TSCFA 台灣超臨界流體協會
Taiwan Supercritical Fluid Association

電子報第 163 期

活動訊息

- ***2020 年「第 19 屆超臨界流體技術應用與發展研討會暨第九屆第一次會員大會」***

時間：2020年**10月23日(星期五)**
地點：**台中逢甲大學 人言大樓B1F『第六國際會議廳』**

專家介紹

- 謝達仁執行長(亞果生醫股份有限公司)
- 廖盛焜教授(逢甲大學纖維與複合材料系)

團體會員介紹

- 台超萃取洗淨精機股份有限公司

政策資源

【政府研發補助資源及介紹】(請另見協會網站最新消息列)

產業新聞

- 一頭豬創造 10 億價值？不只是醫美新寵，還能助人恢復視力

資料來源：https://www.cw.com.tw/article/5102004?template=transformers

技術文摘

- Features and Advantages of Supercritical CO2 Extraction of Sea Cucumber Cucumaria frondosa japonica Semper, 1868 海參超臨界 CO_2 萃取的特徵和優點
- Optimizing Supercritical CO_2 Extraction for Medicinal Cannabis 優化藥用大麻的超臨界二氧化碳萃取
- Rana chensinensis Ovum Oil Based on CO_2 Supercritical Fluid Extraction: Response Surface Methodology Optimization and Unsaturated Fatty Acid Ingredient Analysis 基於 CO_2 超臨界流體萃取的中國林蛙卵油：反應曲面方法優化和不飽和脂肪酸成分分析
- Simulation says supercritical water has no hydrogen bonds 由模擬得知超臨界水沒有氫鍵

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2020 年第 19 屆超臨界流體技術研討會暨一〇九年度年會

親愛的會員 您好：

台灣超臨界流體協會謹訂於民國 109 年 10 月 23 日(星期五)，假逢甲大學人言大樓 B1F 第六國際會議廳，舉辦「第十九屆超臨界流體技術應用與發展研討會」，並於下午 15 時舉行 109 年度會員大會。

恭請

蒞臨指導

技術研討會暨年會籌備會主任委員 **謝達仁 理事長**

王啟昌 院長

副主任委員 **廖盛焜 副理事長**

黃建霖 主任

台灣超臨界流體協會　全體理監事暨籌備會委員　　敬邀

研討會議程

時間	議程內容	
09:30~10:00	報到、註冊	
10:00~10:10	開幕式（主任委員致歡迎詞/貴賓致詞）	
	主持人：廖盛焜教授	
10:10~10:40	**邀請演講 1:**梁明在總經理（達諾生技股份有限公司） 超臨界流體模擬移動床技術及其在魚油產業應用現狀	
10:40~11:10	**邀請演講 2:**葉樹開教授（國立台灣科技大學材料科學與工程系） 彈性體超臨界發泡技術之進程與發展	
	主持人：吳弦聰教授	**主持人：馮瑞陽教授**
11:20~11:40	OP A01：黃彥剴	OP B01：葉怡君
11:40~12:00	OP A02：陳昀	OP B02：張式鈺
12:00~13:00	午餐/聯誼時間	
	主持人：郭子禎副處長	
13:00~13:30	**邀請演講 3:**李金樹教授（國防大學理工學院化學及材料工程學系） 超臨界流體運用於廢舊含能材料之處理	
13:30~14:00	**邀請演講 4:** Srinivasan Periasamy 博士研究員(亞果生醫股份有限公司) Role of supercritical carbon dioxide extraction technology in tissue engineering and regenerative medicine.	
	主持人:劉冠汝教授	**主持人：蘇至善教授**
14:10~14:30	OP A03：林漢權	OP B03：王暄文
14:30~14:50	OP A04：Avinash B. Lende	OP B04：馮瑞陽
14:50~15:30	海報論文展示評選及廠商展示區交流	
15:00~15:30	會員大會報到	
15:30~15:35	理事長致詞	
15:35~16:10	會務報告	
16:10~16:30	提案討論	
16:30~16:50	第九屆理監事選舉	
16:50~17:10	政策資源推廣說明會/理監事選舉開票作業	
17:10~17:20	宣佈第九屆理監事當選名單	
18:00~20:00	晚宴、頒贈捐助廠商感謝狀、研究論文優良獎及佳作獎	

專家介紹

【亞果生醫股份有限公司 謝達仁執行長】

❖專長：生物科技產業經營管理、醫療器材、組織工程再生醫學、生醫材料

❖研究方向：運用超臨界二氧化碳流體技術於生物組織及器官之去細胞製程

亞果生醫謝達仁執行長，最高學歷為紐約州立水牛城分校細胞分子生物學博士。海外學成歸國後，於高雄醫學大學擔任副教授，隨後投入產業界發揮長才。

謝達仁博士曾創設台灣第一家生技投資顧問公司(生橋)，協助生技創業家與投資人之間的媒合橋梁，亦曾擔任台灣動物科技研究所研究員兼商務發展企劃室主任、普力德生物科技股份有限公司董事長兼總經理、國家生技醫療產業策進會副執行長、以及双美生物科技公司總經理等重要職位。

於 2014 年，謝達仁博士創立亞果生醫，將古老技術超臨界二氧化碳創新應用於生物材料的去細胞清洗，提供乾淨無排斥的生醫材料應用於研究及臨床醫學。

專家介紹

【逢甲大學纖維與複合材料系 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

廖盛焜教授獲得逢甲大學紡織工程研究所工學博士學位後，繼續留在逢甲大學服務，自 1988 年進入逢甲大學任教迄今，除了教學與研究之外，曾任導師工作、課外活動組長、系所主任、學務長，在專業教學的主軸係藉由已建置完成之超臨界流體染色設備，針對環保纖維進行一系列之探究，同時配合電漿設備的物理加工方式與 3D 列印技術，順應綠色環保潮流的環境品質，整合產品的上中下游做跨全製程的整理設計，開創循環經濟的紡織纖維產品。廖教授於 1979 年曾獲中華民國斐陶斐榮譽會員、1989 年榮獲第十九屆紡織傑出工程師、1995 年中華民國第六屆發明及創新展覽會發明類教師組二等獎，並曾任財團法人鞋技中心(TFRC)董事乙職。

目前為纖維與複合材料學系專任教授，並於今年教師節榮獲逢甲大學工科院教學績優老師。廖教授目前除了在逢甲大學任教，亦擔任本會副理事長與逢甲大學鞋類製造中心主任乙職，多年服務於協會活動與會務，積極參與國內外之學術活動及推展會務，促進本會各項活動，貢獻良多。

一頭豬創造 10 億價值？不只是醫美新寵，還能助人恢復視力

2020-09-22

座落在南台灣路竹科學園區的亞果生醫，正在等待三軍總醫院收集病人配對，將展開豬眼角膜移植人體的臨床實驗。一旦成功，台灣眼角膜受損患者不用再苦苦排隊等候器官捐贈，豬就能成為人類重見光明的救星。

豬，一直是人類的食物，拜生物科技進步所賜，也能成為修復人體各器官的醫材，創造驚人的價值。

「一頭豬約有 1/4 以上是被當成廢棄物不用的，但你相信這些拿來充分利用，能創造 3 億元的價值嗎？」前台糖董事長、循環台灣基金會董事長黃育徵指出，台糖是全台灣最大的養豬戶，研發萃取豬膽汁來做洗髮精，能讓頭髮烏黑亮麗。

一頭豬值 3 億？亞果生醫董事長謝達仁，背景是美國紐約州立大學水牛城分校細胞分子生物學博士。他表示，除了豬肉之外，豬皮、豬骨、心臟瓣膜都已商業化了，被允許做為人體修護的材料。

醫美當紅炸子雞：豬皮

現在產值最高的，是一頭豬有 4 公斤的豬皮，用來萃取、轉化成為 200 公升的膠原蛋白植入劑，「打一針就能讓人年輕 20 歲，效果最長可維持一年半，要價卻不斐，一針 35 毫克要 6 萬台幣，一頭豬最高能提煉 1 萬 7 千針，創造 10 多億元的產值，」謝達仁說。

標榜能夠修復組織，達到減少皺紋讓肌膚光滑的效果，膠原蛋白植入劑成了中國大陸醫美產業的當紅炸子雞，消費者趨之若鶩。除了亞果，在台南科學園區的雙美生技也生產膠原蛋白植入劑。

靠這款產品，雙美已連續 2 年入圍《天下》快速成長 100 強榜單，3 年平均營收複合成長率 76.81%，高居今年第 6 名。

雙美的祕密，就是與台灣農科院合作開發 SPF 實驗動物標準豬隻（無特定病源），靠這種豬提煉膠原蛋白植入劑，創造年營業額 5.94 億，毛利高達 88.73%，目前雙美是中國最大醫療級膠原蛋白供應商。

比靈長類還適合人體

除了醫美市場，豬皮也可以拿來做為傷口敷料、人工皮膚。2018 年，高雄小吃店氣爆造成 16 傷的意外，亞果就提供了 150 片敷料給高醫，也是來自豬皮。

不只豬皮，豬骨頭也可替代人骨頭。例如口腔癌患者，往往顎骨會有大面積損傷或切除。要重建口腔癌患者的顱面，以前都要從病人的小腿挖骨重建下巴，一次挖一點上來，過程非常痛苦，現在不用了。豬軟骨可以拿來填補顎骨、臉骨，或修護受損的膝蓋軟骨，把豬骨頭磨成一塊塊、像積木拼貼上去。

還有豬心臟瓣膜做成的人工心臟瓣膜，已經使用 40 多年。因為豬心瓣膜移植後，較不易引起血栓，可用來代替人心瓣膜。不過，台灣器官移植的豬心瓣膜，主要是從美國進口。

為何捨棄跟人更相似的靈長類，而選擇用豬？謝達仁說，一是豬的器官都跟人體器官差不多大小，二是因為豬的組織跟人類十分接近，排斥性也低。另外，豬跟人類是跨物種，可避免相通的病毒互相傳播疾病；反之，靈長類跟人有太多共通病毒，恐帶來未知的疾病。

眼角膜、輸尿管都能移植

豬能用的地方還很多，亞果並不只滿足於醫美產業帶來的豐厚利潤，長遠目標鎖定在跨物種的器官再生與移植，第一個是眼角膜。

2016 年，亞果生醫與台南奇美醫院眼科醫生合作，為台南當地的吉娃娃狗動了一個獨步全球的手術，將豬眼角膜移植到吉娃娃右眼，讓本來右眼全盲的牠重見光明，沒有任何排斥跟不良反應。

成功之後，也吸引澳洲廠商 Oculus Biomed 技術移轉，在澳洲進行人體實驗，豬眼角膜朝著在人體使用邁開腳步。

現在，衛福部已批准亞果與三軍總醫院合作人體臨床試驗，等收集、配對完病人，就能把豬眼角膜移植到人眼。

國際上也開始進行，2016 年，中國把豬眼角膜移植到人眼，一個眼角膜能賣 2 萬台幣，光中國就有 400 萬人、全球有 1000 萬人需要移植眼角膜，是一個龐大的市場。

但不是直接從豬身上取出器官、再移植到人體這麼簡單，謝達仁指出，技術的挑戰是如何透過特殊的生醫工程處理，讓這些豬器官移植到人體後，不會產生排斥、感染的副作用，又能維持原本的功用。

如果能夠突破，眼角膜、血管、神經、輸尿管，還有心臟、腎臟、膀胱、肝臟、胰臟等豬器官，都能循著相同方法，拿來取代人體組織器官。例如吸毒造成輸尿管萎縮，就可以用豬輸尿管來移植替代，不需長年包尿布。

高風險、高價、長時間的挑戰

豬不僅是食物，也能造福人類，但路還很艱辛。

眼角膜走到人體臨床實驗已經 5 年多，花了 2000 萬台幣，如果要在美國取得許可，做臨床試驗，一個病人要 5 萬美元。假設要做 300 個臨床實驗，就是 1500 萬美元，對於新創企業來說，這並不是小數目。

還要長時間的等待，豬膠原蛋白植入劑看似簡單，其實是植入人體的第三類醫材，有可能危害生命安全，因此各國要求十分嚴格。謝達仁說，從研發、實驗到取得許可上市，總共走了 10 年多、花了近 2 億台幣，不是所有企業都能撐過這麼漫長的時間與燒錢。

資料來源：https://www.cw.com.tw/article/5102004?template=transformers

Features and Advantages of Supercritical CO2 Extraction of Sea Cucumber Cucumaria frondosa japonica Semper, 1868

海參超臨界 CO_2 萃取的特徵和優點

Alexander Zakharenko[1,2,*] , Denis Romanchenko[1] , Pham Duc Thinh[3] , Konstantin Pikula[1,2] , Cao Thi Thuy Hang[3] , Wenpeng Yuan[4] , Xuekui Xia[5] , Vladimir Chaika[1] , Valery Chernyshev[1,2], Svetlana Zakharenko[2] , Mayya Razgonova[2] , Gyuhwa Chung[6] and Kirill Golokhvast[1,2]

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Abstract: Extraction process of Cucumaria frondosa japonica Semper, 1868, which are subspecies of Cucumaria frondosa (Gunnerus, 1767), were studied. It was shown that supercritical carbon dioxide extraction of holothuria was more effective than conventional solvent extraction. Step-by-step extraction with carbon dioxide followed by supercritical extraction with the addition of a co-solvent of ethanol can almost double the yields of extracts of triterpene glycosides, styrenes and carotenoids. Moreover, the fraction of triterpene glycosides practically does not contain colored impurities, in contrast to traditional ethanol extraction. The obtained extracts by HPLC in combination with tandem mass spectrometry (HPLC-MS/MS) identified 15 triterpene glycosides, 18 styrene compounds and 14 carotenoids. Supercritical extraction made it possible to obtain extracts with yields superior to conventional hexane and alcohol extracts. Moreover, such an approach with the use of supercritical fluid extraction (SFE) and subsequent profiling of metabolites can help with the study of holothuria species that are not as well studied.

Keywords: sea cucumber; supercritical extraction; Cucumaria frondosa japonica; triterpene glycosides; saponins; carotenoids; tandem mass spectrometry

Optimizing Supercritical CO_2 Extraction for Medicinal Cannabis

優化藥用大麻的超臨界二氧化碳萃取

September 6, 2020
by Lance Griffin

Supercritical carbon dioxide (CO_2) extraction is one popular method for the commercial extraction of cannabis. In 2020, Australian researchers investigated supercritical CO_2 extraction strategies to "obtain a GMP license to produce pharmaceutical grade medicinal cannabis" and "optimise the process for extraction of cannabis material at a pharmaceutical scale." [1] Notably, they avoided using any co-solvent (i.e., ethanol) to make the process simpler from a regulatory standpoint and cleaner from a product standpoint.

The investigation was organized using design of experiments (DOE), a Good Manufacturing Practice (GMP)-approved approach to process development that allows the user to analyze how multiple factors interact and affect outputs. [1,2] The factors in this case were extraction parameters [1]:

- CO2 Flow Rate (40-150 g/min)
- Pressure (150-320 bar)
- Time (4-10 hours)

And the outputs were yield parameters:

- CBD recovery (%)
- THC recovery (%)
- Final extract weight (g)

They set the temperature at 60º C, reportedly to match the equipment manufacturer's (Waters) recommendation. The Victorian State Government provided cannabis biomass from multiple chemovars with a total CBD:THC ratio of 1:1.5. The researchers packed 1.0 kg of the biomass for each run. The results are summarized in the table below, reprinted from the open-access study.

	Factor A	Factor B	Factor C	Response 1	Response 2	Response 3
Run	CO_2 Flowrate (g/min)	Extraction time (min)	Extraction pressure (bar)	CBD % Recovery	THC % Recovery	Extract weight (g)
1	150	600	320	101.1	98.6	71.0
2	40	600	150	41.9	16.7	27.5
3	40	240	320	7.5	5.0	4.2
4	40	240	150	22.0	9.0	9.1
5	150	240	320	95.9	66.8	55.1
6	40	600	320	78.1	84.0	55.9
7	150	600	150	107.1	73.6	56.3
8	150	240	150	90.2	75.6	50.8
9	95	420	235	82.7	98.2	62.7
10	95	420	235	68.3	82.9	57.8
11	95	420	235	66.7	82.6	57.2
12	150	600	320	89.2	97.6	68.1
13	150	240	320	81.4	93.0	62.7
14	150	600	150	77.2	93.5	58.3
15	150	240	150	79.1	74.1	47.7

Run #1, with high flow rate (150 g/min), high pressure (300 bar), and a long extraction time (10 hours), dominated the chart in terms of yield for both cannabinoid recovery and extract weight. Flow rate was the most impactful factor overall, followed by time and then pressure. THC recovery depended more significantly on time compared to CBD recovery or weight.

There were unique CBD:THC ratios depending on extraction parameters. Runs #6 and #7 illustrate this point with similar extract weights but unique CBD:THC ratios. If the biomass were hemp, the study authors reason, “this method may be optimised further so that low levels of THC could be removed.”

The study did not account for lipids and other unwanted plant materials, which factor heavily into extract weight. The process would also require adjustment for specific chemovars. [1] Although the procedure might not appeal to every extractor, it does illustrate a methodological approach that is likely to become increasingly relevant as international cannabis operators pursue GMP standards.

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Rana chensinensis Ovum Oil Based on CO_2 Supercritical Fluid Extraction: Response Surface Methodology Optimization and Unsaturated Fatty Acid Ingredient Analysis

基於 CO_2 超臨界流體萃取的中國林蛙卵油：反應曲面方法優化和不飽和脂肪酸成分分析

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Abstract: Rana chensinensis ovum oil (RCOO) is an emerging source of unsaturated fatty acids (UFAs), but it is lacking in green and efficient extraction methods. In this work, using the response surface strategy, we developed a green and efficient CO_2 supercritical fluid extraction (CO_2-SFE) technology for RCOO. The response surface methodology (RSM), based on the Box–Behnken Design (BBD), was used to investigate the influence of four independent factors (pressure, flow, temperature, and time) on the yield of RCOO in the CO_2-SFE process, and UPLC-ESI-Q-TOP-MS and HPLC were used to identify and analyze the principal UFA components of RCOO. According to the BBD response surface model, the optimal CO_2-SFE condition of RCOO was pressure 29 MPa, flow 82 L/h, temperature 50 ◦C, and time 132 min, and the corresponding predicted optimal yield was 13.61%. The actual optimal yield obtained from the model verification was 13.29 ± 0.37%, and the average error with the predicted value was 0.38 ± 0.27%. The six principal UFAs identified in RCOO included eicosapentaenoic acid (EPA), α-linolenic acid (ALA), docosahexaenoic acid (DHA), arachidonic acid (ARA), linoleic acid (LA), and oleic acid (OA), which were important biologically active ingredients in RCOO. Pearson correlation analysis showed that the yield of these UFAs was closely related to the yield of RCOO (the correlation coefficients were greater than 0.9). Therefore, under optimal conditions, the yield of RCOO and principal UFAs always reached the optimal value at the same time. Based on the above results, this work realized the optimization of CO_2-SFE green extraction process and the confirmation of principal bioactive ingredients of the extract, which laid a foundation for the green production of RCOO.

Keywords: supercritical fluid extraction; by-product; Rana chensinensis ovum oil; design of experiment; response surface methodology; Box–Behnken design; unsaturated fatty acids

Simulation says supercritical water has no hydrogen bonds

由模擬得知超臨界水沒有氫鍵

BY **PHILIP BALL**

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Scientists in Germany have proposed a definitive answer to a longstanding debate in chemistry: how much hydrogen bonding exists in supercritical water? The answer, they say, is 'None at all'.[1]

Water's dynamic, three-dimensional network of hydrogen bonds, linking each water molecule to four others on average in a tetrahedral arrangement, makes it special as a solvent and a medium for life. This structure is lost when water is heated above its critical point of 374°C, but it hasn't been clear how much of the hydrogen-bonding still survives. Some neutron scattering studies have suggested that supercritical water is more or less devoid of such bonds,[2] while NMR studies have seemingly indicated that more than a quarter of the hydrogen bonds in normal liquid water survive just above the critical temperature.[3] One recent review insists that some of these bonds do persist in those conditions.[4]

The question is not just academic. Supercritical water, in which the distinction between liquid and vapour is lost, is sometimes used as a solvent for industrial chemical processes such as the production of biofuels, because it is able to solvate substances that would not readily dissolve in the liquid, such as gases and nonpolar compounds. And the water around some deep-sea hydrothermal vents exists in a supercritical state, thanks to the high pressures and the volcanic heat of the vent.

Supercritical simulation

Quantum chemists Philipp Schienbein and Dominik Marx of the Ruhr University of Bochum have now investigated the matter from first principles, using molecular dynamics simulations that incorporate the quantum-mechanical aspects of the bonding within and between water molecules. Such calculations are computationally very demanding, but the researchers were able to look at the dynamics of 128 water molecules – enough to see bulk-like behaviour – over a timescale of 20 nanoseconds, which is many thousands of times longer than the lifetime of a typical hydrogen bond in the liquid. They check that the simulations are giving realistic results by comparing their predictions for terahertz-frequency spectra (which can probe the vibrations of hydrogen-bonded pairs of molecules) and NMR relaxations times (which probe individual molecular rotations) against those seen experimentally.

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https://www.chemistryworld.com/news/simulation-says-supercritical-water-has-no-hydrogen-bonds/4012367.article