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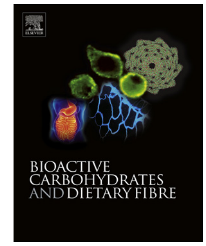

Studies on functional and antioxidant property of dietary fibre extracted from defatted sesame husk, rice bran and flaxseed

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ABSTRACT

The study describes the preparation of functional food ingredient from by-product of vegetable oil industry. Accumulating evidence favours the view that increased intake of dietary fibre in an otherwise low fibre diet can have beneficial effects in both human and experimental animals. These benefits include prevention or alleviation of maladies such as cardiovascular disease, diabetes, diverticulosis and colon cancer. Studies have repeatedly shown that defatted oil bearing materials (such as, sesame husk, rice bran and flaxseed) give interesting health benefits. Compositional analysis reveals that sesame husk, rice bran and flaxseed consists of almost 68%, 27% and 39% dietary fibre respectively and has been reported to have positive health effects, such as in the form of a laxative and cholesterol-lowering agent. This suggests that sesame husk, rice bran and flaxseed are good fibre sources that can be added to various food products. This study examined the effectiveness of a dietary fibre preparation, derived from these sources, as a functional ingredient with potential of antioxidant activity. The observations established that dietary fibre from defatted flaxseed and rice bran had higher water binding, oil binding and emulsifying capacity compared to sesame husk dietary fibre. However, rice bran and sesame husk fibre were found to be less viscous than flaxseed fibre. Whereas in case of antioxidant activity rice bran fibre showed higher activity than flaxseed and sesame husk. The study confirms that the dietary fibre preparation from defatted sesame husk, rice bran and flaxseed have great potential in food applications, especially in development of functional foods.

1. Introduction

Dietary fibre is considered as a useful functional food, i.e., a food with health benefits, in many situations: its benefits for health maintenance and disease prevention have been well demonstrated and it is figured as a main component in medical nutrition therapy (Jalili, Wildman, & Mederon, 2000; Topping et al., 1990). In fact, soluble dietary fibres as a part of the dietary plans used to treat or prevent cardiovascular disease and type 2 diabetes, while incompletely or slowly fermented fibres are integral components of diets used in the management of intestinal disorders, such as constipation, or in the prevention of the development of diverticulosis and diverticulitis (Miguel,

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Gorinstein, & Belloso, 1999). Foods containing dietary fibre to a wide range will contribute to the development of value-added foods or functional foods that currently are in high demand because of the physiological benefits provided by high fibre foods. Studies have shown that fibre components can impart texture, gelling, thickening, emulsifying and stabilizing properties to many foods (Dreher, 1987; Sharma, 1981). By analysing the functional properties of dietary fibre, one can enhance its food applications and aid in developing food products with high consumer acceptance. The most widespread, extensively advertised and consumed DF products are those derived from cereals (breakfast cereals, bakery products, biscuits, etc.). However, over the past decade greater dietary fibre materials from fruits (citrus, apple, and others) are being introduced in the market. Fruit DF concentrates have in general a better nutritional quality than those from cereals because of the presence of significant amounts of associated bioactive compounds (flavonoids, carotenoids, etc.) and their balanced composition (higher fibre content, soluble/insoluble DF ratio, water and fat holding capacities, lower energy value, and phytic acid content) than cereal materials (Sanchez-Moreno, Larrauri, & Saura-Calixto, 1999).

Flaxseeds contain 30% dietary fibre. The water- extractable dietary fibre (the mucilage) belongs to a group of heterogenic polysaccharides. These are neutral arabinoxylans and highly acidic rhamnose-containing polysaccharides present on the outside of the seed coat, which are characterised as highly viscous (Naran, Chen, & Carpita, 2008). Rice is consumed in its polished form as a staple food in many countries. Rice bran is the outer layer of brown rice, obtained as a by-product of the rice milling industry. However, most of them are used in feeds, some of them are even discarded (Harada, Tanaka, Fukuda, & Hashimoto, 2008). Rice bran contains the functional compounds; many biological active polysaccharides extracted from rice bran appeared to elicit excellent physiological properties in maintaining health and preventing diseases such as anti-tumor and enhancing the immune function (Takeshita et al., 1992; Tzianabos, 2000). It has been also reported that dietary fibre from different resource have strong antioxidant properties and can be explored as novel potential antioxidant enrich dietary fibre (Chen, Zhang, Qu, & Xie, 2008; Tseng, Yang, & Mau, 2008). However, as far as no information was available on the in vitro antioxidative activities of dietary fibre from sesame husk, rice bran and flaxseed. Compositional analysis reveals that rice bran consists of almost 27% dietary fibre and has been reported to have positive effects, such as laxative and cholesterol-lowering ability. This suggests that rice bran is a good fibre source that can be added to various food products.

The objective of the study was to note the functional properties of dietary fibre derived from sesame husk, defatted rice bran and deoiled flaxseed meal. An in vitro study was also conducted to evaluate their efficiency as antioxidant to formulate food products enriched with fibre and bioactive compound.

2. Materials and methods

Sesame husk and rice bran were obtained from local oil extraction plant and flaxseeds were purchased from local market. All were defatted by soxhlet method using hexane as a solvent. The dry defatted sesame husk, rice bran and flaxseed meal were then kept in a sealed container in a desiccator until further analyses were performed. All other chemicals and reagents were of analytical grade.

2.1. *Extraction of dietary fibre according to AOAC enzymatic-gravimetric method*

Total dietary fibre content was measured according to the AOAC enzymatic-gravimetric method (Prosky, Asp, Schweizer, DeWries, & Furda, 1988). The basis of this method is the isolation of dietary fibre by enzymatic digestion of the rest of the constituents present. The residue was measured gravimetrically using total dietary fibre assay kit (TDF 100 kit, Sigma, USA). The defatted sesame husk (DSH), rice bran (DRB) and flaxseed (DFS) were gelatinized with heat stable alpha-amylase (termamyl) at 95 °C for 15 min and then digested with protease (60 °C, 30 min at pH 7.5), followed by incubation with amyloglucosidase (60 °C, 30 min at pH 4.5) to remove protein and starch. Four volumes of 95% ethanol were then added to precipitate soluble dietary fibres. Precipitation was allowed to form at room temperature for overnight. The mixture was filtered and the residue (soluble fibre) was then washed with 78% ethanol, 95% ethanol and vacuum dried in rotary evaporator and weighed. After subtracting the values for ash and protein, combined values for SF and IF was accounted for TDF. Protein was analysed by the Kjeldahl method ($N \times 6.25$); ash was determined by ignition at 525 °C for 5 h. Blank assays were run in parallel.

2.2. *Functional properties of dietary fibre preparation from DSH, DRB and DFS*

Water holding capacity (WHC) and Fat Absorption Capacity (FAC) of the extracted fibres were determined using a method by Abdul-Hamid and Siew luan (2000). The method determines WHC and FAC of dietary fibre under external centrifugal force. 4 g of sample was added to 20 mL of distilled water or corn oil in a 50 mL centrifuge tube. The content was then stirred for 30 s at every 5 min and after 30 min the tubes were centrifuged at 1600 g for 25 min. The free water or oil was then decanted and amount of absorbed water or oil was then determined by weight difference. The water absorption and fat absorption capacity were expressed as absorbed water or oil per g of sample. Emulsifying capacity of dietary fibre was measured according to the method of Yasutmasu et al., 1972. 20 mL of 7% (w/v) aqueous dispersion of the fibre was mixed with 20 mL of soybean oil and homogenised (1900 g) for 5 min at high speed. An aliquot was then centrifuged at 3000 g for 5 min. The percentage of total emulsion mixture that remained emulsified after centrifugation was expressed as emulsifying stability index.

2.3. *Viscosity measurement*

Viscosity of the dietary fibre was determined by using "Brookfeld Digital viscometer", Model DV- II+Pro, spindle SC 4-18/13 R at 100 rpm, (Abdul-Hamid and Siew luan, 2000). Three different concentrations of TDF (5, 10 and 15% w/v) and SDF (5% w/v) dispersions were prepared by adding required amount of TDF and SDF to distilled water and mixing at high speed in a high