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REVIEW ARTICLE

A Comprehensive Review on the Phytochemical and Pharmacological Significance of *Pelargonium graveolens*

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ABSTRACT

Pelargonium graveolens L'Hér (Geraniaceae), widely referred to as rose-scented geranium, is a perennial aromatic species recognized for its long-standing use in traditional medicine and its substantial economic significance. This review consolidates contemporary findings on the plant's phytochemical profile, pharmacological properties, and therapeutic relevance. The essential oil and various extracts of P. *graveolens* are rich in bioactive constituents—particularly monoterpenes such as citronellol, geraniol, and linalool, along with diverse polyphenols—that collectively contribute to a broad array of biological activities, including antioxidant, antimicrobial, anti-inflammatory, antidiabetic, and anticancer effects. Evidence from *in vitro* and *in vivo* investigations indicates considerable therapeutic potential; however, clinical validation remains insufficient. This review provides a critical appraisal of the current literature, highlights existing knowledge gaps, and outlines priorities for future research aimed at advancing preclinical insights toward clinical applicability.

Keywords: *Pelargonium graveolens*, rose geranium, essential oil, phytochemistry, pharmacological activities, antimicrobial, antioxidant, traditional medicine, therapeutic applications.

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INTRODUCTION

Pelargonium graveolens (L'Hers),often known as rose-scented geranium, is a perennial aromatic sub-shrub of *Geraniaceae* family, which is very valued in traditional medicine as well as in various commercial industries world over. Traditionally, it has been used to treat a wide range of diseases ranging across respiratory, gastrointestinal, skin, and infectious diseases; its essential oil (PGEO) and several types of extracts are particularly active in the pharmaceutical, cosmetic and food sectors. In recent past, a significant rise in ethnopharmacological and phytochemical research has been observed which has clarified the wide range of biological activities of the compound which is credited to the presence of a variety of secondary metabolites. The review summarises existing information on the phytochemistry, pharmacological significance, therapeutic potential of the plant, as well as future research opportunities[1][2].

Pelargonium graveolens shows noticeable variation in its local forms, which can differ in their appearance. Despite these differences, these forms can still be clearly identified using certain traits without affecting their overall taxonomic classification . The genus Pelargonium is placed within the family Geraniaceae, under the order Geraniales.

Several scientific names have been used for *P. graveolens* in different botanical references. Databases such as Naturalist and Tropicos consider *Pelargonium intermedium* Kunth and *Geranium terebinthinaceum* Cav. to be synonyms for this species. Among the names frequently found in research and traditional literature, Pelargonium graveolens, Pelargonium roseum, and Pelargonium spp. are the most commonly used.

Taxonomic Classification

Kingdom

Plantae

Phylum

Tracheophytes

Class

Magnoliopsida

Order

Geraniales

Family

Geraniaceae

Genus

Pelargonium

Species

P. graveolens

Vernacular names

English

Roses cented Geranium, Sweet-scented Geranium

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Hindi

Gulabi Pati, Sugandha Patti

Tamil

Roja Marikolunthu

Telugu

GulabiPachha

Malayalam

Rosemaram

Kannada

Gulabi Patre

French

Geranium rosat

Traditional Uses

Pelargonium graveolens has a long history of use in traditional African medicine, where it has been relied upon for treating respiratory ailments, skin wounds, and digestive disorders. Although such traditional applications are well documented in Africa, reports from other regions remain limited. Preparations commonly include fresh plant juice, infusions, and decoctions made from either whole plants or specific parts. The aerial parts are traditionally applied for skin-related conditions, while decoctions of the roots—summarized in Table 1—have been used to manage respiratory tract infections and gastrointestinal complaints. Despite these practices, the pharmacological mechanisms supporting many of these traditional claims are still insufficiently understood.

With regard to safety, the Botanical Safety Handbook classifies *P. graveolens* leaves as a Category 1 herb, indicating safe use when handled appropriately. There are no documented contraindications for geranium. However, topical application of geranium oil has occasionally been associated with contact dermatitis, sensitization, or irritation during plant handling. Other studies, however, describe the oil as non-irritating and non-allergenic, suggesting that adverse reactions are generally rare.

Beyond its medicinal relevance, *P. graveolens* also holds significant cosmetic and cultural value. Traditionally, powdered leaves were used as a natural deodorant by African communities. During the Victorian era, geranium leaves were added to finger bowls to provide a refreshing scent during meals. Today, geranium essential oil is widely incorporated into commercial cosmetic and household products, including soaps, lotions, creams, detergents, and perfumes.[1][2][5][6]

P. graveolens comprises diverse significant Phytochemical constituents, mainly monoterpenes, sesquiterpenes, phenolic compounds, tannins, flavonoids, fatty acids, and vitamins are present. The extracted essential oil of aerial parts contains about one hundred known detected compounds, with oxygenated monoterpenes that are present in majority in its composition[3][2][18].

P.graveolens major chemical constituents

- The terpenoids include Citronellol (24-35%), geraniol (10-25%), linalool (5-8%), isomenthone (4-7%), and citronellylformate (3-6%), which are regularly reported as the main components[4][2][1].
- Sesquiterpenes: γ-eudesmol (0.5-2%), germacrene D and guaiadiene derivatives.
- Phenolic Compounds gallicacid, caffeicacid, chlorogenic acid.
- Flavonoids: kaempferol, luteolin, Quercetin.
- Tannins:The different ypes of hydrolysable tannins and condensed tannins.
- Fatty Acids and Vitamins Palmitic, linoleic and stearic acids; ascorbic acid and tocopherol.
- Others:Alkaloids, saponins and coumarins are also found, but usually in smaller amounts.

Table 1: The traditional uses of P. graveolens Phytochemical constituents of P.graveolens

Traditional Use	*Part Used*	*Mode of Use*
Fever	Roots	Decoction (bath)
Internal Pain	Leaves	Mixed with two species
Headache	Leaves	Mixed with vinegar and salt
Backache	Roots	Infusion
Stomach cramps and vomiting	Leaves	Infusion
Cough, Carretones, Pencahua	Flower	Infusion
Asthma	Unspecified	Burned and inhaled
Tuberculosis	Roots	Decoction
Diarrhoea	Roots	Infusion (enema)
Wounds and boils	Leaves	A paste
Cervical cancer	EO	Applied locally
Night blindness	Leaves	Unspecified

Table 2: Typical Chemical Composition of *Pelargonium graveolens* Essential Oil

Compound	*Chemical Class*	*Typical Range (%)*	*Primary Activity*
Citronellol	Monoterpene alcohol	20-35	Antimicrobial, anti-inflammatory
Geraniol	Monoterpene alcohol	10-25	Antioxidant, anticancer
Linalool	Monoterpene alcohol	3-10	Anxiolytic, analgesic
Isomenthone	Monoterpene ketone	4-8	Antimicrobial
Citronellyl formate	Monoterpene ester	3-8	Fragrance, antimicrobial
Geranyl formate	Monoterpene ester	2-5	Antimicrobial
Geranyl acetate	Monoterpene ester	2-5	Anti-inflammatory
Geranyl butyrate	Monoterpene ester	1-4	Antimicrobial
Geranyl tiglate	Monoterpene ester	1-3	Antimicrobial
10-epi-γ-eudesmol	Sesquiterpene alcohol	3-10	Antifungal
Germacrene D	Sesquiterpene	1-3	Antimicrobial
γ-cadinene	Sesquiterpene	1-3	Antimicrobial
Guaia-6,9-diene	Sesquiterpene	0.5-2	Antimicrobial

- Geographical origin, part of plant, harvestings and techniques of extraction may significantly alter the phytochemical profile[5][18][2].

Phytochemical Profile

Recent investigations report that the essential oil of *Pelargonium graveolens* sourced from Australia contains an exceptionally rich and diverse chemical composition, with more than 50 individual constituents identified. Comparable results have been observed in studies of Indian geranium oils, where citronellol and nerol consistently emerge as the predominant components, accompanied by substantial amounts of geraniol.

Beyond these primary constituents, *P. graveolens* has been shown to contain an extensive spectrum of bioactive compounds. Various classes of metabolites—including volatile oils, terpenoids, flavonoids, phenolic compounds, coumarins, cinnamic acid derivatives, and tannins—have been successfully isolated from the plant, highlighting its phytochemical complexity.

A detailed analysis of the essential oil derived from the aerial parts of *P. graveolens* identified several major constituents, notably citronellol (29.90%), trans-geraniol (18.03%), 10-epi-γ-eudesmol (8.27%), isomenthone (5.44%), linalool (5.13%), geranyl acetate (4.52%), γ-cadinene (2.89%), geranyl butyrate (2.53%), geranyl tiglate (2.50%), and germacrene D (2.05%). These compounds collectively contribute to the plant's characteristic aroma and its pharmacological activities.

Earlier phytochemical investigations, such as those reported in 1996, also led to the identification of notable indole alkaloids, including elaeocarpidine and its 20-H epimer, epielaeocarpidine, from the leaves of *P. graveolens*. [2]

Overview of Secondary Metabolites

Pelargonium graveolens is characterized by a rich and diverse phytochemical profile, containing numerous classes of bioactive secondary metabolites. The plant produces approximately 100-150 identified compounds, with the exact composition varying based on multiple factors including geographical origin, environmental conditions, plant age, harvest time, and extraction methodology [2,3,4].

The major classes of phytochemicals present in *P. graveolens* include:

- Monoterpenes and monoterpenoids (primary constituents of essential oil)
- Sesquiterpenes and sesquiterpenoids
- Phenolic compounds (phenolic acids and their derivatives)
- Flavonoids (flavones, flavonols, and their glycosides)
- Tannins (both hydrolyzable and condensed types)
- Fatty acids (saturated and unsaturated)
- Vitamins and organic acids
- Alkaloids (present in minor quantities)
- Coumarins and saponins (trace amounts)

Essential Oil Composition

The essential oil of *P. graveolens* (PGEO) represents the most extensively studied fraction of the plant, owing to its commercial importance and potent biological activities. The oil is obtained primarily through hydrodistillation or steam distillation of fresh or dried aerial parts (leaves and flowers), with typical yields ranging from 0.1% to 0.3% (w/w) depending on the plant material and extraction conditions [4,5] Chemical Composition of Pelargonium graveolens Essential Oil are given in table 2.

Table 3: Pharmacological activity of Pelargonium graveolens

Compound/Extract	*Pharmacological Activity*
Aqueous extract (decoction and infusion) Methanol and hexane extract with essential oil Ethanol extract with essential oil Methanol-aqueous extract	Antioxidant and anti-inflammatory activity. Enzyme-inhibitory effect
Essential oil/extract	Antibacterial and antiviral activity
Essential oil/extract Pure/essential oil	Antifungal activity
Essential oil/extract	Antiviral activity
Essential oil Ethanol extract/essential oil	Anticancer activity
Essential oil/ethanol-aqueous extract	Reproductive activity
Essential oil Ethanol extract with essential oil	Antidiabetic activity
Essential oil	Neuroprotective activity
Essential oil Essential oil/aqueous and ethanol extract	Insecticidal/repellent activity
Essential oil	Cosmetic properties

Major Essential Oil Constituents

The monoterpene alcohols (citronellol, geraniol, and linalool) collectively constitute 35-60% of the total essential oil composition and are primarily responsible for the characteristic rose-like fragrance. These compounds also contribute significantly to the oil's antimicrobial and antioxidant properties [4,5,6].

Regional Variation in Essential Oil Composition

Significant geographical variation in essential oil composition has been documented:

Indian cultivars

High citronellol (30-40%) and geraniol (15-25%) content

Egyptian cultivars

Balanced citronellol and geraniol with higher ester content

Moroccan cultivars

Higher sesquiterpene content, particularly 10-epi-γ-eudesmol

Australian cultivars

More than 50 individual constituents identified, with diverse minor components

Pharmacological Activities

Recent studies have revealed a remarkable pharmacological Activity of *P.graveolens*,the most important bioactivities of which are outlined below in table 3.

Antioxidant Properties

The extracts and PGEO have strong antioxidant properties, which are due to high content of monoterpenoids and polyphenols. DPPH radical scavenging tests show that IC has values down to 3.9 mg/mL, which is a high free radical quencher capacity, similar to standard antioxidants like Trolox. This is due to the phenolic and flavonoid compounds that make *P. graveolens* promising in oxidative stress-related disease[6][1][16][14].

Antimicrobial Activities

The oil is a broad spectrum antifungal and antibacterial. MICs as low as 0.78mg/mL have been detected against the methicillin-resistant *Staphylococcus aureus* (MRSA), and has demonstrated efficacy exceeding that of certain reference antibiotics in vitro. Remarkably,it is also active with considerable intensity against *Escherichia coli*, *Candida albicans* as well as food and clinically significant pathogenic fungi[7][20][21].

Antidiabetic and Metabolic Effects

Mechanistic research suggests that PGEO can inhibit important metabolic enzymes including α-amylase and α-glucosidase (IC50-70mg/mL)and therefore reduces the carbohydrate digestion and absorption, hence, its effects on carbohydrate breakdown and absorption are antidiabetic. In diabetic conditions, further evidenced by animal models, there are reductions in postprandial hyperglycemia, an increase in insulin sensitivity and anti-inflammatory influences[8][1][16].

Anti-Inflammatory and Analgesic Properties

PGEO is selective to inhibit cyclooxygenase (COX-1) and has minimal effects on COX-2 implying dual analgesic and anti-inflammatory effects but reduced adverse effects compared to nonselective NSAIDs. Ex vivo models confirm that there is a large decrease in inflammation,

similar to conventional anti-inflammatory agents such as diclofenac, and the mechanism associated with this is the inhibition of pro-inflammatory cytokines [9][1][15][17].

Anticancer and Cytotoxic Activities

The cytotoxicity assays indicate that it inhibits different tumor cell lines in a dose-dependent fashion (e.g., MCF-7, Hep3B, HeLa) with IC values of 30-300mg/mL. These effects are mediated by apoptosis induction, cell-cycle arrest, and regulatory effects in oxidative and inflammatory pathways. There is some evidence of higher activity with whole extracts than with single compound with some indication of synergism between constituents [1][2][14][19].

Additional Bioactivities

Additional research explains cardioprotective, hepatoprotective, antiviral (especially towards coronavirus and influenza viruses), wound healing, anxiolytic, and insect repellent functions. All these qualities make these properties contribute to the multifunctional therapeutic value of the plant and its extensive traditional application[11][1][2].

Therapeutic Applications

Pelargonium graveolens already has many therapeutic uses in medicine

Metabolic Disorders

Diabetes, dyslipidemia, and obesity treatment by means of enzyme inhibition and oxidative stress regulation.

Infectious Diseases

Prevention and treatment of bacterial, fungal and viral infections, including those that are drug-resistant.

Inflammatory Disorders

Adjuvant or alternative treatment of inflammatory and painful conditions.

Dermatology

Topical formulations of wounds, dermatitis and fungal infections that had been tested in pre-clinical studies were approved in phase 1 clinical trials[12][10].

Oncology

As an add-on or supportive treatment of some types of cancers, but at an early stage of clinical research.

Its use can be acquired in cosmetics, aromatherapy, food preservation and agriculture (natural pesticide/ repellent)[2].

Critical Analysis and Gaps

There is minimal clinical practice translation of results though the *in vitro* and animal evidence is very strong. Most of the clinical data are linked with topical application (e.g.,denturestomatitis), and the oral or systemic efficacy/ safety is not researched extensively. A large scale of mechanistic studies and extract standardization are necessary because the chemical profile is likely to vary with the environment and methodologies[13][1][10][2].

The profiles of safety are not completely established especially during chronic usage or in the case of high dose exposure. Reaction to the oil- Indirect reaction- Allergic reaction, irritant reaction are rare but have to be reported in a systematic manner[1][2].

Future Prospects

Future directions in research are

- Clinical Trials These involve use of well designed and controlled trials to establish efficacy, safety, optimal dose, and pharmacokinetics in human beings.
- Standardization and Quality Control: Extraction, the processing and standards of formulation are developed and structured in a way that provides reproducibility and therapeutic consistency.
- Mechanistic Studies Molecular target and synergistic effect of phytochemicals.
- Novel Uses PGEO discovery and isolation in producing nanoparticle-based items, nutraceuticals, sustainable agriculture, and as an adjuvant to already commercially utilized therapies[2].
- Toxicology and Long-term Safety Toxicological characterization and interactions with drugs and effects in the long-term.

CONCLUSION

The pharmacologically important phytochemicals of Pelargonium graveolens are broad spectrum bioactive and abundant in pharmacologically significant phytochemicals. Though ethnomedical validation and preclinical findings are encouraging on its therapeutic flexibility ,its applicationin evidence-based medicine requires rigorous trials in clinical trials as well as mechanistic research to maximize its potential. The growing contribution of the plant in pharmaceutical, nutraceutical and related industries signifies that it has significant commercial and social ramifications.

REFERENCES

1. Jaradat N, Hawash M, Qadi M, Abualhasan M, Odetallah A, Qasim G, et al. Chemical markers and pharmacological characters of Pelargonium graveolens essential oil from Palestine. Molecules [Internet]. 2022;27(17):5721. Available from: http://dx.doi.org/10.3390/molecules27175721
2. Nikitha A, Mohan GK. Exploring the ethnomedicinal, phytochemical, and pharmacological dimensions of Pelargonium graveolens: A review. Int J Pharmacol Clin Res [Internet]. 2025 [cited 2025 Nov 16];7(2):43–55. Available

from: https://www.pharmacologyjournal.in/archives/2025.v7.i2.A.92/exploring-the-ethnomedicinal-phytochemical-and-pharmacological-dimensions-of-pelargonium-graveolens-a-review

3. Ben Hsouna A, Chahdoura H, GeneralićMekinić I, Maisto M, Kukula-Koch W, Ćavar Zeljković S, et al. A comprehensive review on traditional uses, chemical composition, pharmacological effects and applications in the food industry of Pelargonium odoratissimum (L.) L'Hér. in comparison to other Pelargonium spp. S Afr J Bot [Internet]. 2024;174:456–67. Available from: http://dx.doi.org/10.1016/j.sajb.2024.09.027
4. M'hamdi Z, Bouymajane A, Riffi O, Rhazi Filali F, Ettarchouch M, ELhourri M, et al. Chemical composition and antibacterial activity of essential oil of Pelargonium graveolens and its fractions. Arab J Chem [Internet]. 2024 [cited 2025 Nov 16];17(1):105375. Available from: https://arabjchem.org/chemical-composition-and-antibacterial-activity-of-essential-oil-of-pelargonium-graveolens-and-its-fractions/
5. DAamiji, AM, Sokovi,MD, Risti, MS, Gruji, SM, Mileski KS, Marin PD. Chemical composition, antifungal and antioxidant activity of Pelargonium graveolens essential oil. J Appl Pharm Sci [Internet]. 2014 [cited 2025 Nov 16];4,(3):1–05. Available from: https://japsonline.com/abstract.php?article_id=1200&sts=2
6. Hemmami H, Seghir BB, Zeghoud S, Ben Amor I, Kouadri I, Rebiai A, et al. Desert endemic plants in Algeria: A review on traditional uses, phytochemistry, polyphenolic compounds and pharmacological activities. Molecules [Internet]. 2023;28(4):1834. Available from: http://dx.doi.org/10.3390/molecules28041834
7. Sabzghabaee AM, Shirdare Z, Ebadian B, Aslani A, Ghannadi A. Clinical evaluation of the essential oil of Pelargonium graveolens for the treatment of denture stomatitis. Dent Res J (Isfahan). 2011;8(Suppl 1):S105-8.
8. M'hamdi Z, Davì F, Elhourri M, Amechrouq A, Mondello F, Cacciola F, et al. Phytochemical investigations, antioxidant and insecticidal properties of essential oil and extracts from the aerial parts of Pelargonium graveolens from Morocco. Molecules [Internet]. 2024;29(17):4036. Available from: http://dx.doi.org/10.3390/molecules29174036
9. El-Otmani N, El ouazzani F, Akoh R, Ouazzani R, Zeouk I, Loukili A, et al. Assessment of Pelargonium graveolens flower essential oil: Antimicrobial, antioxidant, enzyme inhibition and in vivo topical analgesic and anti-inflammatory efficacy as treatment for atopic dermatitis. F1000Res [Internet]. 2024 [cited 2025 Nov 16];13(1366):1366. Available from: https://f1000research.com/articles/13-1366/pdf
10. Asker AYM, Al Haidar AHMJ. Cytotoxic properties of Pelargonium graveolens leaf extract and its green-synthesized gold nanoparticles (in vitro study). J Taibah Univ Med Sci [Internet]. 2024;19(4):901–9. Available from: http://dx.doi.org/10.1016/j.jtumed.2024.08.002
11. Carmen G, Hancu G. Antimicrobial and Antifungal Activity of Pelargonium roseum Essential Oils. Adv Pharm Bull [Internet]. 2014 [cited 2025 Nov 16];4(Suppl 2):511–4. Available from: https://www.semanticscholar.org/paper/Antimicrobial-and-Antifungal-Activity-of-roseum-Carmen-Hancu/31e55c866d6298a9ffe460fdcd996e9c294381c3
12. Fayoumi L, Khalil M, Ghareeb D, Chokr A, Bouaziz M, El-Dakdouki MH. Phytochemical constituents and therapeutic effects of the essential oil of rose geranium (Pelargonium hybrid) cultivated in Lebanon. S Afr J Bot [Internet]. 2022;147:894–902. Available from: http://dx.doi.org/10.1016/j.sajb.2022.03.039
13. Anand U, Tudu CK, Nandy S, Sunita K, Tripathi V, Loake GJ, et al. Ethnodermatological use of medicinal plants in India: From ayurvedic formulations to clinical perspectives - A review. J Ethnopharmacol [Internet]. 2022;284(114744):114744. Available from: http://dx.doi.org/10.1016/j.jep.2021.114744
14. Dumlupinar B, Karatoprak GŞ, Demirci B, Akkol EK, Sobarzo-Sánchez E. Antioxidant activity and chemical composition of Geranium oil and its synergistic potential against pneumococci with various antibiotic combinations. Plants [Internet]. 2023;12(17):3080. Available from: http://dx.doi.org/10.3390/plants12173080
15. Al-Mijalli SH, Mrabti HN, Assaggaf H, Attar AA, Hamed M, Baaboua AE, et al. Chemical profiling and biological activities of Pelargonium graveolens essential oils at three different phenological stages. Plants [Internet]. 2022;11(17):2226. Available from: http://dx.doi.org/10.3390/plants11172226
16. Boukhatem MN, Sudha T, Darwish NHE, Nada HG, Mousa SA. Essence aromatique du Géranium Odorant (Pelargonium graveolens L'Hérit.) d'Algérie : exploration des proprieties antioxydant, anti-inflammatoire et anticancéreuse (anti-angiogénique et cytotoxique). Ann Pharm Fr [Internet]. 2022;80(3):383–96. Available from: http://dx.doi.org/10.1016/j.pharma.2021.07.002
17. Boukhris M, Simmonds MSJ, Sayadi S, Bouaziz M. Chemical composition and biological activities of polar extracts and essential oil of rose-scented geranium, Pelargonium graveolens: Chemical composition and biological activities of geranium. Phytother Res [Internet]. 2013;27(8):1206–13. Available from: http://dx.doi.org/10.1002/ptr.4853
18. Kim H, Li S, Nilkhet S, Baek SJ. Anti-cancer activity of rose-geranium essential oil and its bioactive compound geraniol in colorectal cancer cells. Appl Biol Chem [Internet]. 2025 [cited 2025 Nov 16];68(1):30. Available from: https://snu.elsevierpure.com/en/publications/anti-cancer-activity-of-rose-geranium-essential-oil
19. Mahboubi M, Kazempour N, Farzin N. Antimicrobial Activity of Pelargonium graveolens and Oliveriadecumbens Extracts Against Clinical Isolates of Staphylococcus aureus. J Biol Act ProdNat[Internet].2011;1(2):105–11.Availablefrom: http://dx.doi.org/10.1080/22311866.2011.10719076
20. Pedraza PSR, Aguirre OER, Palacios J del CA. Evaluation of antibacterial activity in Pelargonium graveolens extracts. Int J Membr Sci Technol [Internet]. 2023 [cited 2025 Nov 16];10(2):3962–75.Availablefrom: https://cosmosscholars.com/phms/index.php/ijmst/article/view/3292
21. Balabanova V, Zheleva-Dimitrova D, Gevrenova R. Recent studies on Pelargonium graveolens L'Hér.: a review on chemical composition and biological activity. Farmatsiia (Sofia) [Internet].2025;72:1–12.Availablefrom: http://dx.doi.org/10.3897/pharmacia.72.e168167