

Original Research

Investigating the use of date kernel fiber in flat-breads and bulk-breads

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ABSTRACT:

In this research, the usage of date kernel fiber in industrial bread dough and its effect on the quality of bread was studied. For this purpose, the extracted fiber from Rabbi Date was used for baking bread at two levels of %10 and %20, in three replications. After applying the extracted fiber in dough as weigh percentage and baking the breads, organoleptic and shelf life evaluations related to bread was done. The results of penetration test showed that the highest amount of hardness was observed in the treatment of 20% fiber on the first day (1.920 N), and in 10% fiber treatment on the third day (1.744 N). High-fiber breads were more acceptable to the consumer in terms of texture and taste. But the evaluators preferred the control breads in terms of color. There was no significant difference in the odour of the breads. Based on TPA test results, the highest cohesiveness was observed on the first day of baking of breads treated with 20% fiber (0.66 ± 0.071 N.s), 10% fiber (0.235 ± 0.03 N.s) and the control sample (0.21 ± 0.01 N.s) . The lowest cohesiveness was observed in 10% fiber treatment on the fourth day after baking (0.05 ± 0.001 N.s). Finally, the results showed that in addition to adding the nutritional value of bread, the use of date kernel fiber would delay the staling process of industrial breads. It is suggested that the date kernel fiber is used at the industrial scale.

Keywords:

TPA test, Hardness, Fiber, Date kernel, Bulk breads.

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INTRODUCTION

Bread is the main source of food for many people in the world which supplies them with a large portion of energy, protein, minerals and vitamin B for their daily requirement. In Iran, bread supplies 40% of the daily intake of energy, 45% of protein, 60% of iron and much of the salt. Keeping fresh bread and baked goods are one of the goals that are important in terms of economic and nutritional aspects (Rajabzadeh, 2008).

Despite the high consumption of bread in Iran (per capita consumption of bread is 139-164 Kg), about 30% of it is lost due to poor quality. Bread, which is not produced in proper and standard conditions without good quality raw materials, loses its quality immediately after baking. It is called stale bread. To delay staling rate, many methodologies have been used in the world. One of the most effective compounds that are added to bread to delay the staling is polysaccharides (fiber, starch, gum, etc.). These compounds are a large group of polysaccharides and their derivatives that can produce high viscosity (at low concentrations) by absorbing water, and are usually used to improve texture, strengthen the gluten network, makes bread, soft and delay the staling (Farahnaky *et al.*, 2009).

Fibers in foods can alter the cohesiveness, texture, sensory properties and rheological behaviour at the end of the consumption of product. The emergence of new fiber sources gives us new opportunities for using them in the food industry (Guillon and Champ, 2000). The fiber can be produced from sources such as residuals of products. For example wheat straw, soy bean shells, oat hull, almonds and peas shells, maize stalks and corn, consumed grains for beer production, and the fruits and vegetables remnants that are processed in high quantities, can be converted into fiber foods (Pourfarzad *et al.*, 2011). They can be very useful in the common foods. Dietary fiber has all the features to make it an important nutrient in the formation and formulation of common foods, which has beneficial effects of health.

Among the fiber rich foods, the most popular one are cereal that is used in breakfast and bakery products such as bulk and flat breads and cakes (Nelson, 2011) and milk and meat by-products. Tudoric *et al.* (2002) observed that the addition of soluble and insoluble fibers affects the nutritional quality and taste (chemical compositions, cooking properties and texture) of cooked and raw macaroni.

Fiber can be extracted from different plants, but agricultural waste is very important in this regard. Agricultural wastes like fruit waste or cereal brans are cheap and rich sources of dietary fiber. Date kernel is a rich source of dietary fiber that is disposed of as waste after processing of date in factories that produce date syrup, date paste, date chips and seedless date are used as an animal feed. The date seed constitutes 10–15% of the date weight and contains %73.1 of dietary fiber. Also the high content of phenolic compounds in the date kernel presents it as a functional food ingredient (Al-Farsi and Lee, 2008). Bauza *et al.* (2002) states that the date seed has anti-aging properties due to the high amount of phytohormone, and reduces skin wrinkles. The other advantage of the date palm is the low amount of phytic acid.

Bread is a valuable and inexpensive food that plays an important role in supplying the daily energy of Iranian families and is used as the most important source of energy, protein, some minerals and vitamins, so that about 60-65% of protein, calories and 2.3% of the minerals are supplied by eating bread. Flat breads are a major part of the diet in many countries of Middle Eastern, Southeast Asia, the Indian subcontinent, and North Africa. Therefore, flat bread can be used as the simplest nutrient for receiving high dietary fiber and phenol antioxidants. Bread is now produced in various forms with different flavors and texture as well as various flours. Consumers tend to use one or more types based on their taste, and national traditions. In general, breads can be divided into two categories: "flat bread"

and "bulk or mold bread".

According to the standards set by the Institute of Standard and Industrial Research of Iran in 1998, if the bread texture thickness is 2.5 to 5 cm, it is in the semi-bulk bread group and the more thickness is in the bulk bread group, and baguettes, bread roll, hamburger bread, Sheermal and Piroshki (Iranian sweet breads), diet breads, European, French, Lebanese and Arabic ones are among this group.

Considering the functional and nutritional characteristics of date kernel, it is expected to have a beneficial role in increasing nutritional value, sensory qualities, quality and shelf life of bread. The importance of fiber has led to the development of a large and potential market for fiber-rich products in recent years. There is a growing desire to find new sources of fiber in order to use in the food industry (Chau and Huang, 2003).

Therefore, it is necessary to use the date kernel in order to provide the basis for producing a product with better rheological, qualitative characteristics and better shelf life. Considering the fact that no research has been carried out on the effect of date kernel fibers on the quality of flat bread, in this research, powdered date kernel containing fibers are used in the preparation of industrial bread dough and its effect on quality of the produced bread was studied.

MATERIALS AND METHODS

An experiment was conducted at the Pasargad Laboratory located in the University of Tehran Science and Technology Park from May 10, 2015 to July 17, 2015, in order to use the date seed fiber in the dough of industrial breads and investigate its effects on the quality these breads. For this purpose, the fiber content of the Rabbi dates was obtained. In the following, the date seed powder of Rabbi variety was used in the dough at two levels of 10 and 20% in three replicates. After date seed powder were used as a percentage by weight in the dough and the breads was baked, the sensory, organoleptic and shelf-life evaluations were done.

Using rabbi date seed powder in the dough and baking breads

Almana and Mahmoud, (1994), for the preparation of bread dough containing 10% by weight of date seed powder, the temperature of the oven for both flat and bulk bread samples were 230°C. One percent of oil was used and 1780 g of flour, 166 g of date seed powder (equivalent to 10%) and 950 ml of water was consumed. Mixing and making dough took 11 minutes. 130 g of Baguette dough was used and dough dividing process was done. The dough is divided into pieces (130g). The temperature of the incubator was 33-34°C. For 45 minutes, the samples were placed there and then placed

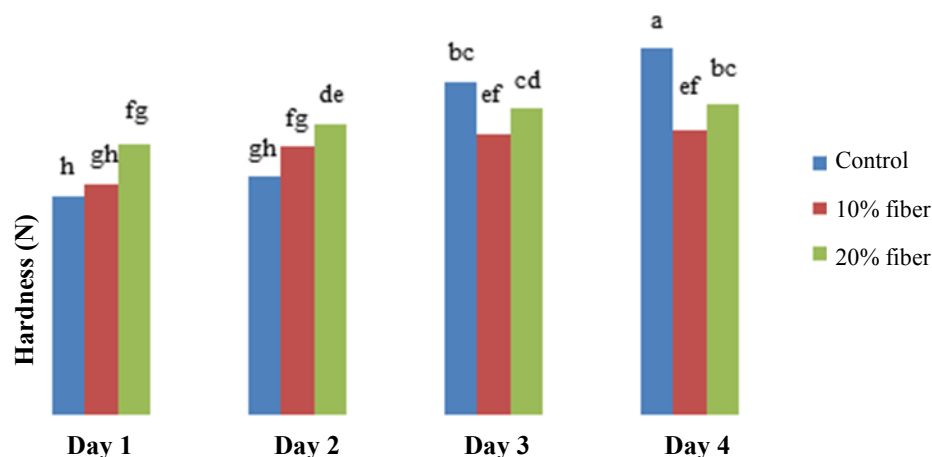


Figure 1. The comparison of mean effect of powder (control, 10 and 20% of weight) on the changes in the hardness of bread texture over time (penetration test)

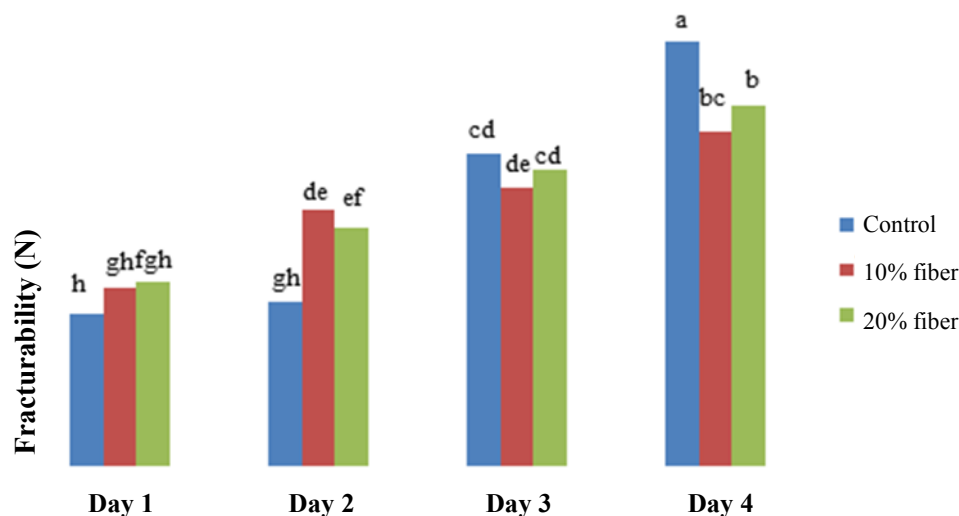


Figure 2. The comparison of mean effect of powder (control, 10 and 20% of weight) on the changes in the fracturability of treated breads over time (penetration test)

in an oven at 230°C for 11 minutes.

To prepare bread from dough enriched with 20% date seed powder, 1780 g flour was mixed with 332 g of date seed powder and 1% of the oil was added. 1.7 liter of water was used to prepare the breads. The making of dough process took nine minutes and the divided dough was placed in the incubator at 34°C for 50 minutes. In this section the whole cooking time was 10 minutes at the same temperature of 230°C. After these steps, the breads were cooled for 1 hour and 10 minutes, and their moldy condition was eliminated and then the packaging was done.

Evaluated characteristics

In this section, the descriptive test was used. The purpose of this test is to determine the severity of the desired characteristics. This test was conducted by 6 evaluators. The coded and untagged samples were given to the evaluators with a pre-designed form, prepared according to the standard (AACC, 2000), which included attributes along with their specific coefficients. Evaluators should give each attribute a score of 1-5, that was multiplied by their own specified coefficient and the final score was obtained. The total scores were divided by 20 to get the bread rating (qualitative number). According to the qualitative numbers, the bread rating in

these forms was as follows: 5 = Excellent. 4.5-4.99= Very Good. 4-4.49=Good. 3-3.99= Fair. Less than 3=Poor. This test was performed separately for 10% and 20% breads. This evaluation was carried out for four days (from the first day (baking) to the fourth day).

Assessment of bread texture

The bread firmness index as the over-time staling indicator was measured with a QTS texture analyzer (CNS Farnell, Hertfordshire, UK) with a cylindrical probe that had an external diameter of 25 mm and a height of 18 mm. The velocity of the probe movement of 30 mm / min into a 10 cm² square piece that is cut from the center of the bread was determined as the bread hardness index. The trigger point and target point was considered as 0.05 N and 30mm, respectively. The data was sorted using Excel software and statistical analysis was performed using SPSS 19 software Farahnaky *et al.* (2009). Duncan's Multiple Range test (DMRT) was used to compare means at the %5 level (Park, *et al.*, 2016).

RESULTS AND DISCUSSION

Penetration test and sensory test in four consecutive days and TPA in the first and fourth days were performed in order to evaluate the quality of bread and

Table 1. Comparison of the mean interacting effect of fiber percentage on sensory test parameters

S. No	Treatment	Total evaluation	Color	Aroma	Taste	Texture
1	a ₁ ×b ₁	4.2±0.68 ^a	4.08±0.63 ^a	4.01±1.01 ^a	3.88±0.66 ^a	4.3±0.72 ^a
2	a ₁ ×b ₂	3.83±0.76 ^a	3.75±0.19 ^{ab}	3.15±0.95 ^b	2.95±0.85 ^{bc}	3.52±0.8 ^{ab}
3	a ₁ ×b ₃	2.69±0.67 ^{bc}	2.58±0.54 ^{ef}	2.6±0.59 ^{cd}	2.07±0.77 ^{cd}	2.68±0.55 ^{cd}
4	a ₁ ×b ₄	2.03±0.7 ^c	1.25±0.41 ^h	1.7±0.57 ^c	1.71±0.53 ^d	2.13±0.49 ^d
5	a ₂ ×b ₁	4.3±0.71 ^a	3.96±0.83 ^a	4±0.79 ^a	4.16±0.82 ^a	4.33±0.99 ^a
6	a ₂ ×b ₂	3.82±0.65 ^a	3.42±0.48 ^{bc}	3.23±0.61 ^b	3.52±0.39 ^{ab}	3.91±0.4 ^a
7	a ₂ ×b ₃	3.04±0.61 ^b	3.15±0.82 ^{cde}	2.74±0.62 ^{bcd}	2.9±0.51 ^{bc}	3.14±0.56 ^{bc}
8	a ₂ ×b ₄	2.54±0.17 ^{bc}	3±0.76 ^{de}	2.09±0.56 ^{de}	2.55±0.9 ^{cd}	2.63±0.6 ^{cd}
9	a ₃ ×b ₁	4.28±0.97 ^a	3.58±0.9 ^{bc}	3.98±0.64 ^a	4.35±0.66 ^a	4.21±0.84 ^a
10	a ₃ ×b ₂	3.97±0.57 ^a	3.25±0.68 ^{cd}	3.25±0.75 ^b	3.94±0.33 ^a	3.95±0.63 ^a
11	a ₃ ×b ₃	3.26±0.77 ^{ab}	2.16±0.74 ^{fg}	2.96±0.91 ^{bc}	3.33±0.83 ^{bc}	3.4±0.88 ^{bc}
12	a ₃ ×b ₄	2.92±0.4 ^{bc}	2.28±0.45 ^g	1.84±0.19 ^c	2.87±0.18 ^{bc}	2.77±0.32 ^{cd}

(a₁: control (without fiber), a₂: treatment containing 10% powder, a₃: treatment containing 20% powder, b₁: first day, b₂: second day, b₃: third day and b₄: fourth day; the same lower case letters in each column indicate that there is no statistically significant difference at the level of p≤0.05)

the staling process.

Penetration test

Four parameters of penetration tests including hardness, fracturability, peak and energy to peak were investigated.

Hardness of bread texture

In the penetration test, the amount of hardness was changed significantly at the 1% probability level under the effect of the date seed powder in the bread dough (10 and 20%) compared to the control samples. According to Figure 1, breads that were treated with 20% showed more hardness than those treated with 10%, but no significant difference was observed between them. The lowest hardness was for the control sample. In the control sample, the highest hardness was observed on day four after treatment (1.920 N) and the lowest hardness was observed in the sample treated with 10% date seed powder on the second day (1.201 N).

In a study done by Qa'farokhi (2012), bran (as a fiber source) was added to barbari bread dough at four concentrations of 5, 7, 10 and 12% and the needed force to penetrate a 3 mm probe into the samples (penetration

test) were calculated in order to calculate the hardness of the bread's crust Majzoobi, *et al.*, (2007). The results showed that increasing the amount of bran in breads from 5% to 12% increased the required force to enter the probe into the samples. In treatment with 7% bran, this increase in force didn't showed a significant difference at the 5% probability level compared to the control sample. However, this difference was significant at levels above 7%.

Fracturability

The amount of fracturability of breads treated with 10% powder was higher than that of the control sample, when treated with 20% date seed powder they showed a significant difference. Breads treated with 20% powder had more fracturability than the control samples (Figure 2). Over time, the fracturability of breads increased so that the most fracturability was observed on the fourth day. Breads containing 10 and 20% date seed powder had less fracturability than the control sample (Figure 2).

Miyazaki *et al.* (2005) investigated the effect of Tapioca starch on the bread and the results showed that

Table 2. Comparison of interacting effect of fiber percentage on TPA test parameters over time

S. No	Treatment	Hardness (N)	Cohesiveness (N.s)	Elasticity (mm)	Fracturability (N)
1	a ₁ ×b ₁	3.89±0.59 ^c	0.21±0.01 ^b	0.92±0.05 ^a	0.2±0.001 ^c
2	a ₁ ×b ₂	7.01±1.2 ^b	0.076±0.001 ^{cd}	0.79±0.09 ^c	0.83±0.03 ^a
3	a ₂ ×b ₁	3.94±0.48 ^c	0.235±0.03 ^b	0.96±0.11 ^a	0.205±0.04 ^c
4	a ₂ ×b ₂	7.8±0.9 ^a	0.05±0.001 ^d	0.87±0.1 ^b	0.757±0.09 ^a
5	a ₃ ×b ₁	3.98±0.75 ^c	0.66±0.071 ^a	0.93±0.08 ^a	0.301±0.002 ^{bc}
6	a ₃ ×b ₂	7.25±0.8 ^{ab}	0.1±0.001 ^c	0.85±0.1 ^b	0.441±0.005 ^b

(a₁: control (without fiber), a₂: treatment containing 10% powder, a₃: treatment containing 20% powder, b₁: first day, b₂: fourth day; the same lower case letters in each column indicate that there is no statistically significant difference at the level of p≤0.05)

the prepared bread had a firm crust on the first. However, the control breads became stale quickly compared with bread prepared from native tapioca starch and wheat flour. Toufeili *et al.* (1999) reported that the waxy barley starch bread become stale faster and showed higher enthalpy of melting in the starch crystal region.

Sensory analysis

Sensory testing was performed using six evaluators in four consecutive days. Qualitative parameters including color, aroma, taste, chewiness, texture and overall acceptance were compared at different treatments of bread and in the control sample and during the storage period at room temperature. As the results revealed all of the sensory properties have received fewer privileges during the maintenance period over the course of time, which indicates a staling phenomenon in the prepared bread.

The observed differences between the control sample and the sample containing fiber can be due to the difference of fibers in the formulation of these samples, and the positive effects that are produced. In addition, this difference can be due to the staling phenomenon that occurred in the control sample and their negative effects are more evident. The texture of all breads, either control sample or treatment sample, received a high score on the first and second day after baking. On the third day, the reduction in texture quality was more

evident in the control breads than on the treatment breads and on the fourth day, this difference was significant at 5% level, and fiber breads had maintained the texture better than the non-fiber breads (Table 1).

In a study conducted by Qa'farokhi (2012), five evaluators evaluated the overall quality of bread enriched with bran (fiber source). It was reported that increasing the amount of bran to 7% in 2 and 24 hours after baking, did not cause the evaluators feel significant difference in qualitative characteristics of breads and even 24 hours after baking, the quality of breads enriched with 5 and 7% bran, were more than the control sample. He attributed this phenomenon to the role of fiber in delaying bread staling, as well as browning the bread crust, and also said that adding this level of bran (fiber) would produce better olfactory properties. Forty eight hours after cooking, the quality of bread was reported low because the bread has gone stale. The result of this study was consistent with the findings of Qa'farokhi (2012).

TPA test

In the study of interacting and simultaneous effect of time and fiber treatments, the highest amount of hardness in the TPA test was observed in the treatment of 10% powder on the fourth day (7.8±0.9 N), followed by the control sample and 20% powder treatment on the fourth day. The lowest amount of hardness was observed in the control treatment on the first day of

baking (3.89 ± 0.59 N) (Table 2).

The highest cohesiveness was observed in breads treated with 20% powder and on the first day of baking (0.66 ± 0.071 N.s). Subsequently, 10% date seed powder on the first day (0.235 ± 0.03 N.s) and the control sample on the first day (0.21 ± 0.01 N.s) had high cohesiveness. The lowest cohesiveness was observed in 10% treatment and on the fourth day after baking (0.05 ± 0.001 N.s) (Table 2). The highest amount of elasticity was obtained on the first day in all treatments and showed a significant decrease on the fourth day. There was no significant difference between the three treatments of control, 10% powder and 20% powder on the first day of baking, but with time and on the fourth day, the least amount of elasticity belonged to the control sample (Table 2).

The lowest amount of fracturability was observed in the control treatment (without fiber) (0.2 ± 0.001 N) and 10% powder treatment (0.205 ± 0.04 N) and a significant difference was observed with 20% powder treatment. On the fourth day after baking, the highest amount of fracturability was belonged to the control treatment (0.83 ± 0.03 N). According to the results, the use of fiber in bread dough has reduced the amount of fracturability than the control sample over time. As a result, it can be said that adding date seed fiber to bread increases the quality of bread in terms of fracturability.

Several studies have been carried out on the use of different types of polysaccharide and protein derivatives in the bread making process. The results indicated the reduction of staling and improving the texture characteristics of various breads. Carboxymethyl cellulose and hydroxypropyl methylcellulose was added to the formulation of bulk breads and barbari breads to improve the quality of dough and bread texture (Lazaridou *et al.*, 2007) and Kappa-carrageenan, Pectin, Xanthan and Guar was added to the formulation of Chapatti bread (Shalini and Laxmi, 2007) and good results were

obtained. Researches have also shown that corn starch, which is a type of modified starch, can be effective in improving the dough resistance and extensibility, as well as the bread specific volume and reducing the stiffness of the bread during storage (Hung and Morita, 2004).

Toma *et al.* (1979) reported that breads prepared with potato peels instead of wheat bran were better in terms of minerals, total dietary fiber and water storage capacity, and have lower phytate and starch content. Cakes prepared from 25% of apple pomace and wheat flour had a very high quality. In addition, the apple pomace prevents the addition of chemical additive to improve taste and, it gives a pleasant taste to cakes and breads as a fruit (Sudha *et al.*, 2007).

Almana and Mahmoud (1994) grind the date kernel and divided into hard and soft parts. The total dietary fiber in these two parts was 71% and 80%, respectively. Then, these parts were used in ratios of 0, 5, 10 and 15% for replacing flour in Mafrud flat bread. The breads containing powdered date seed had lower protein and higher fat, total fiber and soluble fiber than the control sample. Replacement of the hard part at 10% level increased total fiber in bread by four times, and had no negative effect on the bread effect and also had better or similar sensory properties than the control sample. On the other hand, the soft part caused problems in color, smell, taste, chewiness, cohesiveness and general acceptance, and these changes increased with the increase in the level of soft part. The hard part affected the mixing properties and Extensograph parameters are almost the same as the control sample (wheat bran), while the soft part showed a different behaviour.

Blourian (2004) added date kernel powder in two forms of defatted and undefatted to flat bread at 5, 10, and 15 % levels. His results showed that water absorption and dough yield increased with addition of the kernel powder to bread. Among the defatted and undefatted samples, the undefatted ones had more desira-

ble properties. Regarding the sensory properties, the sample containing 5% undefatted date seed powder has the best flavor, odor and organoleptic properties.

Sourki *et al.* (2012) investigated the treatments that had a ratio of 1%: 5% of alkaline hydrogen peroxide to coffee skin, different particle sizes (4 to 150microns), and the extraction time of 1-12 hours in order to extract the dietary fiber of coffee and the effects of these different extraction conditions on the physical and chemical characteristics of the coffee fiber and the quality and shelf life of the bread prepared from it were investigated. The particle size of coffee fiber, extraction time, and the ratio of solution to powder had a significant effect on the physical properties of coffee fiber and the qualitative characteristics and shelf life of bread prepared from it. The high duration had a significant effect on the reduction of dark color of the coffee fiber. By increasing the extraction time, the water-holding capacity of the fiber increased. It was reported that increasing the contact time of alkaline hydrogen peroxide solution with coffee fiber and the ratio of solution to coffee fiber would improve the physical properties of coffee powder. Reducing the particle size reduces the texture hardness of the prepared bread and increases the organoleptic properties and shelf-life of the bread made from the coffee fiber.

CONCLUSION

Penetration test

Adding fiber to bread dough has increased bread firmness compared to the control sample. Over time, this firmness increased and the increase in fiber treatments was lower than the control sample. Fiber treatment also reduced the fracturability of the breads over time as compared to the control. As a result, regarding the penetration test parameters, applied treatments (fiber percentage) improved these parameters. Although at the beginning of the experiment, this effect was not evident or even had a negative effect, but its positive effect was

determined over time.

Sensory analysis

The sensory analysis was performed by six evaluators and five properties of general evaluation characteristics, color, odor, taste and texture were investigated. Fiber breads were more acceptable to the consumer in terms of texture and taste, but for the color characteristics, the evaluators preferred non-fiber breads. There was no apparent and significant difference in odor. In general, based on the score that the evaluators gave to the fiber-treated breads as a general evaluation, fiber enriched breads were more acceptable.

TPA test

The addition of date seed fiber to the bread dough increased the stiffness of breads compared to the control sample. This difference in stiffness was not significant on the first day, but it was significant with the passage of time and on the fourth day. The highest amount of hardness belonged to 10% and 20% fiber treatments.

On the first day of baking the treated breads, the cohesiveness of the treatment with 20% date seed powder was higher than other treatments. On the fourth day after baking, the amount of cohesiveness decreased in all treatments and the highest reduction was observed in 10% date seed powder treatments.

The elasticity of breads on the first day was the same in all treatments, but decreased over time. The elasticity of fiber-enriched breads was higher than the control group. The addition of date seed fiber to bread dough reduces the process of fracturability over time and in this regard, has a positive effect on the quality of breads.

The addition of date seed fiber to bread increases the medicinal and nutritional properties of bread. Most qualitative properties in this study were improved by adding fiber, and it seems that this can be done at the commercial level, especially that most of the foods that are consumed today including fast food and processed

foods are free from dietary fiber and cause many digestive problems. Finally, the results showed that the addition of fiber to the bread dough could delay the onset of bread staling. The extraction of date seed fiber and using it as a natural improver of bread can be useful considering the high waste of date kernel, lack of fiber in the diet, and the high bread waste.

RECOMMENDATIONS

- Creating converting industries to extract fiber from the date seed and process it for use in bread dough.
- Using date seed fiber in other food products and cereals.
- Investigating the effect of other fiber sources on the properties of the dough and breads.
- Investigating the effect of fiber particle size on the characteristics of the dough and breads.
- Due to the negative effects of date kernel fiber on the appearance and color of the bread on the second and third days after baking, structural reforms should be done before using.
- Negative effects in bakery products could be due to the reduction of the gluten contribution and the lesser effect of these materials on water absorption capacity than gluten, which reduces the swelling capacity. The hardening and lack of complete hydration of flour particles weakens the dough due to the discontinuation of gluten filaments.

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