Volume 3, Issue 5, May - 2025
ISSN (E): 2938-3781

Web of Agriculture: Journal of Agriculture and Biological Sciences
webofjournals.com/index.php/8

MEDICINAL PROPERTIES OF THE PLANT FENUGREEK (TRIGONELLA FOENUM-GRAECUM L.) GROWN IN THE CONDITIONS OF SURKHANDARYA REGION

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Abstract
The study of natural medicinal resources remains a crucial focus in modern botanical research, especially in relation to plants with significant therapeutic potential. Among them, Fenugreek (Trigonella foenum-graecum L.) has attracted the most attention due to its diverse pharmacological properties, which deserve further investigation. It is important to consider how these properties can be enhanced by adaptation to specific environmental conditions, an aspect that has often been overlooked in previous studies.
This study carefully examines the medicinal properties of Fenugreek grown in the Surkhandarya region, characterized by unique climatic variations that significantly affect its biochemical composition. By using a systematic methodology that combines qualitative and quantitative analyses, this study effectively demonstrates the relationship between environmental conditions and the efficacy and health benefits of the plant. The findings reveal significant variations in the concentration of active ingredients, suggesting that regional climate change may enhance the medicinal properties of Greek Shambhala, while also offering a broader perspective on the relationship between environmental factors and plant health. Ultimately, this study provides valuable insights into the potential of using local flora to improve health, while also reinforcing the importance of sustainable agricultural practices in traditional medicine.

Keywords: Fenugreek, Trigonella foenum-graecum L., Surkhandarya region, medicinal potential, phytochemicals, antioxidant properties, biologically active compounds, flavonoids, alkaloids, diabetes, pharmacological benefits.
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Introduction

Recently, there has been a great deal of interest in the study of medicinal plants, largely due to the increasing global interest in natural medicines and the growing awareness of their potential benefits. However, it is important to critically evaluate the underlying assumptions and evidence surrounding this trend. Among the many botanical options available, fenugreek (Trigonella foenum-graecum L.) is of particular interest due to its widely recognized medicinal properties and has been used for a wide range of health benefits in various cultures throughout history. Recent studies have shown that

Volume 3, Issue 5, May - 2025
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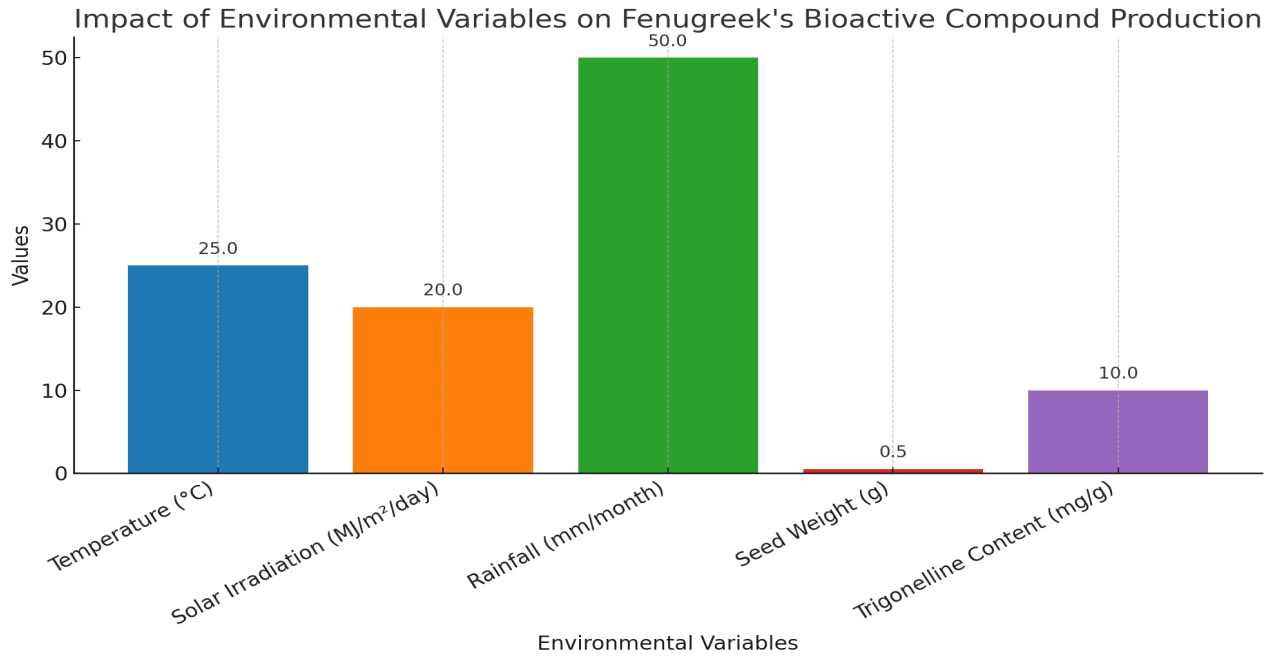
a number of environmental factors, including soil type and climatic conditions, significantly influence the bioactive compounds found in medicinal plants such as fenugreek [4]. This raises an important question about the extent to which these factors can be systematically controlled or manipulated to maximize the medicinal value of the plant. Furthermore, new research suggests that different cultivation methods can profoundly affect the phytochemical properties of these plants, which may enhance their therapeutic efficacy for certain health problems [5].

This study aimed to investigate the Greek shambhala, which is adapted to the specific ecological conditions of the Surkhandarya region, where soil and climate characteristics can significantly affect its phytochemical profile and therapeutic efficacy. While previous studies have fully documented the biochemical composition and health benefits of Greek shambhala, relatively few studies have focused on its adaptation to different regional environments.

This gap in the literature highlights the need to not only understand the medicinal properties of the plant, but also consider environmental influences that may enhance or diminish these benefits. By filling this gap, this study aims to shed light on the complex relationships between various environmental factors and the medicinal potential of plants, thereby enriching the conversation around sustainable herbal medicine and ethnopharmacology, which is increasingly relevant in today's health-conscious society. [1] .



1-grapf.

This line diagram shows the effect of various environmental variables on the bioactive compound production of fenugreek. It highlights key factors such as temperature, solar radiation, precipitation, seed weight, and trigonelline content, and provides an understanding of their respective contributions measured in specific units (Figure 1).

An overview of the historical use of fenugreek in medicine

Throughout the years, many cultures have recognized the medicinal properties of various plants, and fenugreek (Trigonella foenum-graecum L.) has long been a prominent figure in traditional medicine. For example, the ancient Egyptians included fenugreek seeds not only in embalming

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Volume 3, Issue 5, May - 2025
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rituals but also for their health benefits, which has helped to explore how cultural beliefs and practical experiences combined to determine the importance of the plant in herbal medicine. Similarly, ancient Ayurvedic texts mention its use in the treatment of diabetes, digestive disorders, and inflammation. This raises an important question: how do these historical practices fit into modern medical standards, and what empirical evidence is there to support claims about the efficacy of Greek shambhala? Its central position in Eastern medical traditions is important [2], but it is also important to consider the socio-historical context that shaped its use. Later, Greek and Roman herbalists recognized the diverse uses of Greek shambhala and recommended it for respiratory ailments and as a tonic for general health, which invites us to consider whether their understanding of medicinal plants was derived from traditional beliefs or from observation. These diverse applications highlight the legacy of the Greek shambhala as a medicinal agent across civilizations [2], while also creating a complex and promising basis for modern research into its medicinal properties, especially in the unique ecological environment of the Surkhandarya region (Table 1).

Table 1

№	Historical period Use	Historical period Use
1	Ancient Egypt	Greek shambhala has been used as a remedy for various ailments, including digestive problems and to heal wounds.
2	Ancient Greece	Hippocrates recommended Greek shambhala for its healing properties, including treating coughs and stimulating milk production in nursing mothers.
3	Traditional Indian Medicine	Greek shambhala has been used for centuries in Ayurvedic medicine to treat conditions such as diabetes, digestive problems, and to increase libido.
4	Traditional Chinese Medicine	Greek shambhala is used to warm the body, improve digestion, and treat illnesses such as colds and flu.

Medicinal properties of fenugreek

The versatility of fenugreek (Trigonella foenum-graecum L.) extends far beyond its culinary uses, making it a prominent player in traditional medicine. Rich in bioactive compounds such as saponins, flavonoids, and alkaloids, fenugreek has attracted attention for its wide range of medicinal properties. Studies have highlighted its potential to regulate blood sugar levels, which is especially beneficial for people with diabetes. It has also been revered in various ancient health traditions, attesting to its historical importance. The plant is also known for its anti-inflammatory and antioxidant activities that contribute to overall health. In addition, studies show its effectiveness in stimulating lactation, enhancing libido, and even supporting heart health, thus demonstrating its versatile therapeutic potential [1]. This complex of benefits solidifies the status of Greek Shambhala as a crucial component in both traditional and modern medical practice.

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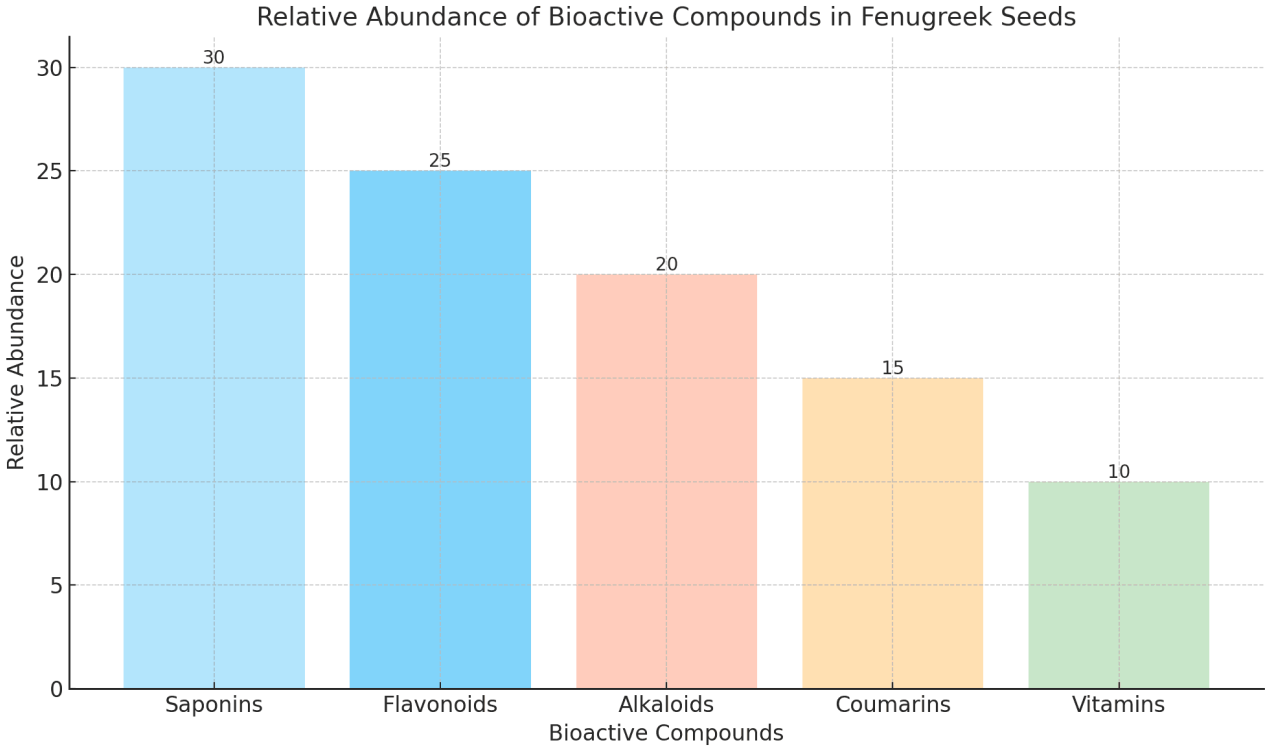
Greek shambhala is one of the oldest medicinal plants, and its health-enhancing effects have been documented in Ayurveda and traditional Chinese medicine. [1].



2-grafik.

This line chart shows the relative abundance of bioactive compounds in the seeds of Greek shambhala and highlights its rich chemical profile. The compounds presented include saponins, flavonoids, alkaloids, coumarins, and vitamins, which clearly compare their abundance (Figure 2).

Biologically active compounds and their health benefits

The therapeutic potential of Greek shambhala is largely due to its rich composition of active compounds. Among them, flavonoids, alkaloids, coumarins, vitamins, and saponins have been identified as the main contributors to its health benefits. It is noteworthy that trigonelline stands out as the most abundant alkaloid, which has significant antioxidant properties, while compounds such as cinnamic acid and scopoletin have anti-inflammatory effects.

The seeds of the Greek shambhala contain a variety of bioactive compounds, including flavonoids, alkaloids, coumarins, vitamins, and saponins, with trigonelline being the most abundant alkaloid among the coumarins, and cinnamic acid and scopoletin.

These bioactive components collectively contribute to a number of physiological benefits, including improved digestive function and metabolic function. Furthermore, emerging research suggests that the Greek shambhala may play a role in blood glucose regulation, making it a valuable addition to dietary strategies for diabetes management. Such findings highlight the importance of understanding the complex bioactivity of the components of the Greek shambhala, which could contribute to its broader application in herbal medicine and nutritional science [1].

[1] Kalyan C Nagulapalli Venkata, Anand Svarop, Debasis Bagchi, Anupam Bishayee

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ISSN (E): 2938-3781

2-tablel

№	Bioactive substances	Health benefits
1	4-gidroksiizolyusin	It increases insulin sensitivity, which helps regulate blood sugar.
2	Trigonellin	It exhibits anti-diabetic properties by inhibiting glucose absorption.
3	Diosgenin	It has anti-inflammatory and antioxidant effects, supporting overall health.
4	Saponinlar	It can lower cholesterol levels and improve lipid profiles.
5	Flavonoidlar	Contribute to antioxidant activity, reducing oxidative stress.

Detailed information on the active compounds in fenugreek and their health benefits is provided in [6], (Table 2).

Acclimatization of fenugreek in Surkhandarya region

The adaptation of fenugreek (Trigonella foenum-graecum L.) to the specific climatic and soil conditions of Surkhandarya region has attracted great interest due to its potential health benefits, which are increasingly recognized in the culinary and medicinal fields. A careful study of phenotypic characteristics shows that the plant exhibits remarkable resilience, demonstrating drought tolerance and increased productivity in response to various local environmental challenges. This resilience is particularly important in a region where water scarcity can be a limiting factor in agricultural productivity.

The introduction process is shaped by many interrelated factors, including soil composition, temperature changes, and water availability, all of which have a complex impact on the physiological responses and overall health of the plant. Recent studies have shown that the genetic diversity in Greek shambhala enhances its adaptability, facilitates optimal growth adapted to specific environmental conditions, and allows it to thrive even under stressful conditions [7].

Furthermore, studies have shown that the use of specific agronomic practices, such as proper irrigation planning and nutrient management, can significantly increase the overall performance of Greek shambhala in Surkhandarya region, highlighting the importance of targeted environmental management strategies in its cultivation.

Studies have shown that Greek shambhala not only retains its traditional medicinal properties, such as its strong anti-inflammatory and antioxidant properties, but also undergoes unique biochemical adaptations that allow it to maximize its growth potential in specific regional conditions. Therefore, understanding the mechanisms of these adaptations can provide critical insights into cultivation methods that are suitable for local conditions, ultimately increasing the agricultural viability of Greek shambhala and its health benefits for the local population, thereby contributing to the nutrition and economy of the Surkhandarya region [8].

Conclusions

Research conducted on fenugreek (Trigonella foenum-graecum L.) in Surkhandarya region has shed light on the medicinal properties of the herb, especially its adaptation to different climatic conditions. The findings suggest that the plant not only retains its nutritional value but also exhibits enhanced therapeutic potential when adapted to this unique environment. This study contributes to existing knowledge by addressing gaps in understanding how local conditions affect the efficacy of

medicinal plants. Future studies should investigate the long-term effects of specific environmental factors on the phytochemical composition of fenugreek, which will enrich our understanding of its use in traditional and modern medicine. Ultimately, using these insights could pave the way for the development of targeted health interventions and the promotion of sustainable agricultural practices in the region.

Summary of Findings and Future Research Directions

The study sheds light on the impressive medicinal properties of the Greek Shambhala plant, particularly in the climate adapted to the Surkhandarya region. Important findings include improved phytochemical profiles associated with traditional uses in herbal medicine, indicating the potential of the plant for anti-inflammatory and antioxidant activities.

Future research directions should emphasize mechanistic studies underlying these medicinal properties, aiming to identify active constituents with health benefits [3]. Furthermore, studying agronomic practices that optimize the cultivation of Greek Shambhala in different climatic conditions may provide insights into sustainable agricultural practices. It is also important to study the socio-economic impact of integrating Greek Shambhala into local health practices, thereby considering the benefits for both health and society

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