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Faculty of nature and life  
sciences



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**MEMORY**

Presented by

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**Ethnopharmacological survey and evaluation of anti-inflammatory  
activity of *Quercus suber* L.**

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**Acknowledgments  
And  
Dedication**

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# DEDICATION

To the kid who dared to dream big, even when the path seemed impossible. This is for you. We made it buddy.

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# DEDICATION

In the Name of Allah, the Most Gracious, the Most Merciful

To those who carried me on wings of prayer and love...

I dedicate this work with deepest gratitude to:

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# **Abstracts**

### المخلص

لطالما استخدمت الطبيعة كصيدلية أولى للإنسان، ومن بين كنوزها يأتي نبات البلوط الفليني (*Quercus suber L.*) الذي تناقلت الأجيال استخداماته التقليدية، لا سيما في علاج آلام وتقرحات المعدة. لكن، هل تخبئ جذور هذا النبات العريق أسراراً علمية تدعم هذه الحكمة الشعبية هذا ما سعينا لكشفه في دراستنا. في رحلة بحثنا هذه، غصنا في أعماق مستخلص جذور البلوط الفليني لنكتشف كنوزه الكيميائية: فقد كشف التحليل عن غناه المذهل بمركبات البوليفينول، بتركيز بلغ  $3.35 \pm 281.54$  لكل ملغرام من المستخلص الجاف (مكافئ حمض الغاليك)، إضافة إلى كميات معتبرة من الفلافونويدات  $2.40 \pm 0.64$  ميكروغرام مكافئ كيرسيتين لكل ملغرام من المستخلص الجاف والتانات  $82.49 \pm 1.89$  ميكروغرام مكافئ كاتيكين لكل ملغرام من المستخلص الجاف هذه المركبات هي عادةً وراء الفوائد الصحية للنباتات. ولم نقف عند الكيمياء فحسب، بل اختبرنا قدرة هذا المستخلص على مكافحة الالتهاب، وهو أساس العديد من الأمراض. في تجاربنا المخبرية، أظهر المستخلص قوة استثنائية في تثبيط تمسخ البروتين، وهو مؤشر حيوي للنشاط المضاد للالتهاب. واللافت أنه تجاوز فعالية دواء الأسبرين نفسه عند أعلى تركيز ( $96.14\%$  مقابل  $93.88\%$ ). أما في الدراسات على الكائنات الحية، تحديداً على الفئران المصابة بوذمة الأذن، فقد برهن المستخلص على فعالية مذهلة في تخفيف الالتهاب بنسبة  $81.48\%$ ، مقترَباً بشكل كبير من قوة دواء الإندوميثاسين المعروف ( $87.65\%$ ). هذه النتائج ترسم صورة واضحة لقوة هذا المستخلص في تهدئة الالتهابات. ولأن الأمان هو حجر الزاوية في أي علاج، قمنا بتقييم السمية الحادة للمستخلص. الفئران التي تلقت جرعات عالية جداً تصل إلى 5000 مغ/كغ لم تُظهر أي علامات موت أو تغييرات سلوكية خلال 14 يوماً، مما يصنفه بوضوح على أنه "غير سام حاد" وفقاً للمعايير الدولية. في الختام، تؤكد دراستنا هذه أن جذور *Quercus suber L.* ليست مجرد حكايات شعبية، بل هي مخزن حقيقي لمركبات نشطة بيولوجياً ذات قدرات هائلة مضادة للالتهاب وملف أمان ممتاز. هذه النتائج تفتح آفاقاً واسعة لمزيد من الأبحاث، وربما تمهد الطريق لتطوير علاجات طبيعية جديدة وفعالة مستوحاة من هذا النبات العجيب.

**الكلمات الرئيسية:** *Quercus suber L.*، دراسة إثنو-فارماكولوجية، بوليفينولات، نشاط مضاد للالتهاب.

## Abstracts

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### Abstract

For centuries, nature has served as humanity's primary pharmacy, and among its many treasures is the cork oak (*Quercus suber* L.), traditionally used for treating gastric ulcers. Our study aimed to scientifically validate these long-held beliefs by delving into the chemical and biological properties of its root extract. An ethnopharmacological study was conducted to highlight its traditional uses. Then our investigation began by uncovering the chemical richness of the *Quercus suber* methanolic root extract. We found it to be exceptionally rich in polyphenols, measuring  $281.54 \pm 3.35$   $\mu\text{g}$  gallic acid equivalent (GAE) per milligram of dried extract (DE). Significant amounts of flavonoids ( $2.40 \pm 0.64$   $\mu\text{g}$  quercetin equivalent/DE) and tannins ( $82.49 \pm 1.89$   $\mu\text{g}$  catechin equivalent/DE) were also identified, known contributors to the beneficial properties of plants. Beyond its chemical composition, we rigorously tested the extract's capacity to combat inflammation, a fundamental process in many diseases. In our *in vitro* experiments, the extract demonstrated remarkable power in inhibiting protein denaturation, a key indicator of anti-inflammatory activity. Strikingly, it surpassed the efficacy of aspirin at the highest concentration (96.14% versus 93.88%). Furthermore, *in vivo* studies using the xylene-induced ear edema model in mice revealed a significant anti-inflammatory effect, achieving an  $81.48 \pm 2.95\%$  inhibition at a dose of 2 mg/ear, closely mirroring the potency of indomethacin (87.65%)—a well-known anti-inflammatory drug. Crucially, safety is paramount for any potential therapeutic agent. Our acute toxicity study showed excellent results: mice administered a very high dose of 5000 mg/kg of the extract exhibited no mortality or behavioral changes over a 14-day monitoring period. This classifies the extract as "acutely non-toxic" according to OECD guidelines, with an  $\text{LD}_{50}$  exceeding 5000 mg/kg. In conclusion, our findings strongly suggest that *Quercus suber* L. Root extract is not merely a subject of traditional folklore; it is a potent source of bioactive compounds with remarkable anti-inflammatory capabilities and an excellent safety profile. This research opens exciting avenues for further investigation and may pave the way for developing novel, natural therapeutic agents derived from this remarkable plant.

**Keywords:** *Quercus suber* L, ethnopharmacological study, polyphenols, anti-inflammatory activity.

## Resumé

Pendant des siècles, la nature a servi de principale pharmacie à l'humanité, et parmi ses nombreux trésors se trouve le chêne-liège (*Quercus suber* L.), traditionnellement utilisé pour le traitement des ulcères gastriques. Notre étude visait à valider scientifiquement ces croyances ancestrales en approfondissant les propriétés chimiques et biologiques de son extrait de racine. Une étude ethnopharmacologique a été menée pour mettre en évidence ses utilisations traditionnelles. Ensuite, notre investigation a commencé par la découverte de la richesse chimique de l'extrait méthanolique de racine de *Quercus suber*. Nous l'avons trouvé exceptionnellement riche en polyphénols, mesurant  $281,54 \pm 3,35$  µg d'équivalent acide gallique (EAG) par milligramme d'extrait sec (ES). Des quantités significatives de flavonoïdes ( $2,40 \pm 0,64$  µg équivalent quercétine/mgES) et de tanins ( $82,49 \pm 1,89$  µg équivalent catéchine/mgES) ont également été identifiées, connus pour contribuer aux propriétés bénéfiques des plantes. Au-delà de sa composition chimique, nous avons rigoureusement testé la capacité de l'extrait à combattre l'inflammation, un processus fondamental dans de nombreuses maladies. Dans nos expériences *in vitro*, l'extrait a démontré un pouvoir remarquable à inhiber la dénaturation des protéines, un indicateur clé de l'activité anti-inflammatoire. De manière frappante, il a surpassé l'efficacité de l'aspirine à la concentration la plus élevée (96,14 % contre 93,88 %). De plus, des études *in vivo* utilisant le modèle d'œdème de l'oreille induit par le xylène chez la souris ont révélé un effet anti-inflammatoire significatif, atteignant une inhibition de  $81,48 \pm 2,95$  % à une dose de 2 mg/oreille, reflétant étroitement la puissance de l'indométacine (87,65 %) un médicament anti-inflammatoire bien connu. De manière cruciale, la sécurité est primordiale pour tout agent thérapeutique potentiel. Notre étude de toxicité aiguë a montré d'excellents résultats : les souris ayant reçu une très forte dose de 5000 mg/kg de l'extrait n'ont présenté aucune mortalité ni de changements comportementaux sur une période de suivi de 14 jours. Cela classe l'extrait comme "non-toxique aigu" selon les directives de l'OCDE, avec une  $DL_{50}$  dépassant 5000 mg/kg. En conclusion, nos découvertes suggèrent fortement que l'extrait de racine de *Quercus suber* L. n'est pas simplement un sujet de folklore traditionnel ; c'est une source puissante de composés bioactifs aux remarquables capacités anti-inflammatoires et à un excellent profil de sécurité. Cette recherche ouvre des voies passionnantes pour des investigations futures et pourrait ouvrir la voie au développement de nouveaux agents thérapeutiques naturels dérivés de cette plante remarquable.

**Mots-clés :** *Quercus suber* L, étude ethnopharmacologique, polyphénols, activité anti-inflammatoire.

