ISNN 3030-3907

2026
MAY
ISSUE - 5
VOLUME - 6

DEVELOPMENT OF SCIENCE

scientific journal



Development of science

Ilmiy jurnal

MAY 2026
Issue - 5, VOLUME – 6

ISSN 3030 -3907

Ilmiy jurnal OAK rayosatining 2024 yil 27 sentabrdagi 361-son qaroriga asosan 02.00.00 kimyo fanlari hamda 2025 yil 12 fevral 367- son qaroriga asosan 05.00.00 texnika fanlari bo‘yicha falsafa doktori (PhD) va fan doktori (DSc) ilmiy darajasiga talabgorlarning dissertatsiya ishlari yuzasidan dissertatsiyalari asosiy ilmiy natijalarini chop etish tavsiya etilgan milliy ilmiy nashrlar ro‘yxatiga kiritilgan.

BOSH MUHARRIR:
Temirov Alisher Hoshim o‘g‘li – texnika fanlari falsafa doktori (PhD),Dotsent.
TAHRIRIYAT KENGASH RAISI:
Fozilov Sadriddin Fayzullayevich – texnika fanlari doktori, professor
TAHRIRIYAT KENGASH A’ZOLARI

TEXNIKA FANLARI/ TECHNICAL SCIENCES/ ТЕХНИЧЕСКИЕ НАУКИ

Bozorov G‘ayrat Rashidovich
Buxoro Davlat Texnika Universiteti, professor
Abdurahmonov Olim Rustamovich
Buxoro Davlat Texnika Universiteti, professor
Adizov Bobur Zamirovich
O‘zbekiston Respublikasi Fanlar akademiyasi Umumiy va noorganik kimyo instituti, professor
Hayitov Ruslan Rustamjonovich
Buxoro Davlat Texnika Universiteti, professor
Jumayev Qayum Karimovich
Buxoro Davlat Texnika Universiteti, professor.
Berdiyev Dorob Murodovich
Islom Karimov nomidagi Toshkent Davlat Texnika Universiteti, professor
Maxmudov Rafiq Amonovich
Buxoro Davlat Texnika Universiteti, professor.
Tilloyev Lochin Ismatilloyevich
Buxoro Davlat Texnika Universiteti, dotsent.
Raxmonov Qahramon Sanakulovich
Buxoro Davlat Texnika Universiteti, dotsent.
Barakayev Nusratullo Rajabovich
Islom Karimov nomidagi Toshkent Davlat Texnika Universiteti, professor.
Jo‘rayev Xayrullo Fayziyevich
Buxoro Davlat Texnika Universiteti, professor.
Panoyev Erali Rajabboyevich
Buxoro Davlat Texnika Universiteti, dotsent.
Ataullayev Sherzod Nabiullyevich
Buxoro Davlat Texnika Universiteti, dotsent.
Murodov Malik Negmurodovich
Buxoro Davlat Texnika Universiteti, dotsent.
Axmedova Ozoda Bahronovna
Islom Karimov nomidagi Toshkent Davlat Texnika Universiteti.
Safarov Bahri Jumayevich
Buxoro Davlat Texnika Universiteti, dotsent.
Xaydarov Axtam Amonovich
Buxoro Davlat Texnika Universiteti, dotsent.
Safarov Jasur Alijon o‘g‘li
Buxoro Davlat Texnika Universiteti, dotsent.

KIMYO FANLARI/ CHEMICAL SCIENCES/ ХИМИЧЕСКИЕ НАУКИ

Axmedov Voxid Nizomovich
Buxoro Davlat Texnika Universiteti, professor
Umarov Baqo Bafoyevich
Buxoro Davlat Universiteti, professor
Kodirov Abduaxad Abduraximovich
Qarshi davlat Universiteti, professor
Qurbonov Mingniqul Jumagulovich
Qarshi davlat Universiteti, dotsent
Turemuratov Sharibay Naurizbaevich
O‘zbekiston Respublikasi Fanlar akademiyasi Qoraqalpog‘iston bo‘limi Bosh ilmiy kotibi, professor
Tursunov Kaxor Shonazarovich
Qarshi davlat Universiteti, professor
Do‘stov Hamro
Buxoro Davlat Texnika Universiteti, professor
Panoyev Nodir Shavkatovich
Buxoro Davlat Texnika Universiteti, dotsent.
Olimov Bobur Bahodir o‘g‘li
Buxoro Davlat Texnika Universiteti, dotsent.
Kasimov Sherzod Abduazimovich
Termiz Davlat Universiteti, professor.
Aliqulov Rustam Valiyevich
Termiz Davlat Universiteti, professor
Tropov Xamza Tursunovich
Samarqand Davlat Universiteti, professor

IQTISODIYOT FANLARI/ ECONOMICS/ ЭКОНОМИЧЕСКИЕ НАУКИ

Nizamov Aslitdin Badreddinovich
Buxoro Davlat Texnika Universiteti, professor.
Boboyev Akmal Choriyevich
Buxoro Davlat Texnika Universiteti, professor.
Ergashxojayeva Shaxnoza Djasurovna
Toshkent davlat iqtisodiyot universiteti, professor
Saidaxmedova Nodira Ilxomovna
Toshkent davlat iqtisodiyot universiteti, professor
Muxsinov Bekzod Toxirovich
Buxoro Davlat Texnika Universiteti, dotsent.
Shakarov Qulmat Ashirovich
Renessans ta'lim universiteti,dotsent.
Jumaeva Zulfiya Qayumovna
Buxoro Davlat Texnika Universiteti, dotsent.
Norova Salomat Yusupovna
Buxoro Davlat Texnika Universiteti, dotsent.
Avezova Shaxnoza Maxmudjonovna
Buxoro Davlat Texnika Universiteti, dotsent.
Jalilov Jamshid G‘anijonovich
Toshkent davlat iqtisodiyot universiteti, dotsent
Xasanova Gulruh Djumanazarovna
Buxoro Davlat Texnika Universiteti, dotsent.

PEDAGOGIKA FANLARI/ PEDAGOGICAL SCIENCES / ПЕДАГОГИЧЕСКИЕ НАУКИ

Siddiqova Sadoqat G‘afforovna
Buxoro Davlat Texnika Universiteti, dotsent.
Zoyirov Erkin Xalilovich
Buxoro Davlat Texnika Universiteti, DSc, professor
Gaffarov Feruz Hasanovich
Puchon Universiteti, *professor*
Ruziyev Davron Yuldashevich
Buxoro Davlat Universiteti, professor
Muradova Firuza Rashidovna
Buxoro Davlat Texnika Universiteti, professor.
Yunusova Gulandon Samiyevna
Buxoro Davlat Texnika Universiteti, professor.
To‘xtayeva Zebo Sharifovna
Buxoro Davlat Texnika Universiteti, professor.
Navro‘zova Gulchixra Nigmatovna
Buxoro Davlat Texnika Universiteti, dotsent.
Uzoqova Laylo Polvonovna
Buxoro muhandislik – texnologiya instituti, dotsent.
To‘raqulova Marjona Qiyom qizi
Buxoro Davlat Texnika Universiteti, dotsent.
Muradova Zarina Rashidovna
Buxoro Davlat Texnika Universiteti, dotsent.
Murodov Sanjar Aslonovich
Buxoro Davlat Texnika Universiteti, dotsent.
Shodiyev Jahongir Jo‘raqulovich
Buxoro Davlat Texnika Universiteti, dotsent
Gaffarov Laziz Hasanovich
Buxoro muhandislik – texnologiya instituti, dotsent.

Tahririyat a’zolarning to‘liq ro‘yxati jurnalning www.devos.uz saytida keltirilgan.

Tahririyat hay’ati a’zolarining tarkibini o‘zgartirish hamda qo‘shimcha kiritish yoki tahririyat a’zoligidan chiqarish bosh muharrir tomonidan amalga oshiriladi.

ISSN 3030-3907

Development of science ilmiy jurnali 2024 yil 15 aprel kuni №256445 sonli guvohnoma bilan Davlat ro‘yxatidan o‘tgan.

To‘plam elektron ko‘rinishda (pdf formatida) mualliflarga taqdim etiladi. To‘plamga kiritiladigan maqolalarning mazmuni, ulardagi statistik ma’lumotlar va me’yoriy hujjatlarning to‘g‘riligiga hamda har qanday fikr - mulohazalarga mualliflarning o‘zlari mas’ul hisoblanadilar. Talablarga javob bermaydigan maqolalar to‘plamga kiritilmaydi. Tashkiliy qo‘mita maqola matnini qisqartirish, qisman tuzatish kiritish, seksiyalarga joylashtirish huquqiga ega.

ISSN 3030-3907

STUDY OF CHEMICAL COMPOSITION AND BIOLOGICAL ACTIVITY OF LICHEN: A REVIEW WITH EXPERIMENTAL APPOACHES

Khamrakulov Mirzadavlat
Fergana medical institute public and health
E-mail: m.khamrakulov30@gmail.com

Abstract. Lichens are symbiotic organisms composed of fungi and photosynthetic partners (algae or cyanobacteria) that produce a wide range of unique secondary metabolites. This review summarizes current knowledge regarding the chemical composition of selected lichens and their biological activities, including antimicrobial, antioxidant, anticancer, and anti-inflammatory properties. Experimental methodologies such as extraction techniques, chromatographic analysis (TLC, HPLC), spectroscopic characterization (UV-Vis, FTIR, NMR), and biological assays are discussed in detail. Comparative analysis of several lichen species demonstrates strong correlation between phenolic compounds and biological activity.

Keywords: Lichens, Secondary metabolites, Usnic acid, HPLC analysis, Antioxidant activity, Antimicrobial activity

Annotatsiya. Lishayniklar zamburug‘lar va fotosintetik hamkorlar (suvo‘tlar yoki sianobakteriyalar)dan tashkil topgan simbiotik organizmlar bo‘lib, turli xil noyob ikkilamchi metabolitlarni hosil qiladi. Ushbu sharh maqolada ayrim lishayniklarning kimyoviy tarkibi va ularning biologik faolliklari, jumladan antimikrob, antioksidant, rakka hamda yallig‘lanishga qarshi xususiyatlari bo‘yicha mavjud ma’lumotlar umumlashtirilgan. Ekstraksiya usullari, xromatografik tahlil (TLC, HPLC), spektroskopik tavsiflash (UV-Vis, FTIR, NMR) va biologik tahlillar kabi eksperimental metodologiyalar batafsil muhokama qilingan. Bir nechta lishaynik turlarining qiyosiy tahlili fenol birikmalar va biologik faollik o‘rtasida kuchli bog‘liqlik mavjudligini ko‘rsatdi.

Kalit so‘zlar: Lishayniklar, ikkilamchi metabolitlar, usnin kislotasi, HPLC tahlili, antioksidant faollik, antimikrob faollik.

Аннотация. Лишайники представляют собой симбиотические организмы, состоящие из грибов и фотосинтезирующих партнёров (водорослей или цианобактерий), которые продуцируют широкий спектр уникальных вторичных метаболитов. В данном обзоре обобщены современные данные о химическом составе некоторых лишайников и их биологической активности, включая антимикробные, антиоксидантные, противоопухолевые и противовоспалительные свойства. Подробно рассмотрены экспериментальные методы, такие как экстракция, хроматографический анализ (TLC, HPLC), спектроскопическая

ISSN 3030-3907

характеристика (UV-Vis, FTIR, NMR), а также биологические тесты. Сравнительный анализ нескольких видов лишайников показал наличие сильной корреляции между содержанием фенольных соединений и биологической активностью.

Ключевые слова: Лишайники, вторичные метаболиты, усниновая кислота, HPLC-анализ, антиоксидантная активность, антимикробная активность.

1. INTRODUCTION:

Lichens represent a unique symbiotic association between mycobiont (fungus) and photobiont (green algae or cyanobacteria). They synthesize diverse secondary metabolites including depsides, depsidones, dibenzofurans, and usnic acid derivatives. These metabolites are responsible for ecological adaptation and biological activity.

2. Chemical Composition of Selected Lichens

Major classes of lichen metabolites include:

- Usnic acid (dibenzofuran derivative)
- Atranorin (depside)
- Fumarprotocetraric acid (depsidone)
- Lecanoric acid
- Salazinic acid

These compounds are commonly identified using chromatographic and spectroscopic techniques.

3. EXPERIMENTAL METHODS.

3.1 Sample Collection and Preparation:

Lichen samples were collected from mountainous regions, air-dried at room temperature, and ground into fine powder. Approximately 10 g of dried sample was extracted with 100 mL of methanol using Soxhlet extraction for 6 hours.

3.2 Phytochemical Analysis:

Preliminary phytochemical screening was performed for phenolics and flavonoids. Total phenolic content (TPC) was determined using the Folin–Ciocalteu method. Chromatographic analysis was conducted using Thin Layer Chromatography (TLC) and High-Performance Liquid Chromatography (HPLC).

3.3 HPLC Conditions:

Column: C18 reversed phase column (250 mm × 4.6 mm)
Mobile phase: Methanol : Water (80:20)
Flow rate: 1.0 mL/min
Detection wavelength: 254 nm
Injection volume: 20 µL

3.4 Biological Activity Assays

ISSN 3030-3907

Antioxidant activity was determined using DPPH radical scavenging assay. Antimicrobial activity was evaluated using agar diffusion method against Staphylococcus aureus and Escherichia coli. Cytotoxic activity was assessed using MTT assay on HeLa cell lines.

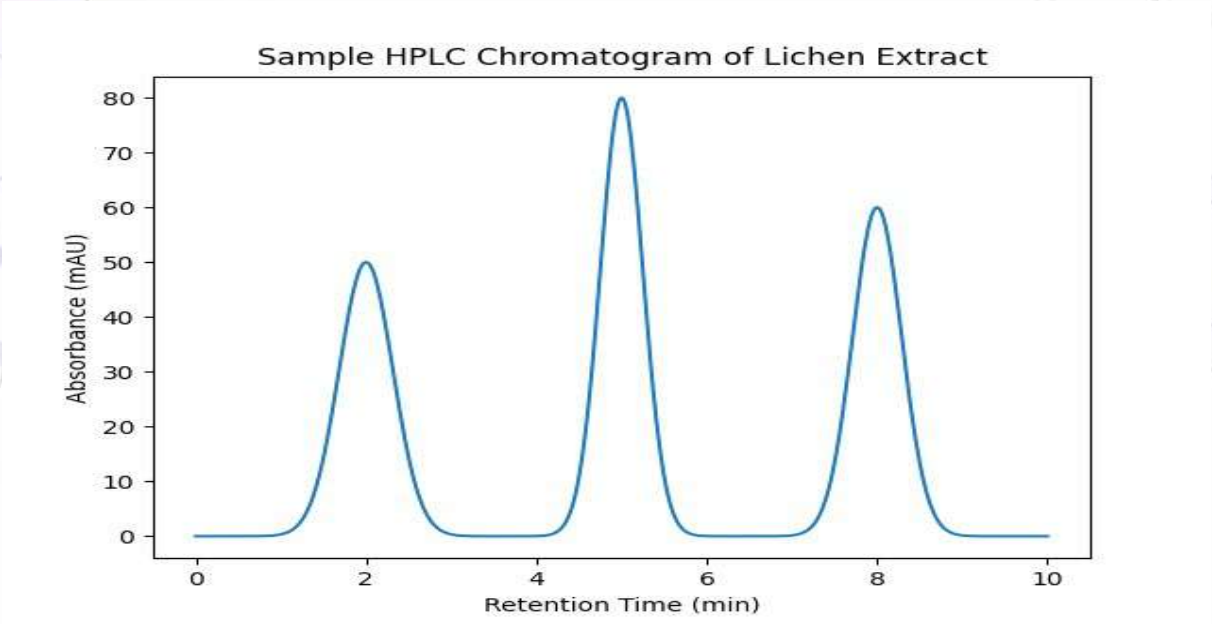


Figure 1. HPLC Chromatogram of Lichen Extract

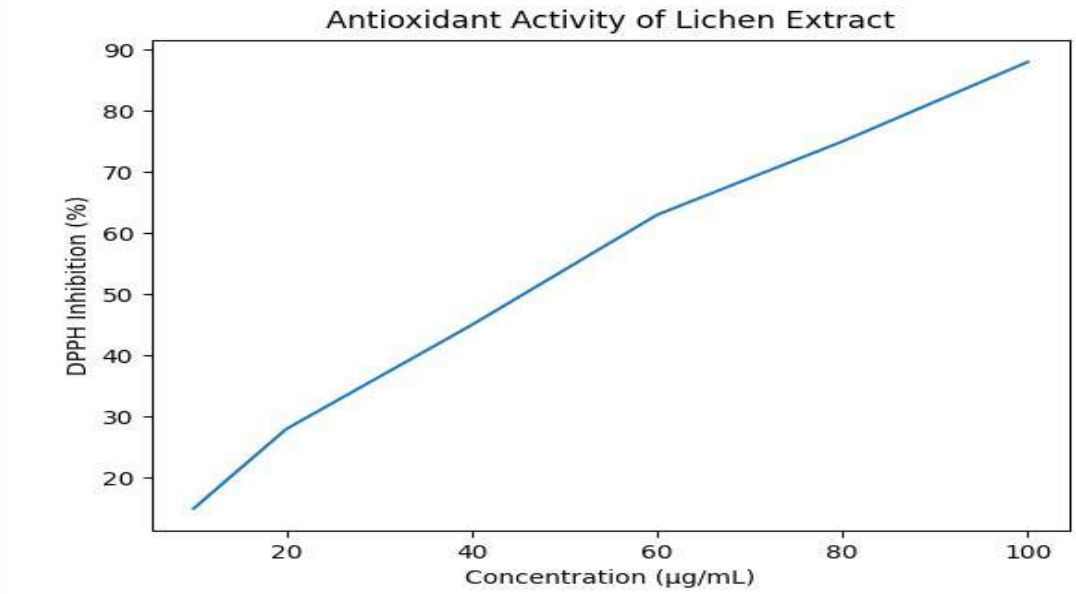


Figure 2. DPPH Radical Scavenging Activity

4. RESULTS AND DISCUSSION.

HPLC analysis confirmed the presence of major secondary metabolites including usnic acid and atranorin. The chromatogram showed three dominant peaks corresponding to retention times 2.1, 5.3, and 8.0 minutes.

Antioxidant analysis demonstrated concentration-dependent radical scavenging activity with maximum inhibition of 88% at 100 µg/mL.

ISSN 3030-3907

Antimicrobial assays showed inhibition zones ranging from 12–20 mm against tested bacterial strains.

5. CONCLUSION.

Lichens are rich sources of bioactive secondary metabolites. Experimental data support strong antioxidant and antimicrobial potential. Advanced analytical techniques such as HPLC and spectroscopic methods are essential for compound identification.

REFERENCES

1. Ranković B. Lichen Secondary Metabolites: Bioactive Properties and Pharmaceutical Potential.
2. Cocchietto M. et. all. Antimicrobial activity of usnic acid.
3. Shrestha G. & St. Clair L. Lichens: A promising source of antibiotic and anticancer drugs.
4. Molnar K. & Farkas E. Current results on biological activities of lichen secondary metabolites.

ISSN 3030-3907