Improving Extractability and Functionalities of Rice Proteins Using Enzymatic Treatments

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Objectives
As the second largest-produced cereal, rice (esp. rice bran) is a potential source of gluten-free and hypoallergenic plant proteins. However, technical challenges such as poor extractability and functionality greatly limit the utilization of rice protein ingredients. The objective of this study was to investigate various enzymatic treatments for improving extractability, solubility, and applicability of different rice proteins and transform them into user-friendly food ingredients for novel product development.
Methods
Enzyme-assisted protein extraction was investigated to compare with the traditional extraction techniques. Rice bran protein was extracted from hexane-defatted rice bran by four methods: alkaline extraction at pH 9 followed by acid precipitation at pH 4 (AEIP), ultrasound-assisted extraction (UlsE), Alcalase-assisted extraction (AlcE), and Amylase-assisted extraction (AmyE). The extraction yield and functionalities of the extracted proteins were examined. In addition, transglutaminase (TG) was used to promote applicability of rice proteins in a gluten-free pasta model food system.
Results
Extraction yield, protein recovery, and protein content of AEIP, UlsE, AlcE, and AmyE were (3.1%, 7.4%, 35.44%), (8.2%, 21.6%, 46.98%), (13.5%, 14.8%, 27.68%), and (5.3%, 7.3%, 23.25%), respectively. Solubility of AlcE proteins (62.81-86.15%) was significantly higher ($P < 0.05$) than that of amylase- (9.36-73.78%) and alkaline-extracted proteins (6.79-37.13%).
TG treatment (0-40 U/g) resulted in a 9.8-16.9% decrease in free amines, indicating TG-induced cross-linking in treated rice proteins. This was supported by SDS-PAGE where low molecular weight bands were thinner in TG-treated samples. TG-treated protein samples showed no differences in color, solubility, or water holding capacity. The inclusion of rice protein increased pasta firmness. TG treatment (10U/g) of the proteins further increased pasta firmness at 5% inclusion level but not at the 10% level.
Conclusion
Among the extraction methods tested, protein recovery and purity were the highest in UlsE, while AlcE resulted in the highest yield but compromised by lower protein purity. We recommend using Alcalase hydrolysis to improve protein solubility after UlsE extraction. TG-induced cross-linking in rice protein is promising to mimic the gluten network and significantly improve the texture of gluten-free pasta.