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THEME

IN VITRO EVALUATION OF THE ANTIOXIDANT, ANTI-INFLAMMATORY, AND ANTIBACTERIAL PROPERTIES OF GLOBULARIA ALYPUM L. EXTRACT

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Abstract

The study investigated aqueous decoction extracts of *Globularia alypum L.* leaves and leaves combined with flowers, focusing on yield, phytochemical composition, and biological activities. Leaf decoction yielded 34.06%, while leaves combined with flowers yielded only 3.56%, highlighting the influence of solvent and plant part selection. Phytochemical screening confirmed richness in polyphenols, flavonoids, tannins, saponins, and steroids, with flowers contributing additional quinones and higher tannin levels. Quantitative assays revealed that leaves combined with flowers contained more polyphenols (139.08 ± 1.97 mg GAE/g), flavonoids (22.61 ± 1.97 mg QE/g), and tannins (19.09 ± 0.70 mg TAE/g) compared to leaves. Antioxidant evaluation showed strong radical scavenging activity: leaves exhibited superior DPPH activity (IC_{50} = 0.0367 mg/mL), while leaves combined with flowers were more effective in the ABTS assay (IC_{50} = 0.010 mg/mL). Anti-inflammatory activity, assessed by BSA denaturation inhibition, was dose-dependent, with leaves combined with flowers showing stronger inhibition at high concentrations (78.95% at 5 mg/mL), whereas leaves were more active at moderate doses. In contrast, antibacterial assays revealed no inhibition zones against tested strains, consistent with literature reporting weak activity of aqueous extracts. Overall, these findings highlight *Globularia alypum* leaves and flowers as a rich source of phenolics and tannins with significant antioxidant and anti-inflammatory potential, while leaves demonstrate stronger radical scavenging efficiency, thereby validating traditional uses and emphasizing the importance of plant part selection and extraction method in optimizing bioactive recovery.

Keywords: *Globularia alypum L.*, aqueous decoction, polyphenols, flavonoids, antioxidant activity, anti-inflammatory, antibacterial activity.

Résumé

Cette étude a évalué les extraits aqueux par décoction des feuilles et des parties aériennes de *Globularia alypum L.*, en mettant l'accent sur le rendement, la composition phytochimique et les activités biologiques. Le rendement des feuilles (34,06 %) était nettement supérieur à celui des fleurs et feuilles (3,56 %), soulignant l'influence du solvant et de l'organe végétal. Le criblage phytochimique a révélé une richesse en polyphénols, flavonoïdes, tannins, saponines et stéroïdes, avec une contribution notable des fleurs (quinones, tannins élevés). Les dosages quantitatifs ont confirmé des teneurs plus importantes en polyphénols (139,08 ± 1,97 mg GAE/g), flavonoïdes (22,61 ± 1,97 mg QE/g) et tannins (19,09 ± 0,70 mg TAE/g) dans les parties aériennes par rapport aux feuilles. L'activité antioxydante a été significative : les feuilles ont montré une meilleure efficacité dans le test DPPH (IC_{50} = 0,0367 mg/mL), tandis que les parties aériennes ont été plus actives dans le test ABTS (IC_{50} = 0,010 mg/mL). L'activité anti-inflammatoire, évaluée par l'inhibition de la dénaturation de la BSA, était dose-dépendante, avec une supériorité des fleurs et feuilles à forte concentration (78,95 % à 5 mg/mL), alors que les feuilles présentaient une activité plus marquée à doses intermédiaires. En revanche, aucun effet antibactérien n'a été observé contre les souches testées. Globalement, ces résultats confirment le potentiel de *Globularia alypum* comme source de composés phénoliques et tanniques dotés d'activités antioxydantes et anti-inflammatoires, et valident son usage traditionnel.

Mots-clés : *Globularia alypum L.*, décoction aqueuse, polyphénols, flavonoïdes, activité antioxydante, anti-inflammatoire, activité antibactérienne

ملخص

تتناول هذه الدراسة التحليل الكيميائي النباتي وتقييم الأنشطة البيولوجية لنبات التاسلغا، وهو نبات طبي شائع في منطقة البحر الأبيض المتوسط وخاصة في الجزائر، بهدف إبراز غناه بالمركبات الثانوية ودراسة خصائصه المضادة للأكسدة والمضادة للالتهاب. تم استخلاص المستحضرات باستعمال طريقة المغلي المائي، حيث بلغ مردود الأوراق 34.06% بينما كان مردود الأوراق مع الأزهار ضعيفاً نسبياً (3.56%)، وأظهر الفحص الكيميائي النباتي وجود البوليفينولات والفلافونويدات والتانينات والسابونينات والستيرويدات، مع مساهمة الأزهار في زيادة التنوع الكيميائي بظهور الكينونات وارتفاع محتوى التانينات. أظهرت التحاليل الكمية أن الأجزاء الهوائية تحتوي نسباً أعلى من المركبات الفينولية(139.08 mg GAE/g) ، الفلافونويدات(22.61 mg QE/g) ، والتانينات 19.09 mg TAE/g). 12.89 ، mg QE/g4.15 ، (83.58 mg GAE/gمقارنة بالأوراق في تقييم النشاط المضاد للأكسدة، سجلت الأوراق فعالية أكبر في اختبار(DPPH (IC_{50} = 0.0367 mg/mL) ، بينما تفوقت الأوراق مع الأزهار في اختبار ABTS (IC_{50} = 0.010 mg/mL).أما النشاط المضاد للالتهاب فقد أظهر اعتماداً واضحاً على التركيز، إذ كانت الأجزاء الهوائية أكثر فعالية عند الجرعات العالية (78.95% عند 5mg/mL) ، في حين أظهرت الأوراق نشاطاً ملحوظاً عند الجرعات المتوسطة (53.67% عند 2 mg/mL).بالنسبة للنشاط المضاد للبكتيريا، لم تُسجَّل أي مناطق تثبيط ضد السلالات المختبرة، مما يؤكد محدودية فعالية المستخلصات المائية في هذا الجانب. بشكل عام، تبرز هذه النتائج أن نبات التاسلغا يمثل مصدراً غنياً بالمركبات الفينولية والفلافونويدات والتانينات، مع كفاءة ملحوظة للأوراق في بعض الاختبارات المضادة للأكسدة، وتدعم هذه المعطيات الاستخدام التقليدي للنبتة وتؤكد أهميتها كمصدر طبيعي واعد لمركبات ذات خصائص مضادة للأكسدة والالتهاب.

الكلمات المفتاحية : *Globularia alypum L*، النشاط المضاد للأكسدة، الفلافونويدات، البوليفينولات، المغلي المائي، المضاد للالتهاب، النشاط المضاد للبكتيري

Introduction

Medicinal plants have been used for centuries as a primary source of healthcare and remain vital today, with nearly 80% of the world's population relying on them for therapeutic purposes **(Farnsworth et al., 1987; Marrelli, 2021).**

They are valued not only for their role in disease prevention and treatment but also for their contribution to pharmaceutical and cosmetic industries. Their bioactive compounds such as polyphenols, flavonoids, alkaloids, and terpenes are widely studied for their pharmacological properties **(Ansari et al., 2024; Arora et al., 2025).**

Algeria, with its diverse bioclimatic regions ranging from humid coastal zones to arid deserts, hosts a rich variety of medicinal plants. More than 300 species have been documented in ethnobotanical studies, traditionally used to treat digestive, respiratory, and inflammatory disorders **(Miara et al., 2018).** This botanical wealth represents both therapeutic and economic potential, positioning medicinal plants as a sustainable resource for scientific research and drug discovery **(Reguieg, 2011; Benzaoui & Fadai, 2021).**

Among these species, *Globularia alypum L.*, a Mediterranean shrub belonging to the Plantaginaceae family, has gained significant attention. Traditionally employed as a hypoglycemic agent, digestive aid, and skin remedy, it is recognized for its rich phytochemical profile, including flavonoids, iridoids. These compounds confer strong antioxidant and anti-inflammatory properties, validated by pharmacological studies **(Harzallah et al., 2010; Nouir et al., 2023; Asraoui et al., 2025).**

In this context, the present study aims to investigate the biological potential of *Globularia alypum L*. through an experimental approach. Aqueous extracts of its leaves and leaves combined with flowers were subjected to phytochemical screening and quantitative assays to determine polyphenol, flavonoid, and tannin content. Furthermore, antioxidant and anti-inflammatory activities were evaluated using in vitro methods.

The findings are expected to provide deeper insights into the correlation between chemical composition and biological effects, and to highlight the value of this plant as a promising natural resource for phytotherapeutic applications.