Rice Bran: A Promising Natural Antioxidant Component in Breadmaking

Commentary

Rice (Oryza sativa L.), after maize, is the second largest cereal grain and the most consumed major staple food that feeds more people over a longer period of time than any other crop. Rice bran, which is a co-product/by-product of rice milling industry, is gaining commercial importance in the world due to its beneficial nutritive and biological properties. Although it is recognized as a good source of many nutraceuticals such as dietary fibre, proteins, minerals and phytochemicals [1,2] it is mainly used in Europe as animal feed at considerably very low prices in comparison with the actual value.

In fact, rice bran could comprise as a substitute for wheat flour supply to enhance the nutritive value. However, in order the replacement procedure to be effective needs appropriate stabilization of the rice bran to prevent the oxidative rancidity and to extend its life. Furthermore, it has a shorter shelf-life compared to the refined white rice due to the increasing of free fatty lipids during storage. Under the normal milling process, rice bran degrades in approximately six hours into an unpalatable material making it unsuitable for human consumption. Under proper packaging and storage recommended conditions, white rice is capable of being stored for decades, compared to the approximately one year of the rice bran fraction [3]. Milling technology advances allow rice bran stabilization via cold storage, sun-drying, steaming, extrusion, infrared radiation, microwave or ohmic heating [4-6]. Although stabilization is a promising feature for rice bran products, most of the rice-producing countries do not utilize that types of technology or infrastructures. Thus, the direct challenge is to develop an effective and inexpensive stabilization method easily adoptable to food industry. Simple heating or steaming could be a valuable tool to accomplish this goal.

Bakery products can be suitable consumer products that can effectively promote the incorporation of functional components with increased nutritional value. Nowadays, there is an increase in new rice bran based products in the human diet, including breads [2,7-9] and cookies [10], mainly due to the content of health-related bioactive components of rice bran. It has been proven that it contains several unique properties that render its suitability for niche markets like nutraceutical and pharmaceutical industry [11].

It was reported that rice bran can substitute successfully at least 20% of the wheat flour in yeast bread formulations without affecting loaf volume and consumer overall acceptability [2]. However, substituting higher than 10% negatively affected the sensory properties of bread in terms of colour crumb and texture. Moreover, substituted breads with rice bran, observed increased firmness with storage due to presence of bran that contributed to the retrogradation of bread [12].

Although rice bran is an excellent source of total dietary fibre (20-27%), it also contains other important compounds, such as γ-oryzanol, tocopherols, tocotrienols, phytosterols and phenolic compounds that are believed to exert important roles in protecting against degenerative diseases [13]. γ-oryzanol, which is a unique component of rice bran, consists of a group of ferulate esters of triterpene alcohols and phytosterols. Also, the phytosterols campesterol and β-sitosterol can be found at relatively high amounts in rice bran oil. Epidemiological studies have been proven that both have the ability to reduce serum cholesterol and possess potent antioxidant properties [14,15]. Vitamin E complex contents (sum of tocopherols and...
tocotrienols) in rice bran range from 181–314 mg/kg [16], while their inclusion in wheat bread at the rate of 20% increased the vitamin E content of substituted bread approximately 40% more than the control (without rice bran) [2]. Both tocopherols and tocotrienols are regarded as the most important natural antioxidants; however, tocotrienols was shown to have a greater biopotency and bioactivities than tocopherols [17].

Several phenolic compounds have already been identified in rice bran. The main phenolics in rice bran are the phenolic acids, mainly ferulic and p-coumaric acids [2,18], which can be classified into 2 types: bound and free phenolic acids. Content of bound form is approximately two times less than the soluble one [2,19] reported that phenolic acids of rice bran contributed 70-90% of the total phenolic acids in the whole grain.

In non-pigmented rice bran, flavones are the most commonly encountered flavonoids. Although phenolic acids have been extensively studied in rice, only a few papers have been focused on the flavonoids polyphenols. Tricin appears to be the major flavonoid of the rice bran accounting for 77%; whereas other minor flavonoids that have been identified are luteolin, apigenin, quercetin, isorhamnetin, kaempferol and myricetin [20]. Anthocyanins, which is another class of flavonoids, are responsible for the cyanic colour of the pigmented rice and are regarded as important nutraceuticals mainly due to their antioxidant effect [21]. Pigmented rice varieties showed an up to fourfold differences in total flavonoid content values compared to the nonpigmented ones [22]. Similarly, significant differences were also found among pigmented rice varieties, with black rice > purple rice > red rice [23]. Pigmented rice bran is a type of product that may provide additional benefits to human health due to its elevated bioactive properties. Until recently, pigmented rice varieties were cultivated only in limited areas of the globe for ornamentation and for producing grains for special cooking recipes and alcoholic beverages. However, nowadays their popularity is quickly increasing.

The concentration of total phenolics in the rice bran has been positively correlated with their antioxidant activity [24,25]. The addition of 5% black rice bran to wheat flour for bread baking produced a notable increase in the free radical scavenging and antioxidant activity compared to the rice bran free bread [25]. Furthermore, a 10% to 30% increase of the rice bran level in bread, induced a two to five folds increase in the total antioxidant activity compared to the control with the simultaneously preference by the panelists [2].

Variation has been detected in the amounts and types of phytochemicals in rice bran with respect to cultivars, growing conditions, degree of milling, and kernel thickness. Significant differences between cultivated rice varieties regarding nutrients and health-promoting values have been established in various countries [26-31], but the worldwide evaluation of rice varieties for nutritional profile is rather limited and practically unwieldy. In addition, there are three challenges that need to be further considered: Global climate, food safety and new technology for producing rice with high nutraceutical properties. Close collaboration on those aspects between rice breeders, technologists, millers, bakers, engineers, nutritionists and biomedical scientists would endorse a better valorisation of rice bran in the near future, even though great progress has been made in the understanding of the nutraceutical profile of rice bran.

### Funding

This project has received funding from the European Union’s Horizon 2020 research and innovation program under grant agreement No 690142.

### References


