



## 電子報第 181 期

### 活動訊息

#### ◆ 論文徵稿

即日起徵求 SuperGreen2022 論文，主題：

- (1)“Physicochemical properties and thermodynamics”
- (2)“Natural products, pharmaceutical and biomedical applications”
- (3)“Reactions, material design and nanotechnology”
- (4)“Process intensification, CO<sub>2</sub> utilization and industrial applications”
- (5)“Applications of SCF technology in Taiwan”

等5大主題領域的研究論文，邀請各界踴躍投稿，及蒞臨與會交流。

<https://supergreen2022.conf.tw/site/page.aspx?pid=901&sid=1429&lang=en>

### 專家介紹

- ◆ 廖盛焜教授(逢甲大學纖維與複合材料系)
- ◆ 翁堉翔組長(台灣中油股份有限公司 綠能科技研究所)

### 團體會員介紹

- ◆ 台灣中油股份有限公司 綠能科技研究所

### 教育訓練班

- ◆ (在職)高壓氣體特定設備操作人員安全衛生在職教育訓練 05/09(一)下午班

### 技術文摘

- ◆ A laboratory study of hydraulic fracturing at the brittle-ductile transition 脆韌轉變水力壓裂的實驗室研究
- ◆ A standardized black pepper seed extract containing  $\beta$ -caryophyllene improves cognitive function in scopolamine-induced amnesia model mice via regulation of brain-derived neurotrophic factor and MAPK proteins 含有  $\beta$ -石竹烯的標準化黑胡椒籽提取物通過調節腦源性神經營養因子和 MAPK 蛋白改善東莨菪鹼致失憶模型小鼠的認知功能
- ◆ Black Bean ( *Phaseolus vulgaris* L.) Polyphenolic Extract Exerts Antioxidant and Antiaging Potential 黑豆 ( *Phaseolus vulgaris* L. ) 多酚提取物具有抗氧化和抗衰老的潛力
- ◆ CO<sub>2</sub> Supercritical Fluid Extraction of Oleoresins from Sea Buckthorn Pomace: Evidence of Advanced Bioactive Profile and Selected Functionality 沙棘果渣油樹脂的 CO<sub>2</sub> 超臨界流體萃取：先進生物活性譜和選定功能的證據



- ◆ *Lippia graveolens* HBK oleoresins, extracted by supercritical fluids, showed bactericidal activity against multidrug resistance *Enterococcus faecalis* and *Staphylococcus aureus* strains 超臨界流體提取的 *Lippia Graveolens* HBK 油樹脂對耐多藥糞腸球菌和金黃色葡萄球菌具有殺菌活性
- ◆ Pharmaceutical Applications of Supercritical Fluid Extraction of Emulsions for Micro-/Nanoparticle Formation 用於微/納米顆粒形成的乳液的超臨界流體萃取的製藥應用
- ◆ Polycyclic aromatic hydrocarbon contamination in soils and sediments: Sustainable approaches for extraction and remediation 土壤和沈積物中的多環芳烴污染：提取和修復的可持續方法
- ◆ Recovery of biologically active compounds from stinging nettle leaves part I: Supercritical carbon dioxide extraction 從刺蓴麻葉中回收生物活性化合物第一部分：超臨界二氧化碳萃取
- ◆ Uncovering the Bioactivity of *Aurantiochytrium* sp.: a Comparison of Extraction Methodologies 揭示金壺菌屬的生物活性：提取方法的比較

台灣超臨界流體協會

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12<sup>th</sup> International Conference on Supercritical Fluids (Supergreen 2022)  
October 27-29, 2022

## 12<sup>th</sup> International Conference on Supercritical Fluid (Supergreen 2022) Abstract Template

Author 1<sup>a</sup>, Author 2<sup>b,\*</sup>

<sup>a</sup>Author's affiliation, City, Country

<sup>b</sup>Author's affiliation, City, Country

\*Corresponding author: E-mail address

This is the abstract template for the 12<sup>th</sup> International Conference on Supercritical Fluid (Supergreen 2022). Please follow these instructions to prepare your abstract.

### 1) Page format

Prepare **one page** abstract in **A4-size**. Top, bottom, right and left margins are set to **25.4 mm**. 'Times New Roman' or similar fonts are used throughout the abstract.

### 2) Title

Title should be **centered** and presented in **14 pt, bold** with a fixed line spacing of **20 pt**. Leave one-line space after the title. The first letter of words in title should be capitalized except for articles, short prepositions, and conjunctions.

### 3) Author name(s)

Author name(s) are centered and presented in **12 pt** with a fixed line spacing of **20 pt**. The corresponding author should be labelled with '\*' and the presenting author should be underlined.

### 4) Affiliation(s)

Affiliations are centered and presented in **10 pt** with a fixed line spacing of **20 pt**. Leave one-line space after the affiliation.

### 5) Abstract

Abstract is presented in **12 pt** with a fixed line spacing of **20 pt**. The text should be **justified left and right**. Figures and tables could be included in the abstract with the sequential numbering. All figures and tables are accompanied with a caption.



## 【專家介紹】

### 逢甲大學纖維與複合材料系/纖維染整實驗室

#### 廖盛焜教授



研究專長：纖維染色學、織物整理工程、奈米絲光、染顏料合成、染整機械、纖維物理化學、人纖紡絲工程、機能性紡織品暨檢驗、織物分析暨檢驗、水污染防治

實驗室內容：皮革/纖維/布料的染色、超臨界流體發泡以及染色、微球改質以及染色、防潑水處理、布料表面處理跟 3D 列印等領域。

聯絡資訊：逢甲大學工學館 2 樓 217 室，電話：(04)2451-7250 分機 3451、3435

重點研究：

紡織產業長年被認為是大量的水資源消費者之一，主要是因為紡織品加工製程複雜且長，每一個工段都需要使用到水資源作為處理媒介。工研院已於 2018 年研發出「超臨界流體染色與機能化同步技術」，在染色的過程中以二氧化碳取代水，並以特製高壓染缸達到特定溫度與壓力，讓缸內的二氧化碳達到氣液界面消失的超臨界流體狀態，以之溶解染料，並擴散至布料纖維內，全程不需使用任何一滴水，這項技術亦獲得「2018 全球百大科技研發獎」。

廖教授多年來致力於纖維染整技術、染顏料合成、人纖紡絲工程、機能性紡織品暨檢驗等研究，因此成立纖維染整實驗室，帶領並培育學生從事相關探討，此實驗室應用超臨界二氧化碳在染色技術的優勢：使用超臨界流體代替水，其具有安全無毒、無廢水汙染、不可燃燒性與可循環再利用等優點。在染色過程中，超臨界二氧化碳所需要的臨界條件操作容易，且在纖維染色時不需要添加任何的界面活性劑。此外，超臨界二氧化碳具有高擴散速率，使得在染色過程中染料更容易擴散滲透到纖維內。在未來的發展中，隨著洗淨、萃取等日漸成熟的技術，染整工業方面擁有相當好的未來性。



圖 1 純化後的染料能在超臨界狀態下完全溶解，進行染色。

### 超臨界發泡：

近年來廖教授也著眼於超臨界發泡的研究，針對各種成核劑對共聚物材料發泡，在超臨界流體物理發泡下探討成核劑添加量與各種物理性質的關係，鑒於傳統化學發泡體系需要高溫與較長時間以達到化學發泡劑的完全反應分解，研究內容主要運用低溫且短時間對不同組合配方進行超臨界發泡，進行成核劑用量對乙烯醋酸乙烯酯共聚物發泡材料的拉伸強度、撕裂強度、延伸率、密度、發泡倍率、表面硬度等各項物理性質的影響，同時探討發泡倍率與上述物理性質的關係，並觀察其表面情況與泡孔結構。

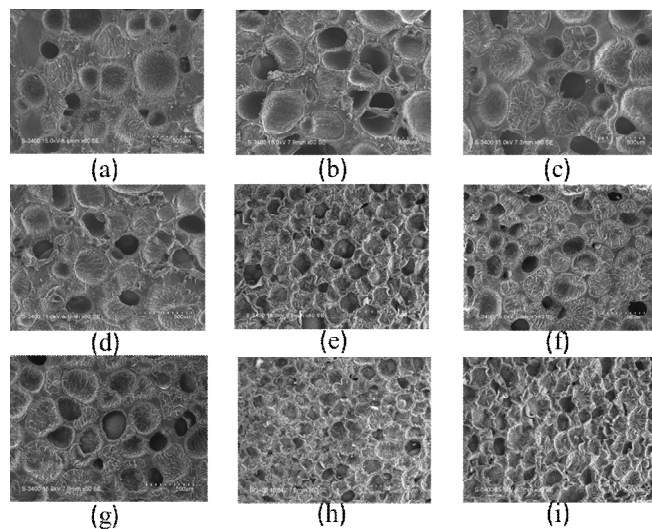


圖 2 超臨界氮氣在相同發泡時間 2 小時不同發泡溫度和發泡壓力下發泡的樣品 SEM 圖。(a)105°C 1500psi (b)115°C 1500psi (c)125°C 1500psi；(d)105°C 2500psi (e)115°C 2500psi (f)125°C 2500psi；(g)105°C 3500psi (h)115°C 3500psi(i)125°C 3500psi

隨著環保意識的高漲，綠色技術受到重視，廖教授對於協助提升產業界的研發具有使命感，近五年來執行各項計畫，如超臨界流體鞋材發泡技術之研究、梭織布數位印花品質提升技術、染整工業上節能減排之研究等。





## 【專家介紹】

### 台灣中油股份有限公司綠能科技研究所 翁堉翔組長



❖專長：海藻養殖技術研發、產品開發、工程經濟評估、薄膜分離技術

❖研究方向：冷能利用與海藻養殖、產品生命週期評估

❖email：078719@cpc.com.tw

翁堉翔組長於 2005 年自國立台灣大學環境工程學研究所畢業，服役後曾於核能研究所纖維酒精專案進行研發，並前往美國德拉瓦大學土木與環境系擔任訪問學者一年，後於 2011 年進入台灣中油公司服務，2020 年升任組長。

翁組長主要研究方向和專長為海藻養殖技術及產品化領域，與團隊合作努力，將海藻原料規格化，進行創新及跨領域之應用研發，研究成果傑出，成果斐然。2019 年海木耳原料試量產成功，以「"藻"到健康-本土大型海藻原料開發」，帶領團隊榮獲第十六屆國家新創獎；2020 年「海水藻類養殖方法與設備」榮獲台灣創新技術博覽會專利競賽金牌獎；2021 年榮獲歐盟頒發之 Seagriculture Innovation Award 金牌獎。相關成果並協助公司數個單位榮獲獎項，對公司 ESG 相當有貢獻。

地球表面 70%以上是海洋，海藻是生物減碳不可或缺的一環，國內海藻原料主要以進口為主。本土大型海藻如海木耳等，以低溫及潔淨的液化天然氣接收站冷海水進行養殖，可確保品質，產品履歷清楚，並且可以大量繁殖，不會有季節性高溫無法繁殖的情形，也可充分利用冷海水，一舉數得，期待在大家共同努力下，讓海藻產業逐步發展。



## 成立宗旨

為配合政府推動再生能源、高值低碳及環保節能之新能源政策，於 100 年 9 月 1 日成立籌備處，101 年 3 月 1 日正式成立綠能科技研究所，104 年 6 月 16 日與新材料試量產及認證中心合併。為本公司再生能源、高值低碳及環保節能產業之研發樞紐，以及試量產平台。期將現有資本、設備、勞力之生產型態，加值轉型為知識、技術、創意之經營模式。

## 經營願景

配合政府推動綠色能源產業及「新材料循環經濟產業研發專區」的政策，建構「綠色材料研製中心」、「海洋資源開發」、「綠色能源研發」及「碳循環應用」四大領域做為發展項目，致力於循環經濟發展與新材料應用，創造資源循環再利用的價值，進行價值創造與技術深耕，期能引領中油邁向高值低碳、環保節能綠色產業領域，奠定企業永續發展基礎。

## 未來目標

建立短期核心技術，逐年增加可商業化產品與技術之產出，預期每年可推出 3~5 件專利或可商業化之產品與技術。

公司拓展現有之營業範疇，逐步邁入再生能源、高值低碳及環保節能之綠能產業，並進行試量產及效益評估，以適時推出具競爭力之綠能產業商業化製程及產品。

## 角色定位

經由創能(生質能、零碳電能)、儲能(儲電、儲氫)、節能(有效燃燒、省電照明、隔熱降溫、廢熱利用)之三能並進，開創研發、創新、永續之再生能源、高值低碳、環保節能之綠能產業。

## 研發策略

以科技整合及策略聯盟，厚植綠能科技產業研發，建立核心技術，加值綠色產品與技術開發之商業價值，提供國內外產、官、學、研之綠能科技研究整合平台，配合公司經營策略及政府新能源政策，以自行研究、委託研究、合作研究之整合模式來推動綠能產業。

## 研發方向

「減碳、節能、淨能」是綠能所研發主軸，將研發成果試量產，以達成「新產品商業化、新技術工程化」的終極目標，綠能所研究主題之擬定原則為：

- ✓ 配合國家能源政策，而有生質能、太陽光電等新能源之相關研究。
- ✓ 延伸中油本業，如以自有料源、或獨有的資源為著眼點，以掌握發展利基。
- ✓ 導入綠能技術，因應節能減碳環保課題，研發儲能/節能產品，以因應產業發展趨勢。

## 產業未來規劃

- 生質能 (柴/航/燃)生產技術開發
- 生質醇生產技術開發
- 太陽能光電技術開發
- 氫能與燃料電池技術開發
- 生質化學品及生質高分子材料開發
- 電池儲能材料開發(LTO、LMNO)
- 環保節能隔熱塗覆材料開發
- 奈米光觸媒之綠色產品開發
- 海藻培育減碳技術開發
- 循環經濟技術開發



### 再生能源

- 生質精煉技術
- 生質物熱裂解技術
- 薄膜太陽能電池技術
- 氫能燃料電池



### 太陽能維運中心

- 太陽光電技術及監測管理



### 材料科技

- 環保高性能塗覆材料
- 鋰酸鋰儲能材料



### 環保科技

- LNG冷排水利用之海藻養殖技術研發



### 方法工程

- 碳五提純
- 精製瀝青
- 非晶型碳材



### 試量產

- Pilot 驗證



### 品保驗證

- 委託檢驗服務
- 檢驗方法建立



### 企劃行銷

- 研發方向規劃
- 研發成果推廣





**高壓氣體特定設備操作人員安全衛生在職教育訓練**

需要有操作證照的單位，歡迎向協會報名。

- 上課日期：**111/05/09(一) 13:30~16:30**
- 上課時數：3 小時
- 課程內容：高壓氣體特定設備相關法規、職災案例探討預防、安全須知及自動檢查
- 上課地點：高雄市楠梓區高楠公路 1001 號【金屬工業研究發展中心研發大樓 2 樓 產業力發展組】(由北側門學員專屬通道進入)
- 參加對象：高壓氣體特定設備操作人員安全衛生訓練結業滿三年者，需有結業証書。
- 費用：本班研習費新台幣 400 元整。
- 名額：每班 30 名，額滿為止。
- 報名辦法：1.傳真報名：(07)355-7586台灣超臨界流體協會  
2.報名信箱：tscfa@mail.mirdc.org.tw  
3.研習費請電匯至 兆豐國際商銀 港都分行(代碼017)  
戶名：社團法人台灣超臨界流體協會 帳號：002-09-018479 (註明參加班別及服務單位) 或以劃線支票抬頭寫「台灣超臨界流體協會」連同報名表掛號郵寄台灣超臨界流體協會，本會於收款後立即開收據寄回。

※洽詢電話：(07)355-5706 吳小姐 繳交一寸相片一張及身份證正本

**報 名 表**

課 程 名 稱	高壓氣體特定設備操作人員安全衛生在職教育訓練				上課日期	111 年 05 月 09 日	
姓 名	出生年月日	身份證字號	手機號碼	畢業校名		公司產品	
服 務 單 位					電 話		
服 務 地 址	□□□				傳 真		
發 票 住 址	□□□				統 一 編 號		
負 責 人	人	訓練聯絡人 / 職稱		email :			
參 加 費 用	共	元	參加性質	□公司指派		□自行參加	
繳 費 方 式	□郵政劃撥 □支票 □附送現金			報名日期	年 月 日		

出生年月日、身份證字號、畢業校名、電話、地址須詳填，以利製作證書。〔！〕



## A laboratory study of hydraulic fracturing at the brittle-ductile transition

脆韌轉變水力壓裂的實驗室研究

Francesco Parisio<sup>1</sup>, Keita Yoshioka<sup>2</sup>, Kiyotoshi Sakaguchi<sup>3</sup>, Ryota Goto<sup>3</sup>, Takahiro Miura<sup>3</sup>, Eko Pramudyo<sup>3</sup>, Takuya Ishibashi<sup>4</sup> & Noriaki Watanabe<sup>3</sup>

<sup>1</sup> Chair of Soil Mechanics and Foundation Engineering, Technische Universität Bergakademie, Freiberg, Germany.

<sup>2</sup> Department of Environmental Informatics, Helmholtz Centre for Environmental Research - UFZ, Leipzig, Germany.

<sup>3</sup> Department of Environmental Studies for Advanced Society, Graduate School of Environmental Studies, Tohoku University, Sendai, Japan.

<sup>4</sup> Fukushima Renewable Energy Institute, National Institute of Advanced Industrial Science and Technology (AIST), Koriyama, Japan.

### Abstract :

Developing high-enthalpy geothermal systems requires a sufficiently permeable formation to extract energy through fluid circulation. Injection experiments above water's critical point have shown that fluid flow can generate a network of highly conductive tensile cracks. However, what remains unclear is the role played by fluid and solid rheology on the formation of a dense crack network. The decrease of fluid viscosity with temperature and the thermally activated visco-plasticity in rock are expected to change the deformation mechanisms and could prevent the formation of fractures. To isolate the solid rheological effects from the fluid ones and the associated poromechanics, we devise a hydro-fracture experimental program in a non-porous material, polymethyl methacrylate (PMMA). In the brittle regime, we observe rotating cracks and complex fracture patterns if a non-uniform stress distribution is introduced in the samples. We observe an increase of ductility with temperature, hampering the propagation of hydraulic fractures close to the glass transition temperature of PMMA, which acts as a limit for brittle fracture propagation. Above the glass transition temperature, acoustic emission energy drops of several orders of magnitude. Our findings provide a helpful guidance for future studies of hydro-fracturing of [supercritical](#) geothermal systems.



**A standardized black pepper seed extract containing  $\beta$ -caryophyllene improves cognitive function in scopolamine-induced amnesia model mice via regulation of brain-derived neurotrophic factor and MAPK proteins**

含有  $\beta$ -石竹烯的標準化黑胡椒籽提取物通過調節腦源性神經營養因子和 MAPK 蛋白改善東莨菪鹼致失憶模型小鼠的認知功能

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**Abstract :**

$\beta$ -caryophyllene (BCP), a natural sesquiterpene present in plants, is a selective agonist of cannabinoid receptor type-2 (CB2) of the endocannabinoid system. In this study, we have prepared an extract from *Piper nigrum* (black pepper) seeds using [supercritical fluid](#) extraction, standardized to contain 30% BCP (Viphyllin<sup>TM</sup>). The beneficial effects of prophylactic treatment with Viphyllin on cognitive functions were demonstrated in Scopolamine-induced dementia model mice. Male Swiss albino mice (25–30 g) were administered with Viphyllin (50 mg and 100 mg/kg body weight *p.o.*) or donepezil (1.60 mg/kg) for 14 days. Subsequently, cognitive deficits were induced by treating the animals intraperitoneally with Scopolamine (0.75 mg/kg). The cognitive behavior of mice was evaluated using a novel object recognition test (NORT) and Morris water maze (MWM) test. The brain homogenates were studied for biochemical parameters including cholinesterase activities and antioxidant status. Western blot analysis was performed to investigate the mechanism of action. Viphyllin dose dependently improved the recognition and spatial memory and cholinergic functions in Scop-treated mice. The extract was found protective against Scop-induced oxidative damage and histopathologic changes in the brain. At 100 mg/kg Viphyllin markedly reduced the proBDNF/mBDNF ratio ( $p < .05$ ) and augmented the TrkB expression ( $p < .01$ ). Viphyllin (100 mg/kg) was found to be neuroprotective by reducing the Scop-induced upregulation of p-JNK and p-p38 MAPK proteins, Bax/Bcl-2 ratio, and caspase activation in the brain. Viphyllin also exerted anti-inflammatory effects by downregulating Cox-2, TNF- $\alpha$ , and NOS-2 in Scop-induced mice ( $p < .05$ ). To summarize, our data encourage Viphyllin as a functional ingredient/dietary supplement for brain health and cognition.

Practical applications



Black pepper is a culinary spice having several medicinal attributes. Essential oils in the seeds of the plant give aroma and flavor to it. Here we have prepared an extract from the seeds of black pepper using **supercritical fluid** extraction, characterized for the presence of  $\beta$ -caryophyllene (not <30%). This research work further validates the neuroprotective mechanism of the extract in Scopolamine-induced cognitive impairment model mice. The findings from this study strongly suggest the beneficial neuroactive properties of black pepper seed extract having the presence of BCP, a CB2 receptor agonist. It can thus be used potentially as a functional food ingredient for cognition and brain function.





## Black Bean ( *Phaseolus vulgaris* L.) Polyphenolic Extract Exerts Antioxidant and Antiaging Potential

黑豆 ( *Phaseolus vulgaris* L. ) 多酚提取物具有抗氧化和抗衰老的潛力

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### Abstract :

Phenolic compounds present in common beans (*Phaseolus vulgaris* L.) have been reported to possess antimicrobial, anti-inflammatory and ultraviolet radiation (UVR) protective properties. UVR from sunlight, which consists of UV-B and UV-A radiations, induces reactive oxygen species (ROS) and free radical formation, consequently activating proteinases and enzymes such as elastase and tyrosinase, leading to premature skin aging. The objective of this work was to extract, characterize and evaluate the antioxidant and antiaging potential of polyphenols from a black bean endemic variety. The polyphenolic extract was obtained from black beans by **supercritical fluid** extraction (SFE) using CO<sub>2</sub> with a mixture of water–ethanol as a cosolvent and conventional leaching with a mixture of water–ethanol as solvent. The polyphenolic extracts were purified and characterized, and antioxidant potential, tyrosinase and elastase inhibitory potentials were measured. The extract obtained using the SFE method using CO<sub>2</sub> and H<sub>2</sub>O–Ethanol (50:50 v/v) as a cosolvent showed the highest total phenolic compounds yield, with  $66.60 \pm 7.41$  mg GAE/g coat ( $p > 0.05$ ) and  $7.30 \pm 0.64$  mg C3GE/g coat ( $p < 0.05$ ) of anthocyanins compared to conventional leaching. Nineteen tentative phenolic compounds were identified in leaching crude extract using ESI-QTOF. Quercetin-3-D-galactoside was identified in crude and purified extracts. The purified SFC extract showed IC<sub>50</sub>  $0.05 \pm 0.002$  and IC<sub>50</sub>  $0.21 \pm 0.008$  mg/mL for DPPH and ABTS, respectively. The lowest IC<sub>50</sub> value of tyrosinase inhibition was  $0.143 \pm 0.02$  mg/mL and  $0.005 \pm 0.003$  mg/mL of elastase inhibition for leaching purified extract. Phenolic compounds presented theoretical free energy values ranging from  $-5.3$  to  $-7.8$  kcal/mol for tyrosinase and  $-2.5$  to  $-6.8$  kcal/mol for elastase in molecular docking (in silico) studies. The results suggest that the purified extracts obtained by SFE or conventional leaching extraction could act as antioxidant and antiaging ingredients for cosmeceutical applications.

**Keywords :** phenolic compounds; black bean; tyrosinase; elastase; antioxidant; **supercritical fluids** extraction



## **CO<sub>2</sub> Supercritical Fluid Extraction of Oleoresins from Sea Buckthorn Pomace: Evidence of Advanced Bioactive Profile and Selected Functionality**

沙棘果渣油樹脂的 CO<sub>2</sub> 超臨界流體萃取：先進生物活性譜和選定功能的證據

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### **Abstract :**

The processing of sea buckthorn generates a significant amount of pomace, seeds and skin considered valuable sources of health-promoting macromolecules, such as carotenoids, pectin, flavonoids, phytosterols, polyunsaturated fatty acids and tocopherols. In this study, the bioactives from sea buckthorn pomace (SBP) were extracted using **supercritical** carbon dioxide (SFE-CO<sub>2</sub>), at different temperatures and pressures, allowing for obtaining four fractions according to separators (S40 and S45). The highest carotenoid content of  $396.12 \pm 1.02$  mg/g D.W. was found in the S40 fraction, at extraction parameters of 35 °C/45 MPa, yielding an antioxidant activity of  $32.10 \pm 0.17$  mMol TEAC/g D.W. The representative carotenoids in the extract were zeaxanthin,  $\beta$ -carotene and lycopene, whereas all enriched SFE-CO<sub>2</sub> extracts contained  $\alpha$ -,  $\beta$ - and  $\delta$ -tocopherol, with  $\alpha$ -tocopherol representing around 82% of all fractions.  $\beta$ -sitosterol was the major phytosterol in the fractions derived from S45. All fractions contained significant fatty acids, with a predominance of linoleic acid. Remarkably, the enriched extracts showed a significant palmitoleic acid content, ranging from 53 to 65  $\mu$ g/g. S40 extracts showed a good antibacterial activity against *Staphylococcus aureus* and *Aeromonas hydrophila* ATCC 7966, whereas S45 extracts showed a growth inhibition rate of 100% against *Aspergillus niger* after three days of growth. Our results are valuable, and they allow identifying the different profiles of extracts with many different applications in food, pharmaceuticals, nutraceuticals and cosmeceuticals.

**Keywords :** sea buckthorn pomace; oleoresins; CO<sub>2</sub> **supercritical fluid** extraction; antioxidant activity; antimicrobial activity



**Lippia graveolens HBK oleoresins, extracted by supercritical fluids, showed bactericidal activity against multidrug resistance *Enterococcus faecalis* and *Staphylococcus aureus* strains**

超臨界流體提取的 *Lippia Graveolens* HBK 油樹脂對耐多藥糞腸球菌和金黃色葡萄球菌具有殺菌活性

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**Abstract :**

**OBJECTIVE:** The aim of this work was to characterize *Lippia graveolens* oleoresins, obtained by [Supercritical Fluid](#) Extraction (SFE), from crops collected at different locations in Mexico. The antimicrobial effect of oleoresins was tested in reference strains and clinical isolates of susceptible and multidrug resistant (MDR) strains of *Enterococcus faecalis* and *Staphylococcus aureus*.

**SIGNIFICANCE:** The increasing of MDR strains is becoming a global public health problem that has led to the search for new treatments, and essential oils have resurged as a source of compounds with bactericidal functions. Oregano essential oil has attracted attention recently, however, this oil is mainly obtained by hydro-distillation (uses large amounts of water) or solvents extraction (potential contaminant). SFE has gained popularity as it represents an environmentally friendly technology.

**METHODS:** *L. graveolens* oleoresins were obtained by SFE, total phenol contents were quantified by Folin-Ciocalteu method, the identification of compounds and thymol and carvacrol quantification was carried out by GC-MS. The antimicrobial activity was tested by minimum inhibitory concentration (MIC) and minimum bactericidal concentration (MBC).

**RESULTS:** SFE showed higher yields compared with the hydro-distillation process. *L. graveolens* grown in different Mexican locations showed differences in oleoresin composition and a slightly different antimicrobial capacity against clinical isolates.



**CONCLUSIONS:** It was demonstrated that SFE is an efficient technology for extracting *L. graveolens* oleoresins. Additionally, the solvent-free extraction method and the observed antimicrobial effect, increases the applications of these oleoresins in fields such as cosmetics, food industry, medicine, amongst others.

**Keywords :** Antimicrobial activity, essential oil, gas chromatography-mass spectrometry, *Lippia graveolens*, multidrug resistance pathogens, oleoresins, phytochemical composition, [supercritical](#) CO<sub>2</sub>





# Pharmaceutical Applications of Supercritical Fluid Extraction of Emulsions for Micro-/Nanoparticle Formation

用於微/納米顆粒形成的乳液的超臨界流體萃取的製藥應用

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## Abstract :

Micro-/nanoparticle formulations containing drugs with or without various biocompatible excipients are widely used in the pharmaceutical field to improve the physicochemical and clinical properties of the final drug product. Among the various micro-/nanoparticle production technologies, emulsion-based particle formation is the most widely used because of its unique advantages such as uniform generation of spherical small particles and higher encapsulation efficiency (EE). For this emulsion-based micro-/nanoparticle technology, one of the most important factors is the extraction efficiency associated with the fast removal of the organic solvent. In consideration of this, a technology called **supercritical fluid** extraction of emulsions (SFEE) that uses the unique mass transfer mechanism and solvent power of a **supercritical fluid** (SCF) has been proposed to overcome the shortcomings of several conventional technologies such as solvent evaporation, extraction, and spray drying. This review article presents the main aspects of SFEE technology for the preparation of micro-/nanoparticles by focusing on its pharmaceutical applications, which have been organized and classified according to several types of drug delivery systems and active pharmaceutical ingredients. It was definitely confirmed that SFEE can be applied in a variety of drugs from water-soluble to poorly water-soluble. In addition, it has advantages such as low organic solvent residual, high EE, desirable release control, better particle size control, and agglomeration prevention through efficient and fast solvent removal compared to conventional micro-/nanoparticle technologies. Therefore, this review will be a good resource for determining the applicability of SFEE to obtain better pharmaceutical quality when researchers in related fields want to select a suitable manufacturing process for preparing desired micro-/nanoparticle drug delivery systems containing their active material.

**Keywords :** **supercritical fluid**; **supercritical fluid** extraction of emulsions; micro-/nanoparticle; pharmaceutical application



## **Polycyclic aromatic hydrocarbon contamination in soils and sediments:**

### **Sustainable approaches for extraction and remediation**

土壤和沈積物中的多環芳烴污染：提取和修復的可持續方法

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#### **Abstract :**

Polycyclic aromatic hydrocarbons (PAHs) are carcinogenic environmental pollutants that are extremely hydrophobic in nature and resistant to biological degradation. Extraction of PAHs from environmental matrices is the first and most crucial step in PAH quantification. Extraction followed by quantification is essential to understand the extent of contamination prior to the application of remediation approaches. Due to their non-polar structures, PAHs can be adsorbed tightly to the organic matter in soils and sediments, making them more difficult to be extracted. Extraction of PAHs can be achieved by a variety of methods. Techniques such as [supercritical](#) and subcritical fluid extraction, microwave-assisted solvent extraction, plant oil-assisted extraction and some microextraction techniques provide faster PAH extraction using less organic solvents, while providing a more environmentally friendly and safer process with minimum matrix interferences. More recently, more environmentally friendly methods for soil and sediment remediation have been explored. This often involves using natural chemicals, such as biosurfactants, to solubilize PAHs in contaminated soils and sediments to allow subsequent microbial degradation. Vermiremediation and microbial enzyme-mediated remediation are emerging approaches, which require further development. The following summarises the existing literature on traditional PAH extraction and bioremediation methods and contrasts them to newer, more environmentally friendly ways.

**Keywords :** Polycyclic aromatic hydrocarbons, Soil, Sediment, Extraction, Bioremediation



# Recovery of biologically active compounds from stinging nettle leaves

## part I: Supercritical carbon dioxide extraction

從刺蓴麻葉中回收生物活性化合物第一部分：超臨界二氧化碳萃取

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### Abstract :

Stinging nettle is annual plant from *Urticaceae* family used as food and medicine. Due to the nonsufficient data, this work aimed to isolate the bioactive compounds from the stinging nettle leaves by **supercritical** carbon dioxide. Extracts were analyzed and assessed for antioxidant and cytotoxic activities. Main fatty acids were  $\alpha$ -linolenic (31.06–58.42 mg/g E), palmitic (9.17–13.12 mg/g E), and linoleic (10.93–16.51 mg/g E) acids. Chlorophylls (33.00–7365.11 mg/100 g E) and carotenoids (166.88–722.62 mg/100 g E) were also found in all samples. Four empirical kinetic equations were effectively utilized for kinetic modeling of **supercritical fluid** extraction. As per proper statistical features, empirical models show good concurrence with experimental data. The numerical modeling of a process is gainful to foresee the process conduct and furthermore extend the methodology from laboratory to industrial scales. The principal component analysis was used to visualize the fatty acids profile, antioxidant capacity, and cytotoxic activity of extract.

**Keywords:** Stinging nettle, **Supercritical fluid** extraction, Chemical profile, Biological activity, Extraction kinetics, Principal component analysis



## Uncovering the Bioactivity of *Aurantiochytrium* sp.: a Comparison of Extraction Methodologies

揭示金壺菌屬的生物活性：提取方法的比較

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### Abstract :

*Aurantiochytrium* sp. is an emerging alternative source of polyunsaturated fatty acids (PUFAs), docosahexaenoic acid (DHA), and squalene, playing an important role in the phasing out of traditional fish sources for these compounds. Novel lipid extraction techniques with a focus on sustainability and low environmental footprint are being developed for this organism, but the exploration of other added-value compounds within it is still very limited. In this work, a combination of novel green extraction techniques (high hydrostatic pressure extraction (HPE) and [supercritical fluid](#) extraction (SFE)) and traditional techniques (organic solvent Soxhlet extraction and hydrodistillation (HD)) was used to obtain lipophilic extracts of *Aurantiochytrium* sp., which were then screened for antioxidant (DPPH radical reduction capacity and ferric-reducing antioxidant potential (FRAP) assays), lipid oxidation protection, antimicrobial, anti-aging enzyme inhibition (collagenase, elastase and hyaluronidase), and anti-inflammatory (inhibition of NO production) activities. The screening revealed promising extracts in nearly all categories of biological activity tested, with only the enzymatic inhibition being low in all extracts. Powerful lipid oxidation protection and anti-inflammatory activity were observed in most SFE samples. Ethanolic HPEs inhibited both lipid oxidation reactions and microbial growth. The HD extract demonstrated high antioxidant, antimicrobial, and anti-inflammatory activities making, it a major contender for further studies aiming at the valorization of *Aurantiochytrium* sp. Taken together, this study presents compelling evidence of





the bioactive potential of *Aurantiochytrium* sp. and encourages further exploration of its composition and application.

**Key Points :**

- Potent anti-inflammatory activity in [supercritical](#) CO<sub>2</sub> extracts.
- High-pressure extracts exhibited strong *C. albicans* inhibitory activity.
- Hydrodistilled extracts maximized most bioactivity responses.