UDC 577.18
AGRIS F60
https://doi.org/10.33619/2414-2948/121/14

PRODUCTION AND USE OF NATURAL ANTIBIOTICS

©Hasanov K., *ORCID: 0009-0007-1526-8770, Nakhchivan State University, Nakhchivan, Azerbaijan, Keremhesenov@ndu.edu.az*
©Rahimova S., *ORCID: 0009-0003-5867-5254, Nakhchivan State University, Nakhchivan, Azerbaijan, rahimovasure@ndu.edu.az*

ПРОИЗВОДСТВО И ИСПОЛЬЗОВАНИЕ ПРИРОДНЫХ АНТИБИОТИКОВ

©Гасанов К., *ORCID: 0009-0007-1526-8770, Нахчыванский государственный университет, г. Нахчыван, Азербайджан, Keremhesenov@ndu.edu.az*
©Рахимова С., *ORCID: 0009-0003-5867-5254 Нахчыванский государственный университет, г. Нахчыван, Азербайджан, rahimovasure@ndu.edu.az*

Abstract. This article presents an analysis of the biological, psychological, and social foundations of antibiotic dependence. An "artificial sense of security" and fear of illness exacerbate psychological dependence on antibiotics, leading to their inappropriate and repeated use. This behavior poses a serious threat not only to human health but also to public health systems and global infection control policies. Extraction and formulation technologies are considered, including the preparation of aqueous and alcohol extracts, tinctures and tinctures, as well as safe glycerin-based alternatives for children. Using the Nakhchivan region as an example, the potential of local flora and research infrastructure is analyzed. Preparations derived from plants common in the region, such as dogwood, garlic, propolis, sage, and mountain ginger, are considered important resources for integrating traditional medicine with modern biotechnology.

Аннотация. Представлен анализ биологических, психологических и социальных основ антибиотикозависимости. «Искусственное чувство безопасности» и страх перед болезнью, испытываемые людьми, усиливают психологическую зависимость от антибиотиков, что приводит к их неправильному и многократному применению. Такое поведение представляет серьёзную угрозу не только для здоровья человека, но и для систем общественного здравоохранения и глобальной политики инфекционного контроля. Рассматриваются технологии экстракции и приготовления лекарственных форм, включая приготовление водных и спиртовых экстрактов, настоек и настоек, а также безопасных альтернатив на основе глицерина для детей. На примере Нахчыванского района проведен анализ потенциала местной флоры и научно-исследовательской инфраструктуры. Препараты, полученные из широко распространенных в регионе растений, таких как кизил, чеснок, прополис, шалфей и горный имбирь, рассматриваются как важные ресурсы для интеграции традиционной медицины с современными биотехнологиями.

Keywords: antimicrobial resistance, phytotherapy, inappropriate use, health, environment.

Ключевые слова: устойчивость к противомикробным препаратам, фитотерапия, ненадлежащее использование, здоровье, окружающая среда.

Т. 11. №12 2025
https://doi.org/10.33619/2414-2948/121

Antibiotics are considered one of the revolutionary discoveries of 20th-century medicine. The discovery of penicillin, the first antibiotic, by Alexander Fleming in 1928 from the mold Penicillium notatum marked the beginning of a new era in medical development. As a result of this breakthrough, many fatal bacterial infections were prevented, and the treatment of infections arising from surgical operations and traumatic injuries became possible. Since the mid-20th century, the use of antibiotics has played a crucial role in extending the average human lifespan and significantly reducing mortality rates [6].

However, alongside this extraordinary success, the uncontrolled and incorrect use of antibiotics has given rise to a new and dangerous phenomenon, antimicrobial resistance (AMR). AMR is characterized by microorganisms (especially bacteria) developing resistance to the effects of antibiotics. As a result, infections that were previously easily treated no longer respond to standard antibiotics. According to the World Health Organization (WHO) fact sheet for 2019, bacterial AMR was directly responsible for an estimated 1.27 million deaths and contributed to around 4.95 million deaths globally. Projections suggest that without effective global action, the number of deaths could reach 10 million per year by 2050 [5].

Among the main reasons for the rapid spread of resistance are the self-administration of antibiotics, incorrect use in viral diseases, non-professional prescribing, as well as the prophylactic use of antibiotics in veterinary medicine and agriculture. As a result of these factors, bacteria undergo genetic mutations, resistant strains emerge and are transmitted to other microorganisms, leading to the development of treatment-resistant diseases [3].

The current situation poses serious challenges for global healthcare systems. To overcome this challenge, a two-directional approach is required:

-Ensuring rational antibiotic use, meaning that antibiotics should be prescribed only based on medical indications and supported by laboratory analyses;

-The application of natural, safe, and scientifically validated alternatives, particularly the integration of advancements in phytotherapy (plant-based treatment) into practical healthcare.

Scientific studies conducted over the past decades have shown that certain plants synthesize bioactive compounds with antibacterial, antiviral, and antifungal properties. These natural compounds, including flavonoids, phenolics, alkaloids, terpenoids, and essential oils, inhibit bacterial growth and reproduction, disrupt cell wall function, or block protein synthesis. For this reason, natural antibiotics possess significant potential as supplementary and supportive agents in combating antimicrobial resistance [7].

Materials and Methods

The present article focuses on reducing antibiotic dependency and determining the scientific foundations for the application of natural antibiotics. Both biochemical, as well as psychological and social factors, are analyzed. The phytotherapy potential of the Nakhchivan region is investigated, and scientifically based dosage and usage guidelines are systematized. The objective is not only to address the medical aspect but also to present a comprehensive approach encompassing educational, behavioral, and ecological dimensions [9; 10].

Discussion of the Study

Reducing Antibiotic Dependencyю Antibiotic dependency (or addiction) is considered one of the most pressing and dangerous problems in modern healthcare. This concept does not only refer to biological dependence on drugs but also represents a complex condition arising at psychological, social, and medical behavior levels. Antibiotic dependency is understood as the unnecessary, repeated, and prophylactic use of antibiotics, that is, their consumption without confirmed bacterial

Т. 11. №12 2025
https://doi.org/10.33619/2414-2948/121

infection or medical supervision. This situation poses numerous risks to both individual health and public healthcare [11].

According to the World Health Organization (WHO) 2024 report, 30–50% of antibiotics are used without medical justification. In particular, antibiotics are still widely prescribed for viral infections such as the common cold, influenza, pharyngitis, bronchitis, and COVID-19, despite their ineffectiveness in these cases. This practice normalizes the unnecessary use of antibiotics and directly contributes to the increase of antimicrobial resistance (AMR) [13].

The causes of antibiotic dependency are multifaceted and interrelated:

-Self-administration and uncontrolled use: Many people obtain antibiotics from pharmacies without a prescription or use leftover medications from previous treatments on their own. This behavior is particularly widespread in regions with low levels of medical awareness [7].

- Incorrect use in viral infections: Antibiotics are effective against bacteria but are ineffective against viruses. Nevertheless, people have developed the habit of taking antibiotics for every cold or cough.

Lack of awareness and education: A large part of the population does not sufficiently understand the mechanisms of antibiotic action or the proper guidelines for their use. The scarcity of medical literacy programs in schools and higher education institutions exacerbates this problem.

Uncontrolled use in veterinary medicine and agriculture: In animal husbandry, antibiotics are frequently used prophylactically or as growth stimulators. This practice leads to antibiotic residues entering the human body through the food chain and contributes to the spread of bacterial resistance.

Priority directions have been established in international healthcare policy to reduce antibiotic dependency: Sale of antibiotics only with a prescription, Implementation of e-prescription and electronic tracking systems, Awareness campaigns (e.g., “Antibiotics are not for the common cold”), Integration of phytotherapy and natural alternatives, Continuous training of healthcare professionals and monitoring of prescribing behaviors.

At the same time, reducing antibiotic dependency involves not only medical but also socio-psychological and ecological dimensions. Excessive reliance on medications, lack of trust in the body’s natural healing mechanisms, and the urgency for “quick recovery” represent the psychological roots of this problem. Thus, antibiotic dependency is regarded as a complex, multifactorial, and global issue in modern healthcare. Its mitigation is possible not only through medical control mechanisms but also through a synthesis of educational initiatives, behavioral therapy, social policies, and scientifically grounded phytotherapy approaches [11, 12].

Treatment - Resistant Infections and Multidrug - Resistant Pathogens. One of the most dangerous consequences of antibiotic resistance is the emergence of infections that are “treatment-resistant” or “multidrug-resistant.” These infections exhibit complete resistance to one or more classes of antibiotics. For example, bacteria such as Staphylococcus aureus (MRSA), Pseudomonas aeruginosa, Klebsiella pneumoniae, and Mycobacterium tuberculosis have developed resistance to many classic antibiotics, including penicillin, tetracycline, and vancomycin. In such cases, standard treatment regimens become ineffective, the course of the disease is prolonged, and mortality rates increase [8].

Antimicrobial resistance poses a threat not only within hospitals but also at the community level. Resistant bacteria can be transmitted to humans through water, soil, food products, and animals. This is particularly associated with the prophylactic use of antibiotics in agriculture and animal husbandry. Such bacteria can infect not only individual patients but entire communities, reducing the effectiveness of epidemiological control. This leads to an increased risk of pandemics and weakens the resilience of healthcare systems. Furthermore, antibiotic resistance poses serious

Т. 11. №12 2025
https://doi.org/10.33619/2414-2948/121

risks to food safety and ecosystem stability. The accumulation of antibiotic residues in soil and water disrupts microbiological balance, negatively affecting the health of both plants and animals [4].

The reduction of antibiotic dependency and antimicrobial resistance (AMR) requires the implementation of comprehensive, multi-level, and integrative strategies. These strategies should be carried out in a coordinated manner, not only at the individual behavior level but also within healthcare systems, the education sector, and agriculture. According to the World Health Organization's "One Health" concept, human, animal, and environmental health are closely interconnected. Therefore, antibiotic use control must be strengthened simultaneously across all three components [1].

To ensure the rational use of antibiotics, medical oversight and decision-making mechanisms should be enhanced through modern technological and administrative tools. Antibiotics should be prescribed only based on precise clinical indications and laboratory diagnostic results. Each prescription should be confirmed by bacteriological analysis (e.g., antibiogram). Clinical protocols in healthcare institutions should be updated, and Antimicrobial Stewardship programs should be implemented to guide antibiotic prescribing practices. Through electronic prescription (e-prescription) and electronic audit systems, antibiotic use can be monitored, statistics collected, and prescription decisions justified. Regular clinical audits and accountability mechanisms enhance oversight in healthcare institutions and strengthen physician responsibility. Thus, strengthening medical oversight not only reduces antibiotic use but also slows the emergence of resistant bacteria [2].

Education is one of the key factors in reducing antibiotic dependency. The higher the level of medical literacy in a community, the lower the incidence of self-administration of antibiotics. Continuous awareness campaigns should be conducted through mass media, social networks, and healthcare institutions. Simple but effective messages such as "Antibiotics are not for the common cold" and "Do not take antibiotics without a doctor's prescription" are effective in changing public behavior. Topics such as "Health Literacy" and "Antimicrobial Resistance" should be included in school and higher education curricula. Local seminars and awareness activities should be organized annually within the framework of World Antibiotic Awareness Week. Awareness measures should not only provide information but also incorporate psychological approaches aimed at changing human behavior, including behavioral psychology, social influence, and motivational strategies [3].

One of the main reasons for the reduced effectiveness of antibiotics is their incorrect and unnecessary use. Therefore, the development and promotion of alternative therapeutic methods are of significant importance. In mild to moderate infections, priority should be given to symptomatic treatment, plant-based preparations (phytotherapy), and strengthening of the immune system. Probiotics and prebiotics help restore the body's microflora and maintain the natural balance of the gut and immune system. Plants containing natural antibiotic compounds — such as garlic, ginger, turmeric, sage, propolis, black cumin, and chamomile — can be used both prophylactically and therapeutically. The mechanisms of action of these plants, including the antibacterial and antioxidant properties of phenolic and flavonoid compounds, have been confirmed through scientific research. Alternative approaches play an important role not only in the treatment of diseases but also in preventing antibiotic resistance [8, 9].

The aim in the preparation of formulations is to ensure the maximum extraction of active components found in plants, such as flavonoids, phenolics, essential oils, alkaloids, and terpenoids, and to stabilize them in a suitable form. Aqueous Extraction (Infusion and Herbal Tea Preparation).

Method: 1–2 tablespoons of dried plant material are added to 200 mL of boiling water, infused for 10–15 minutes, and then filtered.

Т. 11. №12 2025
https://doi.org/10.33619/2414-2948/121

Physical principles: Heat facilitates the transfer of phenolic compounds, flavonoids, and essential oils into the water.

Advantages: Simple, inexpensive, non-toxic.

Limitation: Aqueous solutions have low microbiological stability; therefore, they should be consumed within 1–2 days.

Example uses: Sage, chamomile, and ginger teas are beneficial for respiratory and digestive problems.

Glycerin-Based Extracts. Method: Plant material is added to a 70–80% glycerin solution and kept for 5–7 days.

Advantages: Glycerin is non-toxic and serves as an alternative to alcohol; therefore, it is suitable for children, the elderly, and pregnant women.

Limitation: Extraction efficiency is slightly lower compared to alcoholic solutions.

Example use: Ginger–glycerin extract is widely used as an immune-boosting remedy.

The main reasons for the rapid spread of antibiotic resistance include self-administration of antibiotics, incorrect use in viral infections, non-professional prescribing, as well as prophylactic use of antibiotics in veterinary medicine and agriculture. These factors lead to genetic mutations in bacteria, the emergence of resistant strains, and the transfer of these genes to other microorganisms, resulting in treatment-resistant diseases. The development and promotion of alternative therapeutic methods play a crucial role in preventing unnecessary antibiotic use.

References:

1. AL-Nasiry, B. S. A. N. (2024). Assessment of Antimicrobial Effect Of Curcumin Extract And Sesame Oil Against Staphylococcus aureus in Mastitis Milk And Comparing With Antibiotics. *International Journal of Biological Engineering and Agriculture*, *4*(1), 11-19.

2. Baars, E. W., Weiermayer, P., Szőke, H. P., & van der Werf, E. T. (2025). The Introduction of the Global Traditional, Complementary, and Integrative Healthcare (TCIH) Research Agenda on Antimicrobial Resistance and Its Added Value to the WHO and the WHO/FAO/UNEP/WOAH 2023 Research Agendas on Antimicrobial Resistance. *Antibiotics*, *14*(1), 102. https://doi.org/10.3390/antibiotics14010102

3. Bindawa, A. T., Lame, S. A., & Umar, S. M. (2022). Phytochemical Screening and Antioxidant Vitamins of Acacia Nilotica Pod. *Bima Journal of Science and Technology (2536-6041)*, *6*(03), 121-128. https://doi.org/10.56892/bima.v6i03.52

4. Davies, J., & Davies, D. (2010). Origins and evolution of antibiotic resistance. *Microbiology and molecular biology reviews*, *74*(3), 417-433. https://doi.org/10.1128/MMBR.00016-10

5. European Food Safety Authority (EFSA), & European Centre for Disease Prevention and Control (ECDC). (2024). The European Union summary report on antimicrobial resistance in zoonotic and indicator bacteria from humans, animals and food in 2021–2022. *EFSA Journal, 22*(2), e8583.

6. Fleming, A. (1929). On the antibacterial action of cultures of a penicillium, with special reference to their use in the isolation of B. influenzae. *British journal of experimental pathology*, *10*(3), 226.

7. Hani, N., Baydoun, S., Nasser, H., Ulian, T., & Arnold-Apostolides, N. (2022). Ethnobotanical survey of medicinal wild plants in the Shouf Biosphere Reserve, Lebanon. *Journal of Ethnobiology and Ethnomedicine*, *18*(1), 73. https://doi.org/10.1186/s13002-022-00568-y

8. Ostapets, M., & Kovalenko, V. (2023). Working program of the academic discipline. Pharmacology.

9. Rahimova, S. A., & Alakbarova, C. M. (2020). Total Flavonoids of Alinca Grape form Grown in the Area of Nakhchivan Autonomous Republic. In *Advances in Science and Technology* (pp. 43-45).

10. Rahimova, S., Asadov, E., & Huseynova, A. (2024). Comparative assessment of antioxidant activity in red apricot (Prunus armeniaca L.) and Fig fruits (Ficus carica L.) cultivated in Nakhchivan AR, Azerbaijan. *International Journal of Secondary Metabolite*, *11*(4), 722-728. https://doi.org/10.21448/ijsm.1416227

11. Taufik, F. F., Natzir, R., Patellongi, I., Santoso, A., Hatta, M., Junita, A. R., ... & Febrianti, A. (2022). In vivo and in vitro inhibition effect of propolis on Klebsiella pneumoniae: A review. *Annals of Medicine and Surgery*, *81*, 104388. https://doi.org/10.1016/j.amsu.2022.104388

12. Ventosa, C. L. (2015). The antibiotic resistance crisis. *Pharma. Therapeu*, *40*, 277-283.

13. World Health Organization. (2023). *WHO global report on sodium intake reduction*. World Health Organization.

Список литературы:

1. AL-Nasiry B. S. A. N. Assessment of Antimicrobial Effect Of Curcumin Extract And Sesame Oil Against Staphylococcus aureus in Mastitis Milk And Comparing With Antibiotics // International Journal of Biological Engineering and Agriculture. 2024. V. 4. №1. P. 11-19.

2. Baars E. W., Weiermayer P., Szőke H. P., van der Werf E. T. The Introduction of the Global Traditional, Complementary, and Integrative Healthcare (TCIH) Research Agenda on Antimicrobial Resistance and Its Added Value to the WHO and the WHO/FAO/UNEP/WOAH 2023 Research Agendas on Antimicrobial Resistance // Antibiotics. 2025. V. 14. №1. P. 102. https://doi.org/10.3390/antibiotics14010102

3. Bindawa A. T., Lame S. A., Umar S. M. Phytochemical Screening and Antioxidant Vitamins of Acacia Nilotica Pod // Bima Journal of Science and Technology (2536-6041). 2022. V. 6. №03. P. 121-128. https://doi.org/10.56892/bima.v6i03.52

4. Davies J., Davies D. Origins and evolution of antibiotic resistance // Microbiology and molecular biology reviews. 2010. V. 74. №3. P. 417-433. https://doi.org/10.1128/MMBR.00016-10

5. European Food Safety Authority (EFSA), & European Centre for Disease Prevention and Control (ECDC). The European Union summary report on antimicrobial resistance in zoonotic and indicator bacteria from humans, animals and food in 2021–2022 // EFSA Journal. 2024. V. 22. №2. P. e8583.

6. Fleming A. On the antibacterial action of cultures of a penicillium, with special reference to their use in the isolation of B. influenzae // British journal of experimental pathology. 1929. V. 10. №3. P. 226.

7. Hani N., Baydoun S., Nasser H., Ulian T., Arnold-Apostolides N. Ethnobotanical survey of medicinal wild plants in the Shouf Biosphere Reserve, Lebanon // Journal of Ethnobiology and Ethnomedicine. 2022. V. 18. №1. P. 73. https://doi.org/10.1186/s13002-022-00568-y

8. Ostapets M., Kovalenko V. Working program of the academic discipline. Pharmacology. 2023.

9. Rahimova S. A., Alakbarova C. M. Total Flavonoids of Alinca Grape form Grown in the Area of Nakhchivan Autonomous Republic // Advances in Science and Technology. 2020. P. 43-45.

10. Rahimova S., Asadov E., Huseynova A. Comparative assessment of antioxidant activity in red apricot (Prunus armeniaca L.) and Fig fruits (Ficus carica L.) cultivated in Nakhchivan AR, Azerbaijan // International Journal of Secondary Metabolite. 2024. V. 11. №4. P. 722-728. https://doi.org/10.21448/ijsm.1416227

11. Taufik F. F., Natzir R., Patellongi I., Santoso A., Hatta M., Junita A. R., Febrianti A. In vivo and in vitro inhibition effect of propolis on Klebsiella pneumoniae: A review // Annals of Medicine and Surgery. 2022. V. 81. P. 104388. https://doi.org/10.1016/j.amsu.2022.104388

12. Ventosa C. L. The antibiotic resistance crisis // Pharma. Therapeu. 2015. V. 40. P. 277-283.

13. World Health Organization. WHO global report on sodium intake reduction. – World Health Organization, 2023.

Поступила в редакцию
30.10.2025 г.

Принята к публикации
09.11.2025 г.

Ссылка для цитирования:

Hasanov K., Rahimova S. Production and Use of Natural Antibiotics // Бюллетень науки и практики. 2025. Т. 11. №12. С. 111-117. https://doi.org/10.33619/2414-2948/121/14

Cite as (APA):

Hasanov, K., & Rahimova, S. (2025). Production and Use of Natural Antibiotics. *Bulletin of Science and Practice, 11*(12), 111-117. https://doi.org/10.33619/2414-2948/121/14