

Patpong Sawadikiat 2014: Improving Water Dispersibility of Rice Phytochemicals Concentrated by Molecular Distillation of Rice Bran Oil Deodorizer Distillate. Doctor of Philosophy (Food Science), Major Field: Food Science, Department of Food Science and Technology. Thesis Advisor: Associate Professor Parichat Hongsprabhas, Ph.D. 135 pages.

This study aimed to use the deodorizer distillate (DD) from physical refining process as the source for the production of health-promoting phytochemicals, namely phytosterols, tocopherols and γ -oryzanol. This is to enhance the utilization of oil-soluble nutraceuticals in aqueous phase. Physical refining process resulted in the reduction of phytosterols and γ -oryzanol in refined rice bran oil, which was evaporated together with free fatty acids (FFAs) during deodorization and accumulated in the DD. Therefore, DD was further distilled to evaporate out the FFAs and concentrate phytosterols, tocopherols and γ -oryzanol in the unevaporated fraction (UMD) using a pilot-scale molecular distillation unit (MD). It was found that the MD unit operated at 120, 140 or 160 °C, 0.1 Pa and a flow rate of 10.14 - 10.66 kg/h could concentrate phytosterols from 1,540.8 mg in 100 g DD to 3,990.2 – 4,904.8 mg in 100 g UMDs. Although γ -oryzanol content was increased from 598.9 mg in 100 g DD to 870.0-1,018.1 mg in 100 g UMDs when temperature was raised to 160 °C, such high temperature decreased tocopherol contents from 2,185.7 mg/100 g DD to 850.5 mg/100 g UMD and antioxidant capacity of UMD measured as 2,2-diphenyl-1-picrylhydrazyl (DPPH) scavenging capacity. The dispersibility of oil-soluble phytochemicals in UMD was improved by fabricating the vesicles using polyoxyethylene sorbitan monooleate (Tween80). The size of Tween 80/UMD vesicles ranged from 200 nm to 300 nm in phosphate buffered saline (PBS) pH 7.0 suspensions. The filtered sterile vesicle suspensions in PBS were stable within the temperature range of 4 to 37 °C and maintained the size range of 200 – 300 nm for 96 h. Results indicated that the Tween 80/UMD vesicle was able to carry 814 μ g phytosterol/mL, 453 μ g tocopherols/mL and 200 μ g γ -oryzanol/mL as maximum load without causing phase separation of the oil phase in the PBS after preparation and storage at low temperatures. The suspensions containing Tween 80/UMD vesicle could be uptaken by Caco-2 and THP-1 cells. At high concentration of Tween80/UMD vesicle of 4 mg/mL (130 μ g/mL phytosterol, 72 μ g/mL tocopherols and 32 μ g/mL γ -oryzanol), the vesicles reduced viability of Caco-2 ($p < 0.05$). However, the vesicle showed potential immunomodulation properties in THP-1 macrophages. Overall, this research revealed that a pilot-scale MD unit could be used to evaporate out FFAs, resulting in concentrating rice phytochemicals. The resulting UMD could form vesicle in aqueous phase in the presence of Tween80 that was quite stable at low temperature after filtered sterilization.

Student's signature

Thesis Advisor's signature