H- 12b), 2.80 (1H, dd, N-CH_2),

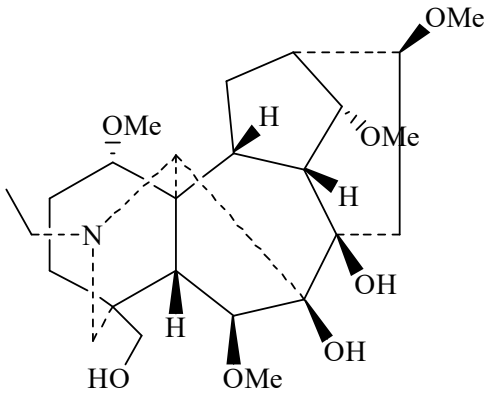

Fig. 1. Molecular structure of Lycoctonine

2.95 (1H, m, N-CH_2), 3.21 (1H, m, H-9),

3.25 (3H, s, 1- OCH_3), 3.34 (1H, s, 16- OCH_3), 3.36 (1H, d, H-18a) 3.41 (3H, s, 6-OCH3), , 3.45 (3H, s, 14-OCH3), 3.60 (1H, d, J=6.34 H-18b), 3.85 (1H, s, H-6).

^{13}C NMR spectrum (150 MHz, $CDCl_3$, δ, ppm, J/Hz): 84.45 (C-1), 26.21 (C-2), 31.68 (C-3), 38.70 (C-4), 43.38 (C-5), 90.69 (C-6), 88.54 (C-7), 77.70 (C-8), 49.67 (C-9), 38.13 (C-10), 49.02 (C-11), 28.88 (C-12), 46.21 (C-13), 84.05 (C-14), 33.71 (C-15), 82.76 (C-16), 65.08 (C-17), 67.81 (C-18), 52.85 (C -19), 51.34 (N-CH2), 14.30 (CH3), 55.99 (1-OCH3), 57.96 (6-OCH3), 58.06 (14-OCH3), 56.44 (16-OCH3). Based on the study of MS, ^{1}H, ^{13}C NMR spectra, compound 4 was identified as lycoctonine [8,9].

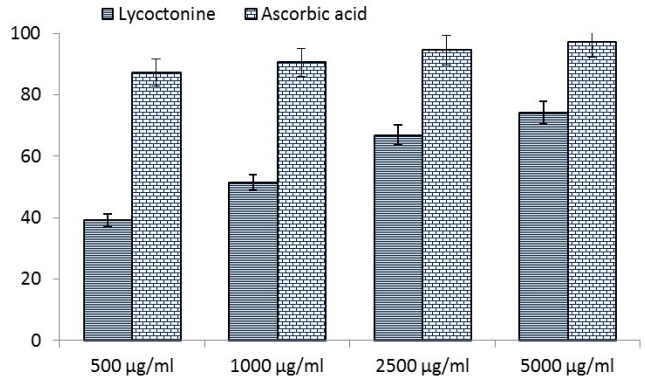

Fig. 2. Free radical scavenging activity of alkaloid (Lycoctonine) and ascorbic acid by DPPH radical.

Fig. 2 show the DPPH radical scavenging activity of Lycoctonine. Radical scavenging activity of these alkaloid increases with increasing dose. The difference between the tested alkaloid and control was statistically significant ($p < 0.05$). The scavenging effect of the alkaloid and standard on the DPPH radical decreased in the order ascorbic acid > Lycoctonine at all concentrations (500 µg/mL, 1000 µg/mL, 2500 µg/mL and 5000 µg/mL), demonstrating a linearity with increasing concentration.

CONCLUSION

The chemical composition of the plant *D. oreophilum* belonging to the genus *Delphinium* was studied. Many diterpene alkaloids have been isolated from the chloroform fraction of the plant extract, one of which is Lycoctonine, a C_{19}-diterpene alkaloid. Its antioxidant activity was similar to that of ascorbic acid, which was obtained as a standard substance.

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THERMOGENIC RESPIRATION IN MITOCHONDRIA OF SOME ANIMALS

ТЕРМОГЕННОЕ ДЫХАНИЕ В МИТОХОНДРИЯХ НЕКОТОРЫХ ЖИВОТНЫХ

BA'ZI HAYVONLARNING MITOXONDRIYALARIDA TERMOGEN NAFAS OLISH

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Abstract

In mitochondria of skeletal muscles of warm-blooded animals, two forms of respiration intensively function - coupled and uncoupled with ATP synthesis. In the cold-blooded animals, the uncoupled form of respiration is less developed. High-uncoupled respiration in mitochondria, considered as thermogenic, as well as efficiency, reducing the metabolic mechanism in warm-blooded organisms.

Аннотация

В митохондриях скелетных мышц теплокровных животных интенсивно функционируют две формы дыхания – сопряженные и несвязанные с синтезом АТФ. У хладнокровных животных несвязанная форма дыхания развита слабее. Высокое несвязанное дыхание в митохондриях считается термогенным, а также эффективным, снижающим метаболический механизм у теплокровных организмов.

Annotatsiya

Issiq qonli hayvonlarning skelet mushaklari mitoxondriyalarida nafas olishning ikkita shakli intensiv ishlaydi – ATF sintezi bilan bog'langan va bog'lanmagan. Sovuqqonli hayvonlarda nafas olishning bog'lanmagan shakli kam rivojlangan. Mitoxondriyadagi yuqori bog'lanmagan nafas olish, termogenik deb hisoblanadi, shuningdek, issiq qonli organizmlarda metabolik mexanizmni samaradorligini kamaytiradi.

Key words: *thermogenesis, skeletal muscles, mitochondria, warm and cold-blooded animals, heat production, ATP-synthesis.*

Ключевые слова: *термогенез, скелетные мышцы, митохондрии, тепло- и холоднокровные животные, теплопродукция, АТФ-синтез.*

Kalit so'zlar: *termogenez, skelet mushaklari, mitoxondriyalar, issiq va sovuqqonli hayvonlar, issiqlik hosil bo'lishi, ATF-sintezi*

INTRODUCTION

Mitochondrial bioenergetics performs various functions in the body, including thermogenesis in warm-blooded organisms. There is no clear answer to the question of whether mitochondria are related to thermogenesis. In this regard, various assumptions have been made [1] that need further refinement. Therefore, since the XIX century, it was generally accepted among biologists that all biological processes in the body proceed with low efficiency and this is an integral property of life regardless of the type of animal world [2-5]. This viewpoint was adopted from physics and chemistry where heat was considered because of an entropic process. Therefore, many scientists did not associate the problem of warm-bloodedness and thermogenesis with the specifics of living things, but attributed it to one of the manifestations of the general laws of nature [2-5].

Only in the process of certain studies, data were obtained in the direction that warm and cold-blooded organisms qualitatively, many times differ in the level of metabolism [6-11]. These results were a prerequisite for revising the nature of metabolism, in particular, for establishing the biological mechanism of thermogenesis, which can be responsible for the consumption of up to 80

- 90% of metabolic energy in the body, and only about 10-20% of the body energy of warm-blooded animals can be used for vital functions. Cold-blooded animals generate little heat, so little oxygen is consumed. Moreover, the efficiency of using the energy of metabolism in the latter is significantly higher than in warm-blooded animals [12-15]. It is possible that at the subcellular level, these groups of animals have different energy metabolic pathways. This question was not very popular at that time and was not widely considered in the literature. A comparative approach was also used at the mitochondrial level by studying their energetics in warm and cold-blooded organisms. Previous results showed that there is no qualitative difference between mitochondria of the compared animals, but only quantitative differences, which are not always clearly expressed [16-20]. In these works, the main way was studied phosphorylated ATP synthesizing respiration of mitochondria of tissues of different animal groups.

However, the study of this issue continued and in this regard, significant progress was made. The presence of uncoupling proteins in the inner mitochondrial membranes of various tissues was discovered [20]. However, thermogenic significance has been considered in brown adipose tissue [21]. In the mitochondria of other tissues, the uncoupling effect of these proteins was not specific, but an increase in proton leakage by these proteins into the inner mitochondrial membrane is indicated [21-23]. A comparison was carried out for membrane proton leakage in mitochondria of tissues in animals with different temperature status. It must be said that no large differences were found in the intensity of proton leakage in different groups of animals, although a lower level of this indicator was noted in cold-blooded animals [24]. It is believed that proton leakage is an important condition for the reduction of reactive oxygen species formed in mitochondria during oxidative processes.

There are also other works devoted to the study of coupled (ATP-synthesis) and uncoupled respiration in tissue mitochondria in different groups of animals. These studies showed uncoupled mitochondrial respiration, which showed about a 10-fold difference between mitochondria of different groups of animals for this indicator. The obtained results gave grounds for the continuation of comparative studies in this regard. In the available works [25-27], it is believed that the uncoupled form of respiration is associated with mitochondria of warm-blooded tissues. Their mitochondria are able to carry out not only coupled ATP synthesizing respiration, but also uncoupled respiration, which was the subject of additional research in this work using the mitochondria of skeletal muscles of warm and cold-blooded animals.

MATERIALS AND METHODS

Isolation of mitochondria from various animal tissues and the study of their respiration. Mitochondria from skeletal muscles were isolated by differential centrifugation [28, 29]. After decapitation of the animals, the necessary tissues were removed from the body cavity of the animal and placed in a cooled isolation medium containing 300 mM sucrose, 10 mM Tris-HCl (pH 7.5). This medium also contained 2 mM EDTA and 1 mg/ml bovine serum albumin (BSA). After preliminary grinding with a micropress, the tissue was homogenized in a homogenizer with a Teflon pestle in a 10-fold volume of isolation medium [28,29]. The homogenate was centrifuged at 700×g for 7 min. Mitochondria were precipitated from the supernatant at 6000×g for 20 min. The mitochondrial sediment was suspended in the same isolation medium (about 30–40 mg protein/ml) and stored in the cold at 0–2°C. Mitochondrial protein was determined according to Lowry method [30]. Oxidation of various substrates in mitochondria was measured polarographically using a rotating platinum electrode [30]. The incubation mixture contained 120 mM KCl, 5 mM KH_2PO_4, 2 mM EDTA, 10 mM Tris-HCl, pH 7.5. The following substrates were used: 5 mM succinate, 1 mM NADH, NADH + cytochrome c 1 mg, 20 mM ascorbate + 2.5 mg cytochrome c per ml, ADP was added to the chamber in portions of 100 μM. The phosphorylation process in mitochondria was assessed according to Chance-Williams [31]. The following symbols are used: V3 - respiration during phosphorylation, V4 - respiration after phosphorylation, Polarographic recordings of mitochondrial respiration were made at 25°C.

RESULTS AND DISCUSSIONS

It must be said that mitochondria, as the energy system of the cell, has long been the subject of research by scientists and to our time they can present certain surprises, in particular, when comparing warm and cold-blooded organisms.

In this work, we have studied mitochondria of skeletal muscles of different animals. In relation to phosphorylated ATP-synthesizing respiration, Table 1 shows a certain difference between the compared animals. Thus, in warm-blooded rats, succinate oxidation occurs at an increased rate of V3 and V4. Under the same conditions, the rates of glutamate oxidation are slower. Therefore, according to the value of metabolic rates, it can be seen that here the respiration rates are much lower than on the succinate substrate, and the respiration control value (respiratory coupling) is noticeably higher on glutamate.

The obtained data on mitochondria of rat muscles show that they are characterized by higher metabolic rates for succinate (FAD-dependent substrate) than for glutamate (NAD-dependent substrate. Succinate also shows less coupling of oxidation (less RC value) with ATP synthesis than glutamate. In general, the difference between these oxidation substrates is quite large. Unequal coupling between these oxidation substrates can have a certain physiological meaning. The more uncoupled oxidation of succinate indicates its greater thermogeny than the oxidation of glutamate.

As previously shown, the oxidation of these two substrates occurs along two different respiratory chains [1] - along the coupled (glutamate) and partially along the uncoupled pathway (succinate).

Table 1. Mitochondrial respiration in skeletal muscles of marsh frogs, turtles and rats (substrates - succinate and glutamate, 4 mM each)

Oxidation substrates	V_3	V_4	RC	ADP/O
Rat tissue mitochondria				
succinate	117±12.1	57.0±5,8	2.1	1.6±0.3
glutamate	68.7±7.1	18.05±2.1	3.8	2.6±0.4
Mitochondria of marsh frog tissues				
succinate	41.6±3.4	11.9±2.1	3.5	1.8±0.21
glutamate	31.5±3.1	7.56±2.1	4.2	2.65±0.3
Turtle muscle mitochondria				
succinate	30.2±3.2	8.4±1.6	3.6	1.8±0.3
glutamate	24.4±2.1	5.54±1.1	4.4	2.7±0.4

V_3 V_4 – respiration rate of mitochondria in nanograms of oxygen atoms per minute per milligram of protein - (ng-at O/min mg of protein).

In the study of mitochondria of frogs and turtles skeletal muscles, we obtained certain important differences from the mitochondria of rats. Thus, the difference between succinate and glutamate in cold-blooded animals is less pronounced (Table 1). In cold-blooded animals, the rate of oxidation is lower and the coupling of respiration with the process of ATP synthesis is higher, since mitochondria have high RC and ADP/O values on both succinate and glutamate.

Studies on cold-blooded animals showed the possibility of other metabolic pathways in the oxidation of substrates; in particular, their mitochondria are more coupled during the oxidation of various substrates. In warm-blooded rats, mitochondrial respiration on succinate can be directly related to heat production, since, in addition to phosphorylating oxidation, it has a higher level of uncoupled oxidation. Earlier, a similar phenomenon was found on mitochondria of other tissue warm-blooded animals [25]. Mitochondria of cold-blooded organisms are characterized by a significantly lower severity of uncoupled oxidation of substrates that is confirmed in further studies.

Earlier, in previous works, it was shown that in mitochondria of warm-blooded organisms other substrates are also oxidized in addition to succinate in an uncoupled way, particularly NADH [25, 26]. It was of interest to study the manifestation of such oxidation in mitochondria of such a massive body tissue as skeletal muscle. Table 2 shows the results of the studies carried out in a comparative way.

Table 2. Uncoupled oxidation NADH and ascorbate in mitochondria of skeletal muscles of different animals

Animals	NADH	NADH+ cytochrome c	Ascorbate +cytochrome c
Rats	82.6± 3,2	155.8±5,4	165.7±7,5
Marsh frogs	15, 21±1.4	17.81± 1,8	32,61±2,6
Steppe turtle	6,4±0,8	11,3±1,1	18,6±1.6

Mitochondrial respiration rate is presented in nanogram atoms oxygen in min of mg of protein (ng-atom O/min mg of protein)

As shown in the table, the NADH substrate is oxidized very intensively in the mitochondria of rat skeletal muscles, and in the presence of cytochrome c, its oxidation is further enhanced. This oxidation is uncoupled, since it does not change when ADP or the uncoupler - dinitrophenol is added to mitochondria. Consequently, this oxidation is not involved in ATP synthesis and can be directly related to heat production, as it proceeds intensively in a warm-blooded animal.

Use of NADH as a substrate for NADH oxidase in mitochondria of skeletal muscles of frogs and turtles has shown that its oxidation proceeds at a very low rate. Moreover, the addition of cytochrome c causes only a slight stimulation of oxidation. It can be said that uncoupled oxidation is poorly expressed in mitochondria of skeletal muscles of cold-blooded organisms and may be directly related to maintaining a low level of metabolism in these groups of animals.

Table 2 also shows the features of the oxidation of ascorbate + cytochrome c - as a substrate of cytochrome oxidase in mitochondria of skeletal muscles of warm and cold-blooded animals. It can be seen that this substrate is intensively oxidized in mitochondria of warm-blooded rats and is poorly utilized in mitochondria of cold-blooded animals. This oxidation is also uncoupled with ATP synthesis, since it is not affected by ADP and dinitrophenol (not shown). Therefore, it is directly related to heat production.

Studies have shown that an uncoupled respiratory chain functions in mitochondria of skeletal muscles of warm-blooded animals that intensively oxidizes NADH and ascorbate + cytochrome c, and partially succinate. This respiratory chain is very weak in mitochondria of skeletal muscles of cold-blooded animals.

CONCLUSION

This uncoupled respiratory system is not the result of mitochondrial damage. During homogenization of muscle tissue or by centrifugation, as previously suggested [32]. We have previously checked their nativeness by studying the nature of the manifestation of uncoupled oxidation of various substrates in a cell preparation [33]. It was confirmed that the uncoupled oxidation of the above investigated substrates occurs uncoupled and with high intensity even inside isolated cells. Therefore, comparative studies were carried out in mitochondria of warm and cold-blooded animals, which made it possible to show the relationship of uncoupled respiration with thermogenesis, as well as to establish a number of functional features of the mitochondrial system.

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SHIMOLIY FARG‘ONA HUDUDI NO‘XAT AGROBIOTSENOZIDA UCHROVCHI TO‘G‘RIQANOTLI HASHAROTLAR BIOEKOLOGIYASI

БИОЭКОЛОГИЯ ПРЯМОКРЫЛЫХ НАСЕКОМЫХ В АГРОБИОЦЕНОЗЕ ГОРОХА СЕВЕРА ФЕРГАНСКОГО РЕГИОНА

BIOECOLOGY OF THREE-LITE INSECTS IN PEAS AGROBIOCENOSE OF THE NORTHERN FERGANA REGION

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Annotatsiya

Maqolada Shimoliy Farg‘ona no‘xat agrobiotsenozlarida uchraydigan hasharotlar haqida ma’lumotlar keltirilgan. Yig‘ilgan namunalar Shimoliy Farg‘ona no‘xat agrobiotsenozida 6 oila va 7 avlodga mansub 10 tur mavjudligini ko‘rsatdi. Shimoliy Farg‘onaning kontinental iqlim sharoiti bu hududda qo‘rg‘onli hasharotlarning tarqalishi va hayot aylanishiga sezilarli ta’sir ko‘rsatadi.

Аннотация

В статье представлены сведения о насекомых, встречающихся в агробиоценозах гороха Северной Ферганы. Собранные образцы показали, что в агробиоценозе гороха Северной Ферганы обнаружено 10 видов, принадлежащих к 6 семействам и 7 родам. Континентальные климатические условия Северной Ферганы оказывают существенное влияние на распространение и жизненный цикл чешуйчатых насекомых в этом районе.

Abstract

The article presents information about the insects found in the pea agrobiocenoses of the Northern Fergana. The collected samples showed that 10 species belonging to 6 families and 7 genera are found in the pea agrobiocenosis of Northern Fergana. The continental climatic conditions of Northern Fergana have a significant impact on the distribution and life cycle of the scaly insects in the area.

Kalit so‘zlar: *No‘xat agrotsenozi, to‘g‘riqanotlilar, bioekologiya, ozuqa resursi, muhit omillari, Shimoliy Farg‘ona.*

Ключевые слова: *Агроценоз гороха, прямокрылые, биоэкология, пищевые ресурсы, факторы внешней среды, Северная Фергана.*

Key words: *Pea agrocenosis, leguminous plants, bioecology, food resource, environmental factors, Northern Fergana.*

KIRISH

No‘xat agrotsenozlaridagi fitofaglar populyatsiyasining mavsumiy rivojlanish sur’atlari va turli mintaqalarda tarqalishini aniqlash, muhim turlarning zararini baholash hamda jiddiy zararkunandalarga qarshi kurash choralarini ishlab chiqish muhim ilmiy-amaliy ahamiyatga ega. Respublikamizda aholining ehtiyoji va bozor talablaridan kelib chiqib, no‘xat yetishtirish hajmi-yil sayin ortib bormoqda. Bu borada, jumladan, Namangan viloyatida no‘xat ekin maydonlari 11 ta tumanda yetishtirish yo‘lga qo‘yilgan.

Muammoning o‘rganilganlik darajasi va tadqiqot usullari. Vodiy hududida sabzavot-poliz ekinlari hasharotlari faunasi vaqti-vaqti bilan o‘rganib kelingan. Qator olimlarning ishlarida alohida turlar, yoki zararkunandalar guruhlari tadqiqot obyekti bo‘lgan. Jumladan, T.Tursunxo‘jayyev 1960-70-yillarda Sharqiy Farg‘ona hududi bo‘yicha [4], I.Zokirov Markaziy Farg‘ona hududi bo‘yicha turlar ro‘yxatini tuzgan bo‘lsa-da, ushbu ro‘yxatda no‘xat agrobiotsenozi hisobga olinmagan [1].

Maqolada qishloq xo‘jaligi entomologiyasi usullaridan foydalanilgan hamda so‘nggi o‘n yillikda Shimoliy Farg‘ona hududidan yig‘ilgan materiallar va olib borilgan kuzatish ishlari natijalari keltirilgan.

BIOLOGIYA

Tadqiqotning maqsadi no‘xat agrotsenozlarida uchrovchi to‘g‘riqanotli hasharotlar tur tarkibini aniqlash va ularni ekologik-faunistik jihatdan tahlil etish, muhim dominant turlarning bioekologik xususiyatlarini ochib berishdan iborat.

OLINGAN NATIJALAR

Shimoliy Farg‘ona hududidagi no‘xat agrotsenozlaridan yig‘ilgan to‘g‘riqanotlilar yilning turli mavsumlarida qayd etilib, hisobga olib borildi. Quyida ularning tasnifiy ro‘yxati, tarqalishiga oziqlanish xususiyatlari keltirilgan.

ORTHOPTERA – to‘g‘riqanotlilar turkumi
GRYLLIDAE oilasi

***Gryllus* Linnaeus, 1758 avlodi.**

1(1) *Gryllus bimaculatus* De Geer, 1773.

Tarqalishi: avlodning vakillari Yer yuzida keng tarqalgan. Avstraliyadan tashqari barcha mintaqalardagi tabiiy va madaniy senozlarda uchraydi. Vodiy sharoitida no‘xat agrobiotsenozlarida bir turi qayd etildi [1, 2].

Aniqlangan joyi va muddati: Namangan viloyati Chust tumani (Karnon, Karkidon, Axcha, Varzik, 15-20.05.2018, 2019, 2021); To‘raqo‘rg‘on (To‘raqo‘rg‘on shahar, 20-25.05.2019, 2021, 2022); Pop tumani (Vodiy, Beruniy, Uchbular, 13-18.05.2018,2021,2022); Chortoq tumani (Karaskan, 15.04-15.05.2018, 2019, 2021); Kosonsoy (Sharq yulduzi, Isparon, 15.04-23.04.2018, 2021; Isparon 24.04-14.05.2018, 2019, 2021); Yangiqo‘rg‘on tumani (Iskovot, 25.04-10.05.2018, 2019, 2021) qishloqlaridagi no‘xat agrobiotsenozlaridan tadqiqot yillari davomida qayd etildi. Turlar qayd etilgan qishloqlar koordinatalari 5-ilovada keltirilgan.

Bioekologiyasi: cho‘l transpalearktik turi. Polifag, aktiv fissurobiont. Bug‘doy, javdar, makkajo‘xori, no‘xat, yasmiq, loviya, lavlagi, kartoshka, tamaki, karam, sabzi, pomidor, shirin qalampir, piyoz, mevali pitomnik ekinlari va boshqalarning yosh nihollari novda, poya va barglarini iste’mol qiladi [2].

***Melanogryllus* Chopard, 1961 avlodi.**

Tarqalishi: Yevropa va Markaziy Osiyo mintaqalari uchun xos bo‘lgan tur. Shimoliy Amerikada ham topilgan. Namangan viloyatining ayrim hududlarida bitta turi aniqlandi.

2(1) *Melanogryllus desertus* (Pallas, 1771).

Aniqlangan joyi va muddati: Mingbuloq (Gulbog‘, 18-22.05.2018, 2019, 2021; Tegirmon, Guliston, 14-18.05.2018, 2020, 2021, 2022); Namangan tumani (Toshbuloq, 20-25.05.2018, 2019, 2021, 2022); Uychi tumani (G‘ayrat, 30.05-05.06., 2018, 2019, 2021, 2022); Pop (G‘urumsaroy, 20-25.2021); To‘raqo‘rg‘on tumani (Saroy, 25-27.05.2021) no‘xat agrotsenozlarida topildi.

Bioekologiyasi: cho‘l transpalearktik turi. Fissurobiont. Polifag. Bug‘doy, makkajo‘xori, no‘xat, loviya, lavlagi, kartoshka, tamaki, karam, sabzi, pomidor, shirin qalampir, piyoz, mevali pitomniklardagi yosh ko‘chatlarning poya, barg va gullari bilan oziqlanadi [3].

GRYLLOTALPIDAE oilasi

***Gryllotalpa* Latreille, 1802 avlodi.**

Tarqalishi: dunyo bo‘ylab keng tarqalgan turlar sirasiga kiradi. Xususan, Shimoliy Amerika, Shimoliy Afrika, Hindiston, Avstraliya, Yevropa va Osiyoda ko‘plab turlarining vakillari aniqlangan [3].

3(1) *Gryllotalpa gryllotalpa* (Linnaeus, 1758).

Aniqlangan joyi va muddati: Mingbuloq (Gulbog‘, Guliston, 18-22.05.2018, 2019, 2021); Namangan tumani (Toshbuloq, 20-26.05.2019; 2021); To‘raqo‘rg‘on (Shaxidon, 20-26.05.2019; 2021); Uychi (G‘ayrat, 29.05-7.06.2019).

Bioekologiyasi: polifag, kavlovchi geobiont. Ildizmevalar, o‘simlik ildizi, yomg‘ir chuvalchangi va tuproq hasharotlari bilan oziqlanadi.

4(2) *Gryllotalpa unispina* Saussure, 1874.

Aniqlangan joyi va muddati: To‘raqo‘rg‘on (Saroy, 20-25.04.2019, 2021, 2022); Pop (Beruniy, 14.04-22.04.2018, 2019); Uychi (G‘ayrat, 30.05-05.06.2018, 2019, 2022); Uchqo‘rg‘on (Chorvador, 24.04-23.05.2018, 2019, 2021); Chust (G‘ova, Karnon, 15.06.2022); (G‘ova – past tog‘ hududi boshlanishidagi no‘xat maydonida ilk marta topildi).

Bioekologiyasi: geobiont. Polifag. Ildizmevalar, o‘simlik ildizlari, tuproq hasharotlari bilan oziqlanadi [3].

ACRIDIDAE oilasi

***Calliptamus* Serville, 1831 avlodi.**

Tarqalishi: Yevropaga xos tur bo‘lib, Markaziy va Sharqiy Osiyo, Kavkaz, Janubi-G‘arbiy Sibir, Shimoliy Afrika, Kichik Osiyo, Eron, Afg‘oniston, Mongoliyada ham ko‘plab uchraydi [2, **3**].

5(1) *Calliptamus italicus italicus* (Linnaeus, 1758).

Aniqlangan joyi va muddati: Pop tumani (Xonobod, G‘urumsaroy, 18-22.05.2018); Chust tumani (Toshqo‘rg‘on, Baymoq, 27.04-15.05.2018, 2019, 2021); To‘raqo‘rg‘on tumani (Oqtosh, 25.04.-10.05.2018, 2019, 2021, 2022); Kosonsoy (Bahoriston, 25.05.2019); Mingbuloq (Avangard, Alami, Baynalminal, Gulbog‘, Guliston, Qozoqovul, Tegirmon, 15.05-10.06.2013, 2018, 2019, 2022); Namangan (Tepaqo‘rg‘on, 29.04.2017); Uychi tumani (G‘ayrat, 30.05-05.06.2018, 2022); Uchqo‘rg‘on (Ittifoq, 24.05.2019); Chortoq (Gulshan, 30.05.2019), Chust (Olmos, Shayon, 6.06.2021); Yangiqo‘rg‘on (Zarkent, Jo‘ra Oxunov 14.05.2014);

Bioekologiyasi: Yevropa-Qozog‘iston cho‘l turi. Keng polifag, fakultativ xortobiont. Deyarli barcha o‘simliklarning yashil qismlari bilan oziqlanadi [**3**].

6(2) *Calliptamus turanicus* Tarbinsky, 1930.

Aniqlangan joyi va muddati: Pop tumani (Uyg‘ur, G‘urumsaroy, Sang, 18-23.05.2018, 2019, 2021); To‘raqo‘rg‘on tumani (Saroy, Shaxidon, Oqtosh, 20-25.05.2019, 2022); Chortoq tumani (Soxibkor, 15-20.05.2019, 2021, 2022); Mingbuloq tumani (Tegirmon, Gulbog‘, Guliston, 14-18.05.2018, 2022).

Bioekologiyasi: polifag, xortobiont. O‘simliklarning yashil qismlari, o‘suv novdalari bilan oziqlanadi.

***Dociostaurus* Fieber, 1853 avlodi.**

Tarqalishi: Bu avlod vakillari Yevropa va Markaziy Osiyo uchun xos turlardir. Janubiy Amerikaning shimoliy qismida va Sharqiy Osiyoda juda kam tarqalgan.

7(1) *Dociostaurus maroccanus* (Thunberg, 1815).

Aniqlangan joyi va muddati: Pop tumani (Xonobod, G‘urumsaroy, Beruniy, 05.04-15.04.2018, 2019, 2021); Chust tumani (Baymoq, 18.04-27.04.2018, 2019, 2021); To‘raqo‘rg‘on tumani (Oqtosh, 25.04.-10.05.2018, 2019, 2021).

Bioekologiyasi: Yevropa-Osiyo cho‘l turi. Fakultativ xortobiont. Keng polifag, uchuvchi migrant. To‘da hosil qiladi. O‘simliklar yashil qismlari, nozik shox va novdalari hamda organik qoldiqlar bilan oziqlanadi.

8(2) *Dociostaurus kraussii* (Ingenitskii, 1897).

Aniqlangan joyi va muddati: Pop tumani (To‘da, 18-22.05.2018, 2019, 2021); Chust tumani (Baymoq, Karkidon, 17.05 -25.05.2018, 2019); Chortoq tumani (Muchum, 25.05-30.05.2018); Uychi tumani (Qizilrovot, Yangihayot, 30.05-05.06., 2018, 2019).

Bioekologiyasi: Yevropa-Osiyo cho‘l turi. Fakultativ xortobiont. Polifag. O‘simliklar va organik qoldiqlar bilan oziqlanadi.

TETTIGONIDAE oilasi

***Tettigonia* Linnaeus, 1758 avlodi.**

Tarqalishi: Yevropa, Rossiyaning Yevropa qismi, Shimoliy Afrika va Osiyo, Old Osiyo, Markaziy Osiyo, G‘arbiy Xitoy, Mongoliya, Shimoliy Hindistonda uchraydi [**2, 3**].

9(1) *Tettigonia viridissima* (Linnaeus, 1758).

Aniqlangan joyi va muddati: Pop tumani (Sang, G‘urumsaroy, 15.04-15.05.2018, 2019, 2021); To‘raqo‘rg‘on tumani (Oqtosh, Shaxidon, 25.04-10.05.2018, 2019, 2021); Uychi tumani (G‘ayrat, 25.04-10.05.2018, 2019); Uchqo‘rg‘on tumani (Chorvador, Guliston, Ittifoq, 25.04-15.05.2018, 2019).

Bioekologiyasi: Shimoliy cho‘l transpalearktik tur. Polifag, aktiv tamnobiont. Bu avlod vakillarining tana o‘lchami yirik bo‘lib, tanasi yashil yoki jigarrang tusda. O‘t o‘simliklar, daraxt va butalar yashil qismlari bilan oziqlanadi.

PYRGOMORPHIDAE oilasi

***Pyrgomorpha* Serville, 1838 avlodi.**

Tarqalishi: Yevropa, Afrika qit’asi, Markaziy Osiyo, Ozarbayjon, Armaniston, Shimoliy Afg‘oniston, Eron, Hindistonda tarqalgan [**1, 2, 3**].

10(1) *Pyrgomorpha bispinosa deserti* Bey-Bienko, 1951.

Aniqlangan joyi va muddati: Pop tumani (Sang, 05.04-25.04.2018, 2021); Uychi tumani (Birlashgan, G‘ayrat, 25.04-18.05.2019, 2021); Uchqo‘rg‘on tumani (Bo‘ston, Chorvador, Yangiyer, Guliston, 25.04-15.05.2018, 2019); Mingbuloq (Avangard, Alami, Baynalminal, Gulbog‘, Guliston, Qozoqovul, Tegirmon, 15.05-10.06.2013, 2018, 2019, 2022); Namangan (Tepaqo‘rg‘on, Sho‘rqo‘rg‘on, 29.04.2017; 30.05.2019); To‘raqo‘rg‘on (Oqtosh, 2-5.05.2018, 17-21.05.2022).

Bioekologiyasi: O‘rta Osiyo-Qozog‘iston cho‘l turi. Polifag, fakultativ xortobiont. O‘simliklarning yashil qismlari bilan oziqlanadi.

XULOSA

Yig‘ilgan namunalar Shimoliy Farg‘ona no‘xat agrobiotsenozida to‘g‘riqanotli hasharotlarning 6 oila 7 avlodiga mansub 10 turi uchrashini ko‘rsatdi. Shimoliy Farg‘onaning kontinental iqlim sharoiti to‘g‘riqanotli hasharotlarning hudud bo‘ylab tarqalishi va hayotiy sikliga jiddiy ta’sir etadi. No‘xat agrobiotsenozida uchrovchi to‘g‘riqanotli hasharotlarning hudud bo‘ylab ozuqa resursi va tarqalishi muhit omillariga chambarchas bog‘liqdir.

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