Journal of Research in Ecology

An International Scientific Research Journal

ISSN No: Print: 2319 –1546; Online: 2319– 1554

Short Communication

Investigation and study of fiber extraction in date kernel

Authors:
Mohammad Nabi[1], Seyed Hadi Razavi[2], Sara Namayandeh[3] and Zahra Emam-djomeh[2]

Institution:
1. Research Scientist of Food Biotechnology, Aras International Campus Branch, University of Tehran, Jolfa, Iran.

2. Faculty Member, Department of Food Science and Engineering, University of Tehran, Karaj, Iran.

3. Food Biotechnology, Aras International Campus Branch, Tehran University, Jolfa, Iran.

.

Corresponding author:
Mohammad Nabi

ABSTRACT:

Dietary fibers have very beneficial nutritional properties that have been recognized as one of the main components of functional foods for many years. Date kernel is also a rich source of dietary fiber is disposed as waste or used for livestock after date processing in factories of syrup, date paste, date chips, or dates without a nucleus. In this research, the extraction of date fiber was investigated. For this purpose, the fiber was extracted from the nucleus of Rabi dates. According to the results obtained from fiber extraction, the best method for extracting date fiber is the enzymatic method at 90°C relative to the chemical and enzymatic method at 60°C. There was no significant difference between pH 6 and 8 in terms of extracted fiber amount.

Keywords:
Fiber, date kernel, extraction, Rabi Date.

Email ID:
mohamadnabi9696@gmail.com

Article Citation:
Mohammad Nabi, Seyed Hadi Razavi, Sara Namayandeh and Zahra Emam-djomeh
Investigation and study of fiber extraction in date kernel
Journal of Research in Ecology (2017) 5(2): 1249-1254

Dates:
Received: 26 Sep 2017 **Accepted:** 16 Oct 2017 **Published:** 02 Nov 2017

Web Address:
http://ecologyresearch.info/documents/EC0494.pdf

Journal of Research in Ecology

INTRODUCTION

Food fiber has a long history, and this term was first introduced by Hipsley (1953), which was discovered as one of the indispensable components of the cell wall, and subsequently, many definitions were provided for it. Botanists defined fiber as an organ of the plant, phytochemists as a group of chemical compounds; consumer defines as a substance with beneficial effects on human health and for the chemical industry is defined as a marketing issue. Later, the fiber was introduced as one of the components of plant foods and includes various chemicals and different morphological structures that are resistant to enzymatic digestion, which is still valid today (Subramanian and Kay, 1982). The best definition for fiber is presented by Trowell *et al*. (1985) that dietary fiber contains the components and residues of plant cells resistant to hydrolysis by human digestive enzymes which include hemicelluloses, cellulose, oligosaccharides, lignins, pectin's, resins, and waxes. AACC in 2000 defined dietary fiber as edible parts of the plant and similar carbohydrates that are resistant to digestion and absorption in the small intestine of humans and undergo partial fermentation in the large intestine. The fibers include polysaccharides, oligosaccharides, lignins, and related plant materials. ANZFA in 2001 provided the same definition of the AACC for dietary fibers.

In 2002, the International Academy of Sciences (MSAA) defined dietary fiber as undigested carbohydrates and lignins are in the plant intactly, and defined as applied and non-digestible applied fibers that had beneficial physiological effects in the human body, and stated that the total fiber is a total and dietary fiber. Soluble and non-soluble fibers form two main groups of fibers in the human diet. Cellulose, hemicellulose, and lignin are not soluble in water, and pectin, resins, and mucilages are soluble in water. Fiber is a complex mixture of polysaccharides with various functions, and many of these biological activities and functions depend on their physicochemical properties. In recent years, the popularity of pragmatic foods has grown more and more (Krystallis *et al*., 2008). Dietary fibers have very beneficial nutritional properties that have been recognized as one of the main components of functional foods for many years. For example, soluble fiber reduces blood cholesterol (Whitehead *et al*., 1986) and insoluble fibers reduce the risk of colon cancer (Wang *et al*., 2002). Fiber can be extracted from different plants, but agricultural waste is very important in this regard. Agricultural wastes such as pulp of fruits or cereals are sources of dietary fiber in addition to cheap. Date kernel is also a source of rich dietary fiber is disposed as waste or used for livestock after date processing in factories of syrup, date paste, date chips, or dates without a nucleus. The date kernel, which forms 10-15% of the weight of the date (Hussein *et al*., 1998), contains, on average, 73.1% of dietary fiber. Also, high content of phenolic compounds in the date kernel has been suggested as a functional food ingredient (Al-Farsi and Lee, 2008). Bauza *et al*. (2002) argued that the date kernel has an anti-aging effect due to its high levels of the phytohormone, which reduces skin's wrinkles. The other advantage of the date kernel is its low phytic acid amount. Habib and Ibrahim (2009) stated that on average, 128 milligrams of phytic acid is in 100 grams of date kernel flour, so the date kernel is superior to cereal bran. Therefore, in this research, we study the fiber extraction in the date kernel.

MATERIALS AND METHODS

A test was conducted at the Pasargad laboratory located in Science and Technology Park of the Tehran University on May 10, 2015, to July 17, in order to extract the date fiber. For this purpose, the fiber amount of the Rabi date was obtained.

Fiber extraction

Preparation of date kernel samples and powdering

The date kernels were obtained from Rabi Vari-

Figure 1. Rabi date nucleus before and after the mill

ety (Figure 1) from Bagherian Company. Shear mills were used for powdering the date kernels, and finally, particles with a final size of 600 microns were obtained (Shokrallahi *et al*., 2015).

The samples were first diluted with the acidic solution, then boiled and diluted with the dilute alkaline solution (extraction experiments were performed in three replicates). During the boiling process, samples are dissolved with acidic and alkaline solutions in solutions, and part of the cell wall is subjected to acidic and base hydrolysis and is converted into soluble materials. The residual material was dried after hydrolysis and then burned. The remainder of the substances in the dietary substance is called raw fiber after acid and base hydrolysis (Shokrallahi *et al*., 2015).

Chemical method

2.5 grams of powdered cores were weighed and transferred to the Arlene Meyer's flask of 600 ml. If the sample's fat amount exceeds 1%, after transferring the specimen to a crucible with a filter, was placed on a 100 ml beaker and 40 ml of acetone was added to it, and after 15 to 20 minutes, the crucible was exited from the beaker and washed with some acetone (Yousuf and Winterburn, 2017).

Acidic digestion stage

150 ml of a sulfuric acid solution was added at a rate of about 12.5% per thousand close to the boiling point to the beaker sample and slowly boiled for 30 seconds. All of the beaker contents inside the crucible mounted on the Buchner Erlen were transferred and cleaned using a vacuum pump and was washed with at least 4 times, and each time with 50 ml of boiling distilled water of the crucible sample (Yousuf and Winterburn, 2017).

Alkaline digestion stage

A volume of 150 ml of potassium hydroxide solution at a rate of about 12.5% close to the boiling point was poured inside the washing bottle and all the contents of the crucible were transferred to a 600 ml beaker. After 30 minutes, the contents of all human contents were filtered using a crucible. The contents of the crucible were washed each time with 50 ml of distilled water, and this was repeated at least 4 times. The crucible was placed in an oven at 130°C for 2 hours to dry completely. It was then cooled and weighed by transferring into the desiccator. The crucible and its contents were transferred to a cold furnace and burned at a temperature of 25 ± 500°C for at least 2 hours and then transferred to the desiccator and weighed. After performing these steps, the raw fiber content was calculated as follows (Bala and Singh, 2013)

Raw fiber percentage = { (Crucible weight and dried sample after digestion) - (Crucible weight and Ash weight) } × 100

Enzymatic method

The fiber extraction standard was used in the enzymatic method. Fiber extraction methods are usually used precisely to measure soluble and insoluble fibers from enzymes, and the chemical method does not allow the amount of soluble and insoluble fiber to be obtained from the resulted fiber from the date kernel. It is worth noting, however, that the amount of insoluble fiber can be estimated somewhat, but with regard to the strength of the acid (the stronger acid by a higher pH washes a greater amount of insoluble fiber and converted it to the solution, and in this case it is possible to guess somewhat the amount of insoluble fiber). A temperature of

Table 1. Comparison of the average amount of obtained fiber by chemical and enzymatic extraction

S. No		Total fiber (%)	Insoluble fiber (%)	Soluble fiber (%)
1	Chemical (Acid of 1.25 and normal soda of 1.25)	13.32 ±0.71^{d}	-	-
2	Chemical (Acid of 2.5 and normal soda of 2.5)	5.04±0.23^{f}	-	-
3	Chemical (Acid of 5 and normal soda of 5)	21 ±0.66^{c}	-	-
4	Chemical (Acid of 5 and normal soda of 1.25)	8.63±0.49^{e}	-	-
5	Enzymatic method at 60° C (pH = 6)	25±1.55^{bc}	12.8±0.16^{b}	12.2±0.63^{b}
6	Enzymatic method at 60° C (pH = 8)	27.9±1.6^{bc}	13.7±0.9 ^{b}	14.2±1.8^{a}
7	Enzymatic temperature of 90° C	42.1±2.01^{a}	38.8±1.7 ^{a}	3.3±0.22^{c}

60°C was used in this study and in this enzyme method. This test was carried out at a temperature of 90°C and in a constant pH. The enzymes used in the enzymatic method were: alpha-amylase, amyloglucosidase and protease (Wu *et al.*, 2017).

RESULTS AND DISCUSSION

After milling the date kernels, the fiber was extracted by chemical methods (different amounts of acid and soda) and enzyme (at different temperature and pH). In the chemical method, in addition to the total fiber, the amount of soluble and insoluble fiber can also be calculated. The highest amount of total fiber was obtained in the enzymatic method at 90°C (42.1%). After that, the enzyme method at 60°C and in two different pH (6 and 8) was 25 ± 1.55 and 27.9 ± 1.2, respectively. There was no significant difference between the two different pH in terms of total fiber amounts. The lowest amount of total fiber was obtained in the chemical extraction procedure (acid 2.5 and normal soda of 2.5) with a value of ± 5.04 ± 0.23. The amount of fiber obtained in the enzymatic method was more than the chemical method. Among the used chemical methods, which differed in terms of acidity and soda, the highest amount of total fiber was observed in the chemical method of acid 5 and the normal soda of 5 with a value of 21 ± 0.66 (Table 1).

The amount of insoluble fiber in the enzyme method with different temperatures showed significant changes at a probability level of 5%. The amount of insoluble fiber in the enzymatic method at temperatures of 90°C (38.8 ± 1.7) was much higher than the temperature of 60°C and both pH 6 and 8 (respectively, 12.8 ± 0.16 and 13.7 ± 0.9, respectively). The highest amount of soluble fiber in the enzymatic method was obtained at temperature of 60°C of pH 8 (14.2% ± 1.8) and the lowest was estimated in the enzymatic method at 90°C (3.3% ± 0.22). The temperature of 90° C was better for extracting insoluble fiber than the temperature of 60° C, but for soluble fibers, the temperature of 60°C was better for extraction than 90°C. pH 8 was better than 6 for extraction of soluble fiber (Table 1). In this study, treatments of alkaline solution of hydrogen peroxide (1 to 5%) to coffee crust, the size of coffee powder particles (4 to 150 microns), and the time when coffee crust was placed in alkaline solution (1 to 12 hours) for extraction of dietary fibers were optimized and its effect on the physical and chemical properties of coffee fiber and the qualitative characteristics and durability of prepared Barbari bread were investigated by it. The results showed that the size of coffee fiber particles, extraction time and soluble/ powder ratio had a significant effect on the physical properties of coffee fiber and its qualitative characteristics and durability. The high duration had a significant effect on the darkening of the fiber color of the coffee crust. By increasing the extraction time, the capacity for water storage of coffee fiber increased. It was reported that increasing the contact time of hydrogen peroxide solution with coffee fiber and the proportion of solution to coffee fiber improves the

physical properties of the coffee powder. The particle size reduction reduces the firmness of the resulting bread tissue and increases the organoleptic properties and durability of the bread made with the fiber of coffee (Sourki *et al*., 2012).

The numbers inside the table are the average of three repetitions ± standard deviations. The same small letters in each column of the table indicate that there is no statistically significant difference at the level of $p \leq 0.05$. The results showed that extraction at high temperatures yields a higher content of soluble fibers, while extraction in the acid buffer shows the least amount of soluble fibers. The operation and fiber composition of the solution vary considerably by changing the extraction conditions and the sample of the used food.

Lacourse *et al*. (1994) presented a method for extracting cassava pulp fiber. This process involves the formation of 5 to 10% by weight of Cassava pulp in an aqueous medium, which was treated with α- 1- 4- D-glucosidase enzymes to depolymerize the starch, and contains 70% of the total fiber, which comprised at least 12% of the soluble fiber. Salehi *et al*. (2008) in a study have been analyzed of the nucleus of two types of dates for chemical analysis. The results showed that 48% of the soluble fiber in detergent is acidic, 67.9% fat, 5.5% protein, 3.6% moisture, and 75% of the studied nuclei had an average of 1.65% ash. Mineral analysis showed that potassium has the highest amount. Iron had the highest density among the micro minerals, followed by manganese, zinc, and copper. The analysis of the oil produced by nuclear gas by gas chromatography showed that the stearic acid is the predominant non-saturated fatty acid in the kernel oil, followed by lactic acid, oleic acid, linoleic acid and dietetic acid. Other fatty acids include myristic acid. The kernel contains a significant amount of fiber and selenium that may be very useful in terms of nutrition and health. Shokrallahi *et al*. (2015) studied the physicochemical properties of crust fiber and date core nuclei. In this research, at first, the date kernel was separated into two parts: the outer (crust) and the inner (core), and then the dehydration was performed from both parts. Powder from the depletion of the crust and the core was called crust fiber and fiber of date kernel core, respectively. Crust fat was significantly higher than the brain. Dietary fiber was also reported is in both the crust and core sections significantly (70.68% and 74.17% respectively). The fiber of the core was brighter than the crust fiber. All three parameters of water, oil, and brightness holding capacity were significant in comparison with many agricultural wastes and commercial fibers.

CONCLUSION

According to fiber extraction results, the best method for extracting kernel fiber of date is the enzymatic method at 90°C relative to the chemical and enzymatic method at 60°C. There was no significant difference between pH 6 and 8 in terms of extracted fiber amount.

RECOMMENDATIONS

It is suggested that the conversion industries for the extraction of kernel fiber of date and its processing be created in bread dough. It is recommended that the kernel fiber of date be used in food and cereals.

REFERENCES

Al-Farsi MA and Lee CY. (2008). Nutritional and functional properties of dates: a review. *Critical Reviews in Food Science and Nutrition*, 48(10): 877-887.

Bauza E, Dal Farra C, Berghi A, Oberto G, Peyronel D and Domloge N. (2002). Date palm kernel extract exhibits anti-aging properties and significantly reduces skin wrinkles. *International Journal of Tissue Reactions*. 24 (4): 131-136.

Eben H Hipsley, (1953). Dietary "fibre" and pregnancy

toxaemia. *British Medical Journal*, 2(4833): 420-422.

Fatemeh Shokrallahi, Masoud Taghizadeh, Arash Koochaki and Mohammad HHKP. (2015). Surveying the physicochemical properties of crust fiber and date kernel nuclei, *Quarterly Iranian Journal of Food Science and Technology*, 12(48): 153-161.

Habib HM and Ibrahim WH. (2009). Nutritional quality evaluation of eighteen date pit varieties. *International Journal of Food Sciences and Nutrition*, 60(1): 99-111.

Hematian Sourki, Mahadvian Mehr H, Pourfarzad A and Sedaghat N. (2012). Optimization of alkaline extraction for dietary fiber of coffee silver skin and its effect on the quality and shelf life of Iranian Barbari bread. *Iranian Journal of Nutrition Sciences and Food Technology,* 8(1): 11-22. (In Persian).

Hongli Wu, Ting Huang, Fei Cao, Qiaogen Zou, Ping Wei and Pingkai Ouyang. (2017). Co-production of HMF and gluconic acid from sucrose by chemo-enzymatic method. *Chemical Engineering Journal,* 327: 228-234.

Hussein AS, Alhadramiand GA and Khalil YH. (1998). The use of dates and date pits in broiler starter and finisher diets. *Bioresource Technology,* 66(3): 219-223.

Krystallis A, Maglaras G and Mamalis S. (2008). Motivations and cognitive structures of consumers in their purchasing of functional foods. *Food Quality and Preference*, 19(6): 525–538.

Manju Bala and Maharaj Singh. (2013). Non destructive estimation of total phenol and crude fiber content in intact seeds of rapeseed–mustard using FTNIR. *Industrial Crops and Products*, 42: 357-362.

Norman L Lacourse, Karen Chicalo, James P Zallie and Paul A Altieri. (1994). Dietary fiber derived from tapioca and process therefor. US. Patent No. 5,350,593.

Salehi A, Haddad Khoda Parast MH, Habibi Najafi MB and Fatemi H. (2008). Chemical decomposition and potential applications of date kernel in food. National conference on nutrition, Mashhad, Iran.

Subu V Subramanian and David Kay (1982). Compacted graphite morphology control (retroactive coverage). American Foundrymen's Society, Inc, 589-603.

Trowell H, Burkitt D and Heaton K. (1985). Definitions of dietary fibre and fibre-depleted foods and disease. London: Academic. 21–30 p.

Wang J, Rosell CM and Benedito de Barber C. (2002). Effect of the addition of different fibers on wheat dough performance and bread quality. *Food Chemistry*, 79(2): 221–226.

Whitehead RH, Young GP and Bhathal PS. (1986). Effect of short chain fatty acids on a new human colon carcinoma cell line (LIM 1215). *Gut*, 27(12): 1457–1463.

Yousuf RG and Winterburn JB. (2017). Waste date seed oil extract as an alternative feedstock for poly (3-hydroxybutyrate) synthesis. *Biochemical Engineering Journal,* 127: 68-77.