Best Practice

November 2025

Extraction efficiency of polyphenols from peanut red skin

Peanut is a key oil crop in China and its seed coat (peanut red skin) is an important by-product of peanut processing. Each year, more than 400,000 tons of peanut red skin are generated in China, yet its valorisation remains limited. Notably, peanut red skin is rich in bioactive phenolic compounds, including proanthocyanidins and resveratrol, with high nutritional and functional value. Natural deep eutectic solvents (NADES) have emerged as promising, environmentally friendly solvents for extracting such compounds.

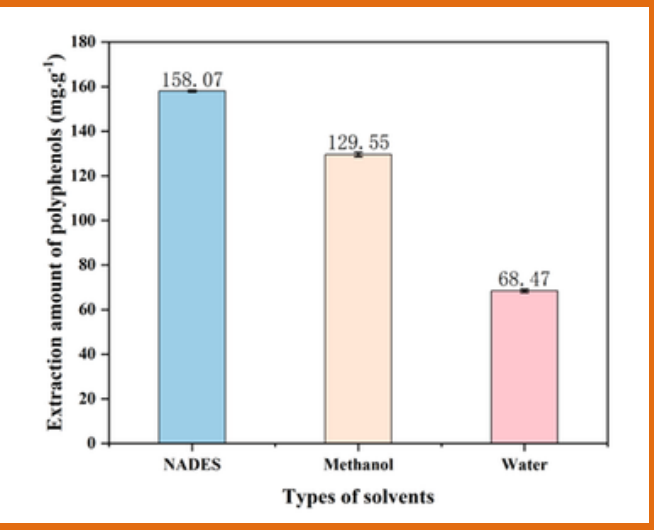
NADES are formed by mixing hydrogen bond donors and acceptors in defined molar ratios, offering easier preparation and biodegradability. Their dense hydrogen-bonding network efficiently extracts polyphenols while preserving structural integrity. They also provide enhanced safety and lower flammability versus conventional solvents like ethanol, reducing infrastructure costs. As such, using NADES for the extraction of polyphenols and other components from peanut red skin could enable high value uses for peanut processing waste.

Project activity

Ultrasonic-assisted extraction of polyphenols from peanut red skin was carried out using NADES in comparison with conventional solvents (methanol, ethanol, and water). Eight NADES formulations were prepared, with choline chloride as the hydrogen bond acceptor (HBA) and ethylene glycol, 1,2-propanediol, glycerol, lactic acid, citric acid, urea, glucose, and sucrose as the hydrogen bond donors (HBDs). Extraction efficiency was assessed by varying key parameters, including HBA/HBD molar ratio, solid-to-solvent ratio, water content in NADES, and ultrasonic conditions (time, temperature, power). Single-factor experiments were conducted by varying each parameter within the following ranges: extraction time (5–30 min), liquid-to-solid ratio (10–50 mL/g), choline chloride/lactic acid molar ratio (3:1 to 1:3), ultrasonic power (200–400 W), temperature (30–70 °C), and water content (10–50%). The process is currently being evaluated at pilot-scale.

agriloop

Key findings and recommendations



The optimal extraction conditions were identified as: choline chloride:lactic acid (1:1 molar ratio), 30% water content, liquid-to-solid ratio of 10 mL/g, ultrasonic power of 250 W, ultrasonic temperature of 40°C, and ultrasonic time of 20 min.

Under these conditions, the polyphenols yield reached 158.07 mg/g, representing a 2.3-fold increase over water extraction and 1.2-fold increase over alcohol extraction. In addition, polyphenols were recovered by static adsorption-desorption using macroporous resin, followed by freeze-drying and the resulting extracts exhibited strong in-vitro antioxidant activity.

References

Novel solvent properties of choline chloride/urea mixtures. Chem Commun (Camb)(1), 70-71. Abbott, A. P., Capper, G., Davies, D. L., Rasheed, R. K., & Tambyrajah, V. (2003). https://doi.org/10.1039/b210714g

Are Natural Deep Eutectic Solvents the Missing Link in Understanding Cellular Metabolism and Physiology? Plant Physiology, 156(4), 1701-1705. Choi, Y. H., van Spronsen, J., Dai, Y., Verberne, M., Hollmann, F., Arends, I. W. C. E., Witkamp, G.-J., & Verpoorte, R. (2011). https://doi.org/10.1104/pp.111.178426

Optimization and modeling of microwave-assisted extraction of curcumin and antioxidant compounds from turmeric by using natural deep eutectic solvents. Food Chemistry, 353, 129337. Doldolova, K., Bener, M., Lalikoğlu, M., Aşçı, Y. S., Arat, R., & Apak, R. (2021). https://doi.org/10.1016/j.foodchem.2021.129337

An integrated process by ultrasonic enhancement in the deep eutectic solvents system for extraction and separation of chlorogenic acid from *Eucommia ulmoides* leaves. Ultrasonics Sonochemistry, 99, 106588. Meng, Y., Sui, X., Pan, X., Yang, Y., Sui, H., Xu, T., Zhang, H., Liu, T., Liu, J., & Ge, P. (2023). https://doi.org/10.1016/j.ultsonch.2023.106588

Enzyme-assisted supercritical fluid extraction: An integral approach to extract bioactive compounds. Trends in Food Science & Technology, 116, 357-369. Patil, P. D., Patil, S. P., Kelkar, R. K., Patil, N. P., Pise, P. V., & Nadar, S. S. (2021). https://doi.org/10.1016/j.tifs.2021.07.032

Green and sustainable solvents of the future: Deep eutectic solvents. Journal of Molecular Liquids, 379, 121676. Prabhune, A., & Dey, R. (2023). https://doi.org/10.1016/j.molliq.2023.121676

Contact

- **Aimin Shi** - IFST-CAAS shiaimin@caas.cn
- **Hui Hu** - IFST-CAAS, huhui@caas.cn

For more information about the AgriLoop Project, visit:

agriloop-project.eu

Funded by the European Union

中华人民共和国科学技术部
Ministry of Science and Technology of the People's Republic of China

UK Research and Innovation

Project funded by
Schweizerische Eidgenossenschaft
Confédération suisse
Confederazione Svizzera
Confederaziun svizra
Swiss Confederation

Federal Department of Economic Affairs, Education and Research EAER
State Secretariat for Education, Research and Innovation SERI

This project has received funding from the European Union's Horizon Europe research and innovation programme under the grant agreement No. 101081776, the UK Research and Innovation (UKRI) fund under the UK government's Horizon Europe funding guarantee, the Swiss State Secretariat for Education, Research and Innovation (SERI) and from the National Key Research and Development Program supported by the Ministry of Science and Technology of the People's Republic of China (No. 2023YFE0104900). Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of neither of the aforementioned Funding authorities. Neither the European Union, the United Kingdom, the Swiss Confederation or the People's Republic of China nor the European Commission, UKRI, SERI or NKRDPC can be held responsible for them.