



“DORIVOR O‘SIMLIKLARNI YETISHTIRISH VA ULARDAN FOYDALANISHNING DOLZARB MASALALARI” MAVZUSIDAGI O‘ZBEKISTON – XITOIY XALQARO SIMPOZIUMI MATERIALLARI TO‘PLAMI



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PROCEEDINGS OF UZBEKISTAN-CHINA INTERNATIONAL SYMPOSIUM ON "CURRENT ISSUES IN THE CULTIVATION AND UTILIZATION OF MEDICINAL PLANTS"



Tashkent, June 18-19, 2026

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“DORIVOR O‘SIMLIKLARNI YETISHTIRISH VA ULARDAN FOYDALANISHNING DOLZARB MASALALARI” MAVZUSIDAGI O‘ZBEKISTON – XITOIY XALQARO SIMPOZIUM DASTURI

SIMPOZIUM HAQIDA

“Dorivor o‘simliklarni yetishtirish va ulardan foydalanishning dolzarb masalalariga bag‘ishlangan O‘zbekiston – Xitoy xalqaro simpoziumi” – turli ilmiy maktablar va yosh olimlar o‘rtasida tajriba almashinuvini yo‘lga qo‘yish, mavjud tizimli muammolarning fundamental va amaliy yechimlarini ishlab chiqish hamda yangi qo‘shma transchegaraviy ilmiy loyihalarni shakllantirish uchun nufuzli integratsiya maydoni bo‘lib xizmat qiladi.

Xalqaro simpoziumni o‘tkazishdan ko‘zlangan bosh maqsad – O‘zbekiston va Xitoy Xalq Respublikasining dorivor o‘simliklarni yetishtirish, xomashyoni chuqur qayta ishlash, fitokimyo, biotexnologiya, agrotexnologiya, oziq-ovqat xavfsizligi, an‘anaviy tibbiyot va xalq tabobati sohalaridagi yetakchi olimlari, tadqiqotchilari hamda brend ishlab chiqaruvchilari (biznes sektori) o‘rtasidagi integratsiyani sifat jihatidan yangi bosqichga ko‘tarishga xizmat qiluvchi yuqori texnologik xalqaro platforma yaratishdan iboratdir.

Simpoziumning ustuvor konseptual vazifasi – dorivor o‘simliklar fito-industriyasida xomashyo yetishtirishdan tayyor yuqori qiymatli mahsulot ishlab chiqarishgacha bo‘lgan vertikal integratsiyani, ya‘ni «Urug‘dan – Bozorgacha» (Seed-to-Market) to‘liq qiymat zanjiri tamoyilini tizimli shakllantirish va ilmiy asoslashdan iboratdir.

SIMPOZIUM TASHKILOTCHILARI:

- ✓ O‘zbekiston Respublikasi Oliy ta‘lim, fan va innovatsiyalar vazirligi;
- ✓ «O‘zkimyosanoat» aksiyadorlik jamiyati (Toshkent, O‘zbekiston);
- ✓ Toshkent kimyo-texnologiya instituti (Toshkent, O‘zbekiston);
- ✓ Dorivor o‘simliklarni yetishtirish va qayta ishlash ilmiy-ishlab chiqarish markazi (Toshkent, O‘zbekiston);
- ✓ Shandun texnologiya universiteti (Zibo, Shandun, Xitoy);
- ✓ Silu texnologiya universiteti (Shandong fanlar akademiyasi, Jinan, Shandong, Xitoy);
- ✓ Shandun Fanlar akademiyasi, Ekologiya instituti (Silu texnologiya universiteti, Jinan, Xitoy);
- ✓ Nankin agrar universiteti (College of Plant Protection, Nankin, Xitoy);
- ✓ Nankay universiteti (School of Life Sciences, Tyanszin, Xitoy);
- ✓ Shimoliy-G‘arbiy qishloq va o‘rmon xo‘jaligi universiteti (Yanlin, Xitoy);
- ✓ Toshkent davlat agrar universiteti (Toshkent, O‘zbekiston);
- ✓ «Soil EcoBiotechnology» Xitoy-O‘zbekiston qo‘shma laboratoriyasi (Xitoy-O‘zbekiston).

HAMKOR TASHKILOTLAR

- ✓ O‘zbekiston Respublikasi Oliy Majlisi Senati Fan, ta‘lim va sog‘liqni saqlash masalalari qo‘mitasi;
- ✓ O‘zbekiston Respublikasi Fanlar Akademiyasi;
- ✓ O‘zbekiston oziq-ovqat sanoati uyushmasi;
- ✓ “O‘zyog‘moysanoat” uyushmasi;
- ✓ O‘zbekiston xalq tabobati assotsiatsiyasi;
- ✓ “SHANAZ” MChJ;
- ✓ “Health Line” MChJ;
- ✓ “Zuma Pharma” MChJ;

XALQARO TASHKILOTLAR:

- ✓ D.I.Mendeleyev nomidagi Rossiya kimyo-texnologiya universiteti;
- ✓ M.Auezov nomidagi Janubiy Qozog‘iston universiteti;
- ✓ “Respublika mikroorganizmlar kolleksiyasi” MCHJ (Qozog‘iston);
- ✓ Integral universiteti (Hindiston);
- ✓ Obuda universiteti (Vengriya);
- ✓ Jianshi universiteti (Xitoy).

- ✓ “Laxisam Pharmaceuticals” MChJ;
- ✓ “Bayan Medical” MChJ.

“DORIVOR O‘SIMLIKLARNI YETISHTIRISH VA ULARDAN FOYDALANISHNING DOLZARB MASALALARI” MAVZUSIDAGI O‘ZBEKISTON – XITOIY XALQARO SIMPOZIUMI”NING ILMIY QO‘MITA A‘ZOLARI

1. **Usmonov Botir Shukurillayevich** – TKTI rektori, professor – rais;
2. **Raximov Farxad Xushbakovich** – TKTI prorektori, professor – rais o‘rinbosari;
3. **Karabayev Dilshod Timurovich** – TKTI professori – simpozium kotibi;
4. **Safarov Toir Tursunovich** – TKTI prorektori, professor;
5. **Qodirov Bobiromon Bekmurodovich** – TKTI prorektori, professor;
6. **Boborajabov Baxodir Nasriddinovich** – TKTI prorektori, dotsent;
7. **Ziyadullayev Odiljon Egamberdiyevich** – TKTI prorektori, professor;
8. **Kamolov Azizbek Baxtiyor o‘g‘li** – TKTI bo‘lim boshlig‘i, dotsent;
9. **Buxorov Shuxrat Buriyevich** –TKTI dekani, professor;
10. **Normatov Anvar Mirzayevich** – TKTI dekani, professor;
11. **Xo‘jamshukurov Nortoji Abdixalikovich** – TKTI professori, «Soil EcoBiotechnology» Xitoy-O‘zbekiston qo‘shma laboratoriyasi mudiri;
12. **Nazarov G‘olib Abdushukurovich** – TKTI "Biotexnologiya" kafedrasi mudiri, dotsent;
13. **Babaxanova Zebo Abdullayevna** – TKTI professori;
14. **Toshmuxammedov Mugrajitdin Saloxovich** – TKTI professori;
15. **Serkayev Qamar Pardayevich** – TKTI professori;
16. **Izbasarov Baxrom Ergashevich** – Dorivor o‘simliklarni yetishtirish va qayta ishlash ilmiy-ishlab chiqarish markazi bosh direktori, professor;
17. **Bo‘riyev Hasan Chutbayevich** – Toshkent davlat agrar universiteti professori;
18. **Fangling Du** – Shandun texnologiya universiteti Partiya qo‘mitasi kotibi o‘rinbosari, professor (Xitoy);
19. **Yemin Guo** – Shandun texnologiya universiteti, Sabzavotlar xavfsizligi va sifatini nazorat qilish, muhandislik tadqiqot markazi direktori, professor (Xitoy);
20. **Xia Sun** – Shandong Texnologiya Universiteti, Shandong provicaial muhandislik tadqiqot markazi katta ilmiy xodimi, professor (Xitoy);
21. **Xiao Wang** – Kimyo va farmatsiya fakulteti direktori, Silu texnologiya universiteti, professor (Xitoy);
22. **Shanshan Wang** – Kimyo va farmatsiya fakulteti partiya kotibi o‘rinbosari, Silu texnologiya universiteti, professor (Xitoy);
23. **Wei Liu** – Shandong tahlil va sinov markazi direktori o‘rinbosari, Kimyo va farmatsiya fakulteti, Silu texnologiya universiteti, professor (Xitoy);
24. **Wei Liu** – Shandong tahlil va sinov markazi ilmiy xodimi, Silu texnologiya universiteti, dotsent (Xitoy);
25. **Jinqian Yu** – Sili texnologiya universiteti (Shandun Fanlar akademiyasi), Shandong Tahlil va Sinov Markazi katta ilmiy xodimi, dotsent (Xitoy);
26. **Jin-Hua Xiao** – Nankay universiteti professori (Xitoy);
27. **Jishun Li** – Shandun fanlar akademiyasi, Ekologiya instituti, Atrof-muhit mikroorganizmlari tadqiqot guruhi va «Soil EcoBiotechnology» Xitoy-O‘zbekiston qo‘shma laboratoriyasi direktori, professor (Silu texnologiya universiteti, Xitoy);
28. **Yanli Wei** – Shandun fanlar akademiyasi, Ekologiya instituti bosh ilmiy xodimi, professor (Silu texnologiya universiteti, Xitoy);
29. **Fajun Chen** – Nankin agrar universiteti professori (Xitoy);
30. **Kedelbayev Baxitjan** – M.Avezov nomidagi Janubiy Qozog‘iston tadqiqot universiteti professori;
31. **Temirxanov Aslan** - Respublika Mikroorganizmlar To‘plami (Qozog‘iston), professor;
32. **Nurbekova Jadirassin** - Yevroosiyo Milliy Universiteti dotsenti (Qozog‘iston);
33. **Farooqui Alvina** – Integral universiteti, Biomuhandislik kafedrasi mudiri, professor (Hindiston);

34. **Mukesh Kumar Awasthi** – Shimoliy-Gʻarbiy qishloq va oʻrmon xoʻjaligi universiteti dotsenti (Xitoy);
35. **Viktor Machtcherine** – Drezden Texnika Universiteti, Qurilish Materiallari Instituti direktori (Germaniya).

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Simpozium shoʻbalari

1-shoʻba. Dorivor oʻsimliklar bioxilma-xilligi, genofondi va zamonaviy agrotexnologiyalari

Rais: Dorivor oʻsimliklarni yetishtirish va qayta ishlash ilmiy-ishlab chiqarish markazi bosh direktori, professor **B.E.Izbasarov**.

Hamrais: “Biotexnologiya” kafedrası mudiri, dotsent **Gʻ.A.Nazarov**.

Kotib: “Biotexnologiya” kafedrası katta oʻqituvchisi **X.O.Abdullayev**.

2-shoʻba. Dorivor oʻsimliklar fitokimyosi, biotransformatsiyasi va xomashyoni chuqur qayta ishlash

Rais: Silu texnologiya universiteti (SDAS), Kimyo va farmatsiya fakulteti partiya kotibi oʻrinbosari, professor **Shanshan Van** (Xitoy);

Hamrais: “Oziq-ovqat va parfyumeriya-kosmetika mahsulotlari texnologiyasi” kafedrası mudiri, t.f.d., professor **A.T.Ruziboyev**.

Kotib: “Biotexnologiya” kafedrası katta oʻqituvchisi **A.Sh.Otajonov**.

3-shoʻba. Farmakologiya, tibbiyot va oziq-ovqat sanoatida dorivor oʻsimliklardan foydalanishning dolzarb masalalari

Rais: Shandun texnologiya universiteti Partiya kotibi, professor **Fangling Du** (Xitoy);

Hamrais: OʻzR FA akademik O.Sodiqov nomidagi “Bioorganik kimyo” instituti yetakchi ilmiy xodimi, k.f.n., k.i.x. **U.J.Ishimov**.

Kotib: “Biotexnologiya” kafedrası katta oʻqituvchisi **D.Sh.Matchanova**.

4-shoʻba. Fito-industriya iqtisodiyoti, marketing va xalqaro hamkorlik istiqbollari

Rais: Nankay universiteti professori **Jin-Hua Xiao** (Xitoy);

Hamrais: “Biotexnologiya” kafedrası professori, t.f.d., prof. **S.S.Ravshanov**.

Kotib: “Biotexnologiya” kafedrası katta oʻqituvchisi **F.B.Abdullayeva**.

Simpozium moderatorlari:

Pulatov Khayrulla Lutpullaevich - TKTI, «Sanoat ekologiyasi va yashil texnologiyalar» kafedrası professori;

Salijonova Shahnozaxon Dilmurodovna - TKTI, «Oziq-ovqat va parfyumeriya-kosmetika mahsulotlari texnologiyasi» kafedrası dotsenti, DSc.

Simpozium shakli

Simpozium turli xil formatlarni oʻz ichiga oladi, jumladan, ochilish marosimidan soʻng yalpi (planar), asosiy va taklif etilgan maʼruzalar tinglanadi. Parallel shoʻba majlislarida maʼruzalar taqdimoti boʻlib oʻtadi, poster maʼruzalar esa vorkshop (amaliy seminar) davomida namoyish etiladi. Simpozium gibril (ham offlayn, ham onlayn) formatda oʻtkaziladi.

Link for online participation:

<https://voovmeeting.com/dm/s4yb4fw9VBHJ>

#Tencent Meeting : 859-0871-0474

Rasmiy til

Simpoziumning rasmiy tillari oʻzbek va ingliz tillari hisoblanadi.

Muhim sanalar

18/06/2026 Tabrik soʻzi + Ochilish marosimi + Asosiy maʼruzalar + Shoʻba yigʻilishlari
19/06/2026 Asosiy maʼruzalar + Shoʻba yigʻilishlari + Yopilish marosimi + Toshkent boʻylab
ekskursiya (ixtiyoriy va toʻlov asosida*)

***Soʻrovlar yoki bekor qilish toʻgʻrisidagi bildirishnomalar quyidagi manzilga yuborilishi lozim:**

e-mail: kdtinfo659@gmail.com; *Telegram:* [@KDT0803](https://www.instagram.com/KDT0803)

PROGRAM

OF THE UZBEKISTAN-CHINA INTERNATIONAL SYMPOSIUM ON "CURRENT ISSUES IN THE CULTIVATION AND UTILIZATION OF MEDICINAL PLANTS"

ABOUT THE SYMPOSIUM

The Uzbekistan–China International Symposium on "Current Issues in the Cultivation and Utilization of Medicinal Plants" serves as a prestigious integration platform for establishing experience exchange between various scientific schools and young scientists, developing fundamental and practical solutions to existing systemic problems, and forming new joint transboundary scientific projects.

The main objective of the international symposium is to create a high-tech international platform that serves to elevate the integration between leading scientists, researchers, and brand manufacturers (the business sector) of Uzbekistan and the People's Republic of China in the fields of medicinal plant cultivation, advanced raw material processing, phytochemistry, biotechnology, agrotechnology, food safety, traditional medicine, and folk medicine to a qualitatively new level.

The priority conceptual task of the symposium is to systematically form and scientifically substantiate the vertical integration in the medicinal plant phyto-industry from raw material cultivation to the production of ready high-value products, specifically the complete value chain principle: "Seed-to-Market".

SYMPOSIUM ORGANIZERS:

- Ministry of Higher Education, Science and Innovations of the Republic of Uzbekistan;
- "Uzkimyosanoat" Joint-Stock Company (Tashkent, Uzbekistan);
- Tashkent Institute of Chemical Technology (Tashkent, Uzbekistan);
- Scientific and Production Center for the Cultivation and Processing of Medicinal Plants (Tashkent, Uzbekistan);
- Shandong University of Technology (Zibo, Shandong, China);
- Qilu University of Technology (Shandong Academy of Sciences), Faculty of Chemistry and Pharmacy, Shandong Analysis and Test Center (Jinan, Shandong, China);
- Institute of Ecology, Shandong Academy of Sciences (Qilu University of Technology, Jinan, China);
- Nanjing Agricultural University (College of Plant Protection, Nanjing, China);
- Nankai University (School of Life Sciences, Tianjin, China);
- Northwest A&F University (College of Natural Resources and Environment, Yangling, China);
- Tashkent State Agrarian University (Tashkent, Uzbekistan);
- Uzbek–Chinese Joint Laboratory of "Soil Eco Biotechnology" (Uzbekistan- China).

PARTNER ORGANIZATIONS

- ✓ Committee on Science, Education and Health of the Senate of the Oliy Majlis of the Republic of Uzbekistan;
- ✓ Academy of Sciences of the Republic of Uzbekistan;
- ✓ Uzbekistan Food Industry Association;
- ✓ "Uzyogmoysanoat" Association;
- ✓ The association of traditional medicine of Uzbekistan;
- ✓ "SHANAZ" LLC;
- ✓ "Health Line" LLC;

INTERNATIONAL ORGANIZATIONS

- ✓ Dresden University of Technology (Germany);
- ✓ Mendelev University of Chemical Technology of Russia;
- ✓ M.Auezov South Kazakhstan University;
- ✓ "Republican Collection of Microorganisms" LLP (Kazakhstan);
- ✓ Integral University Lucknow, India;
- ✓ Óbuda University, Hungary;
- ✓ Jiangsu University (China).

- ✓ “Zuma Pharma” LLC;
- ✓ “Laxisam Pharmaceuticals” LLC;
- ✓ “Bayan Medical” LLC.

Scientific Committee Members of the Uzbekistan–China International Symposium on "Current Issues in the Cultivation and Utilization of Medicinal Plants"

1. **Botir Usmonov** – Rector of TICT, Professor – Chairman;
2. **Farxad Raximov** – Vice-Rector of TICT, Professor – Vice-Chairman;
3. **Dilshod Karabayev** – Professor of TICT, – Symposium Secretary;
4. **Toir Safarov** – Vice-Rector of TICT, Professor;
5. **Bobiromon Kodirov** – Vice-Rector of TICT, Professor;
6. **Baxodir Boborajabov** – Vice-Rector of TICT, Professor;
7. **Odiljon Ziyadullayev** – Vice-Rector of TICT, Professor;
8. **Azizbek Kamolov** – Head of Department at TICT, Associate Professor;
9. **Shuxrat Buxorov** – Dean of the Faculty at TICT, Professor;
10. **Anvar Normatov** – Dean of the Faculty TICT, professor;
11. **Nortoji Khujamshukurov** – Professor at the TICT, Head of the Uzbek–Chinese Joint Laboratory of "Soil EcoBiotechnology", professor;
12. **G'olib Nazarov** – Head of the Department of Biotechnology at TICT, Associate Professor;
13. **Mugrajitdin Toshmuxammedov** – Professor of TICT;
14. **Zebo Babaxanova** – Professor at the TICT;
15. **Qamar Serkaev** - Professor at the TICT;
16. **Baxrom Izbasarov** – Director General of the Scientific and Production Center for the Cultivation and Processing of Medicinal Plants, Professor;
17. **Hasan Bo'riyev** - Professor at the Tashkent State Agrarian University;
18. **Fangling Du** – Deputy Secretary of the Party Committee of Shandong University of Technology, Professor (China);
19. **Yemin Guo** – Director of the Engineering Research Center for Vegetable Safety and Quality Control at Shandong University of Technology, Professor (China);
20. **Xia Sun** – Senior Researcher at the School of Agricultural Engineering and Food Science and the Shandong Provincial Engineering Research Center, Shandong University of Technology, Professor (China);
21. **Xiao Wang** – Director of the Faculty of Chemistry and Pharmacy, Qilu University of Technology, professor (SDAS, China);
22. **Shanshan Wang** – Deputy Party Secretary of the Faculty of Chemistry and Pharmacy, Qilu University of Technology, professor (SDAS, China);
23. **Wei Liu** - Deputy Director of Shandong Analysis and Test Center, Faculty of Chemistry and Pharmacy, Qilu University of Technology, professor (SDAS, China);
24. **Wei Liu** – Researcher at Shandong Analysis and Test Center, Qilu University of Technology, Associate Professor (SDAS, China);
25. **Jinqian Yu** – Senior Researcher at Shandong Analysis and Test Center, Qilu University of Technology, Associate Professor, (SDAS, China);
26. **Jin-Hua Xiao** – Professor at the Nankai University (China);
27. **Jishun Li** – Director of the Environmental Microbiology Research Group at the Institute of Ecology, Shandong Academy of Sciences (Qilu University of Technology) and Director of the Uzbek–Chinese Joint Laboratory of "Soil EcoBiotechnology", Professor (China);
28. **Yanli Wei** – Chief Researcher at the Institute of Ecology, Shandong Academy of Sciences, professor (Qilu University of Technology, China);

29. **Fajun Chen** – Professor at the Nanjing Agricultural University (China);
30. **Bakhytzhan Kedelbaev** – Professor at the M.Auezov South Kazakhstan Research University;
31. **Aslan Temirkhanov** – Scientific Secretary, Republican Collection of Microorganisms (Kazakhstan);
32. **Zhadyrassyn Nurbekova** - Associate professor, L.N.Gumilyov ENU (Kazakhstan);
33. **Farooqui Alvina** - Head Department of Bioengineering, Integral University, professor (India);
34. **Mukesh Kumar Awasthi** - Associate Professor, Northwest A&F University (China);
35. **Viktor Mechtcherine** – Director of the Institute of Construction Materials, Technische Universität Dresden (Germany).

Organizing Committee Members of the Uzbekistan–China International Symposium on "Current Issues in the Cultivation and Utilization of Medicinal Plants"

Scientific Sessions

Session 1. Biodiversity, Gene Pool, and Modern Agrotechnologies of Medicinal Plants

Chair: Professor **B.E.Izbasarov** – Director General of the Scientific and Production Center for the Cultivation and Processing of Medicinal Plants (Uzbekistan);

Co-Chair: Associate Professor **G'.A. Nazarov** – Head of the Department of Biotechnology, TICT (Uzbekistan);

Secretary: **X.O.Abdullayev** – Senior Lecturer at the Department of Biotechnology, TICT (Uzbekistan);

Session 2. Phytochemistry, Biotransformation, and Advanced Processing of Medicinal Plant Raw Materials

Chair: Professor **Shanshan Wang** - Deputy Party Secretary of the Faculty of Chemistry and Pharmacy, Qilu University of Technology (SDAS, China);

Co-Chair: Professor **A.T.Ruziboyev** – Head of the Department of Food and Perfume-Cosmetic Products Technology, professor, TICT, (Uzbekistan);

Secretary: **A.Sh.Otajonov** – Senior Lecturer at the Department of Biotechnology, TICT (Uzbekistan);

Session 3. Current Issues in the Utilization of Medicinal Plants in Pharmacology, Medicine, and the Food Industry

Chair: Professor **Fangling Du** – Party Secretary of Shandong University of Technology (China);

Co-Chair: Dr. **U.J.Ishimov** – Leading Researcher at the Institute of Bioorganic Chemistry named after Academician O.Sadikov of the Academy of Sciences of the Republic of Uzbekistan, PhD (Uzbekistan);

Secretary: Dr. **D.Sh.Matchanova** – Senior Lecturer at the Department of Biotechnology, TICT (Uzbekistan);

Session 4. Economics of Phyto-Industry, Marketing, and Prospects for International Cooperation

Chair: Professor **Jin-Hua Xiao** – Professor of Nankai University (China);

Co-Chair: Professor **S.S.Ravshanov** – Professor of the Department of Biotechnology, TICT (Uzbekistan);

Secretary: **F.B.Abdullayeva** – Senior Lecturer at the Department of Biotechnology, TICT (Uzbekistan);

Symposium Moderators

Khayrulla Pulatov - Professor of the Department of Industrial Ecology and Green Technologies, TICT.

Shakhnozakhon Salijonova - Associate Professor of the Department of Technology of Food and Perfumery-Cosmetic Products, DSc, TICT.

SYMPOSIUM FORMAT

The symposium will feature a diverse range of formats, including an opening ceremony followed by plenary, keynote, and invited lectures. Parallel sessions will host oral presentations, while poster presentations will be exhibited throughout the workshop. The symposium will be conducted in a hybrid (both offline and online) format. **Link for online participation:** <https://voovmeeting.com/dm/s4yb4fw9VBHJ> #Tencent Meeting : 859-0871-0474

Official Languages

Uzbek and English is used as the official language at the symposium.

Important dates

18/06/2026 Welcome + Opening ceremony + Keynote lectures + Parallel sessions
19/06/2026 Keynote lectures + Parallel sessions + Closing ceremony + *Excursion in Tashkent
(*optional and pay fee*)

***Inquiry or cancellation should be sent to:** e-mail: kdtinfo659@gmail.com; Telegram: [@KDT0803](https://t.me/KDT0803)

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Abstract. The synthesis, characterization and optimization of TiO₂, CuS and TiO₂/CuS composite nanomaterials for enhancing solar energy conversion efficiency was investigated. TiO₂ nanomaterials were developed using sol-gel method. CuS nanomaterials were synthesized using hydrothermal method. Then TiO₂/CuS composite nanomaterials were synthesized. These samples were analysed for their electrochemical, optical, morphological and structural properties.

X-ray diffraction and field emission scanning electron microscopy confirmed the successful formation of desired crystal phases and surface morphologies. Optical characterization revealed promising band gap energies and light absorption capabilities while electrochemical tests indicated improved photoactivity and stability.

The comparative study of TiO₂, CuS and TiO₂/CuS composite nanomaterials shows improved results in the composite form.

Keywords: Composite nanomaterials; sol-gel method; hydrothermal method; band gap; X-ray diffraction studies.

CARBOHYDRATE-BASED NANOCOMPOSITE HYDROGEL BIOMATERIALS: AN OVERVIEW OF THEIR SYNTHESIS AND FUTURE PERSPECTIVES

Spursh Srivastava*, Tahmeena Khan, Abdul Rahman Khan

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Abstract. In recent years, medicine has evolved rapidly with the rise of nanocomposite hydrogel biomaterials, which offer significant potential for a large range of biomedical applications. Nanocomposite hydrogels based on carbohydrates represent an evolved and good class of biomaterials in modern biomedical science. These hydrogels are primarily integrated using carbohydrate-based polymers such as cellulose, chitosan, and alginate, which are biocompatible, biodegradable, and renewable. However, these materials alone often have limitations, such as fragility and rapid degradation. To overcome these issues, researchers combine them with nanoparticles to form nanocomposite hydrogels. Mixing these materials makes them stronger, tougher, and more useful. Because they function as the body's natural building blocks, they blend seamlessly with real tissues. As a result, they are highly useful in applications like drug delivery, tissue engineering, wound healing, and degenerative medicine. These materials are great because they can release medicine exactly where and when it is needed. Scientists have recently upgraded how these are made—using special freezing methods,

chemical bonds, or built-in tiny particles—making them work even better and for many different uses. These materials are safer for the body because they cause fewer bad reactions and blend better with your natural tissues. Ultimately, these smart gels offer exciting new ways to address longstanding medical problems, paving the way for customised treatments designed just for you.

Keywords: Hydrogel, Nanocomposite, Biomaterial, Biocompatible, Carbohydrate

Introduction. The field of medicine has changed significantly due to the integration of new technologies and advanced materials. One of the most promising new developments is the use of nanocomposite hydrogel biomaterials, which have great potential for a large range of medical applications [1]. Incorporating nanoparticles into hydrogels enhances their properties and functions, helping to improve and transform modern healthcare [2]. These hydrogels are derived from biopolymers such as fibrin, silk, and keratin, which are biocompatible and renewable but exhibit poor mechanical properties and rapid degradation [3].

The present review was conducted through a comprehensive literature survey focusing on carbohydrate biopolymers, such as cellulose and starch, which are incorporated into hydrogels to overcome these limitations, yielding nanocomposite hydrogels with improved properties [3]. Combining nanotechnology with hydrogel-based systems offers a promising strategy for modulating the physicochemical and biological characteristics of biomaterials. Such advancements facilitate the design of application-specific materials that meet challenging biomedical requirements [4].

Research Methodology. Carbohydrate - based nanocomposite hydrogel biomaterials, with particular emphasis on their synthesis strategies and future perspectives. Relevant scientific articles were retrieved from electronic databases, including Scopus, Web of Science, PubMed, Google Scholar, and Science Direct.

The synthesis approaches used for carbohydrate-based nanocomposite hydrogels include physical crosslinking, chemical crosslinking, radiation-assisted techniques, freeze-thaw methods, and in situ nanoparticle formation [5]. The formulation and design of nanocomposite hydrogels require careful optimisation to achieve the desired performance and functionality [4].

Bovone et al. discuss a strategy to reinforce and expand polymer-nanoparticle (PNP) hydrogels [6]. PNP hydrogels are formed by mixing polymer chains and nanoparticles and can exhibit shear thinning and self-healing properties [6]. Similarly, Yang et al. created an injectable nanocomposite hydrogel to promote wound healing for infected chronic diabetic wounds [7]. Overall, various synthesis methods have been used to prepare carbohydrate-based nanocomposite hydrogels, each with advantages depending on the intended application.

Result and Discussion. The reviewed studies indicate that carbohydrate-based nanocomposite hydrogels possess improved properties compared to conventional hydrogels due to the incorporation of nanoparticles. Carbohydrate polymers such as chitosan, cellulose, and alginate have been extensively utilised because of their

biodegradability and biocompatibility [8]. Despite the promising characteristics of these biomaterials, challenges related to large-scale production and reproducibility still need to be addressed. Further research is required to optimise synthesis strategies and improve the practical applicability of carbohydrate-based nanocomposite hydrogels [8].

Conclusion. Natural biopolymers such as cellulose and chitosan offer inherent biocompatibility and renewability; their poor mechanical properties are mitigated by nanocomposite hydrogels. Hydrogel Biomaterials provide innovative solutions to longstanding challenges in drug delivery, tissue engineering, and regenerative medicine [3]. Carbohydrate-based nanocomposite hydrogels hold great potential for future healthcare advancements. Carbohydrate-based nanocomposites should be explored further, as they hold promise for improving patient outcomes and addressing unmet clinical needs.

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**BUG‘DOY KEPAGI VA ISIRIQ EKSTRAKTLARI ASOSIDA BIOLOGIK FAOL
KOMPLEKS OLIH VA UNING XUSUSIYATLARINI BAHOLASH**
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