A green approach for simultaneous hydrothermal inactivation of rice bran lipase enzyme and extraction of its edible oil using subcritical water

Omid Pourali[1], Feridoun Salak Asghari[2], Hiroyuki Yoshida[1, 2, *]
1) Department of Chemical Engineering, College of Engineering, and 2) Research Institute on Material Cycling Engineering, 21st Century Science Laboratory, Osaka Prefecture University, 1-1 Gakuen-cho, Sakai-shi, Osaka 599-8531, Japan,

* Phone/Fax: +81-72-254-9298, Email: yoshida@chemeng.osakafu-u.ac.jp

Rice bran is a major by-product of rice milling process accounting as 8% of milled rice. This abundant biomass contains 10 to 26% good quality oil [1]. Rice bran oil (RBO) is very appealing oil for food industries. But only a small portion (<10%) of this oil is used for edible oil production [2]. The main reason is that after rice milling, RBO is exposed to rice bran lipase enzyme which causes the triglyceride of RBO is quickly hydrolyzed into glycerol and free fatty acids (FFAs) that makes RBO unfit for human consumption.

The objective of the present study was inactivation of lipase enzyme in a batch type subcritical water (sub-CW) reactor. This inactivation was performed at temperature ranging from 393 to 513 K for 10 and/or 20 min. Figure 1 shows that total FFAs content increased sharply from 5.6 to 36.0% in untreated sample during 12 weeks storage, while total FFAs concentration in the RBO treated by sub-CW was constant. These results proved that sub-CW inactivated lipase completely. Although, traditional treatment method (direct extraction of RBO with hexane soon after rice milling) had some damping effects on lipase enzyme activities, however it could not completely inactivate lipase, and total FFAs concentration in the extracted oil by this method gradually increased from 5.0 to 5.6% in the course of storage period (see Figure 1).

Another application of sub-CW was the effective extraction of RBO in a short residence time (10 and/or 20 min) simultaneous with inactivation process (see Table 1). It was found that RBO extraction yield was a function of temperature; the more temperature was, the more RBO was extracted. Maximum extraction yield of RBO by sub-CW was 248.87 (mg/g dry matter) obtained at 513 K and 10 min residence time.

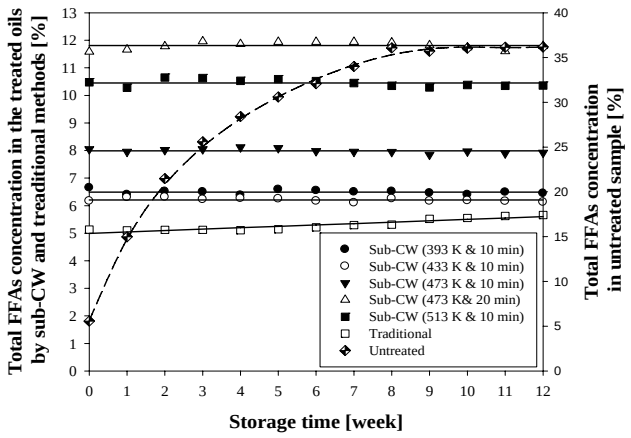

Figure 1. Total FFAs concentration in the stored treated and untreated samples

Table 1. RBO yield by sub-CW extraction

No.	Temp [K]	Extraction time [min]	RBO yield [mg/ g dry matter]
1	393	10	140.63
2	433	10	173.74

References:

1) Prabhakar, J. V.; Venkatesh, K. V. L.; A simple chemical method for stabilization of rice bran. JAOCS, 1986, 63, 644-646.

2) Zullaikah, S.; Lai, C.-C.; Vali, S. R.; Ju, Y.-H.; A two-step acid-catalyzed process for the production of biodiesel