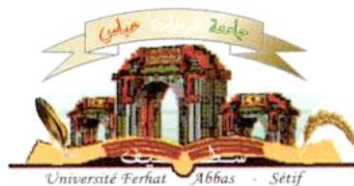


الجمهورية الجزائرية الديمقراطية الشعبية
وزارة التعليم العالي و البحث العلمي

Ferhat Abbas University, Setif 1
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جامعة فرحات عباس، سطيف 1
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Department of Animal Biology and Physiology

Dissertation

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To obtain the diploma of

MASTER

Branch: Animal Biology and Physiology

Specialty: Cellular Physiology and physiopathology

THEME

Phytochemical analysis, toxicity and anti-inflammatory activity of *Inula viscosa* extracts used in traditional medicine

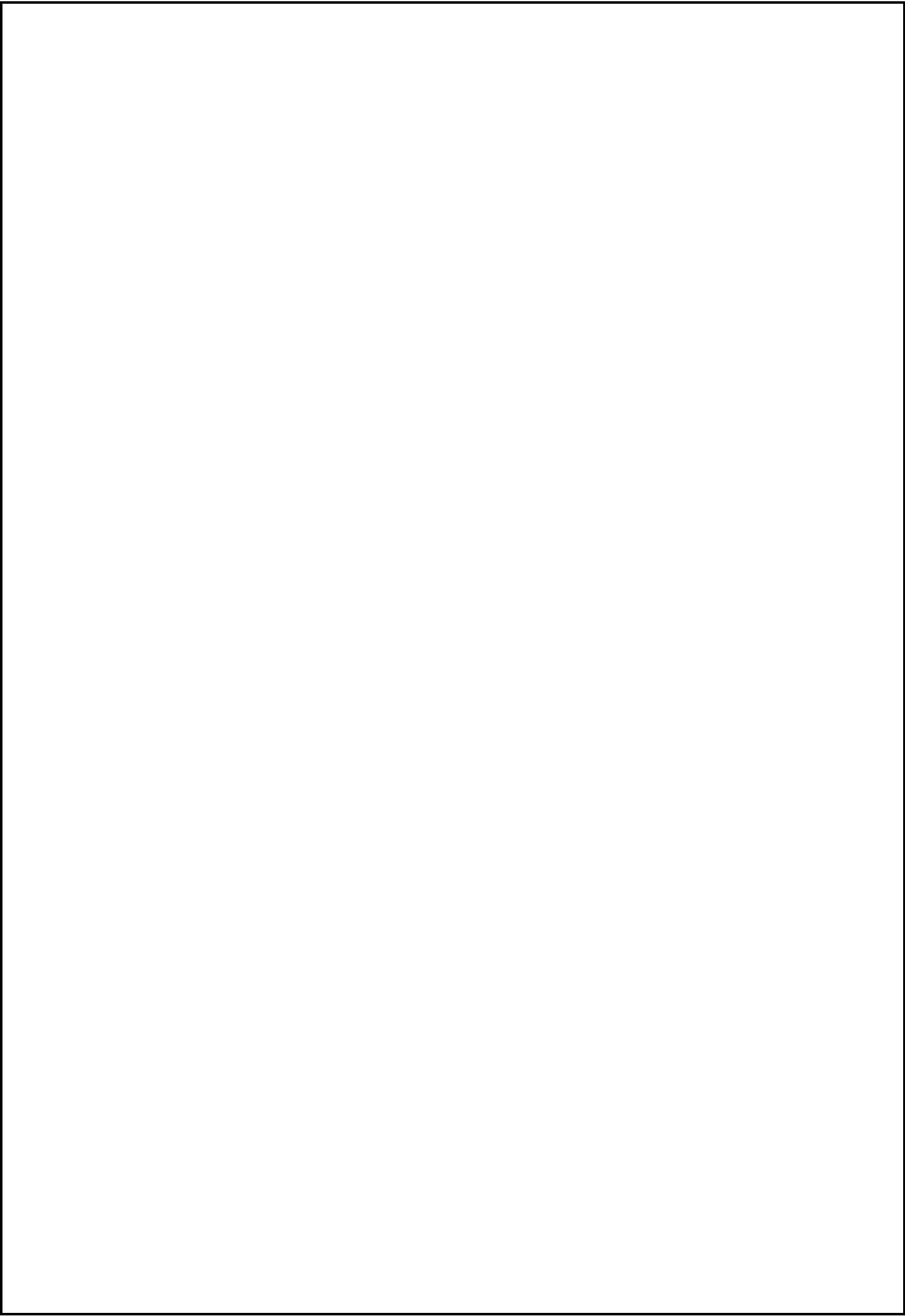
Defended on: 29/06/2026

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ملخص

تهدف هذه الدراسة إلى تقييم الخصائص البيولوجية لنبات التيون (المقرمان) من خلال تحضير مستخلصين مختلفين الأول مستخلص إيثانولي و الثاني مستخلص مائي . في البداية، تم إجراء دراسة فيتوكيميائية للمستخلصين من خلال تقدير محتواهما من البوليفينولات الكلية والفلافونويدات، وذلك لتقييم غناهما بالمركبات الثانوية ذات النشاط الحيوي. تم تقييم النشاط المضاد للأكسدة للمستخلصين باستعمال عدة اختبارات مكملية شملت DPPH و ABTS و TAC و H_2O_2 و اختبار β -carotène ، بهدف تحديد قدرتهما على معادلة الجذور الحرة والحد من الإجهاد التأكسدي. كما تم إجراء دراسة السمية الحادة لمدة 14 يوماً باستعمال جرعتين مختلفتين (2000 مغ/كغ و 5000 مغ/كغ من وزن الجسم). وتمت متابعة الفئران يومياً لرصد أي علامات سمية محتملة، بالإضافة إلى مراقبة تغيرات الوزن واستهلاك الماء. وفي نهاية التجربة، تم تشريح الحيوانات ووزن الأعضاء الرئيسية المتمثلة في القلب والرئتين والكبد والكليتين والطحال، بهدف الكشف عن أي تأثيرات أو تغيرات مرضية محتملة ناتجة عن المعالجة بالمستخلصات. وفي المرحلة الأخيرة، تم تقييم النشاط المضاد للالتهاب للمستخلصين باستعمال نموذجين تجريبيين للالتهاب المستحدث، هما اختبار الكاراجينان (Carrageenan) واختبار الزيلين (Xylene) ، وذلك لدراسة قدرة المستخلصات على التخفيف من الاستجابة الالتهابية. أظهرت النتائج أن مستخلصات نبات المقرمان تمتلك خصائص مضادة للأكسدة ومضادة للالتهاب، مع عدم تسجيل أي مؤشرات سمية حادة عند الجرعات المدروسة، يعني أن الجرعة المميّنة أكبر من 5000 مغ / كغ في السمية الحادة مما يؤكد الأهمية العلاجية المحتملة لهذا النبات ويدعم استخدامه في الطب التقليدي والبحوث الصيدلانية الحديثة.

الكلمات المفتاحية :

المستخلص المائي , المستخلص الإيثانولي , البوليفينولات , الفلافونويدات , السمية الحادة , النشاط المضاد للالتهاب , الكاراجينان , مضادة للأكسدة , الطب التقليدي , *Inula viscosa* الزيلين ,

ABSTRACT

This study aimed to evaluate the biological properties of *Inula viscosa* (magraman) through the preparation of two different extracts an ethanolic extract and an aqueous extract. Firstly, a phytochemical investigation was carried out by determining the contents of total polyphenols and flavonoids in both extracts in order to assess their richness in bioactive secondary metabolites. Subsequently, the antioxidant activity of the extracts was evaluated using several complementary assays, including DPPH, ABTS, total antioxidant capacity (TAC), hydrogen peroxide (H₂O₂), and β -carotene bleaching tests. These assays were performed to determine the ability of the extracts to scavenge free radicals and reduce oxidative stress. Additionally, an acute toxicity study was conducted over a period of 14 days using two doses (2000 mg/kg and 5000 mg/kg body weight). The mice were monitored daily for signs of toxicity, changes in body weight, and water consumption. At the end of the experiment, the major organs, including the heart, lungs, liver, kidneys, and spleen, were collected and weighed to assess any potential physiological or pathological alterations induced by the extracts. Finally, the anti-inflammatory activity of the extracts was investigated using two experimental models of induced inflammation: the carrageenan-induced oedema test and the xylene-induced inflammation test. These models were used to evaluate the ability of the extracts to reduce inflammatory responses. The results demonstrated that *Inula viscosa* extracts possess significant antioxidant and anti-inflammatory properties, while showing no evidence of acute toxicity at the tested doses. This means that the lethal dose is greater than 5000 mg/kg in acute toxicity. These findings support the potential therapeutic value of this plant and justify its traditional use as well as its possible application in pharmaceutical and biomedical research.

Keywords:

Inula viscosa, aqueous extract, ethanolic extract, polyphenols, flavonoids, toxicity, anti-inflammatory activity, xylene, carrageenan, antioxidant, traditional medicine.

Résumé :

Cette étude visait à évaluer les propriétés biologiques d'*Inula viscosa* (magraman) à travers la préparation de deux extraits différents un extrait éthanolique et un extrait aqueux. Dans un premier temps, une investigation phytochimique a été réalisée en déterminant les teneurs en polyphénols totaux et en flavonoïdes dans les deux extraits, afin d'évaluer leur richesse en métabolites secondaires bioactifs. Par la suite, l'activité antioxydante des extraits a été évaluée à l'aide de plusieurs tests complémentaires, notamment le DPPH, l'ABTS, la capacité antioxydante totale (TAC), le peroxyde d'hydrogène (H₂O₂) et le test de blanchiment du β -carotène. Ces tests ont permis de déterminer la capacité des extraits à piéger les radicaux libres et à réduire le stress oxydatif. Par ailleurs, une étude de toxicité aiguë a été menée sur une période de 14 jours en utilisant deux doses (2000 mg/kg et 5000 mg/kg de poids corporel). Les souris ont été surveillées quotidiennement afin de détecter tout signe de toxicité, ainsi que les variations de poids corporel et de consommation d'eau. À la fin de l'expérience, les principaux organes, à savoir le cœur, les poumons, le foie, les reins et la rate, ont été prélevés et pesés afin d'évaluer d'éventuelles altérations physiologiques ou pathologiques induites par les extraits. Enfin, l'activité anti-inflammatoire des extraits a été étudiée à l'aide de deux modèles expérimentaux d'inflammation induite : le test de l'œdème induit par la carragénine et le test de l'inflammation induite par le xylène. Ces modèles ont permis d'évaluer la capacité des extraits à réduire les réponses inflammatoires. Les résultats ont démontré que les extraits d'*Inula viscosa* possèdent des propriétés antioxydantes et anti-inflammatoires significatives, sans montrer de signes de toxicité aiguë aux doses testées. Cela signifie que la dose létale est supérieure à 5000 mg/kg en toxicité aiguë. Ces résultats confirment la valeur thérapeutique potentielle de cette plante et justifient son usage traditionnel ainsi que son application possible dans la recherche pharmaceutique et biomédicale.

Mots-clés :

Inula viscosa, extrait aqueux, extrait éthanolique, polyphénols, flavonoïdes, toxicité, activité anti-inflammatoire, xylène, carraghénane, antioxydant, médecine traditionnelle.

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Introduction:

Algeria has an vast variety of plants and a long history of using them. There are 3744 taxa and 3139 species, 464 of which are endemic and 1818 of which are relatively uncommon. In order to find novel compounds, it is crucial to investigate this botanical richness using ethnobotanical expertise. (Qu'ezel et Santa, 1962; Vela et Benhouhou, 2007).

Many of these species may have negative effects on human health due to the opacity of their chemical composition. On the other hand, recent years have witnessed a growing interest in herbal medicine, highlighting the importance of medicinal plants as a natural resource that contributes to treating and limiting the spread of many diseases. (OMS, 2007)

Among these plants, the species *Inula viscosa* (L.), or *Dittrichia viscosa* (whose synonym is Magraman), a perennial plant with glands, a viscous texture, and a fragrant scent, is one of Algeria's most significant medicinal herbs. It has long been used to treat and alleviate a number of illnesses. For this reason, we decided to investigate the *I.viscosa* unique to Algeria. (Haoui et al., 2015)

The exceptional antioxidant and anti-inflammatory properties of *I.viscosa* may play a significant role in the prevention and management of chronic diseases. Oxidative stress and persistent inflammation are recognized as major contributing factors in the development of several long-term disorders, including cancer, type 2 diabetes, cardiovascular diseases, and neurodegenerative conditions such as Alzheimer's and Parkinson's diseases. Bioactive compounds present in *I.viscosa*, particularly phenolic compounds and flavonoids, can help neutralize free radicals, reduce cellular damage, and modulate inflammatory pathways. By limiting oxidative damage and controlling excessive inflammatory responses, this medicinal plant may contribute to the protection of tissues and organs from progressive deterioration. Furthermore, its therapeutic potential has attracted increasing scientific interest, suggesting that it could serve as a valuable natural source for the development of preventive and complementary treatments aimed at improving human health and reducing the burden of chronic diseases (Lounis et al., 2018).

Thus, the goal of the current study was to assess the biological potential of its ethanolic and aqueous extracts by measuring their total polyphenol and flavonoid contents, evaluating their antioxidant activity using various in vitro assays, and examining their acute toxicity and anti-inflammatory effects using experimental

