A water extraction preparation method for the preparation of black soldier fly oil by CNPs@Cu immobilization catalyst

Tao Bai 1, Xiao-Meng Xun 1, Jin-Zheng Wang 1, Lu Tan 1, Ze-Lai Huang 1, X 1, 2, Jun Wang 1, 2, *

[1]School of biotechnology, Jiangsu University of Science and Technology, 212018 Zhenjiang, China
[2]Sericultural Research Institute, Chinese Academy of Agricultural Sciences, 212018 Zhenjiang, China
E-mail: wangjun@just.edu.cn (Prof. Dr. Jun. Wang)

Introduction

The larvae of Black soldier fly are rich in protein and fat, generally the dry matter of worm meal contains 35%~45% of crude protein, 10%~40% of crude fat, and the protein level of defatted worm meal is up to 56.9%, and it has the essential amino acid pattern similar to that of fish meal, and the content of some essential amino acids is higher than that of soybean meal. However, the current resource utilization of Black soldier fly is low, the common oil processing technology equipment cost is high, the operating system is complicated and a large number of organic reagents are used, the conversion of Black soldier fly into high value-added feeding and industrial products is one of the important contents of the development of the diversified utilization of Black soldier fly resources. Therefore, it is of great practical significance to develop an efficient and environmentally friendly oil extraction method for Black soldier fly.

Methods

Using the ultrasonic nanoparticle synergistic hydro-enzymatic method of Black soldier fly grease extraction, the dried Black soldier fly powder was mixed with buffer solution in a certain proportion, and the appropriate amount of protease was added, placed at a certain temperature and pH, and finally the enzymatic reaction was carried out under physical field assisted conditions. Black soldier fly oil and protein were collected by centrifugal separation.

Results & Discussion

Table 1 Extraction efficiency and oil properties corresponding to different extraction processes

Techniques	Yield Oil (%)	Acid value (mg/g)	Iodine value (g/100g)
Soxhlet extraction	42.91±2.6	1.40±0.08	57.51±6.61
Enzyme-assisted aqueous extraction	29.91±5.3	2.48±0.32	66.14±4.25
Solvent extraction	28.45±4.1	1.95±0.24	61.95±3.25
CNPs@Cu-Trypsin-assisted	33.53±3.5	1.29±0.01	50.84±9.86

Compared with ultrasound assisted organic solvent extraction and enzyme assisted water extraction technologies, the extraction time of water extraction technology was shortened by 32.5% and 55% respectively (from 10 and 6 hours to 4 hours), and the temperature was reduced by 10% and 43.75% respectively (from 80 and 50 ℃ to 45 ℃), which may be beneficial for maintaining the nutritional value of the collected lipids and peptides.

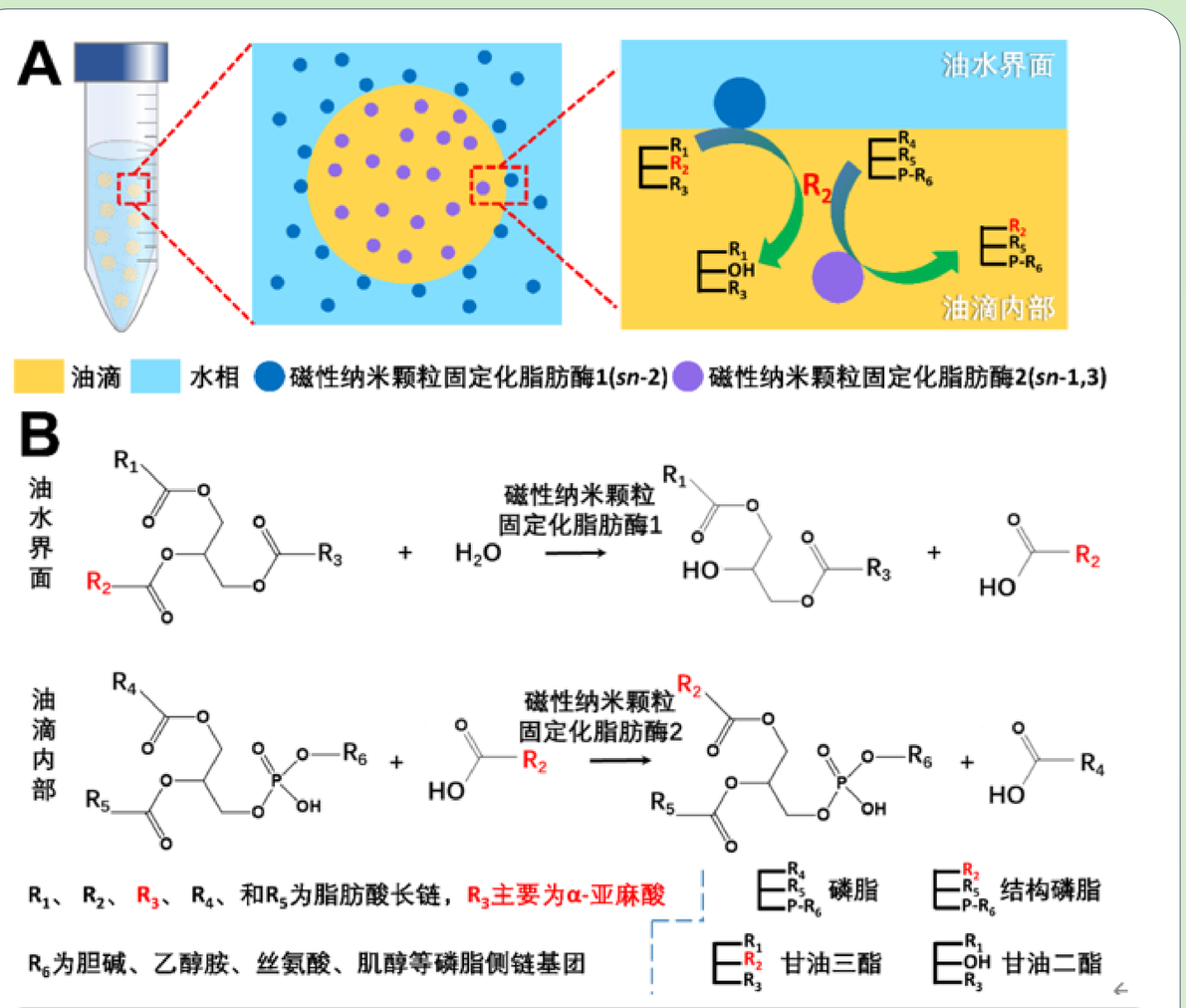

Figure 1 Schematic diagram (A) and reaction equation (B) of the emulsion prepared in a centrifuge tube, in which the magnetic nanoparticle immobilized lipase 1 and 2 have *sn*-2 and *sn*-1,3 position selectivity, respectively

Based on the dense complex formed by oil and protein in Black soldier fly, the oil extraction rate of Black soldier fly was used as the index to screen the protease with high oil extraction rate for the preparation of immobilized enzyme. The enzyme activity was used as the index to select the metal ions that could strengthen the magnetic nanoparticle immobilized protease, and the metal ion chelating process was identified by combining X-ray electron spectroscopy and SEM-EDS to determine the catalytic kinetic parameters and enzyme properties, so as to construct the magnetic nanoparticle immobilized protease strengthened by the metal ions. The metal ion-enhanced magnetic nanoparticle-immobilized protease was used to hydrolyze Black soldier fly protein in the aqueous phase to release the oil therein, and combined with the ultrasonic field enhancement to accelerate the process of oil extraction, to investigate the effects of immobilized enzyme usage, temperature, and time on the oil extraction rate of Black soldier fly oil, and to determine the acid value of the fat and the bioactivity of the Black soldier fly protein hydrolysate. Thus, we constructed A water extraction preparation method for the preparation of black soldier fly oil by CNPs@Cu immobilization catalyst.

Conclusion

The aqueous extraction and preparation method of oil from black soldier fly using CNPs@Cu immobilization catalyst was mainly studied, and a new method for preparing oil from black soldier fly larvae and dried insects was studied. Compared with the prior art, the preparation method of the present invention is simple to operate, the enzymatic hydrolysis stability is high, the specificity is strong, and the oil yield is high .

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References

[1] Tao, X H., Xiang, F M., Ahmad Khan.,et al. *Chemosphere*, 2023, 317, 137861.
[2] Miebach, A. C., Bauer, J., Adamek, M, Dietz, C., Gährken, J., Rosenau, S.,et al. *Aquacult Rep*, 2023, 32, 101697.
[3] Ganesan, A. R., Mohan, K., Kandasamy, S., Surendran, R. P., Kumar, R., Rajan, et al. *Process Saf Environ*, 2024, 184, 170-189.