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Date Seeds: A Novel and Inexpensive Source of Dietary Fiber

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Abstract. The date palm (phoenix dactylifera) is the major fruit tree in the Persian Gulf region including south, southeast and eastern parts of Iran. Date fruit seeds (pits) comprise 6-12% of total weight in Tamr stage (completely ripe date fruit), depending on variety and quality grade. The seeds become available in concentrated quantities when pitted dates are produced in packing plants or in industrial date processing plants based on juice extraction and considered as a waste stream. Finding a way(s) to make value added products and increase the utilization of date seeds other than pulverized date seeds which are being used traditionally on small scale in animal feed, would be beneficial to both date farmers and processors. The presence of large quantities of fiber and substantial amount of tannins, resistant starch, anabolic agents as well as selenium in date seeds are being recently approved by several investigators, suggest that may have health benefit and it is possible to be evaluated as an excellent source of functional foods components. Approximate analysis of date seeds as well as the latest finding on the bioactive constituents with antimicrobial, antioxidant and other health promoting activities will be discussed in detail.

Keywords*:* Date seed, dietary fiber, approximate analysis, bioactive constituents

1. Introduction

The beneficial effects of fiber consumption in protection against heart disease and cancer, normalization of blood lipids, regulation of glucose absorption and insulin secretion and prevention of constipation and diverticular disease, has led scientists to study and characterize different sources of dietary fiber (1-4). Dietary fiber is defined as lignin plus the polysaccharide components of plants which are indigestible by enzymes in the human gastrointestinal tract [5]. The components of dietary fiber include cellulose, hemicellulose, pectins, hydrocolloids and lignin. These components are typically divided into two categories. Soluble dietary fiber is those components that are soluble in water and includes pectic substances and hydrocolloids. Good sources of soluble fibers include fruits, vegetables, legumes, soybeans, psyllium seeds and oat bran. Insoluble dietary fiber is those components that are insoluble in water and includes cellulose, hemicellulose and lignin. Whole grains are good sources of insoluble fiber [6]. Supplementation has been used to enhance fiber content of foods. Traditionally, fiber supplementation has focused on the use of milling by-products of cereal grains. All of the milling by-products of wheat, corn, sorghum and other grains, as well as the by-products from the wet milling of corn and wheat, have been investigated as possible fiber supplements [7].There are many other sources of dietary fiber, however, such as fruits, vegetables and less commonly used cereals and seeds such as barley and date seeds, which are potential sources of dietary fiber supplements as described in the excellent review by McKee and Latner [8]. The aim of this review is an attempt to introduce the underutilized and potential sources of dietary fiber with emphasize on date seeds as cheap and high nutritional value source to be used as dietary fiber supplement.

2. Fruits and Vegetables

Apple, pear and kiwi pomace, have been investigated for their dietary fiber capacity. The fiber content of apples, kiwi and pears can be recovered from the juicing process and used as a food ingredient [9]. The

products, which consisted of cellulose, hemicellulose, lignin and pectin, had water holding capacities of 9–10 to 1 (apple fiber) and 5 to 1 (pear fiber). Prospective applications for these fiber products included bread and other baked goods, cereal and granola products, pharmaceuticals, laxatives and pet food [9]. Chen et al. [10] investigated spray-dried apple fiber compared to wheat and oat brans in bread, cookies and muffins. The apple fiber contained more total dietary fiber than either wheat or oat bran. On a dry basis, the composition of apple fiber was 40% cellulose, 19% water-soluble hemicellulose, 15% lignin, 9% water-insoluble pectin and 4% water-insoluble hemicellulose. Water holding capacity of apple fiber (9.36 g water/g solid) was greater than that of either wheat bran (5.03 g water/g solid) or oat bran (2.10 g water/g solid). Apple fiber increased the water absorption and loaf weight of breads, but resulted in lower loaf volume when compared to products made with wheat or oat brans. Quality of cookies and muffins was not adversely affected by apple fiber at a replacement level of 4% or less. Apple fiber was recommended as both a dietary fiber source and a humectant [10].

Orange, grapefruit, pineapple, and mango peel and pulp refuse from juice extraction contained a significant amount of dietary fiber and rich in pectic substances, cellulose and hemicellulose and lignin [11]. The citrus fiber had a low caloric content (3.5 to 3.7 kcal/g), high water holding capacity (7.3 to 10.3 g water/g fiber) and high oil absorption (0.9 to 1.3 g oil/g fiber) properties. The citrus dietary fiber was suggested as a potential source of pulp for cloudy beverages, as a thickener, gelling agent, binder and texturizer and as a low kilocalorie bulking agent [11].

Olives. Valiente et al. [12] studied the composition and enzymatic modification of the fiber fraction of olive cake, a by-product of olive processing. Total dietary fiber content was reported to be 800 g/kg dry matter with the majority being insoluble. The insoluble fraction contained primarily cellulose, xyloglucans and uronic acids while the soluble fraction was composed mainly of arabinans and uronic acids. Enzymatic treatment of the olive cake with either Viscozyme or Olive resulted in improved baking properties when tested at the 10% substitution level [12].

3. Legumes

Peas and beans. Field pea hulls contained 82.3% (DMB) total dietary fiber with 8.2% hemicellulose and 62.3% cellulose in a study by Sosulski & Wu [13]. Although incorporation of field pea hulls into flour increased water hydration capacity, few differences were noted in mixograph and gassing power characteristics compared to controls. Water absorption increased and loaf and specific volumes decreased as level of field pea fiber increased in bread formulations. Crust color in breads became lighter and more yellow as level of pea fiber increased. Shape/shred and grain/texture were rated as very good in breads supplemented with 10% field pea hulls and good in breads containing 15% pea fiber. Total dietary fiber, in bread supplemented with 15% pea hull fiber, was 15% compared to only 3% in control products [13].

Peanut hulls. Collins & Post [14] investigated the use of peanut hull flour prepared from either Virginia-type or Runner-type peanuts as a dietary fiber source. Both types of hull flour contained about 47% crude fiber, with relatively large amounts of cellulose, hemicellulose and lignin, and had similar water-holding capacities. Oil-holding capacity of the Virginia-type hull flour was 1.8 g oil/g flour while that of Runner-type hull flour was 1.5 g oil/g flour. Color of the hull flours was described as light tan and sensory evaluation indicated the flours had a weak peanut flavor and aroma. Results of the study indicated peanut hull flour would have potential as a dietary fiber source [14].

Rice. Rice bran, the outer layer of brown rice, is typically used as animal feed. Since rice bran usually contains the germ, rancidity can be a major problem. Carroll [15] reported on the functional properties of rice bran stabilized by an extrusion process. The stabilized rice bran was said to be high in insoluble fiber with a total dietary fiber content ranging from 25 to 40% depending on the product. Variation in processing was used to produce stabilized rice bran with a consistency ranging from a fine powder to a flake with a taste described as slightly sweet and nutty. The stabilized rice bran was successfully incorporated into baked goods such as muffins, cookies and bread at levels up to 20%. The hygroscopicity of the rice bran improved moisture retention in the baked products while foaming ability of the bran improved air incorporation and leavening [15]. Rice bran fiber was reported to contain high amounts of functional proteins and fats along with antioxidants, vitamins and trace minerals in addition to being a concentrated source of fiber [16]. The

presence of these nutrients allows rice bran fiber to be used as both a nutritional and functional ingredient. For example, products such as chicken coated with rice bran fiber tend to absorb less fat during frying while the small amount of fat found naturally in rice bran fiber can act as a carrier for flavors [16].

Corn. Burge & Duensing [17] discussed the use of corn bran as a food ingredient. Corn bran, one of four products produced in the dry-milling of corn, was reported to contain 88.0% total dietary fiber with 67% of that total coming as hemicellulose and 18% as cellulose. The high fiber content would result in a lower level of corn bran being needed to achieve a particular fiber level in a product compared to supplements such as wheat bran. This would in turn result in corn bran supplementation having a lower impact on quality characteristics of foods. Corn bran was also reported to have a water-holding capacity of 2.4:1 which could improve shelf-life and provide important functional properties in reduced kilocalorie products [17].

Barley. Hudson et al. [18] compared muffins containing the barley *β*-glucan fraction with those containing either oat bran or rice bran. Acceptable formulations were prepared with 40% barley *β*-glucan / 60% all purpose wheat flour, 100% oat bran and 60% rice bran/40% all purpose wheat flour. Muffins were evaluated by four untrained sensory panels using a nine point hedonic scale (9 = like extremely, 1 = dislike extremely) and were analyzed for proximate composition. The overall sensory scores were 6.4 for the barley *β*-glucan muffins, 6.2 for oat bran muffins and 5.7 for rice bran muffins. Muffins prepared with barley *β*-glucan had the highest total dietary fiber content (13.88 _ 0.23%) and intermediate soluble dietary fiber content (3.49 _ 0.32%). All high fiber muffins evaluated contained more than 7 g fiber/100 g muffin and had low glycemic properties [18].

4. Seeds

Date seeds considered a waste product of many date processing plants producing pitted dates, date syrup and date confectionery. At present, seeds are used mainly for animal feeds in the cattle, sheep, camel and poultry industries. With world production of dates reaching 6.9 million tones in 2004, from this approximately 863 thousand tones of date seeds are produced [19]. Thus, utilization of such waste is very important to date cultivation and to increase the income to this sector. Al- Farsi *et al* who researched the functional properties of date seeds, their reported composition was 3.1–7.1% moisture, 2.3–6.4% protein, 5.0–13.2 fat, 0.9–1.8% ash and 22.5–80.2% dietary fiber. Also, seeds contain high levels of phenolics (3102–4430 mg gallic acid equivalents/ 100 g), antioxidants (580–929 lm trolox equivalents/g) and dietary fiber (78–80 g/100 g) [20]. The good nutritional value of date seeds is based on their dietary fiber content, which makes them suitable for the preparation of fiber-based foods and dietary supplements. Since a large quantity of date seeds are being produced as a waste material and the seeds contain a significant amount of bioactive phenolics and dietary fiber. Palm date seeds were evaluated by Almana & Mahmoud [21] as a source of dietary fiber. Finely milled date seed fiber had a total dietary fiber content of 71% while the coarsely milled fraction contained 80% total dietary fiber. Total dietary fiber contents, rheological characteristics and sensory properties of Saudi Mafrood flat breads containing 0, 5, 10 and 15% date seed fibers were compared to control flat breads containing wheat bran. Rheological properties were similar for doughs containing coarse date seed fiber or wheat bran. Bread containing 10% coarse date seed fiber had a higher dietary fiber content and similar sensory properties to the wheat bran control. Breads containing the fine date seed fiber had higher dietary fiber contents than wheat bran controls, but lower color, flavor, odor, chewing, uniformity and overall acceptability sensory scores [21]. In addition, date seed extract shows an ability to restore the normal functional status of the poisoned liver, and also to protect against subsequent carbon tetrachloride hepatotoxicity on the liver in rats [22]. Other sources of seeds such as grape seed, pomegranate seed, and olive seed are also important in terms of functional food and dietary fiber but not covered here due to space limitation.

5. Conclusion

The health benefits coupled with functional properties such as water holding capacity, synergism with sweeteners and fat replacement properties have created a renewed interest in fiber, particularly in the functional food and nutraceutical industry [23]. Many of the fiber supplements which have been researched are obtained from by-products resulting from the processing of fruits, vegetables, legumes and other food

products. Increased use of fiber supplementation would therefore not only improve the health benefits and functional properties of many foods, but could also provide ecological benefits to food producers. It is therefore possible to use date seeds as a replacement of all alternative underutilized aforementioned sources of dietary fiber.

6. References

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